Lecture Notes in Networks and Systems 529

Tijana Tufek-Memišević
Maja Arslanagić-Kalajdžić
Naida Ademović *Editors*

Interdisciplinary Advances in Sustainable Development

Proceedings of the BHAAAS International Conference on Sustainable Development - ICSD 2022

Springer

Lecture Notes in Networks and Systems

Volume 529

The series "Lecture Notes in Networks and Systems" publishes the latest developments in Networks and Systems—quickly, informally and with high quality. Original research reported in proceedings and post-proceedings represents the core of LNNS.

Volumes published in LNNS embrace all aspects and subfields of, as well as new challenges in, Networks and Systems.

The series contains proceedings and edited volumes in systems and networks, spanning the areas of Cyber-Physical Systems, Autonomous Systems, Sensor Networks, Control Systems, Energy Systems, Automotive Systems, Biological Systems, Vehicular Networking and Connected Vehicles, Aerospace Systems, Automation, Manufacturing, Smart Grids, Nonlinear Systems, Power Systems, Robotics, Social Systems, Economic Systems and other. Of particular value to both the contributors and the readership are the short publication timeframe and the world-wide distribution and exposure which enable both a wide and rapid dissemination of research output.

The series covers the theory, applications, and perspectives on the state of the art and future developments relevant to systems and networks, decision making, control, complex processes and related areas, as embedded in the fields of interdisciplinary and applied sciences, engineering, computer science, physics, economics, social, and life sciences, as well as the paradigms and methodologies behind them.

Indexed by SCOPUS, INSPEC, WTI Frankfurt eG, zbMATH, SCImago.

All books published in the series are submitted for consideration in Web of Science.

For proposals from Asia please contact Aninda Bose (aninda.bose@springer.com).

More information about this series at https://link.springer.com/bookseries/15179

Tijana Tufek-Memišević ·
Maja Arslanagić-Kalajdžić ·
Naida Ademović
Editors

Interdisciplinary Advances in Sustainable Development

Proceedings of the BHAAAS International Conference on Sustainable Development - ICSD 2022

Springer

Editors
Tijana Tufek-Memišević
CANDARC LLC
Arlington Heights, IL, USA

Naida Ademović
University of Sarajevo-Faculty of Civil Engineering
Sarajevo, Bosnia and Herzegovina

Maja Arslanagić-Kalajdžić
School of Economics and Business
University of Sarajevo
Sarajevo, Bosnia and Herzegovina

ISSN 2367-3370 ISSN 2367-3389 (electronic)
Lecture Notes in Networks and Systems
ISBN 978-3-031-17766-8 ISBN 978-3-031-17767-5 (eBook)
https://doi.org/10.1007/978-3-031-17767-5

Preface

The book is a result of the **BHAAAS International Conference on Sustainable Development—ICSD2022** within the 13th Days of BHAAAS (Bosnian-Herzegovinian American Academy of Arts and Sciences)—an annual scientific event that gathers professionals, academia, researchers, students, international and national organizations, and authorities to share innovation, experiences, networking opportunities and foster dialog, knowledge transfer, development as well as to strengthen the bond between society and science.

The 13th Days of BHAAAS during 23–26 June 2022 were held in Sarajevo, BiH, and are considered the largest scientific gathering in the Western Balkans region which placed a special focus on sustainability and interdisciplinarity with over 1,000 participants and researchers from 26 countries.

At BHAAAS, we recognize that sustainable development is an overarching concept that now permeates all areas of society and all scientific disciplines. Promoting and investing in sustainable development in the Western Balkans is highly important considering that the region has the highest air pollution problem in Europe, and many of its countries are dealing with large-scale emigration due to complex political issues, struggling economies, and threats of possible new conflicts under the influence of Russia. The Sustainable Development Report for 2022 (Sachs et al, 2022) shows that Bosnia and Herzegovina stand out in significant and major (particularly for SDG 11) challenges remaining in reaching the 2030 Agenda.

The program of the event dedicated to sustainable development consisted of the International Conference on Sustainable Development-ICSD2022 with three specialized symposia:

- **Quadruple Helix Approach to Sustainable Development**
- **Sustainable Urban Development: Designing Smart, Inclusive, and Resilient Cities**
- **Sustainable Civil Engineering.**

In addition to the symposia, two open public sessions were organized to foster dialog among different stakeholders. The first was a plenary discussion with representatives of the UNDP, local authorities, and academic researchers discussing

climate change, the built environment, and the adopted SDG framework for BiH. The second was a special session on the EU initiative on the New European Bauhaus that connects the European Green Deal to living spaces and creative professions through interdisciplinarity.

The sustainable development program within the 13th Days of BHAAAS was supported by UNDP, ISOCARP, The Architects' Council of Europe, PC Motorways of the Federation of Bosnia and Herzegovina, CIGRE, and other partners.

The **first chapter** of this book is devoted to **Quadruple Helix Approach to Sustainable Development** (social sciences, humanities, and related fields). The quadruple helix approach includes the following areas: (1) government (with all institutions, legal frameworks, systems, policies, strategies, and action plans), (2) academia (focusing on R&D and education), (3) community (focusing on the broad societal issues from the general public to marginalized groups), and (4) industry (focusing on market positions, product/service development, entrepreneurship, corporate social responsibility, carbon footprint, green economy, and much more). The topics treated in this chapter cover environmental and economy interactions as well as the finance-growth nexus in Western Balkan countries. They assess the role of the ESCO firm model and its implementation in BiH as well as the role of science and technology parks as drivers of sustainability. Researchers assess the sustainable development education research as well as sustainable production and consumption literature in the region and outline challenges in implementing a monitoring system for SEE Strategy 2030. Furthermore, specific topics such as cultural heritage and sustainable tourism, subjective well-being and emigration, employee job performance, social marketing, sustainable consumption, and corporate social responsibility are treated by researchers in this chapter. The symposium was organized and led by Dr. Maja Arslanagić-Kalajdžić.

The **second chapter** is dedicated to the **Sustainable Urban Development: Designing Smart, Inclusive and Resilient Cities** symposium. Cities and human settlements are at the forefront of the impacts of climate change. They were the epicenters of the COVID-19 pandemic and its aftermath. The urban population is projected to grow to approx. 68% of the total world population by the year 2050. Together with the ongoing war in Ukraine and conflicts around the world, these conditions constitute multiple interlinked crises, which significantly hinder the process of achieving the UN 2030 Agenda. (UN SDG Progress Report, 2022)

The symposium on Sustainable Urban Development hosted authors from different parts of the world, both in-person and virtually, who contributed valuable insights into the different approaches and methodologies in sustainable architecture, urban planning, heritage, mobility, inclusiveness, resilience, and green infrastructure. Guest lectures consisted of academic professionals from the US and New Zealand presenting the topic of compact vs decentralized cities and research on the regenerative design of existing buildings. Additionally, presentations by UNDP representatives showed the solar energy potential in BiH as well as citizen-led public space design and transformation.

As part of the symposium, the session on the New European Bauhaus Forum in BiH hosted architects, urban planners, landscape architects, and other design professionals and organizations in a roundtable discussion, supported by keynote addresses from EU representatives. The symposium was organized and led by Dr. Tijana Tufek-Memišević.

The **third chapter** is devoted to **Sustainable Civil Engineering** (civil engineering and related fields). The four main pillars of sustainability in civil engineering are identified as pillars of carbon, biodiversity, resilience, and social value. Sustainability is more and more given a fundamental and vital consideration in all civil engineering fields. The presented papers tackle sustainability in structural design, railway corridors, and the water sector. The presentations were delivered by professors, researchers, and students. This is a great opportunity to exchange knowledge and to meet new colleagues from all over the world.

Two invited speakers have given talks on transport infrastructure and climate change–mutual impact and mitigation and adaptation measures and how to improve the way to reduce air pollution on Motorway Vc. The construction of the Motorway Vc is currently being the largest infrastructure project ever built in Bosnia and Herzegovina. Five peer-reviewed papers with scientific and technical quality were presented. The symposium was organized and led by Dr. Naida Ademović.

References

(1) Sachs J.D., Lafortune G., Kroll C., Fuller G., Woelm F., (2022): From Crisis to Sustainable Development: the SDGs as Roadmap to 2030 and Beyond. Sustainable Development Report 2022. Cambridge: Cambridge University Press.

(2) UN Secretary General (2022): SDG Progress Report Report 2022 https://sustainabledevelopment.un.org/content/documents/29858SG_SDG_Progress_Report_2022.pdf accessed June 30th 2022

Contents

Civil Engineering

Quadruple Helix Approach to Sustainable Development

Environment and Economy Interactions in the Western Balkans: Current Situation and Prospects

Petar Mitić[1], Aida Hanić[1](✉), Milena Kojić[1], and Stephan Schlüter[2]

[1] Institute of Economic Sciences, Zmaj Jovina 12, 11000 Belgrade, Serbia
aida.hanic@ien.bg.ac.rs

[2] Ulm University of Applied Sciences, Prittwitzstraße 10, 89075 Ulm, Germany

Abstract. In the sustainable development paradigm, the environment and the economy are closely intertwined in many ways. Everything that happens in the environment, whether positive or negative, has a considerable impact on the economy, and vice versa. This research aims to gain a better understanding of the existing condition and prospects of economic-environmental links in the Western Balkans (Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia). The issue of environmental protection is fundamental, especially given the Western Balkan countries' desire to join the European Union and the fact that the decisions made by their governments will have an impact not only on the environment in the region but also on the environment of other countries on the European continent. After gaining a deeper theoretical understanding of the economy-environment relationship, we proceed with a desk study of the economic and environmental state and prospects for the Western Balkans and individual countries. A panel regression analysis is used to further investigate the GDP-CO_2 link in the Western Balkan region. The findings show that higher GDP values are associated with higher CO_2 emissions and that each additional increase in GDP above the average results in 0.08% higher CO_2 emissions. All this confirms that economic growth has harmed the environment in the Western Balkans over the last six decades.

Keywords: Economy · Environment · Western Balkans · GDP · CO_2 emissions

1 Introduction

The natural environment includes all living organisms and inanimate objects and all their actions and interactions that naturally take place. We can think of the natural environment as a system that maintains everything alive. Therefore, every activity that influences nature in any form has to be undertaken with a tremendous amount of responsibility. Johnson et al. (1997) state that the environment encompasses all living species, climate, weather conditions, and natural resources that affect human survival and economic activity [1]. Resources such as air, water, and natural habitat support the lives of plants, animals, and people. The standards we set to protect the environment are

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 3–21, 2023.
https://doi.org/10.1007/978-3-031-17767-5_1

essential, especially given that the population of the planet Earth is constantly growing. In addition, an increasing number of people live in or migrate to cities, adding to the complexity of global environmental challenges. A substantial number of prudent and coordinated activities and measures are required to ensure that air and water resources remain clean and that land, other natural resources, and ecosystems are exploited in a way that ensures sustainability while keeping climate change tolerable.

Economics will inevitably come up during the examinations and discussions about environmental issues. There are various areas where the economy and the environment intertwine. The economy has a massive impact on everything that happens in the environment, whether beneficial or harmful. However, because most dangerous substances directly result from industry and other human activities, the economy has become the source of inadequate and mediocre environmental management. People's desire for affluence necessitates increased output and environmentally hazardous industrial processes and technology. As a result, human activities are primarily responsible for today's environmental issues, whether causing, alleviating, or fostering them [2]. Therefore, we need effective methods to significantly reduce or eliminate dangerous emissions, which would entail difficult economic decisions due to the massive costs. It also takes time for individuals to become aware of the environmental effects of particular activities or exploits. In other words, it takes time to develop connectedness to nature [3] in terms of considering the environment as one of the stakeholders [4].

Economic growth is defined as an increase in real output per capita. As a result, increased production and consumption are likely to have negative repercussions on the environment. Economic expansion has environmental repercussions such as increased consumption of finite resources, pollution, global warming, and the potential loss of environmental areas. However, it is essential to highlight that not all forms of economic growth are harmful to the environment. As people's actual earnings rise, they can better devote resources to environmental conservation and mitigating the adverse effects of pollution. Furthermore, more significant technology-driven economic growth can improve output with less pollution [2].

It is vital to note that the environment and the economy are inextricably linked in the sustainable development paradigm. All definitions essentially state that sustainable development means meeting the needs of current generations without risking the ability of future generations to meet their own. Increased demand for nonrenewable energy sources, raw materials, and other natural resources has resulted from worldwide population growth accompanied by intensive technical and technological processes. Creating and implementing sustainable development strives to establish an appropriate link between economic growth, natural resource extraction, and living conditions [5].

When environmental concerns grew more serious and pollution levels rose in the late twentieth century, sustainable development became a responsible and progressive behavior model. Sustainable economic development can be achieved in any economy through sustainable environmental development [6]. The relationship between environmental quality and economic growth is significant because it allows policymakers to comprehend the environment's impact on the economy. Because any economy aims to optimize economic growth, the environmental impact of economic growth and development is critical for analysis [7–9].

This study aims to provide a deeper insight into the current state and prospect of economic-environment interconnections in the Western Balkan region. This study includes Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia. Due to a lack of data, Kosovo (under UN resolution 1244/99) was not included in the analysis. In the case of the environment issue, the region of Western Balkan characterizes outdated coal plants, heavy industry, and a high level of dependence on fossil fuels. This region has been previously analyzed concerning these topics, but to the best of our knowledge, no previous study attempted to provide an extensive description of the situation, on the one hand, and none investigated the historical data from 1960, on the other hand. As most of these countries gained independence after the breakup of the Yugoslav federation, this is the first attempt to look at GDP and CO_2 emissions from a more historical perspective.

This study contributes to the existing literature in several ways. First, even though the topic of economy-environment interactions has been in the scientific and professional spotlight in recent decades, few studies have investigated these interactions in Western Balkan countries. Secondly, this is the first attempt to systemize relevant particularities of all individual Western Balkan countries' economies and natural environments, only to investigate the Western Balkan as a region later. Finally, this is the first time all countries' independent historical data from 1960 to 2018 has been used. Except for Albania, which was never a part of the Socialist Federal Republic of Yugoslavia (SFRY), all Western Balkan countries gained independence after the SFRY collapse in the 1990s. As a result, most Western Balkan studies focus on the years 1995 and onward.

After the introduction, we undertake a discussion to shed further light on the relationship between the economy and the environment. After that, an in-depth analysis of the economic and environmental situation and prospects was carried out, both for Western Balkans and the five countries individually. Subsequently, a panel regression analysis was performed. This study ends with concluding remarks.

2 The Relationship Between the Economy and the Environment

Conventional wisdom and a well-run economy can go a long way toward preventing additional environmental deterioration. The relationship between the environment and the economy is still contentious, and it will most likely stay so for a long time. Experts regard current pollution issues, the failure to address and prevent global warming, and the expanding population in third-world countries as apparent proof that people only see problems in the short term. They concentrate on urgent global environmental challenges. On the other hand, some believe that significant progress was made during the previous period [10].

Nonetheless, economics and environmental scientists debate the quantity of pollution acceptable to the ecosystem even today. According to most economists and environmentalists, zero pollution is neither desirable nor sustainable [11]. However, it remains to be seen how much pollution above "zero" is acceptable.

It is undeniable that everyone prefers a healthy and clean environment. Nevertheless, it is impossible to avoid the generation of numerous residues as long as the economy is founded on transforming land, labor, capital, and raw materials as material inputs into economic goods. Pollution is an unavoidable by-product of economic activity, and these residues of the economic process are pollution. However, this is not a topic on which there is unanimity. According to Tietenberg & Lewis (2016), the environmental economy views the natural environment as a commodity or asset with various qualitative features [12].

Greening the economy has become a skill due to the endeavor to secure the infinite duration of limited resources. According to Barry Commoner, a well-known American biologist and ecologist, the entire world symbolizes an everlasting closed loop in which every technological development in production damages nature. As a result, the origins of environmental issues should be traced back to economic factors such as production and consumption [13]. Production, which is primarily supported by consumption, produces environmental problems as a result of the quest for larger profits.

The planet's finite natural resources have long been thought to be a significant stumbling block to development. However, natural raw material sources are no longer the only source of development restrictions [14]. Furthermore, nature's limited ability to absorb human waste is unquestionably the source of limited growth. As per Brock and Taylor (2004), it is natural to think of the environment as a source of raw materials, oil, and valuable minerals [14]. This perspective, in which nature serves humanity, has resulted in the substantial and still-growing theoretical and empirical literature on the growth constraints imposed by a scarcity of natural resources.

In general, the function of nature as a final location for all unwanted by-products of industrial activity has received less emphasis in professional literature and debate. Nature absorbs hazardous contaminants and serves as a landfill for tons of waste. When the environment's ability to dissolve or absorb pollution is exceeded, the environment's quality suffers. The policy response to the deterioration of environmental quality may stifle growth. Growth is constrained because diminishing environmental quality necessitates more extensive mitigation methods or a lower return on investment. More negatively, growth may be restricted if people cause irreversible damage to the ecosystem and the economy-environment interaction is reconfigured, resulting in a lower and lower productive steady state.

The discussion about the economy-environment interconnections cannot be assessed as complete without addressing climate change, globalization, and environmental awareness issues.

Climate change is one of the most pressing issues that the world community has faced in the past. This issue necessitates an interdisciplinary approach, with specialists from diverse professions addressing the causes and implications of climate change, as well as adapting to and minimizing its effects. The global economic crisis and its ramifications, various energy crises, water and food shortages, and overall ecological deterioration, all point to the need for a new financial framework that can appropriately respond to these difficulties. Even though this problem has been significant for many years, it was not until 2012, during Mexico's presidency, that the G20 made green development one of its top goals for the first time in history [10].

On the other hand, globalization has resulted in the rapid diffusion and spread of products and services, techniques, technology, and information worldwide, regardless of origin [15]. Although it has resulted in countless positive improvements in the growth of society as a whole, globalization and the rapid advancement of science and technology continue to have detrimental environmental repercussions. The global ecological crisis arose due to rapid advances in science and technology, which enhanced people's lives but negatively affected the environment.

Environmental consciousness has risen in many countries worldwide, though not to the same degree or breadth everywhere. Numerous anti-pollution efforts, environmental education, and various economic and political actions all contribute to the prevention of environmental problems and the remediation of those that already exist. Despite the preceding, human irresponsibility, disinterest, superficial and short-term observation of potential negative impacts, and corporate profit orientation have worsened environmental issues. As a result, different prevention and adaptation approaches cannot produce satisfying results.

3 Western Balkan Economy-Environment Relations

The Western Balkans region has a population of 17.6 million people and a combined GDP per capita of $17,000, according to an OECD report from 2021 [16]. This region is unique in various aspects from a socio-economic standpoint. Due to the transition from a centrally planned to an open market economy, all countries (except Albania) were an integral part of Yugoslavia with the same socio-economic organization and hence suffered the same social and cultural reforms. As Yugoslavia slipped into a financial crisis in the 1980s, this centrally planned economy crumbled, and the debt of $ 1.4 billion in 1966 increased to over $ 20 billion in 1980 [17], accounting for around 30% of Yugoslavia's total GDP. Be that as it may, exceedingly high-interest rates were more of a problem than debt. With the collapse of the former Yugoslavia in the 1990s, today's independent countries are transitioning to a new socio-economic model with the pretension of membership in the European Union. The aspiration towards membership largely determines the harmonization of regulations and the regulation of the social order, which primarily refers to the economy and the environment.

Although the countries share the same geographical area and a common economic past, there is currently a scarcity of analysis of the economy-environment interaction in the Western Balkans in the scientific and professional literature. Mining, manufacturing, agriculture, and forestry are important pollutants of the environment and constitute significant components of the Western Balkans economies. According to the Chronic Coal Pollution report, 16 outmoded coal-fired power plants in the Western Balkans released more sulfur dioxide pollution in 2016 than all 250 coal-fired power plants in Europe combined [18]. This statement does not include Albania because its energy sources predominantly come from hydropower. In this context, notably in the case of Serbia, around 75% of Serbia's energy is currently derived from fossil fuels [19].

At the end of 2020, the European Union adopted an economic investment plan for the Western Balkans worth up to 9 billion euros based on five pillars:

1. climate action, including decarbonization, energy, and mobility,
2. circular economy, which deals specifically with waste, recycling, sustainable production, and efficient use of resources,
3. biodiversity, which aims to protect and restore the natural wealth of the region,
4. combating air, water, and soil pollution, and
5. sustainable food systems and rural areas [20].

According to the OECD report [16], each of the analyzed countries of the Western Balkans can be viewed as a diverse and competitive economy in this region, but with very similar problems when it comes to the environment, and some of them are:

– exposure to natural hazards,
– low energy efficiency and high carbon intensity,
– high dependence on coal,
– high levels of air pollution, and
– poor waste and wastewater management.

In terms of climate, the Western Balkan region encompasses the low-altitude Pannonia valley in the north, hilly and mountainous parts in the central-south and west, and the Adriatic Sea's coastal area. Spatial temperature variability ranging from coastal subtropical to temperate continental with high mountains in between provided this area with a vast diversity of vegetation cover. As EU candidates and potential candidates, all are determined to uphold the Paris Agreement and fulfill the EU2020 and EU2030 goals for greenhouse gas (GHG) emission reduction. The burden of the effort related to climate change challenges that each economy is obliged to implement is recognized as a substantial setback due to a lack of people and financial resources, which encourages regional collaboration and development [21].

3.1 A Deeper Look into Western Balkan Economic State and Prospectives

Before discussing the situation in all five Western Balkan economies that are the subject of this study, we will briefly analyze the historical trends of the main indicator of every economy – GDP per capita (Fig. 1).

The figure depicts the trend in GDP per capita in all of the observed Western Balkan countries. There was a general upward trend until the 1990s when the separation of Yugoslavia caused a considerable drop, followed by the start of the economic and social transformation process. The decline is visible in all of the countries, but it is clear that North Macedonia, for example, was in a far better condition than the others. Following the 2000s, all countries, particularly Montenegro, have seen a new upward trend. It remains to be seen how the economies of the Western Balkan countries will deal with the ongoing COVID-19 crisis. It imposed lockdowns in almost all countries worldwide, effectively shutting down economic activity and causing socioeconomic instability [23].

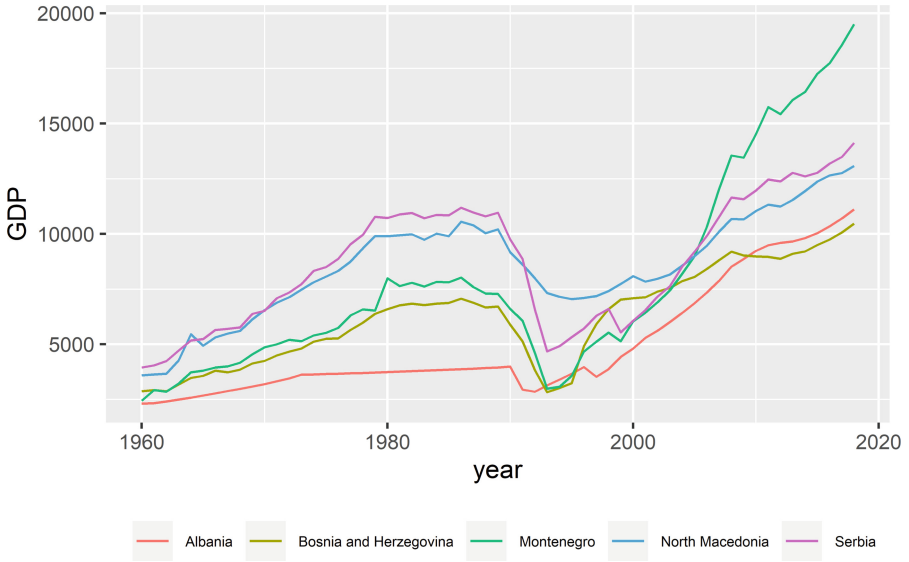

Fig. 1. GDP per capita for five Western Balkan Countries from 1960 to 2018 [22]

Nonetheless, a deeper insight into economic conditions and prospects is necessary to provide a clearer economic picture.

The Economy of Albania

Albania's transition from a centrally planned to a market economy has led to considerable economic development. Albania has progressed from Europe's poorest country in the early 1990s to a middle-income country in 2008. Although it was able to weather the initial waves of the World Economic Crisis to some extent, the subsequent negative consequences caused a significant economic slowdown. The global economic crisis has exposed all of the growth model's flaws, emphasizing the necessity to shift from consumption to investment and export growth. As a result, to boost economic growth, Albania must pursue structural reforms that raise productivity and competitiveness. In line with the preceding, the Albanian government began a comprehensive reform program centered on macroeconomic and fiscal stability, financial sector stabilization, energy issues, the pension system, and public administration. This reform process should be maintained and implemented if Albania's current and future economic growth is to be sustained. Albania must also make specific efforts to enhance infrastructure, particularly within its borders, to link with its neighbors [24].

Construction now leads GDP growth and is likely to continue in the first quarter of 2021. Exports of extractives, energy, and tourism have benefited from robust external demand and excellent hydrological conditions. Albania is now dealing with a significant case of rising inflation as average inflation increased to 1.8% in 2021. Demand expansion, as well as monetary and fiscal stimulus, might amplify upward pressure. The government was able to expand infrastructure investment due to increased tax collection and additional debt. The deadline for fiscal restructuring and establishing a positive primary

balance has been extended to 2024. A smooth vaccination rollout, no more lockdowns, and a steady recovery of services, led by tourism and construction are expected to boost GDP growth in 2021 and beyond. Poverty may continue to fall if labor participation and employment increase [25].

The Economy of Bosnia and Herzegovina

Bosnia and Herzegovina's economy is in transition, with limited market reforms. A highly decentralized administration delays economic policy coordination and reforms, while excessive bureaucracy and a segmented market deter international investment. The banking sector is dominated by foreign banks, albeit the most notable is a private domestic bank. The national currency (convertible mark) was created in 1998 and is tied to the euro via a currency board structure, ensuring monetary stability and facilitating solid trade relations with European partners [26]. Metals, oil, textiles, and furniture exports, as well as foreign aid and remittances, are all critical to Bosnia and Herzegovina's economy.

The imbalance of Bosnia and Herzegovina's economic model is its fundamental economic challenge. Public policies and incentives are more public-oriented rather than private-sector. Also, they are more focused on consumption than investments, on imports rather than exports. According to the World Bank's recommendations, Bosnia and Herzegovina should make a turnaround in a business environment conducive to private investment that supports small and medium enterprises' growth, facilitating exports and improving productivity, all with private sector employment growth. It is projected that the implementation of new labor regulations and the deployment of support programs for first-time job searchers will improve employment outcomes in the following years [27].

The political uncertainty that may prevent reforms poses the most significant risk. As a result, the Council of Ministers of Bosnia and Herzegovina, the Government of the Republika Srpska, and the Government of the Federation of Bosnia and Herzegovina established a joint structural reform program in July 2015. This reform initiative provides a major opportunity because it is backed by a broad national consensus on its key concerns and priorities and key development partners' support [27].

The Economy of Montenegro

Montenegro voted to break its ties with Serbia in June 2006, following a referendum on independence from the two-state union. Montenegro began using the euro as its national currency despite not being a eurozone member and joined the World Bank and IMF in January 2007 and the World Trade Organization in December 2011. Montenegro launched negotiations to join the EU in 2012 after meeting the European Council's requirements, including steps to combat corruption and organized crime [28].

Montenegro is a small, open economy still transitioning to a more market-oriented one. It is particularly vulnerable to external shocks because it relies significantly on foreign capital inflows to fuel its expansion. The shift to a market economy necessitates a diminution in the government's economic influence. It is necessary to restructure state-owned enterprises and rationalize public spending to create a favorable climate for private sector development [29]. Be that as it may, around 90% of state-owned

businesses, including banking, telecommunications, and oil distribution, have been privatized. Montenegro's tourism industry accounts for more than 20% of the country's GDP.

Along with tourism, energy and agriculture are considered two separate pillars of the economy. Only in 2023 is real GDP projected to reach its pre-COVID crisis level. International travel is not projected to return to pre-pandemic levels for many years; therefore, the dominating tourist sector will recover slowly. In 2022–23, unemployment will also stay high. Nonetheless, Montenegro is contemplating massive road and rail network overhauls and possible air transportation system expansions [28]. However, the combined consequences of large-scale public infrastructure projects and a slew of new, high-cost social spending initiatives pose a fiscal challenge [29].

The Economy of North Macedonia

North Macedonia has progressed in liberalizing its economy and strengthening its business environment in recent decades. Modest tax rates and free economic zones have aided in attracting foreign investment, which remains low compared to the rest of Europe. Corruption and a lack of the rule of law continue to be significant issues. North Macedonia went through a severe political crisis from 2014 to 2017, and a new government was formed in June 2017. The government started an ambitious reform program focused on economic growth, job creation, fairer taxation, small and medium-sized enterprises support, and social protection. In June 2018, Macedonia and Greece signed the Prespa Agreement, by which the Republic of Macedonia agreed to change its name to the Republic of North Macedonia. After the ratification of both countries, the agreement entered into force on February 12, 2019 [30].

Economic growth is expected to pick up as the pandemic subsides. This argument assumes greater foreign demand, further immunization, and no future lockdowns. Restored consumer and investor confidence is anticipated to rise private spending, private investment, and trade. In 2021, the government continued to assist businesses and households. Over the foreseeable future, restoring public finances to a sustainable state will be necessary since public and publicly guaranteed debt exceeds 64% in 2021. Re-entering the labor market and educational and governance reforms could boost development potential [31].

The World Bank notes that the EU admission process for North Macedonia is still blocked due to a dispute with Bulgaria. Members of the European Parliament have called on the EU to formally begin accession negotiations with North Macedonia, noting consistent progress in implementing EU reforms. It is worth mentioning that Bulgaria and North Macedonia have yet to negotiate a bilateral agreement on topics such as discrimination against citizens who freely show their Bulgarian identity and/or ethnic background [31].

The Economy of Serbia

Serbia has a transitional economy governed mainly by market forces, but the government still plays a substantial role in several areas. Serbia has made headway in trade liberalization, restructuring, and privatization, but several significant industries remain state-owned, such as power utilities, telecommunications, and natural gas. Staggered

household incomes, the need for private-sector job creation, state-owned company structural reforms, strategic public-sector reforms, and significant foreign direct investment are all important economic challenges ahead. An inefficient legal system, significant levels of corruption, and an aging population are all severe long-term challenges. Strategic location, a relatively low-priced and skilled labor force, and free trade agreements with the EU, Russia, Turkey are factors that favor Serbia's economic growth [32].

The global economic crisis exposed all of the inherent flaws in Serbia's economic growth paradigm. It became clear that fiscal consolidation and the completion of the unfinished transition were required. Domestic consumption dominated Serbia's rapid economic expansion from 2001 to 2008, resulting in severe internal and external imbalances. The government accelerated structural changes in 2016, focusing more on social sector transformations while emphasizing public administration, financial regulation, economic reforms, and the EU membership process. The government's economic reform program aims to ensure economic and financial stability, prevent additional debt buildup, and foster economic recovery and growth to increase employment and living standards [33].

According to the World Bank, the Serbian government concentrated its efforts in 2020 on assisting the economy's recovery from the COVID-19 crisis. At the start of the pandemic, it passed a massive fiscal stimulus package worth approximately 13% of GDP. The economy only endured a minor recession (ca. 1%) in 2020 due to the program's prompt implementation. However, the program's success came at a high financial cost [33].

The Serbian economy is predicted to recover to pre-pandemic levels of growth over the next five years. However, the country continues to encounter obstacles that limit its future growth. Eroding governance, an insufficient infrastructure, an unreformed education, and impediments to private sector investment are just a few of the issues. Labor shortages and skill gaps could severely harm Serbia's competitiveness due to its aging population [33]. According to Domazet, Zubović, & Lazić (2018), boosting the economy's competitiveness is one of the most difficult challenges for policymakers in Serbia [34]. Climate change is also a concern since more severe weather extremes might harm agriculture and the food supply while increasing infrastructure costs.

3.2 A Deeper Look into Western Balkan Environmental State and Prospective

Before discussing the environmental situation and challenges in all five Western Balkan countries that are the subject of this study, we will briefly analyze the historical trends of one of the main indicators of environmental degradation – CO_2 emissions per capita (Fig. 2).

The CO_2 emissions pattern somewhat follows the GDP pattern from Fig. 1, as there is a significant decline in the 1990s. The figure shows that Serbia is the largest emitter of CO_2 in the region, which should not be a surprise considering that it is also the largest economy in the region. Serbia also has a high level of heavy industry and the already mentioned fact that most of the energy comes from fossil fuels.

The Environment in Albania

Albania's comparatively decent environmental status results from good water and air quality, plentiful natural resources, and rich biodiversity. According to Feuersenger (2012), this results from decades of political isolation until the 1990s, rather than

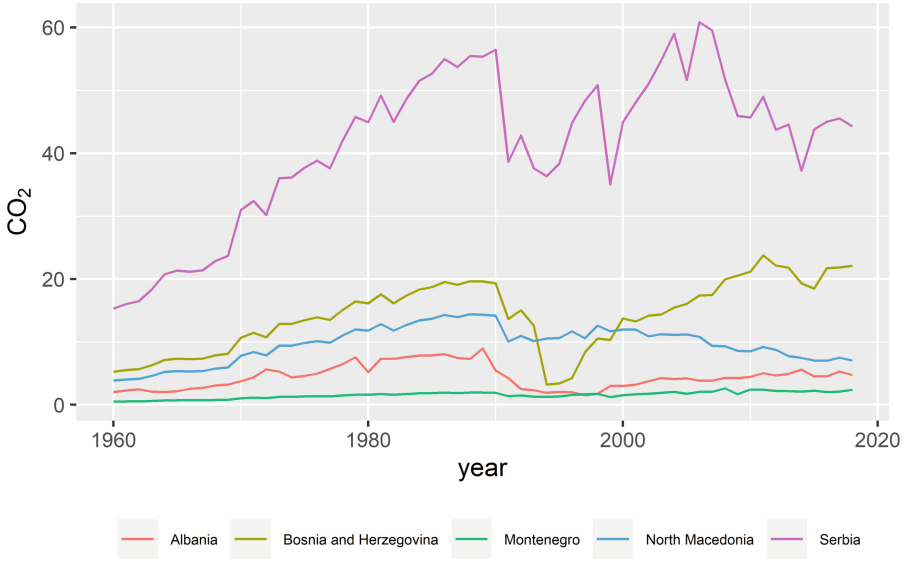

Fig. 2. CO_2 emissions per capita for five Western Balkan Countries from 1960 to 2018 [35–38].

an acceptable environmental strategy [39]. From the 1990s onwards, the new Albanian democratic society faced complex environmental problems. Now, the government, together with other political actors, professors, ecologists, and other eminent members of society, has committed itself to emphasize active participation and taking a leading role in preserving and protecting the environment [40].

At the beginning of the democratic process, Albanian citizens' environmental awareness was low. However, with the improved economic and overall quality of life, environmental thoughtfulness has been elevated, getting closer to the sustainable development paradigm. Albania is currently fulfilling its obligations under the EU Stabilization and Association Agreement. Environmental legislation is one of the main priorities, and efforts are focused on adopting EU directives on air quality, water, nature and biodiversity, waste, climate change, noise, and chemicals. The efforts of the government and civil society to create an environmental mentality within Albanian society are one of the most evident effects of the integration process towards the European Union, which pays due attention to environmental issues [41].

Albania intends to reduce harmful emissions to 48% of 2015 levels by 2025 to combat climate change. Major emitting sectors, such as industry, services, transportation, and agriculture, are all subject to mitigation efforts. Furthermore, air quality in Albania improved in the previous period, owing primarily to increased infrastructure and legal measures. Many older car types on Albania's roadways emit toxic fumes, causing considerable air pollution in major cities. Old industrial facilities and outmoded plants, particularly those in the steel industry, are another significant source of pollution. Nonetheless, carbon monoxide and benzene concentrations are within EU guidelines [42].

On the other hand, Albania lacks raw materials for energy production; therefore, it relies on its abundant water resources to generate electricity. The government has

constructed massive dams that provide nearly all of the country's energy. Hydropower is primarily responsible for the country's reasonably decent environmental position as a clean and renewable energy source [39].

The Environment in Bosnia and Herzegovina

Bosnia and Herzegovina is abundant in nature, with a high percentage of endemic and peculiar living organisms. "More than 5,000 species and sub-species of vascular plants, more than 100 species of fish, over 320 species of birds and other components of biological diversity have been identified in BiH." [43].

The process of Bosnia and Herzegovina's accession to the European Union is one of the main drivers in the reform of the environmental sector, which is mainly related to the harmonization of domestic legislation with the acquis communautaire. The Constitution stipulates that jurisdiction over environmental issues is shared between the Federation of Bosnia and Herzegovina and the Republika Srpska, while jurisdiction exists in the Brcko District and cantons/municipalities. The only institution with jurisdiction in environmental protection at the state level is the Ministry of Foreign Trade and Economic Relations, and it coordinates all international agreements and projects. In addition to national legislation, enforcement regulations, rules and procedures, and international documents, several strategic documents have been adopted in the past, which are the basis for ongoing efforts to implement environmental solid waste, environmental protection, biodiversity, climate change, monitoring international conventions, and energy reforms [43].

Today, awareness and desire to improve and enhance the quality of the environment in Bosnia and Herzegovina is growing. The topic of the environment is increasingly in the focus of both journalists and politicians. For example, efforts to raise awareness of the impact of air pollution in Bosnia and Herzegovina and stimulate the discovery of solutions will occur under the UN Air Quality Initiative and Response [44].

According to the UNECE's Bosnia and Herzegovina Environmental Performance Reviews, the air quality deteriorates during the winter, especially in urban areas, due to wood heating and transport. The geographical location of cities in the valleys only worsens this situation. To achieve the IPPC Directive's objectives, the 2015 National Emission Reduction Plan for Large Combustion Plants seeks to cut SO_2, NO_x, and dust emissions from large combustion plants by 95%, 65%, and 85%, respectively, by 2027. However, the project's costs are expected to exceed €300 million, and a finance solution has yet to be found. When combined with air emissions from an increasing number of automobiles and domestic heating using firewood and lignite, industrial air emissions result in severe air pollution in industrial and urban zones, causing significant nuisance and health issues. High levels of air pollution in and around Bosnia and Herzegovina's cities cause major health problems, including cardiovascular, respiratory, and lung ailments [45].

The Environment in Montenegro

According to WHO guidelines, air quality in Montenegro is moderately dangerous, especially in big cities. Domestic industrial activities (steelmaking and aluminum industries, agriculture, and tourism) all contribute to poor air quality in Montenegro. The air quality in its coastal region is very satisfactory due to short winters and numerous breezy days,

whereas the rest of the country suffers from periods of poor air quality due to heavy traffic year-round and domestic heating in the winter [46].

Montenegro's Coastal Area Management Program is regarded as one of the country's most notable success stories. The Mediterranean Action Plan - in collaboration with UNEP and the Montenegro Ministry of Sustainable Development and Tourism - implemented this project in collaboration with local governments in the project area and organizations such as the Environmental Protection Agency [47].

The Environment in North Macedonia

North Macedonia is undergoing European integration and is in the process of adopting and implementing the EU acquis. Specific policies encourage industrial structural transformation, with particular advantages for low-energy-intensive industries, technological advancements, equipment, and systems, and the use of renewable energy sources in emission-intensive areas. More development and investment in information systems and institutional capability at the national and local levels are required [48].

Although total greenhouse gas emissions have fallen by almost a third in the past two and a half decades, air pollution in North Macedonia has shown continuous fluctuations in SO_2 and NO_x. Air quality does not exceed the threshold values for SO_2, NO_x and CO. Only O_3 emissions exceed the limit values during the summer months, while the daily exceeding of PM_{10} resulted in this pollutant exceeding the annual limit. Policies related to urban transport aim to reduce traffic jams, improve traffic, and the role of transport infrastructure that reduces greenhouse gas emissions [48]. Total emissions are primarily the result of industrial combustion processes and transport.

Climate change, particularly extreme weather occurrences, puts the country at risk. The policy framework and the human and technical resources allocated to combating climate change are insufficient to meet climate change's problems. North Macedonia regularly meets its UNFCCC, Kyoto Protocol, and Paris Agreement reporting responsibilities. It has been commended for being one of only 16 countries on track to meet their Paris Agreement commitments [49]. Climate change is visible in North Macedonia, mainly due to rising temperatures, particularly in the summer, and severe precipitation reductions in all seasons except winter. Global climate change is anticipated to inflict damage on the regions of Ohrid and Lake Prespa, while mountainous regions will be hit hardest. The high mountain ranges of North Macedonia confront the same issues as other mountain areas worldwide, notably snowmelt and biodiversity loss [50]. Overall, integrating climate change into other sectoral policies will require significant effort.

The Environment in Serbia

Serbia's air quality is primarily degraded in urban centers, where PM_{10} and high NO_2 concentrations are the most severe issues. The high pollen content, particularly ragweed, is another issue with air quality. While PM_{10} emissions are steady, SO_2 and NO_x emissions fluctuate significantly. The energy sector is Serbia's key source of air pollution, followed by agriculture [51]. As a result, energy policy seeks to boost the usage of renewable energy sources. It is also planned to improve energy supply reliability and implement energy efficiency programs. The energy sector and transportation account for 75–78% of greenhouse gas emissions, making it a critical area to focus on if emission reductions are to be realized [52].

From the 1950s until the present, average yearly temperatures in most parts of Serbia have risen. Northern Serbia has had a more significant rise in temperature than the south. On the other side, there is no discernible trend in the average annual rainfall. The number of days with severe rain has, nevertheless, increased. Drought risks have grown, water resources have decreased, extreme temperatures have increased, and floods have increased as a result of these unpredictable temperatures and precipitation. Summers are hot and dry, which increases the risk of fire [52].

It is interesting to note that Serbia has 1760 species under strict protection and 868 under protection. International treaties and EU Directives list more than half of the strictly protected species [51]. "Serbia is home to 39% of European vascular flora species, 51% of European fish fauna, 49% of European reptile and amphibian fauna, 74% of European bird fauna, and 67% of European mammal fauna." [52].

4 An Empirical Examination of GDP-CO_2 Relationship in Western Balkans: Panel Regression

In order to deepen our analysis of the situation, we provide evidence that, for the Western Balkan countries, it is the economy that has a significant impact on the deterioration of the environment. To do that, we apply panel regression analysis.

4.1 Data and Methodology

Data for GDP per capita in constant 2011$ prices for all five Western Balkan countries has been taken from The Maddison Project Database, version 2020 [22]. The data for tonnes of CO_2 emissions per capita have been taken from The Global Carbon Atlas [35], further noting that the data came from [36–38]. The data covers the years 1960 to 2018.

To investigate the effect of GDP on CO_2, we use panel regression models. Panel or longitudinal data is a type of data that contains both components, temporal and spatial. In other words, panel data represent repeated measurements of subjects over time and thus explain the behavior of different subjects over multiple time periods. Hence, panel data models are used to describe individual behavior both across time and individuals.

The functional form of the panel regression is given by

$$y_{it} = \alpha_i + x'_{it}\beta_{it} + e_{it}, i = 1, \cdots, N, t = 1, \cdots, T, \tag{1}$$

where y_{it} denotes a dependent variable, x_{it} denotes an independent variable, e_{it} random error (noise), α_i shift, β_{it} loadings, N number of subjects, and T number of time periods. There are three types of panel models: pooled, fixed effects, and random-effects. This research excludes pooled models since this group is the most restrictive one and specifies the constant coefficients – a common cross-sectional analysis assumption. We perform the Hausman test to verify whether the adequate model is with random or fixed effects. Hausman test exams whether there is a significant difference between the fixed and random effects estimators. If individual-specific effects α_i are correlated with the regressors, we have the fixed-effects model. Otherwise, the adequate model is a random-effects model. The null hypothesis states that the preferred model is a model with random effect, while the alternate hypothesis states that the model with fixed effects is appropriate.

4.2 Results

The Hausman test supports using random-effects model (Chi-square(1) = 0.603587, p = 0.437213). The panel regression model with random effects is summarized in Table 1. The random-effects (GLS) included 5 cross-sectional units; the time-series length is 59. For the purpose of our analysis, the dependent variable is CO_2.

Table 1. Panel regression with random-effects.

	Coefficient	Std. Error	z	p-value
Constant	8.14661	7.23881	1.125	0.2604
GDP	0.000834383	0.000109366	7.629	<0.0001
Mean dependent var	14.19874	S.D. dependent var	15.47051	
Sum squared resid	64184.13	S.E. of regression	14.77543	
Log-likelihood	−1212.511	Akaike criterion	2429.022	
Schwarz criterion	2436.396	Hannan-Quinn	2431.975	
rho	0.888078	Durbin-Watson	0.179097	

Results show that higher values of GDP are associated with higher values of CO_2 emissions. Each additional GDP increase above the average leads to 0.08% higher CO_2 emissions. A large proportion (rho = 88%) is explained by the individual specific term and the rest due to idiosyncratic error.

Given that economic growth adds to increasing CO_2 emissions, Western Balkan countries have a long way to go to balance pollution levels with acceptable economic growth rates. Investment in pollution-reducing agricultural and industrial technologies should be prioritized in policies. Furthermore, one of the key priorities should be establishing and changing environmental levies. Participating in emissions trading systems and investing in renewable energy sources can help the environment while achieving suitable levels of economic growth. In addition, substantial work needs to be done in the Western Balkan countries to raise awareness of environmental issues.

5 Conclusion

In recent decades, there has been a greater universal desire for prosperity and economic progress, which has resulted in increased use of natural resources and increased pollutant emissions, particularly carbon dioxide. As a result, there has been a loss in energy security, depletion of natural resources, and the most prominent one - climate change. The academy, policymakers, industry, and civil society representatives agree that economic and human well-being must be pursued without increasing the consumption of natural resources or negatively impacting the environment. Although rich countries are well on their way to reaching these goals, developing countries, like the Western Balkan ones, face significant uncertainty since they lack the necessary structures and instruments.

Therefore, the current economic system is depleting our natural resources and jeopardizing the prosperity of future generations. Large-scale deforestation, global air pollution, depletion of ocean fish stocks, biodiversity deterioration, and loss of arable land are only a few examples of this trend. Experts argue that by 2050, the costs of climate change and biodiversity loss alone could amount to a fourth of global gross domestic product.

Economic growth and development can no longer be viewed only as the measure of the progress and development of a society. Environmental issues are gaining increasing focus as climate change affects every segment of the social paradigm. It is precisely these factors that will eventually overcome human action, which has been highly destructive for many decades. Following a period of conflict and social turmoil in the 1990s, the Western Balkan countries have embarked on a period of transition in which the environment has yet to position itself as a top priority. Low levels of environmental awareness, high levels of air pollution, especially during the winter months, heavy industry, high dependence on fossil fuels, and inefficiently implemented structural changes have all led to environmental degradation. Our results show that higher GDP values are associated with higher CO_2 emissions and that each additional increase in GDP above the average results in 0.08% higher CO_2 emissions. All of the evidence demonstrates that economic growth has degraded the environment in the Western Balkans during the last six decades.

The findings of this study should be regarded with various cautions in mind. The fact that the econometric analysis was done at the aggregate level is one of the drawbacks. Other metrics for environmental damage and economic state and prospects may be used to better understand the linkages between economy and the environment in future studies. As a result, future research should focus on new variables such as international trade, renewables, capital formation, wealth, wellbeing, and agriculture. In other words, the whole ensemble of production, socioeconomic, institutional, environmental, and sustainability indicators can be used. Furthermore, various potential methodological approaches can be adequate for this type of study, ranging from econometric approaches such as ARDL, VAR, VECM, GMM, and PMG, to machine learning and multifractal analysis approaches.

Acknowledgments. This research has been funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

References

1. Johnson, D.L., et al.: Meanings of environmental terms. J. Environ. Qual. **26**(3), 581–589 (1997)
2. Mitić, P., Kostić, A., Petrović, E., Cvetanovic, S.: The Relationship between CO_2 emissions, industry, services and gross fixed capital formation in the Balkan countries. Eng. Econ. **31**(4), 425–436 (2020)
3. Restall, B., Conrad, E.: A literature review of connectedness to nature and its potential for environmental management. J. Environ. Manage. **159**, 264–278 (2015)
4. Hanić, A., Jovanović, O., Stevanović, S.: Environmental disclosure practice in the Serbian banking sector. Management **26**(2), 115–144 (2021)

5. Munitlak-Ivanović, O., Zubović, J., Mitić, P.: Relationship between sustainable development and green economy: emphasis on green finance and banking. Ekonomika Poljoprivrede **64**(4), 1467–1482 (2017)
6. Shahbaz, M., Lean, H.H., Shabbir, M.S.: Environmental Kuznets curve hypothesis in Pakistan: cointegration and Granger causality. Renew. Sustain. Energy Rev. **16**(5), 2947–2953 (2012)
7. Narayan, P.K., Narayan, S.: Carbon dioxide emissions and economic growth: panel data evidence from developing countries. Energy Policy **38**(1), 661–666 (2010)
8. Mitić, P., Munitlak Ivanović, O., Zdravković, A.: A Cointegration analysis of real GDP and CO2 Emissions in transitional countries. Sustainability **9**(4), 568 (2017)
9. Živanović, L., Kovačević, V., Subić, J., Jeločnik, M., Zubović, J.: Economic cost-effectiveness of different nitrogen rates application in the production of corn hybrids of different FAO maturity groups on brown forest soil (Euteric Cambiosol). Custos e Agronegócio Online **12**(4), 279–294 (2016)
10. Mitić, P.: Interdependence between economic growth and environmental pollution in southeastern European countries. Doctoral dissertation (2020)
11. Hussen, A.M.: Principles of Environmental Economics - Economics, Ecology and Public Policy. Routledge, New York (2000)
12. Tietenberg, T.H., Lewis, L.: Environmental and Natural Resource Economics, 11th edn. Routledge, New York (2018)
13. Commoner, B.: The Closing Circle: Nature, Man, and Technology. 1st edn. Random House Inc. (1971)
14. Brock, W., Taylor, M.S.: Economic growth and the environment: a review of theory and empirics. NBER Working Paper Series - Working Paper 10854 (2004)
15. Ristovska, K., Ristovska, A.: The impact of globalization on the business. Econ. Anal. **47**(3–4), 83–89 (2014)
16. OECD: Multi-dimensional Review of the Western Balkans: Assessing Opportunities and Constraints, OECD Development Pathways. OECD Publishing, Paris. https://www.oecd-ilibrary.org/sites/4d5cbc2a-en/index.html?itemId=/content/publication/4d5cbc2a-en. Accessed 13 Feb 2022
17. Vuković, S.: Ekonomski uzroci razbijanja/raspada Jugoslavije. Sociološki pregled **45**(4), 477–504 (2011)
18. Health and Environment Alliance (HEAL): Hronično zagađenje ugljem. https://www.env-health.org/wp-content/uploads/2019/03/Chronic-Coal-Pollution-report_SRB.pdf. Accessed 13 Feb 2022
19. Ministry of Mining and Energy of the Republic of Serbia. Energy Security of Serbia. https://www.mre.gov.rs/sites/default/files/inline-files/Energetska%20bezbednost%20Srbije.pdf. Accessed 13 Feb 2022
20. EU u Srbiji: Western Balkans: An Economic and Investment Plan to Support the Economic Recovery and Convergence. https://europa.rs/western-balkans-an-economic-and-investment-plan-to-support-the-economic-recovery-and-convergence/?lang=en. Accessed 8 Feb 2022
21. Vuković, A., Vujadinović Mandić, M.: Study on climate change in the Western Balkans region. Regional Cooperation Council. https://www.rcc.int/pubs/62/study-on-climate-change-in-the-western-balkans-region. Accessed 12 Feb 2022
22. Jutta, B., van Zanden, J.: Maddison style estimates of the evolution of the world economy. a new 2020 update. Maddison Project Databases. https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2020?lang=en. Accessed 18 Dec 2021
23. Videnović, S., Hanić, A., Sućeska, A.: Ethically relevant values and behavior of employees in Serbia during the Covid-19. Teme **45**(3), 821–842 (2021)
24. Rapoza, K.: Albania becomes latest China magnet. https://www.forbes.com/sites/kenrapoza/2016/06/13/albania-becomes-latest-china-magnet/#13bf05332490. Accessed 27 Dec 2021

25. The World Bank: The World Bank in Albania Overview. https://www.worldbank.org/en/country/albania/overview#3. Accessed 8 Feb 2022
26. The World Factbook. Bosnia and Herzegovina – Economy. https://www.cia.gov/the-world-factbook/countries/bosnia-and-herzegovina/#economy. Accessed 7 Feb 2022
27. The World Bank: The World Bank in Bosnia and Herzegovina Overview. https://www.worldbank.org/en/country/bosniaandherzegovina/overview#1. Accessed 7 Feb 2022
28. The World Factbook: Montenegro – Economy. https://www.cia.gov/the-world-factbook/countries/montenegro/#economy. Accessed 12 Feb 2022
29. The World Bank: The World Bank in Montenegro Overview. https://www.worldbank.org/en/country/montenegro/overview#1. Accessed 12 Feb 2022
30. The World Factbook: North Macedonia – Economy. https://www.cia.gov/the-world-factbook/countries/north-macedonia/#economy. Accessed 10 Feb 2022
31. The World Bank: The World Bank in North Macedonia Overview. https://www.worldbank.org/en/country/northmacedonia/overview#3. Accessed 10 Feb 2022
32. The World Factbook: Serbia – Economy. https://www.cia.gov/the-world-factbook/countries/serbia/#economy. Accessed 8 Feb 2022
33. The World Bank: The World Bank in Serbia Overview. https://www.worldbank.org/en/country/serbia/overview#3. Accessed 8 Feb 2022
34. Domazet, I., Zubović, J., Lazić, M.: Driving factors of Serbian competitiveness – digital economy and ICT. Strateg. Manag. **23**(1), 20–28 (2018)
35. Global Carbon Atlas. http://www.globalcarbonatlas.org/en/CO2-emissions. Accessed 18 Dec 2021
36. Friedlingstein, P., et al.: Global carbon budget 2021. Earth Sys. Sci. Data Discuss., 1–191 (2021)
37. Andrew, R.M., Peters, G.P.: The global carbon project's fossil CO2 emissions dataset. https://zenodo.org/record/5569235#.Ygk_yN_MJPZ. Accessed 18 Dec 2021
38. UN 2019: World Population Prospects: The 2019 Revision. United Nations Population Division. https://esa.un.org/unpd/wpp/. Accessed 18 Dec 2021
39. Feuersenger, W.: Albania struggles with environmental challenges |DW|. https://www.dw.com/en/albania-environment-challenges/a-16343222. Accessed 29 Dec 2021
40. Proko, A., Pambuku, A., Shumka, S., Vako, E., Beqiraj, H., Beshku, H.: The environmental research in Albania (Rep.). Tirana, Albania: EC funded project WBC-INCO.NET (2009)
41. Hitaj, E.: Environment protection under the Albanian domestic legislation. Eur. Sci. J. **11**(10), 611–620 (2015)
42. European Environment Agency: Albania country briefing - The European environment - state and outlook 2015 (last modified 2020). https://www.eea.europa.eu/soer/2015/countries/albania. Accessed 8 Feb 2022
43. European Environment Agency: Bosnia and Herzegovina country briefing - The European environment - state and outlook 2015 (last modified 2020). https://www.eea.europa.eu/soer/2015/countries/bosnia-and-herzegovina. Accessed 7 Feb 2022
44. UN environment programme: Coming up for clean air in Bosnia and Herzegovina. https://www.unep.org/news-and-stories/story/coming-clean-air-bosnia-and-herzegovina. Accessed 8 Feb 2022
45. UNECE: 3rd Environmental Performance Review of Bosnia and Herzegovina (Rep. No. ECE/CEP/184). https://unece.org/sites/default/files/2021-08/ECE.CEP_.184.Eng_.pdf. Accessed 8 Feb 2022
46. UNECE: UNDA Project 1819AE: Montenegro - Improving air quality. https://unece.org/environment-policy/environmental-performance-reviews/unda-project-1819ae-montenegro-improving-air#:~:text=Overall%2C%20the%20air%20quality%20in,hospitalizations%20and%20other%20health%20impacts. Accessed 13 Feb 2022

47. European Environment Agency: Montenegro country briefing - The European environment - state and outlook 2015 (last modified 2020). https://www.eea.europa.eu/soer/2015/countries/montenegro. Accessed 12 Feb 2022
48. European Environment Agency: North Macedonia country briefing - The European environment - state and outlook 2015 (last modified 2020). https://www.eea.europa.eu/soer/2015/countries/the-former-yugoslav-republic-of-macedonia. Accessed 12 Feb 2022
49. UNECE: 3rd Environmental Performance Review of North Macedonia (Rep. No. ECE/CEP/186). https://unece.org/sites/default/files/2021-12/ECE.CEP_.186.Eng_.pdf. Accessed 12 Feb 2022
50. Naturvernforbundet: Environmental issues in Macedonia. https://naturvernforbundet.no/international/environmental-issues-in-macedonia/category939.html. Accessed 12 Feb 2022
51. European Environment Agency: Serbia country briefing - The European environment - state and outlook 2015 (last modified 2020). https://www.eea.europa.eu/soer/2015/countries/serbia. Accessed 8 Feb 2022
52. UNECE: 3rd Environmental Performance Review of Serbia (Rep. No. ECE/CEP/174). https://unece.org/sites/default/files/2021-08/ECE_CEP_174.pdf. Accessed 8 Feb 2022

The Finance-Growth Nexus and the Role of Institutional Development: A Case Study of the Western Balkan Countries

Edib Smolo(✉)

Effat University, 8482 Qasr Khouzam, Al-Nazlah Al-Yamaniyah, Jeddah 22332, Saudi Arabia
edib.smolo@gmail.com, esmolo@effatuniversity.edu.sa

Abstract. This paper empirically investigates the impact of finance and institutions on the economic growth of the Western Balkan economies – Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia – using a panel data analysis covering 2000–2020. While individually, neither finance nor institutions significantly impact economic growth, they increase the sample countries' GDP when the two interact. Furthermore, the results suggest that the finance-growth relationship is non-linear, with a positive impact having a threshold. This relationship also depends on the sample's institutional development (and vice versa). Similarly, this relationship depends on the proxy used, and hence, we need to be careful when making conclusions.

Keywords: Financial development · Institutional development · Economic growth · Emerging countries · Transition economies · Western Balkans

1 Introduction

The economic growth of any country is affected by several factors such as government spending, human capital, monetary and fiscal stability, financial sector, and institutional development. Studies show that their impact may depend on internal conditions. Since Schumpeter wrote his seminal work in 1912, the debate on the importance of financial development is not fading (Schumpeter 1912). Although financial development is among the most influential factors, its role is continuously challenged. For instance, Ali et al. (2020) and Rousseau and Wachtel (2011) find that this finance-growth relationship has diminished in recent years. Besides, different proxies sometimes provide conflicting results. The efficiency of traditional measures of financial development (private credit, liquid liabilities, broad money, etc.) is also questioned. The financial sector is a dynamic and complex system. Thus, its measures need continuous updates to reflect their true nature. This is why Svirydzenka (2016) developed alternative and more comprehensive measures of financial development.

Furthermore, as the finance-growth relationship is fading and knowing that other factors may influence this relationship, researchers are shifting their focus to institutional quality and its impact on growth directly and indirectly via its effects on financial

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 22–37, 2023.
https://doi.org/10.1007/978-3-031-17767-5_2

development. Studies show that political stability, the rule of law, corruption, property rights, and government efficiency – among other institutional development proxies – affect this relationship (Anayiotos and Toroyan 2009; Gani and Ngassam 2008; Law and Habibullah 2009; Hakimi and Hamdi 2017; Slesman et al. 2019). Nevertheless, all these variables and their relationships with growth may significantly depend on the overall conditions and development of sample countries.

The existing literature, except few studies, focuses primarily on developed economies, ignoring less developed ones, particularly transition economies (TE) such as those from the Western Balkans (WB). These countries differ in many dimensions and go through social, political, economic, and institutional changes that affect their overall performance. While significant reforms have been introduced in the WB countries, they are far from reaching the EU standards. These countries are among the most corrupt countries globally, where the rule of law is the lowest (Popovic et al. 2020). Such a business environment is not conducive to economic growth (Smolo 2021a).

In short, WB countries need institutions (financial and otherwise) that would support and promote economic growth. This study addresses the finance-growth nexus using the Western Balkans as the sample, whose financial and institutional developments are similar. The main objective of this study is to determine the effect of financial and institutional development on economic growth within the sample mentioned above. The WB countries are important for several reasons. First, they occupy an important geopolitical position. Given the ongoing crisis in Ukraine and political instability in the region, these countries represent a socio-political threat to the EU and the wider region. Effective institutions and growing economies of these countries would benefit not only the WB region but also the EU. Second, while aspiring to become members of the EU, failing to meet the EU standards may undermine the integrity and stability of the EU. Finally, by evaluating the financial and institutional developments of these countries, the study will evaluate the various programs implemented in these sectors by the EU and other international financial institutions. The international community, in general, played and still plays a vital role in regional development.

The rest of the study is structured as follows: Section 2 provides a literature review; Sect. 3 describes the data and methodology used; Sect. 4 analyses empirical results; and Sect. 5 offers concluding observations.

2 Literature Review and Hypothesis Setting

As pointed out in the introduction, the finance-growth relationship attracts a significant amount of research. Schumpeter (1912); Robinson (1952); Goldsmith (1969); Shaw (1973); and Lucas (1988) provide a theoretical foundation that led to an expansion of the literature on the topic. Although the pioneers of the issue pointed to a positive relationship between finance and growth, the literature reveals conflicting results.

Many of those studies align with the view advocated by the authors mentioned above. For instance, one of the earliest studies on the topic was carried out by Levine (1997 2003). He found that financial development – proxied by the banking size and the stock market liquidity – leads to economic growth. This view is the most prevailing one in the literature and is known as the 'supply-leading hypothesis' (Ahmed and Ansari 1998; An et al. 2020; Beck et al. 2000, 2014; Bittencourt 2012; King and Levine 1993; Levine et al. 2000; Rajan and Zingales 1998; Seetanah et al. 2009). However, once a certain threshold is reached, this positive impact turns negative, making this relationship non-linear (Law and Singh 2014; Prochniak and Wasiak 2016; Swamy and Dharani 2019a).

While the importance of finance for economic growth is evident, the results show that its effect depends on financial development proxy, sample countries, study period, methodology used, income level, and type of economy (An et al. 2020; Barajas et al. 2013; Carré and L'œillet 2018; Hsueh et al. 2013; Nyasha and Odhiambo 2018; Yang 2019). Consequently, Luintel and Khan (1999), Khan (2001), and Andersen and Tarp (2003), among others, found a negative impact of finance on economic growth. Still, several studies found more than one relationship between finance and growth (Hassan et al. 2011; Hsueh et al. 2013; Marques et al. 2013; Smolo 2020), while others found no significant impact of finance on growth (Lucas 1988; Shan and Morris 2002; Nyasha and Odhiambo 2015; Smolo 2021b).

Besides, many studies indicate that legal system, education, investment, trade openness, and institutional development – among others – have a significant impact on financial development directly (Bittencourt 2012; Levine et al. 2000; Seetanah et al. 2009). As a result, they would impact growth through their impact on finance. Hence, the researchers focused on other factors, such as institutional development proxied by several measures. For instance, among the crucial factors that affect the finance-growth relationship are political stability, property rights, the rule of law, accounting standards, control of corruption, and government efficiency (Anayiotos and Toroyan 2009; Demetriades and Fielding 2012; Gani and Ngassam 2008; Girma and Shortland 2007; Law and Azman-Saini 2008; Slesman et al. 2019). In other words, the positive impact of finance on growth is subject to a certain level of institutional development/quality (Minea and Villieu 2010; Djeri 2020; Slesman et al. 2019; Kutan et al. 2017). In addition, government efficiency and democracy lead to institutional efficiency and eventually economic growth in Pakistan (Murtaza and Faridi 2016) and economic growth of sub-Saharan African countries (Sani et al. 2019).

All in all, while the discussion over the finance-growth relationship is exhaustive, the results are unconvincing. The interconnectedness of social, economic, and political institutions sheds some light on this complex issue. In particular, there is a reasonable doubt that institutional development has a direct and indirect effect on economic growth and finance-growth relationship, respectively. As a result, this tripartite relationship – institutions-finance-growth – lacks proper attention and requires further investigation. Thus, this study is trying to address it using the Western Balkan countries, which are considered transition economies. The study will provide new insights on the topic and offer valuable policy recommendations while adding to the existing and growing literature.

In short, based on existing literature, this study will test the following hypotheses:

H_1: Financial development affects economic growth positively.

H_2: The impact of financial development on economic growth is non-linear.

H_3: The effect of financial development on economic growth depends on institutions.

H_4: The finance-growth nexus depends on proxies used for financial development indicators.

3 Model Specification, Methodology, and Data

3.1 Data and Sample Selection

To investigate the relationship between financial and institutional development on one side and economic growth on the other, this study uses annual-level data for the Western Balkan countries – Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, and Serbia.[1] These economies are relatively small and open, transitioning from a planned or command to a market economy.

In line with the existing literature, our dependent variable is the GDP growth rate (GDP) as a measure of economic growth (Swamy and Dharani 2019b). For robustness tests, we are using the real per capita GDP growth rate (GDPp) instead (Kutan et al. 2017; Swamy and Dharani 2019b). When it comes to financial development variables, previous studies used several proxies. Some studies use a ratio of credit to the private sector as a percentage of GDP (PR) to capture the efficiency of funds channeling to the private sector (Al-Malkawi and Abdullah 2011; Levine 1997; Smolo 2020). Others use a ratio of liquid liabilities to GDP (LL) to capture the financial sector size and depth (King and Levine 1993; Levine 1997; Compton and Giedeman 2011; Law and Singh 2014; Smolo 2020). Due to missing data for these proxies, this study relies on domestic credit (DC) to the private sector by banks and broad money (BM), both as a percentage of GDP.[2]

[1] Although Croatia belongs to the Western Balkans, we excluded it from the sample as it joined the EU on 1 July 2013. On the other hand, there are sufficient data for Kosovo and thus we excluded Kosovo from the study as well.

[2] The full data for PC and LL are not available for all countries. For instance, these data are not available for Serbia.

Besides, Svirydzenka (2016) argues that these traditional variables do not reflect the multifaceted nature of financial development. Consequently, apart from the two proxies for financial development mentioned above, this study explores the financial development index suggested by Svirydzenka. This index considers the depth, accessibility, and efficiency of financial institutions and markets jointly.[3] Furthermore, as several studies find a non-linear relationship between finance and growth, this study also uses squared terms of these financial variables (Rousseau and Wachtel 2011; Breitenlechner et al. 2015; Haini 2020).

Similarly, institutional development is also a complex, multidimensional concept as scholars used various indicators as its proxies. This study relies on two different measures. The first one is the Heritage Foundation's institutional development (overall score). The second is the institutional quality index constructed based on six World Bank database's World Governance Indicators (WGI) indicators. These indicators are control of corruption, political stability, the rule of law, regulatory quality, voice and accountability, and government effectiveness developed by Kaufmann et al. (2010). However, instead of examining each indicator separately or jointly, we construct the institutional quality index using the principal component analysis (PCA). Using each indicator separately may not provide the overall quality of institutions as it is a complex phenomenon. At the same time, using all these indicators simultaneously may not be appropriate as they are highly correlated (Globerman and Shapiro 2002; Buchanan et al. 2012). Hence, using factor analysis and following Globerman and Shapiro (2002) and Buchanan et al. (2012), we construct the institutional quality index by extracting the first principal component of those six institutional quality indicators. In addition, to determine the indirect impact of institutions on growth through financial development, the study employs interaction terms of each financial development indicator with institutional development proxies (Haini 2020).

Furthermore, besides finance and institutions, other factors also influence economic growth. Thus, the study uses several control variables commonly used in the literature on the topic. These control variables are: GCF, the gross capital formation (% GDP) reflecting the overall economic development of a country; TO, trade openness is measured by the sum of exports and imports of goods and services (% GDP) representing the significance of international trade on economic activities; FCE, final consumption expenditure (% GDP) as a proxy for investment in physical capital; LF, measured by total labor force and represent the human capital development; and INF, inflation rate measured by GDP deflator (annual %) indicating macroeconomic and business environment (in)stability (Beck et al. 2014; Bist 2018; Ibrahim et al. 2017; Sabir et al. 2019; Swamy and Dharani 2019b). Table 1 provides summary statistics of all variables used in model estimations, while Table 4 (see the Appendix) provides the correlation matrix between these variables.

[3] These results using financial development proxies suggested by Svirydzenka are not reported in this paper. We will only briefly discuss some findings towards the end of the study. One of the reasons for not including them in the main discussion is that this index is not available for Montenegro. As such, the results may not be directly comparable with other results where the data are available.

Table 1. Descriptive statistics

Variable	Sign	Obs	Mean	Std. Dev.	Min	Max
Dependent Variables						
GDP per capita growth (annual %)	GDPp	105	2.935	.327	.089	3.373
GDP growth (annual %)	GDP	105	2.943	.327	.088	3.361
Independent Variables						
Domestic credit to private sector by banks (% of GDP)	DC	103	3.546	.563	1.583	4.46
Broad money (% of GDP)	BM	103	3.863	.467	2.422	4.501
Institutional development (Overall Score - Heritage)	ID	89	4.08	.135	3.6	4.267
Institutional quality index	IQ	95	1.478	.272	.002	1.829
Control Variables						
Trade (% of GDP)	TO	105	4.467	.238	3.113	4.931
Gross capital formation (% of GD)	GCF	104	3.206	.245	2.215	3.718
Inflation, GDP deflator (annual %)	INF	104	1.605	.748	.007	4.483
Labor force, total	LF	105	13.854	.82	12.37	15.038
Final consumption expenditure (% of GD)	FCE	105	4.567	.092	4.376	4.832

Note: All variables are in log form.

All data are sourced from World Development Indicators (World Bank), World Governance Indicators (World Bank), the Heritage Foundation, and the IMF Financial Development Index Database (Svirydzenka 2016) and cover the 2000–2020 period. The study focuses on this period because the majority of the Western Balkan countries went through turbulent times during the'90s, and it took some years for these countries to get their economies back on track. Including observations from earlier periods might affect relationships that focus on this study.

3.2 Models and Method Used

The literature is overwhelmed with numerous techniques, indicators, and samples used to investigate the finance-growth nexus. Consequently, previous studies led to mixed results and different conclusions. The majority of studies that used panel data applied models such as fixed (FE) and random effect (RE) or least square dummy variable (LSDV), assuming homogeneity of impact across countries. Studies also used the generalized method of moments (GMM) estimation method for dynamic panel data considering it superior to other methods. However, the GMM method is applicable only when we have many cross-section units (i.e., long N) and a short time period (T). Our sample consists of only five countries (i.e., a short N) and relatively long period (T), so we cannot rely on this technique.

Given relative similarities between the sample countries, this study relies on RE and FE methods to assess the impact of financial development and institutional quality on economic growth using the following dynamic panel data model (Agbloyor et al. 2016; Compton and Giedeman 2011):

$$GDP_{it} = \alpha GDP_{it-1} + \beta FD_{it} + \delta ID_{it} + \theta X_{it} + \varepsilon_{it} \quad (1)$$

where for country i (the cross-sectional dimension) at time t (the time dimension), GDP_{it} is the log of annual GDP growth rate, GDP_{it-1} is the lagged value, FD_{it} is a measure of financial development, ID_{it} is a measure of institutional development, X_{it} is a vector of all control variables; μ_i is a country-specific effect, η_t is a time-specific effect, and ε_{it} is a random error term that captures all other variables.

As pointed out earlier, there is potential non-linearity in the finance-growth nexus. Hence, we will test this using square terms of financial development indicators as illustrated in the following model:

$$GDP_{it} = \alpha GDP_{it-1} + \beta FD_{it} + \gamma FD_{it}^2 + \delta ID_{it} + \theta X_{it} + \varepsilon_{it} \quad (2)$$

where FD_{it}^2 represents the square term of our financial development measures.

Finally, to test whether the impact of financial development depends on the level of institutional development, we introduce an interaction term to Eq. (1) as presented in Eq. (3) below. These interaction terms allow us to distinguish the direct and indirect impacts of financial and institutional development on growth. As suggested by Brambor et al. (2006), we include all relevant terms in the interaction model specification as follows:

$$GDP_{it} = \alpha GDP_{it-1} + \beta FD_{it} + \delta ID_{it} + \vartheta (FD_{it} \times ID_{it}) + \theta X_{it} + \varepsilon_{it} \quad (3)$$

where, $FD_{it} \times ID_{it}$ represents the interaction variable. Other terms are as defined earlier.

4 Empirical Results and Discussion

Table 2 presents the estimated results for the linear model based on Eq. (1). This table tests our first hypothesis (H_1) whether finance contributes to economic growth. While RE estimations indicate a significantly negative impact of financial development on economic growth, we cannot rely on them as the Hausman test supports FE results. The results show that domestic credit (DC) and broad money (BM) have no significant impact on economic growth except in model (8), which indicates a significantly negative effect of BM on economic growth. These results might be due to the transitional nature of these countries and their low levels of financial market development. All these contribute to the overall instability of economies that could consequently make financial development ineffective. In brief, based on the results, we cannot confirm (H_1).

Similarly, institutional development proxies have an insignificant impact on economic growth. It seems that these institutions are not developed enough to significantly impact growth as is expected based on the theoretical underpinnings. This is in contrast to previous studies that showed a significant impact of ID on growth Singh et al.

(2009), Nguyen et al. (2018), and Kutan et al. (2017). Similar conclusions are reported by Rousseau and Wachtel (2011).

The results indicate that the lagged dependent variable (GDP_{t-1}) and final consumption expenditure (FCE) have significantly reduced economic growth when it comes to controlling variables. At the same time, trade openness (TO), inflation (INF), and labor force (LF) have a significantly positive impact on growth in most model specifications. Finally, gross capital formation (GCF) is insignificant in all models.

Results based on Eq. (2) that test the possible non-linear relationship between finance and growth (H_2) are presented in Panel A of Table 3.[4] A non-linear relationship is confirmed in two models, (1) and (2), when used in combination with an institutional development proxy sourced from the Heritage Foundation. The results now indicate that financial development contributes significantly to these countries' economic growth up to a certain point when it turns out to decrease it. In other words, there is an inverted U-shaped relationship between finance and growth. These results align with those reported by Swamy and Dharani (2019b), Law and Singh (2014), and Prochniak and Wasiak (2016). Regardless of these changes, institutional development still has an insignificant impact on economic growth.

Although the individual impact of institutional development is not evident so far, its impact might be strengthened via interaction with financial development proxies. To check whether the effect of financial development depends on institutional development (and vice versa), we introduce the interaction term in Panel B of Table 3. These results are based on our Eq. (3), which investigates whether finance's impact on growth depends on institutions (H_3). In contrast to the results reported in Table 2, the interaction models in Panel B of Table 3 indicate the positive impact of financial and institutional development proxies on economic growth. The interaction terms are also significant but with the negative signs landing support to H_3. The results are in contrast to those reported by Minea and Villieu (2010), Djeri (2020), Slesman et al. (2019), and Smolo (2021a). All other control variables are in line with previously reported results.

Earlier, we detected a non-linear relationship between financial development and economic growth (Panel A). We also confirmed an indirect impact of financial development on economic growth via institutional development and vice versa (Panel B). The study goes a step forward and investigates non-linear relationships together with interaction terms. These results are presented in Panel C of Table 3. The earlier results are confirmed, i.e., there is a positive impact of both financial development and institutional development on economic growth with a negative impact of their interaction terms. In line with the results from Panel A, these results also confirm an inverted U-shaped relationship between financial development and economic growth.

As for robustness tests, we run the exact estimations using the real per capita GDP growth rate (GDPp). The main results of the robustness tests are reported in Appendix 1 (see Table 5). The results remain similar to the results from Table 3. Along with all the above estimations, the study also runs additional models using the financial development indices suggested by Svirydzenka. In contrast to the results reported earlier

[4] To conserve the space, we are providing results for the main variables only. The impact of control variables remains relatively the same under these specifications. The full results, however, are available upon a request from the author.

Table 2. The institutions-finance-growth nexus: linear models using GDP.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	RE	FE	RE	FE	RE	FE	RE	FE
GDP_{t-1}	−0.022**	−0.024**	−0.018**	−0.022**	−0.026**	−0.027***	−0.024**	−0.023**
	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)	(0.010)
DC	−0.386**	0.111			−0.649***	−0.267		
	(0.175)	(0.367)			(0.195)	(0.283)		
BM			−1.037***	−0.915			−1.247***	−1.197***
			(0.308)	(0.569)			(0.294)	(0.383)
ID	−1.680**	−0.254	−0.530	0.577				
	(0.719)	(0.822)	(0.789)	(0.847)				
IQ					−0.119	0.371	−0.088	0.371
					(0.359)	(0.345)	(0.362)	(0.364)
GCF	−0.290	−0.462	−0.193	−0.295	0.217	0.091	0.139	0.025
	(0.334)	(0.357)	(0.325)	(0.314)	(0.301)	(0.318)	(0.295)	(0.298)
TO	1.573***	2.262***	1.591***	2.181***	1.897***	2.155***	1.748***	2.025***
	(0.420)	(0.460)	(0.400)	(0.425)	(0.447)	(0.465)	(0.432)	(0.475)
FCE	−5.723***	−7.000***	−6.711***	−7.107***	−3.721***	−6.596***	−4.379***	−5.984***
	(1.059)	(1.097)	(1.007)	(0.974)	(0.979)	(1.116)	(0.997)	(1.105)
LF	2.973***	0.239	1.993***	0.423	1.767***	0.246	1.350	0.169
	(0.229)	(0.368)	(0.340)	(0.364)	(0.236)	(1.152)	(0.255)	(1.139)
INF	0.027	0.110*	0.057	0.064	0.016	0.122*	0.057	0.121*
	(0.060)	(0.060)	(0.057)	(0.056)	(0.065)	(0.061)	(0.066)	(0.064)
Constant	27.552***	−1.806***	27.140***	−3.402***	9.555	3.726*	17.129**	11.744***
	(8.055)	(0.160)	(8.461)	(0.141)	(6.714)	(2.202)	(7.194)	(3.543)
Observations	86	81	86	81	90	85	90	85
No. of groups	5	5	5	5	5	5	5	5
R-squared	0,113	0,312	0,095	0,266	0,063	0,564	0,135	0,236
Hausman test		23,031		26,01		44,772		34,566
Hausman Prob > chi2		(0.003)		(0.001)		(0.000)		(0.000)
F-test/Wald-test p-val.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: See Table 1 for variable definitions. Standard errors in parentheses. * F-stat. p-val. And Wald-test p-val. For joint significance. FE is Fixed Effects estimation, RE is Random Effects estimation.
***p < 0.01, **p < 0.05, *p < 0.10.

using domestic credit and broad money, these proxies provided mixed results. These results, however, should not be taken for granted as our data are not complete. Still, these findings suggest that the finance-growth nexus depends on financial development proxies used (Fernandez and Galetovic 1994; De Gregorio and Guidotti 1995; Luintel and Khan 1999; Ram 1999; Naceur and Ghazouani 2007; Favara 2003; Hsueh et al. 2013; Carré and L'œillet 2018; Nyasha and Odhiambo 2018). While limited in nature, these findings support the idea that the finance-institutions-growth nexus depends on the interaction of financial and institutional development within sample countries. Hence, we found support for our H_4 hypothesis.

Table 3. The institutions-finance-growth nexus: non-linear and interaction models using GDP.

	(1) FE	(2) FE	(3) FE	(4) RE	(5) FE	(6) FE	(7) FE	(8) FE	(5) FE	(6) FE	(7) FE	(8) FE
	Panel A				Panel B				Panel C			
GDP_{t-1}	-0.026***	-0.020**	-0.027***	-0.024**	-0.027***	-0.019**	-0.024**	-0.019*	-0.028***	-0.019**	-0.024**	-0.021**
	(0.009)	(0.009)	(0.010)	(0.011)	(0.010)	(0.008)	(0.010)	(0.011)	(0.009)	(0.009)	(0.010)	(0.010)
DC	4.414***		1.947		9.560***		2.897**		11.336***		2.582	
	(1.573)		(1.666)		(2.821)		(1.249)		(2.806)		(1.754)	
DC-squared	-0.731***		-0.300						-0.658**		0.079	
	(0.255)		(0.221)						(0.269)		(0.292)	
BM		14.496***		1.168		9.424***		0.601		12.983***		14.543**
		(3.773)		(3.388)		(2.759)		(1.371)		(4.207)		(6.815)
BM-squared		-2.086***		-0.311						-1.271		-1.856**
		(0.475)		(0.445)						(1.097)		(0.890)
ID	0.104	-0.006			7.481***	10.813***			6.083**	4.762		
	(0.813)	(0.900)			(2.471)	(2.595)			(2.436)	(5.842)		
IQ			0.462	-0.174			7.333***	4.717			7.901**	2.916
			(0.361)	(0.375)			(2.685)	(2.942)			(3.359)	(3.001)
DCxID					-2.468***				-1.910***			
					(0.707)				(0.718)			
BMxID						-2.814***				-1.247		
						(0.693)				(1.508)		
DCxIQ							-1.997**				-2.168**	
							(0.757)				(0.970)	
BMxIQ								-1.229				-0.755
								(0.811)				(0.824)
Constant	-2.636***	0.474***	-4.931*	12.206	-1.351***	-1.240***	-8.490***	4.726	-2.026***	-0.043	-7.422**	-17.698***
	(0.164)	(0.164)	(2.603)	(9.159)	(0.165)	(0.136)	(2.807)	(4.651)	(0.170)	(0.200)	(2.925)	(5.242)
Observations	81	81	85	90	81	81	85	85	81	81	85	85
No. of groups	5	5	5	5	5	5	5	5	5	5	5	5
R-squared	0.651	0.713	0.615	0.003	0.643	0.712	0.625	0.574	0.67	0.716	0.624	0.599
Hausman test	21.486	1181.665	27.634	6.464	24.155	29.133	26.53	32.127	26.305	64.344	28.787	68.469
Hausman Prob > chi2	(0.011)	(0.000)	(0.001)	(0.693)	(0.002)	(0.001)	(0.002)	(0.000)	(0.003)	(0.000)	(0.001)	(0.000)
F-test/Wald-test p-val.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: See Table 1 for variable definitions. Standard errors in parentheses. * F-stat. p-val. And Wald-test p-val. For joint significance. FE is Fixed Effects estimation, RE is Random Effects estimation. ***p < 0.01, **p < 0.05, *p < 0.10.

Finally, it is essential to note that our results are robust to different combinations of two dependent and two institutional development proxies. These results are not reported but are available upon a reasonable request.

5 Conclusion

The study revisits the finance-growth relationship within the Western Balkan countries, taking into account institutional development. Our results reveal that the linear impact of either financial or institutional development on economic growth is insignificant. The results based on non-linear estimations point to an inverted U-shaped relationship between finance and growth. However, no impact of institutions on growth is detected again. Once interaction terms between financial and institutional proxies enter equations, all terms become positive. The insignificance of financial and institutional proxies individually could be attributed to their underdevelopment. Hence, once they are joined together, their significance comes to the surface.

All in all, our main and robustness results indicate that the impact of finance on growth is positive and non-linear. Similarly, institutional development only plays a positive role in growth when interacting with financial development proxies. Both finance and institutions in these countries are not developed enough to significantly impact economic growth. Based on the results from this study, the policymakers should focus on developing both to foster further economic development of the sample countries. The results, nevertheless, should be viewed with a cation as different proxies may lead to different results. Hence, further analysis is needed to support these findings.

Declarations. The author has no relevant financial or non-financial interests to disclose. The data are available upon a reasonable request from the author.

Appendix: Robustness Tests

Table 4. Correlation matrix: all countries.

Variables	GDP	GDPp	GCF	INF	LF	DC	BM	ID	IQ	TO	FCE
GDP	1.000										
GDPp	0.965	1.000									
GCF	0.388	0.338	1.000								
INF	0.596	0.545	0.413	1.000							
HC	−0.022	0.125	0.129	−0.028	1.000						
DPC	−0.428	−0.399	−0.233	−0.208	−0.020	1.000					
BM	0.061	0.143	0.444	−0.116	0.676	0.047	1.000				
ID	−0.142	−0.235	0.249	−0.232	−0.341	0.293	0.324	1.000			
IQ	−0.477	−0.482	−0.408	−0.396	−0.291	0.834	−0.154	0.406	1.000		
TO	−0.104	−0.172	0.065	0.081	−0.560	0.612	−0.222	0.509	0.663	1.000	
FCE	−0.183	−0.070	−0.547	−0.001	0.345	0.196	−0.318	−0.796	0.060	−0.307	1.000

Table 5. The institutions-finance-growth nexus: robustness test s using GDPp.

	(1) FE	(2) FE	(3) FE	(4) RE	(5) FE	(6) FE	(7) RE	(8) FE	(9) FE	(10) FE	(11) FE	(12) FE
	Panel A				Panel B				Panel C			
$GDPp_{t-1}$	-0.432***	-0.342**	-0.447***	-0.410**	-0.487***	-0.325**	-0.401**	-0.337*	-0.501***	-0.336**	-0.394**	-0.357*
	(0.159)	(0.147)	(0.164)	(0.184)	(0.167)	(0.145)	(0.175)	(0.182)	(0.160)	(0.148)	(0.166)	(0.180)
DC	4.646***		2.079		9.844***		1.295		11.693***		2.744	
	(1.582)		(1.742)		(2.803)		(0.823)		(2.792)		(1.838)	
DC-squared	-0.769***		-0.324						-0.690**		0.053	
	(0.256)		(0.231)						(0.269)		(0.300)	
BM		14.465***		1.080		9.420***		0.528		12.609***		12.063*
		(3.812)		(3.363)		(2.720)		(1.383)		(4.278)		(6.756)
BM-squared		-2.084***		-0.291						-1.126		-1.542*
		(0.479)		(0.442)						(1.104)		(0.885)
ID	0.104	-0.041			7.595***	10.879***			6.181**	5.500		
	(0.812)	(0.913)			(2.433)	(2.542)			(2.411)	(5.816)		
IQ			0.486	-0.178			4.671**	4.733			7.950**	3.166
			(0.368)	(0.381)			(2.024)	(2.962)			(3.437)	(3.056)
DCxID					-2.553***				-1.949***			
					(0.700)				(0.714)			
BMxID						-2.832***				-1.445		
						(0.680)				(1.497)		
DCxIQ							-1.392**				-2.177**	
							(0.578)				(0.992)	
BMxIQ								-1.233				-0.824
								(0.817)				(0.840)
Constant	-2.551***	0.502***	-4.196	11.877	-1.237***	-1.088***	4.519	6.302	-1.947***	-0.079	-6.852**	-11.996**
	(0.164)	(0.164)	(2.841)	(8.968)	(0.169)	(0.137)	(6.482)	(5.120)	(0.170)	(0.200)	(3.178)	(5.787)
Observations	81	81	85	90	81	81	90	85	81	81	85	85
No. of groups	5	5	5	5	5	5	5	5	5	5	5	5
R-squared	0.649	0.709	0.603	0.173	0.637	0.710	0.323	0.562	0.672	0.713	0.612	0.580
Hausman test	236.927	246.558	20.983	-86.571	20.059	27.238	-438.798	30.789	23.696	57.701	22.221	43.301
Hausman Prob > chi2	(0.011)	(0.000)	(0.013)	(1.000)	(0.018)	(0.001)	(1.000)	(0.000)	(0.008)	(0.000)	(0.014)	(0.000)
F-test/Wald-test p-val.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: See Table 1 for variable definitions. Standard errors in parentheses. * F-stat. p-val. and Wald-test p-val. for joint significance. FE is Fixed Effects estimation, RE is Random Effects estimation. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

References

Agbloyor, E.K., Gyeke-Dako, A., Kuipo, R., Abor, J.Y.: Foreign direct investment and economic growth in SSA: the role of institutions. Thunderbird Int. Bus. Rev. **58**(5), 479–497 (2016). https://doi.org/10/ghrkfz

Ahmed, S.M., Ansari, M.I.: Financial sector development and economic growth: the South-Asian experience. J. Asian Econ. **9**(3), 503–517 (1998)

Ali, M., Ibrahim, M.H., Shah, M.E.: Impact of non-intermediation activities of banks on economic growth and volatility: an evidence from OIC. Singapore Econ. Rev., 1–16 (2020). https://doi.org/10/ghr5zk

Al-Malkawi, H.-A., Abdullah, N.: Finance-growth nexus: evidence from a panel of MENA countries. Int. Res. J. Financ. Econ. **63**, 129–139 (2011)

An, H., Zou, Q., Kargbo, M.: Impact of financial development on economic growth: evidence from SUB-SAHARAN Africa. Aust. Econ. Pap. (2020). https://doi.org/10.1111/1467-8454.12201

Anayiotos, G.C., Toroyan, H.: Institutional factors and financial sector development: evidence from Sub-Saharan Africa. IMF Working Papers 09(258), 1 (2009). https://doi.org/10/ghsb4f

Andersen, T.B., Tarp, F.: Financial liberalization, financial development and economic growth in LDCs. J. Int. Dev. **15**(2), 189–209 (2003). https://doi.org/10.1002/jid.971

Barajas, A., Chami, R., Yousefi, S.R.: The Finance and Growth Nexus Re-Examined: Do All Countries Benefit Equally? IMF Working Paper No. 13/130. International Monetary Fund (2013)

Beck, T., Degryse, H., Kneer, C.: Is more finance better? Disentangling intermediation and size effects of financial systems. J. Financ. Stab. **10**, 50–64 (2014)

Beck, T., Levine, R., Loayza, N.: Finance and the sources of growth. J. Financ. Econ. **58**(1–2), 261–300 (2000)

Bist, J.P.: Financial development and economic growth: evidence from a panel of 16 African and non-African low-income countries. Cogent Econ. Finan. **6**(1), 1449780 (2018). https://doi.org/10.1080/23322039.2018.1449780

Bittencourt, M.: Financial development and economic growth in Latin America: Is Schumpeter right? J. Policy Model. **34**, 341–355 (2012)

Breitenlechner, M., Gächter, M., Sindermann, F.: The finance–growth nexus in crisis. Econ. Lett. **132**, 31–33 (2015). https://doi.org/10/ghsmqn

Buchanan, B.G., Le, Q.V., Rishi, M.: Foreign direct investment and institutional quality: some empirical evidence. Int. Rev. Finan. Anal. **21**, 81–89 (2012). https://doi.org/10/c2r6j5

Carré, E., L'œillet, G.: The literature on the finance–growth nexus in the aftermath of the financial crisis: a review. Comp. Econ. Stud. **60**(1), 161–180 (2018). https://doi.org/10.1057/s41294-018-0056-6

Compton, R.A., Giedeman, D.C.: Panel evidence on finance, institutions and economic growth. Appl. Econ. **43**(25), 3523–3547 (2011). https://doi.org/10.1080/00036841003670713

De Gregorio, J., Guidotti, P.E.: Financial development and economic growth. World Dev. **23**(3), 433–448 (1995). https://doi.org/10.1016/0305-750X(94)00132-I

Demetriades, P., Fielding, D.: Information, institutions, and banking sector development in West Africa. Econ. Inq. **50**(3), 739–753 (2012). https://doi.org/10/dv5n7t

Djeri, L.D.: Institutional quality and financial development in West Africa Economic and Monetary Union. Global J. Manag. Bus. Res. (2020). https://doi.org/10/ghr5z5

Driscoll, J.C., Kraay, A.C.: Consistent covariance matrix estimation with spatially dependent panel data. Rev. Econ. Stat. **80**(4), 549–560 (1998). https://doi.org/10/b88vxp

Favara, G.: An empirical reassessment of the relationship between finance and growth. IMF Working Paper, WP/03/123 (2003)

Fernandez, D., Galetovic, A.: Schumpeter might be right-but why? Explaining the relation between finance, development, and growth. Johns Hopkins University SAIS Working Paper in International Economics (1994)
Gani, A., Ngassam, C.: Effect of institutional factors on stock market development in Asia. Am. J. Finan. Acc. **1**(2), 103 (2008). https://doi.org/10/dj2c97
Girma, S., Shortland, A.: The political economy of financial development. Oxford Econ. Papers **60**(4), 567–596 (2007). https://doi.org/10/d6f8xv
Globerman, S., Shapiro, D.: Global foreign direct investment flows: the role of governance infrastructure. World Dev. **30**(11), 1899–1919 (2002). https://doi.org/10/dcmbjp
Goldsmith, R.W.: Financial Structure and Development. Yale University Press (1969)
Haini, H.: Examining the relationship between finance, institutions and economic growth: evidence from the ASEAN economies. Econ. Change Restructuring **53**(4), 519–542 (2020). https://doi.org/10/ghrhq2
Hakimi, A., Hamdi, H.: Does corruption limit FDI and economic growth? Evidence from MENA countries. Int. J. Emerging Markets **12**(3), 550–571 (2017). https://doi.org/10/ghrkhs
Hassan, M.K., Sanchez, B., Yu, J.-S.: Financial development and economic growth: new evidence from panel data. Q. Rev. Econ. Finance **51**(1), 88–104 (2011). https://doi.org/10.1016/j.qref.2010.09.001
Hausman, J.A.: Specification tests in econometrics. Econometrica **46**(6), 1251 (1978). https://doi.org/10/bgbj6d
Hoechle, D.: Robust standard errors for panel regressions with cross-sectional dependence. Stata J. Promoting Commun. Stat. Stata **7**(3), 281–312 (2007). https://doi.org/10/gf4j23
Hsueh, S.-J., Hu, Y.-H., Tu, C.-H.: Economic growth and financial development in Asian countries: a bootstrap panel Granger causality analysis. Econ. Model. **32**, 294–301 (2013)
Ibrahim, S., Abdullahi, A.B., Azman-Saini, W.N.W., Rahman, M.A.: Finance-growth nexus: evidence based on new measures of finance. Int. J. Econ. Manag. **11**(1), 17–29 (2017)
Kaufmann, D., Kraay, A., Mastruzzi, M.: The worldwide governance indicators: methodology and analytical issues. World Bank (2010). https://doi.org/10.1596/1813-9450-5430
Khan, A.: Financial development and economic growth. Macroecon. Dyn. **5**(3), 413–433 (2001). Cambridge Core
King, R.G., Levine, R.: Finance and growth: schumpeter might be right. Quart. J. Econ. **108**(3), 717–738 (1993)
Kutan, A.M., Samargandi, N., Sohag, K.: Does institutional quality matter for financial development and growth? Further evidence from MENA countries. Australian Econ. Papers **56**(3), 228–248 (2017). https://doi.org/10/gfhx9c
Law, S.H., Azman-Saini, W.N.W.: The Quality of Institutions and Financial Development (2008)
Law, S.H., Habibullah, M.S.: The determinants of financial development: institutions, openness and financial liberalisation. South African J. Econ. **77**(1), 45–58. https://doi.org/10/bb4bd4
Law, S.H., Singh, N.: Does too much finance harm economic growth? J. Bank. Finance **41**, 36–44 (2014). https://doi.org/10.1016/j.jbankfin.2013.12.020
Levine, R.: Financial development and economic growth: views and agenda. J. Econ. Lit. **35**(2), 688–726 (1997)
Levine, R.: More on finance and growth: more finance, more growth? Federal Reserve Bank St. Louis Rev. **85**, 31–46 (2003)
Levine, R., Loayza, N., Beck, T.: Financial intermediation and growth: causality and causes. J. Monet. Econ. **46**(1), 31–77 (2000)
Lucas, R.E.: On the mechanics of economic development. J. Monet. Econ. **22**(1), 3–42 (1988)
Luintel, K.B., Khan, M.: A quantitative reassessment of the finance-growth nexus: evidence from a multivariate VAR. J. Dev. Econ. **60**(2), 381–405 (1999)
Marques, L.M., Fuinhas, J.A., Marques, A.C.: Does the stock market cause economic growth? Portuguese evidence of economic regime change. Econ. Model. **32**, 316–324 (2013)

Minea, A., Villieu, P.: Financial development, institutional quality and maximizing-growth trade-off in government finance. Econ. Model. **27**(1), 324–335 (2010). https://doi.org/10/bxb8vw
Murtaza, G., Faridi, M.Z.: Economic institutions and growth nexus: the role of governance and democratic institutions—evidence from time varying parameters' (TVPs) models. Pakistan Dev. Rev. **55**(4), 675–688 (2016). JSTOR. https://doi.org/10/ghrbtf
Naceur, S.B., Ghazouani, S.: Stock markets, banks, and economic growth: empirical evidence from the MENA region. Res. Int. Bus. Financ. **21**(2), 297–315 (2007). https://doi.org/10.1016/j.ribaf.2006.05.002
Nguyen, C.P., Su, T.D., Nguyen, T.V.H.: Institutional quality and economic growth: the case of emerging economies. Theor. Econ. Lett. **08**(11), 1943–1956 (2018). https://doi.org/10/ghrkht
Nyasha, S., Odhiambo, N.M.: Do banks and stock markets spur economic growth? Kenya's experience. Int. J. Sustain. Econ. **7**(1), 54 (2015). https://doi.org/10/ghsgg4
Nyasha, S., Odhiambo, N.M.: Financial development and economic growth nexus: a revisionist approach: finance-growth nexus: a revisionist approach. Econ. Notes **47**(1), 223–229 (2018). https://doi.org/10/ghr9mb
Popovic, G., Eric, O., Stanic, S.: Trade openness, institutions and economic growth of the western balkans countries. Montenegrin J. Econ. **16**(3), 173–184 (2020). https://doi.org/10/gmmj73
Prochniak, M., Wasiak, K.: The impact of the financial system on economic growth in the context of the global crisis: empirical evidence for the EU and OECD countries. Empirica **44**(2), 295–337 (2016). https://doi.org/10.1007/s10663-016-9323-9
Rajan, R.G., Zingales, L.: Financial dependence and growth. Am. Econ. Rev. **88**(3), 559–586 (1998)
Ram, R.: Financial development and economic growth: additional evidence. J. Dev. Stud. **35**(4), 164–174 (1999). https://doi.org/10.1080/00220389908422585
Robinson, J.: The Generalization of the General Theory in the Rate of Interest and Other Essays. Macmillan (1952)
Rousseau, P.L., Wachtel, P.: What is happening to the impact of financial deepening on economic growth? Econ. Inq. **49**(1), 276–288 (2011)
Sabir, S., Rafique, A., Abbas, K.: Institutions and FDI: evidence from developed and developing countries. Finan. Innov. **5**(1), 8 (2019). https://doi.org/10/ggtctd
Sani, A., Said, R., Ismail, N.W., Mazlan, N.S.: Public debt, institutional quality and economic growth in Sub-Saharan Africa. Institutions Econ. 39–64%@ 2232–1349 (2019)
Schumpeter, J.A.: The Theory of Economic Development. Harvard University Press (1912)
Seetanah, B., Ramessur, S.T., Rojid, S.: Financial development and economic growth: new evidence from a sample of island economies. J. Econ. Stud. **36**(2), 124–134 (2009)
Shan, J., Morris, A.: Does financial development "Lead" economic growth? Int. Rev. Appl. Econ. **16**(2), 153–168 (2002). https://doi.org/10/d4b5fj
Shaw, E.S.: Financial Deepening in Economic Development. Oxford University Press (1973)
Singh, R.J., Kpodar, K.R., Ghura, D.: Financial deepening in the CFA Franc zone: the role of institutions. IMF Working Paper, WP/09/113 (2009)
Slesman, L., Baharumshah, A.Z., Azman-Saini, W.N.W.: Political institutions and finance-growth nexus in emerging markets and developing countries: a tale of one threshold. Q. Rev. Econ. Finance **72**, 80–100 (2019). https://doi.org/10.1016/j.qref.2019.01.017
Smolo, E.: Bank concentration and economic growth nexus: evidence from OIC countries. Appl. Finan. Lett. **9**, 81–111 (2020). https://doi.org/10/ghsgg7
Smolo, E.: The FDI and economic growth in the western balkans: the role of institutions. J. Econ. Cooperation Dev. **42**(4), 147–170 (2021)
Smolo, E.: Finance-growth nexus: evidence from systematically important islamic finance countries. In: 11th Foundation of Islamic Finance Conference (FIFC), Kuala Lumpur, Malaysia (2021b)

Svirydzenka, K.: Introducing a new broad-based index of financial development. IMF Working Papers **16**(05), 1 (2016). https://doi.org/10/ggr942

Swamy, V., Dharani, M.: The dynamics of finance-growth nexus in advanced economies. Int. Rev. Econ. Finan. **64** 122–146 (2019a). https://doi.org/10/ghr87b

Swamy, V., Dharani, M.: The dynamics of finance-growth nexus in advanced economies. Int. Rev. Econ. Financ. **64**, 122–146 (2019). https://doi.org/10.1016/j.iref.2019.06.001

Wooldridge, J.M.: Econometric Analysis of Cross Section and Panel Data. MIT Press (2002)

Yang, F.: The impact of financial development on economic growth in middle-income countries. J. Int. Finan. Markets Inst. Money **59**, 74–89 (2019). https://doi.org/10/gjm22k

Challenges in Implementing ESCO Model in Bosnia and Herzegovina

Dragana Kosorić[1(✉)] and Gorana Veselinović[2]

[1] Ministry of Finance and Treasury of Bosnia and Herzegovina, 71 000 Sarajevo, Bosnia-Herzegovina
dkosoric@mft.gov.ba
[2] Grijanjeinvest LLC., 71 126 E. Sarajevo, Bosnia-Herzegovina

Abstract. This paper provides an inductive theoretical framework that explains how and why ESCO happens, showing that implements measures for improving energy efficiency and takes the financial risk to a certain extent. Likewise, implementation of the ESCO model is the most powerful instrument for launching the energy-efficient investment. The gains from savings achieved are setting off a cost-effective project activities both for the ESCO and for the users, bringing up the innovative projects. ESCO model in Bosnia and Herzegovina could mean energy efficiency increasing, affecting economic activity and employment, improving the existing infrastructure and achieving budget savings.

Keywords: ESCO model · Energy efficiency · Sustainable development · Financial savings

1 Introduction

The reduced energy end-use and improved energy efficiency are both needed for the reduction of primary energy consumption in Europe by 20% by 2020. Several priority actions and policy measures of the Energy Efficiency Plan, as well as member-state policies, aim at the introduction of innovative financing instruments and facilitation of the Energy Services Companies or ESCOs [1]. Usage of the energy efficiency could be one of the most cost-effective ways to achieve the sustainable development, which means less energy consumption for the same amount of products and services. By that way, money savings could be assured. But, implementation of the energy efficiency programs brings certain barriers like expertise and time failing during implementation of energy efficiency measures, unsteadiness in realization of financial benefits and lack of funds. In order to overcome all implementation obstacles, specialized companies for the implementation of energy efficiency programs have been emerged, called ESCO (Energy Service Companies).

ESCO concept assumes that the designated company takes the risk and accepts technical and financial responsibilities for each phase of the project development and implementation in increasing energy efficiency for the benefit of third parties (users). The service includes planning, execution and financing of an energy efficient project in

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 38–48, 2023.
https://doi.org/10.1007/978-3-031-17767-5_3

such a way that the return on investment is achieved through savings in energy costs and maintenance.

On the basis that the ESCO is being paid to deliver the final energy-related functionality their customers' desire, they are intrinsically incentivized to apply their expertise to ensure that the conversion process from fuel to energy service is achieved as efficiently as possible. This is because it is the ESCO who bears the cost of any associated inefficiency, not the customer. It is therefore characteristically distinct from companies who sell units of energy (e.g. gas, oil), where the customer is responsible for converting these into the energy services they desire, in turn bearing the costs of inefficient conversion [2]. Consequently, this model has been identified by various scholars as a potential means of fulfilling consumers' energy needs in a more sustainable manner than at present [3–7].

In addition, loans for improving energy efficiency projects are repaid based on energy savings made (cost reduction). This cost reduction is mainly achieved by reducing the consumer's demand for delivered energy (i.e. imported fuel or electricity) via technical and operational efficiency improvements across both the primary conversion equipment and the distribution infrastructure [8]. The ESCO and the user have an interest in cooperation. The profit from energy savings is shared between the user and the ESCO according to the provisions of the contract, and based on the achieved energy efficiency.

Energy efficiency can be simply defined as the sum of planned and implemented measures, which aims to use the minimum possible amount of energy, so that the level of quality of life and the rate of production remains preserved [9]. Energy is a key element in the development of economic systems and it is very important for the survival on the planet.

According to the experience of developed countries, the rational energy management and its usage is a basic for sustainable development. Therefore, greater promotion of energy efficiency measures, the use of renewable energy sources and the use of energy saving technologies is necessary. Since the demographic changes are resulting in a huge energy consumption and lack of natural resources, it is necessary to develop technologies that result in energy savings. In that term, energy efficiency is the most cost-effective way to achieve sustainable development in the world. The Law on Efficient Use of Energy in Direct Consumption defines energy efficiency as ratio of the energy consumption and the performance achieved like a services, goods or energy [10].

It is very important to point out that energy efficiency should not be seen as saving energy, because saving always implies certain sacrifices, while efficient use of energy it never violates working and living conditions [11]. The goal of energy efficiency is: the use of solar energy, the use of renewable energy sources, reducing heat loss from buildings, improving the thermal insulation of external elements, increasing the efficiency of heating and cooling systems. Improving energy efficiency means: financial savings through smaller bills for heating, cooling, electricity, longer facility life and environmental protection, reduction of global climate change, greater industrial competitiveness and job creation. However, barriers for ESCO adoption such as hindering public procurement rules, lack and mismatch of financing, low client confidence and unclear contracts still exist [12].

The contribution of this paper is its consideration of how as well as why is needed understanding of economic profitability and development advantages of introducing

ESCO model in Bosnia and Herzegovina, focusing on the underlying drivers that bring it about.

2 Methodology

ESCO is an organization that provides its customers with energy services, which relate to the physical benefit, utility or good derive from energy [13]. These services are provided via long-term energy service contracts, normally lasting between 5 and 25 years, which fall into two broad categories: energy performance contracts (EPCs) and energy supply contracts (ESCs) [4, 5, 8, 14]. For the purposes of this paper focus is on importance of both ESCs (considered that have typically employment) and of EPCs. EPCs involve the provision of final energy services (e.g. lighting, heating, motive power), which constitute energy streams that have been converted by secondary conversion equipment and can thus been joyed directly by customers, without the need for additional conversion processes [8, 15]. In contrast ESCOs offering ESCs provide useful energy streams to their customers, such as hot water, coolant and electricity, which have already been converted by primary conversion equipment (e.g. a boiler, CHP plant etc.) but have not yet undergone secondary conversion. Here the customer is usually charged per unit of useful energy [5] or a fixed price for the supply of a predetermined level of energy service [14].

The period of the ESCO assumes control over the consumer's primary conversion equipment, as well as the distribution infrastructure. The ESCO uses this control to maximize the efficiency of the system in order to satisfy its consumer's energy needs at the lowest cost. This cost reduction is mainly achieved by reducing the consumer's demand for delivered energy (i.e. imported fuel or electricity) via technical and operational efficiency improvements across both the primary conversion equipment and the distribution infrastructure [8, 15].

Improving the energy performance is a key for improving energy efficiency, as well as improving the energy efficiency of the equipment and devices used. Improving energy efficiency in buildings will improve comfort, reduce operating costs, reduce investment payback times, increase productivity and generate higher rental or sales revenues.

In Bosnia and Herzegovina, energy efficiency goals are realized in the following ways: (1) Direct energy efficiency measures are concrete measures for the procurement and installation of equipment that improves the energy performance of buildings. These measures are implemented both through programs and directly through the market and own financing; (2) Energy efficiency programs are organizational structures for the implementation of energy efficiency goals and the provision of incentive schemes to finance the implementation of measures. The programs implement direct measures, providing certain incentives to end users; and (3) The main energy efficiency policy measures aim to establish an efficient environment for the implementation of direct measures through the program. These include activities to establish a legal and regulatory framework, provide the necessary implementation instruments, strengthen capacity, and establish dialogue platforms and exchange information [16].

Accessing to the EU, Bosnia and Herzegovina has undertaken a large number of obligations, but it is significantly behind in developing proper institutional and legal framework in the field of energy. It means that introducing the ESCO model in Bosnia and Herzegovina needs fulfilling the curtain number of preconditions.

ESCO procurement process has been realized by applying the Procurement Law, where the value of the savings offered after the initial investment is one of the selection criterions besides its total cost. So, the relative important criteria for determining the advantage of the offer is the amount of savings in annual operating costs of contracted facilities or plants, where the value of the bid (VP) is calculated using the formula:

$$\text{VP} = \text{OAOC}/\text{maximum OAOC} \times 100 \quad (1)$$

OAOC = offered annual operating costs.

The most favorable bid is considered to be the bid with the highest calculated value, because it enables the achievement of the largest savings in current budget expenditures for operating costs of contracted facilities or plants. Other bids should be ranked in descending value of the bid relative to the best bid [17].

Once selected the ESCO starts conducting a detailed feasibility study. If the feasibility study is unfavorable, the firm may withdraw. In that case, the procurement committee addresses the next best ranked bidder who can purchase the feasibility study from the original contractor. The main goal is the maximum savings of the owner of the facility. After signing the contract, the ESCO implements energy efficiency measures.

The scope of the empirical study is focused on the ESCO model engagement in Bosnia and Herzegovina, focusing on its existence in the private sector community. The empirical part also deals only with energy supply contracting and not energy performance contracting. The contextual and background information to support pointed results were provided from the stakeholders and policy makers comments, which were mainly focused on the wider energy issues and on regulatory context influencing the development of sustainable energy efficiency, regionally and locally. Additionally, the working papers of different consultants were consulted. Also, there have been several attempts to make this model living in Bosnia and Herzegovina but it has not been absolutely possible. The private companies were involved in the development of the ESCO model frame making its own assessments.

This study began with a review of academic, governmental and industrial literature on energy service provision and ESCO activities in Bosnia and Herzegovina. It presents an inductive theory based on an in-depth, qualitative study of the evaluation of the ESCO model. The level of analysis is the complete ESCO sector [18]. This setting was chosen on conceptual grounds, rather than for representativeness [19]. The aim was to point a good and a bad example of ESCO model implementation pertaining to the research questions.

3 Results

3.1 Framework Background for ESCO Model

The Energy Community Treaty was signed on 25th October 2005 and entered into force on 1st July 2006, between the EU and the following countries: Albania, Bosnia and Herzegovina, Montenegro, Kosovo (UN 1244 resolutions), Macedonia, Moldova, Serbia and Ukraine. The aim was to harmonize the national legislation of those countries

to the regulations and norms of the European Union in the fields of energy, environmental protection and the use of renewable energy sources.

By this agreement, the contracting parties committed to establish a common electricity and gas market in compliance with the EU energy market standards. This required the implementation of EU directives and regulations [13, 17].

In accordance with EU directives, Bosnia and Herzegovina should have set up and adopt the proper legislation in the field of energy efficiency and renewable energy sources, all together with establishing the institutions for their implementation. One of the important obligations for Bosnia and Herzegovina from the Energy Community Treaty was development of a National action plan for energy efficiency.

For the Republika Srpska level: An Energy Efficiency Action Plan was adopted in 2013 and updated in 2017, where the obligations set out in Directive 2012/27/EU on energy efficiency in primary energy consumption were also taken into account, resulting in the inclusion of new measures to increase energy efficiency planned in the field of electricity generation, heating and cooling, and measures in the field of transmission and distribution of electricity and gas. The analysis and revision of the structure of existing energy efficiency measures in the field of final energy consumption was performed, as well as its content (the description of existing measures).

For the Federation of Bosnia and Herzegovina level: Action Plan for Energy Efficiency in the Federation of Bosnia and Herzegovina for the period 2019–2021 – EEAPF was adopted in 2021 (published in the "Official Gazette of the Federation of BiH", No. 11/21 of February 10, 2021).

By integrating the above mentioned two documents, the Energy Efficiency Action Plan for Bosnia and Herzegovina was created where main goals are focused on reducing final and primary energy consumption in three-year period 2019–2021 and on fulfillment of commitments from the Agreement on the Establishment of the Energy Community.

The described framework gives us slide background for ESCO model engagement. A clear legal framework is needed for the ESCO model to be involved and fully functional as a possible method to be used in improving energy efficiency.

3.2 Factors Influencing Decision on ESCO Model Engagement

All EU directives in the field of energy efficiency and renewable energy sources have a large number of requirements that need to be included in the Bosnia and Herzegovina laws, but it has not been fully done yet. But, the energy service and ESCO model have been recognized by domestic laws, where energy service is intended to be provided by the Energy Service Company (ESCO) or another legal entity on the basis of an energy service contract. The ESCO prepares a detailed feasibility study for the energy performance contract, proposing measures to improve energy efficiency and the financial model, assumes financial, technical and commercial risk when implementing energy efficiency measures.

Since the public sector does not have sufficient funds available to finance energy efficiency projects, cooperation between public and private partners is a good option in Bosnia and Herzegovina. In order to implement the ESCO model, good legal regulations on public-private partnership are necessary. On June 11, 2009 the Republic of Srpska adopted the Law on Public-Private Partnership. Thorthermore, laws on public-private

partnership have been adopted in 9 of the 10 cantons of the Federation of Bosnia and Herzegovina. But, at the level of the Federation of Bosnia and Herzegovina and at the state level this law does not exist yet. Complicated legal regulations in Bosnia and Herzegovina make an obstacle to the realization of cooperation between public and private partners.

Implementing ESCO, state needs to make available various energy services and financial instruments for energy saving and, in addition, national legislation and regulations must not hinder or restrict the use of different financial instruments on the energy services market [13].

The energy policy is at the entity level, where no institution at the state level is exclusively dealing with energy efficiency and has not yet adopted a strategy for energy development and energy efficiency. International organizations such as the EU, GIZ, USAID and UNDP play an important role in drafting laws and regulations together with delivering education on energy efficiency issues. But the national authorities must complete this work themselves and create legal opportunities for implementing energy efficiency projects.

One of the key preconditions for introducing the ESCO in Bosnia and Herzegovina is the possibility of introducing multi-year budgeting of energy efficiency projects in public sector facilities, since the contractual duration of the based on ESCO model ranges between 4 and 10 years, depending on the type of building and measures applied, and that the budget is planned for a period of one to three years. The fact is that too short period would not allow ESCOs company to reimburse their costs. It is also essential that for ESCO revenues to be a regular budget item. Its possibility for implementation furthermore is linked to a lack of funds and professional training of employees in the public sector who would be capable to prepare and implement this concept. Another problem is the provision of financing for the costs of the initial investment, since companies in Bosnia and Herzegovina do not have a surplus of capital. If the ESCO is financed from borrowed funds, the debt burdens its balance sheet and the ESCO is limited in terms of new projects. Commercial banks are not very interested for financing these activities because they do not know enough about these types of projects and financial instruments. In addition, they are not prepared to bear such credit risk and they need technical support for project assessment and credit risk assessment. It is very important to acquaint local banks, as well as potential clients, with the ESCO concept and to reduce the level of their skepticism through demonstration of these projects. An obstacle for development of the ESCO concept is the long period of collecting receivables and the long period of loan repayment to the banks (if it is financed by loan).

According to the recommended financial model for the implementation of energy efficiency programs and measures by 2030, most of the achieved energy savings would be covered from the incentive system, 56–61%, and the rest through its own financing. Support schemes are made up of two main mechanisms, namely energy efficiency obligation schemes and alternative programs. Unlike bond schemes, alternative programs target all final consumption sectors. For example, programs aimed at energy efficiency

measures in public buildings and utilities are financed exclusively from alternative programs. Programs in industry, the commercial sector, and transportation use some combination of alternative programs and self-financing for funding. On the other hand, housing programs use a combination of all three funding mechanisms [20].

There is no data on energy consumption in public buildings registered because there is no obligation set up for it to be monitored and reported. Although, providing this information is one of the requirements from energy efficiency directives, our institutions are planning energy cost on the basis of last year's costs instead of on the basis of the records and real analysis on energy consumption provided.

3.3 Findings Related to ESCO Model Engagement

To pint out the all aspects related to ESCO model following present situation in Bosnia and Herzegovina, SWOT analysis has been conducted, and the results are as follows (see Fig. 1):

Strengths	**Weaknesses**
Achieving great energy savings ESCOs provide the public sector with knowledge in the field of energy efficiency The risk of success is on the ESCO Financing the investment from the realized energy savings Financial institution protected from insolvency risk ESCO investment is not treated as public debt	Lack of legal preconditions for the development of the ESCO model Insufficient information of participants Underdeveloped financial market
Opportunities	**Threats**
The ESCO benefits if the savings are exceeded Raising economic activity, through hiring designers, contractors, consultants, increasing production, delivery of equipment ... Creating budget savings Increasing employment	The project did not materialize The ESCO firm takes risks if the savings are not realized Non-payment of public administration It is not possible to pay for investments from the realized energy savings Big drop in energy prices

Fig. 1. SWOT analysis of the ESCO model in Bosnia and Herzegovina

Additionally, two study cases are described like a good and a bed example of ESCO models implementation.

First is related to heating of faculty buildings as an unsuccessful example where the facilities were built on the edge of the former production plant for wood processing, near the current heating plant. Until the heating season 2015/16 heat for all three buildings

was produced in its own boiler room on light fuel oil. The distribution of costs was done in accordance with the heat consumed, which was individually measured calorimeters of individually.

At the beginning of the heating season 2015/16, based on the concluded "Agreement on the supply and use of thermal energy", heat is supplied to faculties from the district heating system, using wood chips as energy. The distribution of heat and costs is still based on the data read on the calorimeters.

In 2015, Heating company took out a loan in the amount of 400,000.00 BAM for the installation of a new boiler and heating pipeline, whereby a loan repayment was agreed for a period of 8 years with an interest rate of 5.15% and a grace period of 10 months. The heating plant procured and installed a wood waste boiler plant with associated equipment in the amount of 231,192.00 BAM and pre-insulated steel pipes with associated equipment in the amount of 69,461.35 BAM without VAT. Therefore, the total investment cost for the installation of the boiler and the new heating pipeline was around 300,653.35 BAM.

Based on data on energy consumption, prices of wood chips and heating oil, costs of hiring qualified boiler room operators and certain earnings of the heating plant, the expected savings by replacing energy was about 80,000.00 BAM at the annually.

The heating company paid interest in the amount of 1,716.67 BAM per month for the first 10 months (during the grace period), and for the next 96 months the principal plus interest was paid in equal installments of 5,092.00 BAM.

The application of the ESCO model means that the heating company would deliver thermal energy at a price that would be lower than the cost of heating oil. However, this was not the case here.

By analyzing the data on the actual amount of fuel oil and heat consumed in the period when fuel oil was used as the only energy source, it can be concluded that the measured 1 MWh of heat per calorimeter approximately corresponds to the amount of 115 L of heating oil. Knowing the price of 1 L of heating oil, the price of 1 MWh of heat can be calculated.

At that moment, approximate price of 1 L of heating oil was about 1.2 km without VAT (the price of heating oil did not include excise for highways and roads), which means that the price of 115 L of heating oil from which gets 1MWh of heat is:

$115 \times 1.2 \approx 140$ BAM without VAT.

Following articles from the Agreement between Heating company and Client, the price of 1 MWh of heat costs 165.5 BAM without VAT, which was about 20% more than the price that would be paid for the consumed heat obtained from heating oil.

According to the data from the Feasibility Study, the price of the heat obtained from the wood chips, with the heating plant's earnings and the part for repaying the loan installment, should have been around 0.10 km/kWh without VAT. This was about 40% lower than what is currently charged.

If the real ESCO model from the realized savings was applied (difference between heating oil costs and cutting costs), the Client could repay the loan. The ESCO guarantees that the savings will be equal to the installment of the loan for the duration of the contract. If the savings are bigger than this amount, the excess funds are retained by the ESCO.

After the time period required to repay the loan, all savings remain to the client. This is a principle which should be realized.

In addition, since this is an energy efficiency improvement project, there should be a possibility of getting funds under more favorable terms, where the savings would be bigger.

Second study case is based on reconstruction of public lighting in a municipality as the example of successful implementation of the ESCO model. The reconstruction of public lighting, which includes the complete replacement of old mercury lamps with energy-saving LED bulbs, was carried out using the ESCO model. From the entrance to the town, 1,000 lamps of modern design and technology have been installed. Additionally to be economical, LED lamps provide better lighting and last about 15 years, so there is no investment in their maintenance.

The tender for the reconstruction of public lighting through procurement, delivery and installation of LED lamps and other equipment together with its full operationally was announced in December 2015.

The criterion for awarding the contract was the lowest price. The bidder was obliged to give a statement on guaranteeing electricity savings of at least 60%. Thus, the contract was signed in 2016 where company took the obligation to achieve electricity savings of at least 60% and that would be charging its services from the savings.

The ESCO guarantees the client energy savings. If the guaranteed electricity savings amount would be less than 60% of the amount stated in the contractor's bid, the company is obliged to eliminate it and to bring it into conditions it was stated initially in its bid. The control of electricity savings was determined at the moment of commissioning and final acceptance of delivered lamps and performed works.

Payment is agreed as follows:

- 20% of the contracted value would be paid upon submission and acceptance of final and completed situation and
- the remaining contracted amount would be paid from the realized savings (payment of the remaining part would be paid after the expiration of six months, in 60 equal monthly annuities, without interest). As a means of securing payment, the client submitted bills of exchange.

About 150,000 BAM have been allocated annually from the municipal budget for the maintenance of lighting, and now the savings of more than 50% will be paid to the contractor in the next five years. After the expiration of the five-year period, this municipality retains all savings and benefits from the reduction of current expenditures.

4 Conclusions

In terms of practice, the presented framework explains when and why is divergence occurs and thus provides a useful base for everyone who want to understand whether ESCO model is viable to be introduced in Bosnia and Herzegovina. It seems like a good solution, since the private companies can use their knowledge through this model to help the public sector and to point out energy efficiency measures that need to be

applied and which are willing to invest and to charge for their services from the savings. Implementation of this financing model brings significant energy savings. It mainly refers to the reconstruction of the heating and air conditioning system, replacement of energy sources for heating, measures on the system for the preparation of domestic hot water, the measure on the public lighting system. The fact is that in Bosnia and Herzegovina ESCO activities are still not sufficiently developed, there are only attempts to introduce the ESCO market.

The orientation towards the application of the ESCO model would enable the engagement of private capital for investments in the public sector. Since the repayment is made from savings in current costs, we would initiate investments using funds that we currently spend unnecessarily on energy. Moreover, the application of the ESCO model would also lead to raising economic activity through the engagement of designers, contractors and consultants, increasing the production and delivery of equipment, improving the existing infrastructure, creating savings in the budget. This means not only that the project would lead to large energy savings, greater construction activities, improved comfort conditions in public buildings, but also to new employment in Bosnia and Herzegovina. Also, ESCO model implementation would lead to a reduction of public expenditures and increasing of public revenues. Thus, significant budget savings could be achieved. Budget savings remain available to the public sector for other priorities and it can be directed to further development.

The framework pointed here contextualizes more or less positive claims; it identifies the conditions under which improvements should be happen. In a rapidly changing world, analyzing ESCO implementation and its determinants can help guide practice by providing more robust foundations for strategy and policy alike.

Finally, this study is highlighting the factors that influence ESCO engagement and suggest changes that should be considered and not take present situation for granted.

References

1. COM: 109 final: Energy Efficiency Plan 2011 (2011). https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0109:FIN:EN:PDF. Accessed 9 Apr 2022
2. Hannon, M.J., Foxon, T.J., Gale, W.F.: The co-evolutionary relationship between energy service companies and the UK energy system: implications for a low-carbon transition. Energy Policy **61**, 1031–1045 (2013)
3. Vine, E.: An international survey of the energy service company (ESCO) industry. Energy Policy **33**, 691–704 (2005)
4. Fawkes, S.: Outsourcing Energy Management Saving Energy and Carbon Through energy Partnering. Gower Publishing Limited, Aldershot (2007)
5. Hansen, S.J.: ESCos Around the World: Lessons Learned in 49 Countries. The Fairmont Press Inc., Lilburn (2009)
6. Marino, A., Bertoldi, P., Rezessy S.: Energy Service Companies Market in Europe, Status Report 2010, European Commission Joint Research Centre Institute for Energy Ispra (2010)
7. Fang, W.S., Miller, S.M., Yeh, C.-C.: The effect of ESCOs on energy use. Energy Policy **51**, 558–568 (2012)
8. Sorrell, S.: The economics of energy service contracts. EnergyPolicy **35**, 507–521 (2007)
9. Simeunović, V., et al.: Uloga lokalnih zajednica u poboljšanju sistema energetske efikasnosti, 10. Međunarodni naučni skup Sinergija, Bijeljina, pp. 59–69 (2012)

10. Boromisa, A.M., et al.: Financiranje provedbe mjera energetske učinkovitosti, CENEP, Zagreb (2011)
11. Marković, B., Savić, M.: Energetska efikasnost uskladu sa EN ISO 50001, GLASNIK BAS, 4/12, Sarajevo (2012)
12. World Energy Council: Energy Efficiency Policies Around the World: Review and Evaluation (2008)
13. EUR-Lex-32006L0032-EN. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32006L0032. Accessed 22 Feb 2022
14. Hannon, M.: Co-evolution of Innovative Business Models and Sustainability transitions: The case of the Energy Service Company (ESCo) Model and the UK Nergy System, School of Earth and Environment, University of Leeds, Leeds (2012)
15. Sorrell, S.: The contribution of energy services to alow carbon economy, Tyndall Centre Technical Report 37, Tyndall Centre for Climate Change Research (2005)
16. Marino, A., et al.: A snapshot of the European energy service market in 2010 and policy recommendations to foster a further market development. Energy Policy **39**, 6190–6198 (2011)
17. Đukanović, D., Matejić, M., Gluščević, M.: Vodič za jedinice lokalne samouprave za uključivanje aspekata energetske efikasnosti u kriterijumu za javne nabavke, Stalna konferencija gradova i opština Srbije - Savez gradova i opština Srbije, Beograd (2013)
18. Jacobides, M.G.: Industry change through vertical disintegration: how and why markets emerged in mortgage banking, London Business School. Acad. Manag. J. **48**(3), 465–498 (2005)
19. Miles, M.B., Huberman, A.M.: Qualitative Data Analysis: An Expanded Sourcebook, 2nd edn. Sage, London (1994)
20. Akcioni plan za energetsku efikasnost Bosne i Hercegovine (NEEAP) za period 2019–2021. godina, Ministarstvo vanjske trgovine i ekonomskih odnosa BiH (2019)
21. Akcioni plan za energijsku efikasnost u Federaciji Bosne i Hercegovine za period 2019–2021 – EEAPFF, Federalno ministarstvo energije, rudarstva i industrije (2021)
22. EUR-Lex-32010L0031-EN. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32010L0031. Accessed 22 Feb 2022
23. EUR-Lex-32012L0027-EN. https://eur-lex.europa.eu/eli/dir/2012/27/oj. Accessed 22 Feb 2022
24. Izmjene i dopune Akcionog plana energetske efikasnosti Republike Srpske do 2018. godine, Ministarstvo energetike i rudarstva RS (2017)

Science and Technology Parks as Part of Innovation Ecosystem: The Case of Bosnia and Herzegovina

Sabina Đonlagić Alibegović[1], Vedrana Ajanovic[2(✉)], and Robert Martić[2]

[1] Faculty of Economics, University of Tuzla, Urfeta Vejzagića 8, 75 000 Tuzla, Bosnia and Herzegovina
sabina.djonlagic@unitz.ba
[2] BIT Centar Tuzla, Trg slobode 16, 75 000 Tuzla, Bosnia and Herzegovina
{vedrana,robert}@bit.ba

Abstract. The innovative ecosystem with Science and technology parks were observed through helix models, specifically the Triple Helix model. The concept of the Triple Helix (Quadruple Helix, Penta Helix) has been intensively discussed among researchers. It is acknowledged that the collaboration of academy, industry, and government creates an enabling innovation environment which is important for economic development and development of the knowledge society. The Triple Helix connection between academy, industry, and government is important for local development, especially in transition economies. Science and technology parks (STP) are commonly used for economic development as they adopt a non-linear model of innovation, the Triple Helix, which promotes interaction between different actors: university, industry, and government. STPs play an important role in establishing and strengthening connections between these actors through R&D, innovation, etc. The paper is based on the research conducted in 2021 on all of three established STPs in Bosnia and Herzegovina. The objective of the research is to explore the role and the success of STPs in B&H within the Triple Helix model and provide answer whether STPs in B&H have the capacity to act as an important stakeholder shaping the Triple Helix model in this country. Results show that efficient collaboration between STPs, academy and industry contribute to better STP performance, better and more attractive new start-ups and competitive economic growth.

Keywords: Science and technology parks · Triple Helix model

1 Introduction

The Triple Helix model of innovation has been used to analyze interactions between industry, university, and government as they foster innovation and development processes. This multiple-stakeholder approach is based on the presumption that the synergy between them has a significant impact on innovation and development. The triple helix interplay between education, innovation industries, culture with its deep roots and strong

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 49–57, 2023.
https://doi.org/10.1007/978-3-031-17767-5_4

connections to local communities represents a model that can serve as an important driver of sustainable and smart development [1]. Etzkowitz and Leydesdorff defined the main institutions of the triple helix model: university, industry, and government as carriers of an innovation system. They developed this model and claimed that there was a shift from the dual helix model to the triple helix relationships [2]. The Triple Helix model is used as a framework for the analysis of knowledge-based innovation systems, emphasizing the multiple and reciprocal relationships among the three main actors of knowledge creation and capitalization [3]. It is believed that the interaction between academics as parties that develop knowledge, industry, and businesses as those driving the economy and the government which regulates policies will contribute to competitive advantages for the country, region, or local community [4].

However, recent economic and social findings contributed to reshaping the Triple Helix model. One criticism of this model is that it does not take into consideration the social aspect of innovation. The Triple Helix was expanded with a new helix - the civil society as a supporter of knowledge dissemination towards a knowledge society which led to the development of Quadruple Helix concept [3, 5]. The Quadruple Helix originated from the Triple Helix by integrating civil society, innovation, and knowledge [6]. Appio et al. (2019) emphasizes the benefits of the Triple Helix model for the environmental challenges and economic growth and development, while the importance of the evolved Quadruple Helix model accentuates the significance of a continuous and interactive process involving diverse stakeholders and investors without neglecting citizens [7].

2 The Role of Science and Technology Parks in Innovation Ecosystem

Science and technology parks (STPs) are a three-dimensional expression of the growing importance of innovation, creativity, and knowledge as an economic resource [8]. STPs are a type of innovation environments with multiple stakeholders involved which enable innovation and development. STPs adopt a non-linear model of innovation, the Triple Helix, which promotes interaction between different actors: university, industry, and government [3, 9, 10]. STPs can be seen as a framework for the creation of synergies between universities and research institutions and companies contributing to innovation and development. However, the role of universities and companies has evolved over the years. Universities have become more research oriented and play a key role in innovation. They are actively involved in the utilization and capitalization of knowledge they have generated and are vital in the networks that foster innovation between industry and government [3, 11, 12] (Fig. 1).

Even though there are some controversies over the first established STPs- some authors claim that the first STP was established at Stanford University (Stanford Research Park) in 1951, and others claim that the first STP is The University Science Center at the University of Philadelphia which was established in 1963. Nevertheless, their expansion took place all over the world [13]. Significant growth and development occurred in the 1980s and early 1990s. Since then, STPs gained worldwide popularity and their success can be divided into several phases known as *generations*. Initially STPs were located at universities and the model was described as a 'science push'. Founders of STPs were

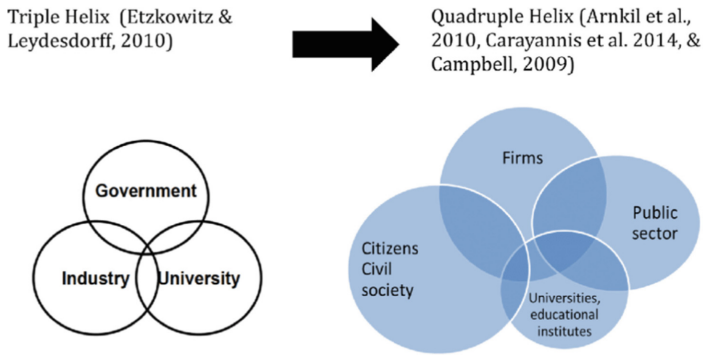

Fig. 1. Triple Helix vs. Quadruple Helix model Source: Nordberg K., Mairussen A.O., Vikkala S., (2020), Community-driven social innovation and quadruple helix coordination in rural development, Journal of Rural Studies, 79, pp.157–168.

mostly Universities, and their goal - the philosophy was commercialization of new ideas in new companies, which were the result of R&D. The second generation of STPs, known as 'market pull', was characterized by certain development changes of focus, founders, as well as the location. The second generation of STPs did not have to be primarily located at universities. They were market-oriented, focusing on the final stages of innovation or research results which could have been materialized. The third generation of STPs known as 'interactive local flow' features a triple helix model where the philosophy of innovation is focused on the cluster of 'interactive innovation', and strong network communications are effectively used in the relations between universities, industry, and government. Parks are located in urban areas and are managed by professionals [14]. From the very beginning, the challenge was in providing the infrastructure and later creating an environment that will work and meet the needs of the high technology sector. New challenges and developments, in general, have influenced the discussion and definition of the fourth generation of STPs, which included a society, and because of that, are also called Network STPs [15]. Although only three generations of STPs are most often mentioned in literature, the fourth generation of science and technology parks needs be mentioned as well, due to developmental needs within companies and business models [16]. This model known as "Quadruple Helix" introduces a fourth part, society or market, to "triple helix" consisting of governments, universities and businesses, simply because the result of the "triple helix" innovative product or service must relate to the market or society in order to create added value or jobs as the main reason for establishing an STP.

Generally, STPs as institutions play a vital role between the University, Industry and Government, and provide services for transferring university research (through faculty-based spin-offs) and stimulating development of innovative products [17, 18]. STPs provide a strong linkage between these three factors: it ensures that research and development are done within universities, and that research has its demand in the market and industry, thus providing a stable environment for research and innovation.

3 Research Methodology

This paper presents an inductive theory based on an in-depth, qualitative study of role and the success of STPs in B&H within the Triple Helix model. The paper is a case study based explorative research with an aim to describe the process of theory building from case studies. This research was conducted to provide an answer to the question whether *STPs in Bosnia and Herzegovina have the capacity to act as the most important factor in the Triple Helix model as a link to the academy, industry and government in B&H*? The research is based on the presumption that STPs as an instrument of entrepreneurial infrastructure play a very important role in the creation of an innovative environment, strengthening the collaboration of government, academy and industry in B&H. We assume that the interaction between these actors is very strong in the STPs in B&H.

The research in this paper was conducted in 2021. Data collection was done via interviews as they can provide a rich set of data [19]. The research included all of the established STPs in Bosnia and Herzegovina (100% of all STPs): BIT Center Tuzla, ICBL Banja Luka and INTERA Mostar. This research was done by series of semi-structured interviews since the interview is regarded as one of the most effective means of gathering information [19]. This methodological approach is considered applicable when the case is unusual from other cases, which B&H is compared to other countries which are much further in the triple helix cooperation.

4 Science and Technology Parks and the Triple Helix Models: Case of Bosnia and Herzegovina

The legal and political system of Bosnia and Herzegovina has created a very specific political and legal framework for economic development of entrepreneurship, entrepreneurial infrastructure within the country, and thus, science and technology parks.

There are various forms of entrepreneurial infrastructure in Bosnia and Herzegovina, but it is not developed in a planned and systematic way because there is no national law or strategy for the development of entrepreneurial infrastructure or STPs as a part of entrepreneurial infrastructure at the state, entity, or cantonal levels. STPs in Bosnia and Herzegovina were not established on a strategy, instead, they were a result of donor-funded projects in order to develop entrepreneurship infrastructure, stimulate entrepreneurship and create an ambient for IT startup companies to prevent "brain drain" of high educated people.

The establishment of STPs in Bosnia and Herzegovina began in 2004. Analyzed STPs in Bosnia and Herzegovina have different years of establishment, founders, forms of organization, way of functioning, different intensity of cooperation with universities, but also common goals which include: establishment and development of companies based on knowledge with high growth potential, strong links with the academic community, a role to connect science, business community and government, all with the aim of commercialization and contribution to the economic development of the region in which they are located.

In October 2005, BIT Center was established in Tuzla, ICBL was established in Banja Luka in 2010, followed by INTERA TP which was established in Mostar in 2011. BIT Center in Tuzla, Innovation Center Banja Luka in Banja Luka and INTERA Technology Park in Mostar were established on the initiative in cooperation and funded by the Kingdom of Norway with the aim of supporting small and medium enterprises in the field of information and communication technologies (ICT). During the research managers of all of these three STPs have been interviewed.

Based on the objective of the paper, we analyzed the infrastructural capacities of the three STPs based on the data collected during interviews. When it comes to the infrastructure of the STPs, ICBL and INTERA have cca.2500m2 with 3 and 1 building respectively, and BIT Center cca.3500m2 of space with 5 buildings. Some of the STP buildings share these premises with other organizations, foundations, or academic institutions, but most of the space is reserved for STP enterprises.

STPs vary in the way they are established and managed, generally. While BIT Center is a public enterprise (established by the local government), the other two STPs: ICBL (20% Republic of Srpska, 20% City of Banja Luka, 20% Development Agency of RS and 40% University of Banja Luka) and INTERA (100% private property), are established as foundations which is the most common legal form for STPs, generally. However, the status of a public enterprise provides some stability for the STP funding, even though the overall operations and activities are burdened with formal bureaucratic procedures. The number of full-time employees within STPs in Bosnia and Herzegovina varies from three in BIT Center, seven in ICBL to ten in INTERA TP.

Public or so called “not for profit” STPs are financed by governments or non-profit organizations. However private STPs are focused on the return on the investment in SME tenants within the park. We analyzed the total investments into the three STPs in B&H. The data obtained through interviews indicates over EUR 2,100,000.00 was invested in physical infrastructure, out of which investments in ICBL and INTERA TP amount to EUR 600,000.00, and the rest belongs to the investments into BIT Center. The sources for STP funding are mostly local governments, projects, and lease. ICBL and BIT have a higher percentage of governmental support due to their ownership structure.

An important aspect of STP operations and funding are project activities. INTERA and ICBL STPs have a portfolio project in total of more than 1.5 mil EUR, and BIT Center has a total portfolio project of cca.1.5 mil EUR. Most of the projects are international projects due to very little R&D funding by the governments. According to research results, the enterprises in the three STPs are dominantly focused on international markets and clients. All three STPs are focused on start-ups and enterprises in certain sectors (e.g., ICT).

STPs provide various services to member enterprises. The STPs ranked their services by importance as following (Fig. 2):

All three STPs provide similar services to park tenants. In the picture above we can see that consulting and networking services are among the two most important services which are needed by these enterprises. When it comes to networking services, STPs provide help in finding potential business partners, mentors, and experts - making connections with the industry or University and establishing connections with financial institutions. The

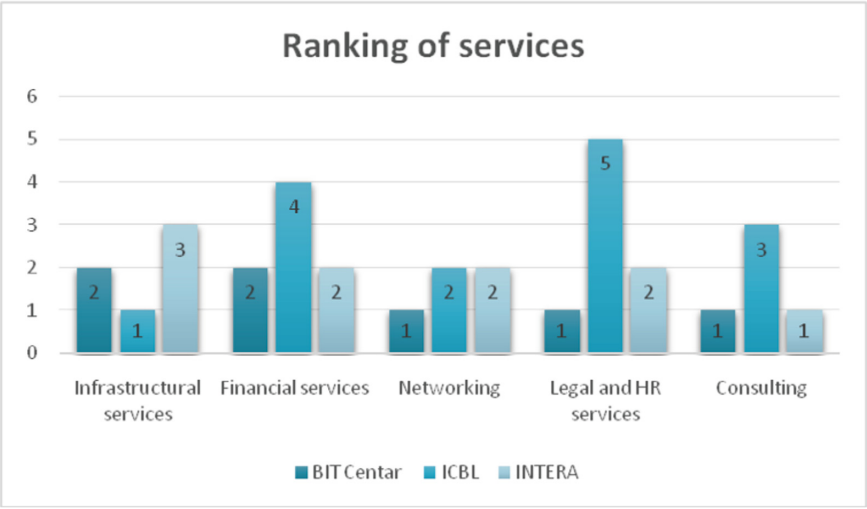

Fig. 2. Ranking of STP services

most important consulting services are support in research and development, marketing, business trainings and education.

The STPs were asked to evaluate the importance of networks they are managing. Answers indicate that the relationship between University and industry is very important for the overall function of the STPs and the enterprises within the park. Basically, STPs are the framework for the connection between start-ups, academy, industry, and government support (Table 1.)

Table 1. Ranking of STP networks by importance. Source: Authors' research

	BIT Centar	ICBL	INTERA
Connection with the University	Very important	Less important	Important
Connection with other STPs	Very important	Important	Very important
Connection with the industry	Very important	Very important	Very important
Connection with outsourcing service providers	Important	Important	Important

Furthermore, the STPs have confirmed their collaboration with the University, outlining their partnership on research projects and activities, student internships, training and education activities, etc. All respondents confirmed that the STPs are the main link to the University and industry.

5 Discussion and Conclusion

STPs operate under the Triple Helix model, linking university, industry, and government. Research results indicate that STPs have better information about and access to finance, infrastructure (space, laboratories etc.), markets, and therefore, are oriented to provide park enterprises with solution-oriented projects. The existence of university and research infrastructure and quality human capital are main factors of the success of the STP. The research results indicate that STPs operate sustainably, with good infrastructure and diverse financial resources. Efficient collaboration between STPs, academy and industry contribute to better STP performance, better competitive advantage and consequently will be more attractive to new start-ups and other institutions in the future. All of the STPs have their own buildings outside the University which can be considered as a weakness, because campus located STPs can have easier access to scientific and research information. The respondents pointed out the importance of networking and consulting services, as well as the importance of networking with the academy and industry. Networking is considered to be the most relevant additional value of the STP. In the end, the respondents confirmed that the STPs are the most important link between academy, industry, and government in B&H. The benefit of the STPs lies in the communication which is easier and more efficient between all the actors in the Triple Helix. This results in easier access to new knowledge for the industry, better employability for university students, more funding for university research etc.

According to the recommendations of many world and national STP associations, STPs should have a management structure dominated by highly educated management team, capable of not only running the park itself, but also enabling all companies to use services and their own network, in order to develop, grow, and cooperate with the local business community. That way, they can improve their services, relationships with universities, and transfer the latest knowledge from science to the business world and channel the needs of the economic to the academic community.

The three STPs in Bosnia and Herzegovina have a high-quality infrastructure and services, create an environment for highly educated entrepreneurs who establish and develop knowledge-based companies. STPs are connected with the business community, local governments, academia and partners locally, regionally and internationally.

Results show that STPs are successful part of innovation ecosystem regardless of bad legal regulations and framework conditions, which can be a suggestion to policy and political decision makers to introduce a Law on entrepreneurial infrastructure if not on state than an entity level which can help in strategic and faster development of STPs in Bosnia and Herzegovina.

The analyzed STPs cooperate with the academic community and this connection is reflected in the activities on projects they implement together but which do not have a research component. This cooperation is further reflected through work on research projects, sharing resources, mutual communication, and exchange of resources and through work on development activities. Additional component of this connection is presented through organizing teaching processes, additional training, internships, and student employment, as well as through the establishment of joint laboratories.

References

1. Gebhardt, C., Piplas, H., Blagojevic, M.: From science parks to science cities. Organizational and Planning Perspectives of the New Paradigm. Triple Helix J. Univ. Ind. Gov. Innov. Entrepreneurship (2020)
2. Etzkowitz, H., Leydesdorff, L.: The dynamics of innovation: from national systems and "Mode 2" to Triple Helix of University-Industry-Government Relations. Res. Policy **29**, 109–123 (2000). https://doi.org/10.1016/S0048-7333(99)00055-4
3. Da Costa Mineiro, A.A., De Souza, T.A., De Castro, C.C.: The quadruple and quintuple helix in innovation environment (incubators and science and technology parks). Innov. Manag. Rev. **18**(3) (2021). https://doi.org/10.1108/INMR-08-2019-0098
4. Sudiana, K., Sule, E.T., Soemaryani, I., Yunizar, Y.: The development and validation of the Penta helix construct. Bus. Theor. Pract. **21**(1), 136–145 (2020). https://doi.org/10.3846/btp.2020.11231
5. Carayannis, E., Campbell, F.J.D.: 'Mode 3' and 'Quadruple Helix': toward a 21st century fractal innovation ecosystem. Int. J. Technol. Manage. (2009). https://doi.org/10.1504/IJTM.2009.023374
6. Setyani, S.W.L.H.: The quadruple helix model: enhancing innovative performance of Indonesian creative industry. Int. J. Sci. Technol. Res. **6**(11) (2017)
7. Appio, F.P., Lima, M., Paroutis, S.: Understanding smart cities: innovation ecosystems, technological advancements, and societal challenges. Technol. Forecast. Soc. Chang. **142**, 1–14 (2019)
8. Bellgardt, F., Gohlke, J., Haase, H., Parzonka, R., Schicketanz, J.: Triple Helix and residential development in a science and technology park: the role of intermediaries. Triple Helix Springer Open J. **1**(10) (2014). https://doi.org/10.1186/s40604-014-0010-1
9. Etzkowitz, H., Leydesdorff, L.: The Triple Helix – university-industry-government relations: a laboratory for knowledge based economic development (January 1, 1995). EASST Rev. **14**(1), 14–19 (1995). SSRN. https://ssrn.com/abstract=2480085
10. Laguna, N.E., Duran-Romero, G.: Science parks approaches to address sustainability: a qualitative case study of the science parks in Spain. Int. J. Soc. Ecol. Sustain. Dev. **8**(3) (2027). https://doi.org/10.4018/IJSESD.2017070103
11. Bellgardt F., Gohlke J., Haase H., Parzonka R., Schicketanz J.: Triple Helix and residential development in a science and technology park: the role of intermediaries. Triple Helix Springer Open J. **1**(10) (2014). https://doi.org/10.1186/s40604-014-0010-1
12. Leydesdorff, L.: The triple helix, quadruple helix, …, and an n-tuple of helices: explanatory models for analyzing the knowledge-based economy? J. Knowl. Econ. **3**, 25–35 (2012). https://doi.org/10.1007/s13132-011-0049-4
13. Henriques, C.I., Sobreiro, A.V., Kimura, H.: Science and technology park: future challenges. Technol. Soc. **53**, 144e160 (2018)
14. Annerstedt, J.: Science parks and high-tech clustering. In: International Handbook on Industrial Policy, Cheltenham, Elgar, pp. 279–297 (2006). ISBN 1-84376-836-4 (2006)
15. Economic and Social Commission for Western Asia: Science and Technology Parks: Global Outlook with a Focus on the Arab Region, United Nations (2018)
16. Carayannis, E.G., Campbell, D.F.J.: Triple helix, quadruple helix and quintuple helix and how do knowledge, innovation and the environment relate to each other? A proposed framework for a trans-disciplinary analysis of sustainable development and social ecology. Int. J. Soc. Ecol. Sustain. Dev. **1**(1), 41–69 (2010)
17. Hidroglu, D., Aktug, S.S., Yilmaz, O.: COVID-19- and New Business Ecosystem, Gazi Kitabevi (2020)

18. Unlu, H., Arbi, K.A.: The qualitative research interview. Qual. Res. Account. Manag. **8**(3), 238–264 (2011). https://doi.org/10.1108/11766091111162070
19. Kvale, S., Brinkman, S.: Inter Views: Learning the Craft of Qualitative Research Interviews. Sage Publications, Los Angeles (2009)

Sustainable Development Education Research in South East Europe, 2016–2022: A Bibliometric Study

Nikša Alfirević[1](✉), Maja Arslanagić-Kalajdžić[2], and Vlatka Škokić[1]

[1] Faculty of Economics, Business and Tourism, University of Split, Cvite Fiskovića 5, 21000 Split, Croatia
{nalf,vlatka.skokic}@efst.hr

[2] School of Economics and Business, University of Sarajevo, Trg Oslobodenja-Alija Izetbegovic 1, 71000 Sarajevo, Bosnia and Herzegovina
maja.arslanagic@efsa.unsa.ba

Abstract. Sustainable development has become an essential part of responsible education, regardless of its level or the professional field. As part of the 'third mission' of higher education institutions (HEIs), sustainable development education should be accompanied by the relevant research, dissemination, and outreach toward the communities, civil society organizations, and governments. This study focuses on sustainable development education research in South East Europe (SEE). We analyze the extant SEE academic literature on sustainable development education using a popular bibliometric tool (Elsevier SciVal). We identify the implications of the obtained results for the educational practice and higher education policies in sustainable development and discuss the potential contribution of research to the sustainable development education and dissemination/outreach practices of HEIs in SEE.

Keywords: Sustainable development education · Bibliometric benchmarking · South East Europe

1 Introduction

Becoming sustainable is no longer just a phrase that individuals and organizations use without understanding its meaning – it has become an immanent liability that every individual and organization carries with itself to ensure the future of humankind. Driven by the United Nations' Sustainable Development Goals (SDGs), which represent a *"universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030"* [1], many actions coincide for the world to develop more sustainably.

Higher education is not an exemption. Covered with *Goal 4: Quality Education*, sustainability is higher education institutions' (HEIs') third or even fourth mission [2] on the path of development. HEIs usually cover various disciplines, and each addresses the problem differently. E.g., while sustainability can be an integral aspect of curriculum

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 58–68, 2023.
https://doi.org/10.1007/978-3-031-17767-5_5

and actions at a department focused on science, it can be an additional topic in teaching, requested from an external quality assurance agency at a business school.. However, sustainability orientation is signaled through curricula and programs offered and through institutional actions and behavior in the public space.

This study focuses on sustainable development education research, defined as *"the educational culture that enables individuals to reflect through multicultural, global and future-oriented perspectives, on their responsibility for the complex effects of decision-making and behavior"* [3]. The main aim is to understand the research developments in this area by analyzing the extant literature. We rely on the reviews done in the past, such as the one from Hallinger and Chatpinyakoop [4]. Furthermore, we narrow in on the South East Europe (SEE) region (with the following countries analyzed: Slovenia, Croatia, Bosnia & Herzegovina, Serbia, Montenegro and North Macedonia), as responding to calls [5] to focus on the SEE (as a part of the wider Eastern Europe region). In the entire Eastern and Southern Europe, significant issues in education for sustainable development have been identified, such as *"a lack of adequate instruction materials, the inefficient use of the capacity of higher education and research institutions, a shortage of skilled educators and insufficient awareness-raising, as well as a lack of interdepartmental and multi-stakeholder cooperation on ESD"* [5].

Against this background, we define the following research questions (RQs):

(1) RQ1: Are there differences across SEE countries in their contribution to the sustainable development education research?
(2) RQ2: How do SEE countries compare to other European countries regarding their sustainable development education contribution?
(3) RQ3: What are the productivity and impact of the SEE higher education institutions in the sustainable development education research?

By answering these research questions, we contribute to the contextualization of sustainable development education research and its significance in academic practice. Furthermore, we generate propositions for higher education policies in the field of sustainable development, with a particular focus on the developing European regions (such as the SEE).

2 Methods

To capture the general trends in the development of the sustainability education literature, in the first step, we performed a bibliometric search of the Elsevier Scopus database by using the broad phrase of *'education for sustainability',* as recommended by Wu & Shen [6]. It should be noted that the query performed does not necessarily cover the entire sustainability education literature but rather serves as a proxy for the assessment of global research trend [6]. Further bibliometric research is needed to develop a comprehensive query covering the entire scientific topic.

The query is further filtered for the original scientific papers and reviews published in Scopus-referred journals since 2016 to capture the five-year period. The resulting Scopus advanced search query is as follows:

```
TITLE-ABS-KEY("education for sustainability") AND (LIMIT-TO
(PUBYEAR,2022) OR LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2020)  OR
LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO
(PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2016)) AND (LIMIT-TO (DOCTYPE,"ar")
OR LIMIT-TO (DOCTYPE,"re"))
```

Results of the global trends in the sustainability education literature, based on our initial query of Scopus-indexed publications, are presented in Sect. 3.1 of this study.

In the second step of the analysis, presented in Sect. 3.2 of the paper, we use the predefined bibliometric reporting to zero in on the research output of SEE countries and institutions. Instead of developing the own comprehensive query to capture the SEE region's sustainable development eduction research topic, we used the OECD Fields of Research and Development (FORD) classification [7]. This classification is available with the Elsevier SciVal scientometric software solution for reporting and benchmarking scientific productivity and impact. SciVal also uses the latest available Scopus data but makes it relatively easy to employ a wide range of performance metrics and conduct benchmarking on the personal, institutional, or national levels [8].

In SciVal, we used the FORD topic *'Education for Sustainability; Higher Education Institutions; Sustainability Science and Engineering'* (topic code T.3407) to analyze the relevant regional literature.

3 Results

3.1 Scopus-Based Bibliometric Overview of General Trends in the Academic Literature on Sustainable Development Education

The general query of the Scopus database in the first step resulted in 395 documents, showing slow but continuous growth in the researchers' interest in the sustainability education throughout the 2016–2021 period – starting with less than 50 outputs in 2016, reaching more than 80 outputs in Scopus-referred journals annually in 2021.

The most productive countries, from the viewpoint of scientific output, are Spain (75 Scopus documents), Australia (64), US (41), UK (38), Sweden (24), Brazil (19), Germany (17), Norway (15), Israel (13) and Turkey (13). The most productive institutions in the field are: Spanish Universidad de Granada leading (11 Scopus documents in the analyzed period); Queensland University of Technology (9 outputs); Universidad de Cadiz (9 outputs); Deaking University (9 outputs); James Cook University (8 outputs); Universidad del Pais Vasco (8 outputs), etc.

This research field is a multi-disciplinary one, with the majority of research output (337 documents, i.e., 41.9%) belonging to social science, followed by environmental science (154 documents, i.e., 20.4%), energy research (120 documents, i.e., 14.9%), business, management, and accounting (48 documents, i.e., 6%), etc.

All identified documents received Scopus citations in the 2016–2021 period, with a total number of 3,265 citations. The researchers' interest in the topic increases, with less than ten citations of the analyzed body of literature before 2017, increasing to 1,440 citations in 2021. The ten most cited studies in Scopus are presented in Table 1.

Only three SEE studies in the analyzed Scopus corpus were obtained by a simple query (two with co-authors with affiliations from Serbia and Slovenia and one from

Table 1. The most cited Scopus journal papers in sustainability education research (2016–2021)

Reference	Year of pub.	Cit. < 2017	Cit. 2017	Cit. 2018	Cit. 2019	Cit. 2020	Cit. 2021	Cit. 2016–2021
Annan-Diab, F., & Molinari, C. (2017). Interdisciplinarity: Practical approach to advancing education for sustainability and for the sustainable development goals. *International Journal of Management Education, 15*(2), 73–83. https://doi.org/10.1016/j.ijme.2017.03.006	2017			11	24	45	52	**132**
Aleixo, A. M., Leal, S., & Azeiteiro, U. M. (2018). Conceptualization of sustainable higher education institutions, roles, barriers, and challenges for sustainability: An exploratory study in Portugal. *Journal of Cleaner Production, 172*, 1664–1673. https://doi.org/10.1016/j.jclepro.2016.11.010	2018		2	8	28	37	53	**128**
Leal Filho, W., Raath, S., Lazzarini, B., Vargas, V. R., de Souza, L., Anholon, R.,… Orlovic, V. L. (2018). The role of transformation in learning and education for sustainability. *Journal of Cleaner Production, 199*, 286–295. https://doi.org/10.1016/j.jclepro.2018.07.017	2018			2	23	43	55	**123**
Tejedor, G., Segalàs, J., & Rosas-Casals, M. (2018). Transdisciplinarity in higher education for sustainability: How discourses are approached in engineering education. *Journal of Cleaner Production, 175*, 29–37. https://doi.org/10.1016/j.jclepro.2017.11.085	2018			6	20	30	21	**77**
Setó-Pamies, D., & Papaoikonomou, E. (2016). A multi-level perspective for the integration of ethics, corporate social responsibility and sustainability (ECSRS) in management education. *Journal of Business Ethics, 136*(3), 523–538. https://doi.org/10.1007/s10551-014-2535-7	2016	1	8	6	18	27	17	**76**
Howlett, C., Ferreira, J. -., & Blomfield, J. (2016). Teaching sustainable development in higher education: Building critical, reflective thinkers through an interdisciplinary approach. *International Journal of Sustainability in Higher Education, 17*(3), 305–321. https://doi.org/10.1108/IJSHE-07-2014-0102	2016	1	3	9	22	11	21	**66**

(*continued*)

Table 1. (*continued*)

Reference	Year of pub.	Cit. < 2017	Cit. 2017	Cit. 2018	Cit. 2019	Cit. 2020	Cit. 2021	Cit. 2016–2021
Evans, N. S., Stevenson, R. B., Lasen, M., Ferreira, J. -., & Davis, J. (2017). Approaches to embedding sustainability in teacher education: A synthesis of the literature. *Teaching and Teacher Education, 63*, 405–417. https://doi.org/10.1016/j.tate.2017.01.013	2017		2	9	17	11	25	**64**
Tejedor, G., Segalàs, J., Barrón, Á., Fernández-Morilla, M., Fuertes, M. T., Ruiz-Morales, J.,… Hernández, À. (2019). Didactic strategies to promote competencies in sustainability. *Sustainability (Switzerland), 11*(7) https://doi.org/10.3390/su11072086	2019				4	19	25	**48**
Bell, D. V. J. (2016). Twenty-first century education: Transformative education for sustainability and responsible citizenship. *Journal of Teacher Education for Sustainability, 18*(1), 48–56. https://doi.org/10.1515/jtes-2016-0004	2016	1	2	10	10	12	12	**46**
Giangrande, N., White, R. M., East, M., Jackson, R., Clarke, T., Coste, M. S., & Penha-Lopes, G. (2019). A competency framework to assess and activate education for sustainable development: Addressing the UN sustainable development goals 4.7 challenge. *Sustainability (Switzerland), 11*(10) https://doi.org/10.3390/su11102832	2019				5	21	20	**46**

Source: Authors, based on Elsevier Scopus data (December 2021).

Croatia). However, the Elsevier SciVal analysis revealed the existence of the entire body of regional literature. The complete list of those publications is available as an online resource (appendix) to this study, along with a list of the most influential 100 European authors in the field, as well as authors from the SEE region, belonging to the top 500 most influential researchers in Europe [9].

3.2 Productivity, Impact, and Benchmarking of South East European Countries and Institutions in Sustainable Development Education Research

Based on the previously described SciVal procedure, the national productivity of European countries in the research of sustainability education can be evaluated. Concerning RQ1 and RQ2, national scientific productivity results are presented in Table 2. These provide data on the top ten European countries and the SEE nations and their rank. Performance assessment is based on the scholarly output, i.e., the number of Scopus-indexed publications. The table also reports the total citation count and the Field-Weighted Citation Impact (FWCI). It is a popular metric, which enables individuals, institutions, and countries to compare the impact of their research directly. FWCI normalizes contextual

factors' influence on the citation count by comparing the number of citations received to the expected number of citations. The averages determine the expected citation rate for the field and the document type. FWCI value of 1.0 sets the global benchmark of average research impact, with values higher than 1.0, indicating the above-average impact [10].

Table 2. Top ten European countries and SEE nations' performance in sustainable education research (2016-)

	Country	Scholarly output	National research field-weighted citation impact	Citation count
1	Spain	442	1.51	3090
2	United Kingdom	440	1.36	3512
3	Germany	296	1.58	2307
4	Italy	150	1.18	825
5	Portugal	150	1.32	1229
6	Sweden	137	1.63	1438
7	Russian Federation	110	0.73	240
8	Netherlands	105	1.22	755
9	Poland	95	0.7	320
10	Finland	78	1.07	499
22	**Serbia**	**25**	**1.87**	**345**
25	**Slovenia**	**22**	**0.59**	**87**
28	**Croatia**	**15**	**0.65**	**26**
34	**North Macedonia**	**4**	**0.47**	**21**
38	**Bosnia & Herzegovina**	**1**	**0.00**	**0**

Source: Authors, based on Elsevier SciVal data (December 2021).

Out of the analyzed SEE countries, only Serbian researchers have a relatively high FWCI score, which results from a relatively high number of citations received by the scholarly output, comparable to other SEE countries.

Concerning RQ3, it should be noted that none of the SEE research organizations belong to the top ten European institutions in the research of sustainability education (see Table 3). University of Belgrade (Serbia) ranks as the 33rd European institution in the field, with small output but a very high FWCI, consistent with the Serbian national research performance. University of Maribor (Slovenia) is the only other SEE research organization in the top 100 European institutions in the field, with nine research publications and an institutional research FWCI value of 0.87. Such an output seems to result from a small research group affiliated with individual researchers from Croatia, Bosnia & Herzegovina, and Serbia.

Table 3. Top ten European research institutions and SEE institutional performance in sustainable education research (2016-)

	Institution	Country/Region	Scholarly output	Institutional research field-weighted citation impact	Citation count
1	Polytechnic University of Catalonia	Spain	53	2.03	563
2	Manchester Metropolitan University	United Kingdom	52	2.46	976
3	Leuphana University of Lüneburg	Germany	48	2.86	568
4	Hamburg University of Applied Sciences	Germany	47	2.28	718
5	University of Aveiro	Portugal	38	2.54	640
6	University of the Basque Country	Spain	37	1	127
7	University of Seville	Spain	29	3.12	304
8	Delft University of Technology	Netherlands	28	1.24	168
9	University of Lisbon	Portugal	28	0.76	127
10	Aalborg University	Denmark	27	1.19	207
33	**University of Belgrade**	**Serbia**	**17**	**2.41**	**314**
90	**University of Maribor**	**Slovenia**	**9**	**0.87**	**51**

Source: Authors, based on Elsevier SciVal data (December 2021).

The most productive European researcher in the field is Walter Leal Filho, affiliated with the Hamburg University of Applied Sciences in Germany, with a scholarly output of 46 publications, 954 citations, and the FWCI value of 2.52 since 2016. Only one SEE researcher affiliated with the University of Belgrade (Serbia) is ranked (on the 84th position) among the top 100 European individuals, according to their performance and impact in sustainability education research. Since the entire author list is too large to be reproduced and could be of limited interest to the readers, it is available as an online resource

(appendix) [9]. It should be noted that additional seven individuals from the SEE region, with affiliations from the University of Maribor and University Primorska (Slovenia), the University of Zagreb and University of Split (Croatia), and the University of Nis (Serbia) are ranked among the top 500 European researchers in the field. Their current rank and bibliometric data are also available in the online resource (appendix) [9].

4 Discussion

As far as the authors are informed, this study is among the few which attempts to understand the sustainability education research in the SEE region. Thus, identifying the productivity and impact of SEE higher education institutions offers a baseline against the future growth of this field in the SEE countries.

The study attempts to address three research questions. In terms of the productivity and impact of the SEE countries in the sustainable development education research, the findings show that the entire SEE region does not follow the global trends. Our analysis of the extant sustainability education research literature and the bibliometric analysis performed by Hallinger and Chatpinyop [4] reveal that the field seems to be multiplying, which is not the case with the regional literature. In addition, among the analyzed countries (Croatia, Bosnia & Herzegovina, North Macedonia, Serbia, Slovenia), only researchers from Serbian institutions achieved the above-average impact, measured by the value of the FWCI metric above 1. However, the achieved level of influence was the result of several highly influential individual contributions, rather than the outcome of the systematic work on the sustainable development issues, planned and supported by the scientific policy (for instance, Serbia has 25, while top-ranked Spain has 442 scholarly outputs in the observed period).

In terms of the differences across SEE countries, regarding their contribution to the sustainable development education research, our results show that only Serbia (25), Slovenia (22), and Croatia (15) have increasing scholarly output (although still relatively low compared to other top performing countries). At the same time, North Macedonia and Bosnia & Herzegovina just stepped into the field. Although there is a difference between SEE countries, two clusters are forming, with one consisting of Serbia, Slovenia, and Croatia, and the other cluster including North Macedonia and Bosnia & Hercegovina.

Results of our study also show a significant gap between the SEE countries and other European countries in terms of their sustainable development education contribution. This is not surprising since there exists evidence that the generated knowledge is concentrated in a small number of developed economies. Hallinger and Chatpinyop [4] show that only 16% of the literature was authored in developing countries, representing a considerable challenge for sustainable development research. On the one hand, developed countries cannot assume that the sustainability perspectives, policies, measures, and educational curriculum are easily exported to the developing countries. On the other hand, developing economies, such as observed SEE countries, need to set up different programs for research funding, encouraging various forms of sustainable development research.

Also, HEIs have to encourage world-class research, leading to a higher impact. This is especially important when the productivity and impact of SEE HEIs are considered

since none of them belongs to the top thirty European institutions in sustainability education research. Only the University of Belgrade, Serbia, and the University of Maribor (Slovenia) rank among the top 100 European institutions in the field.

5 Conclusion

This study demonstrates the urgent need for the SEE countries to focus on all forms of sustainable development research, including the sustainable development education field. Namely, it is widely accepted that *"education will play a key role in the global effort to achieve the UN's sustainable development goals"* [4]. Only by creating an interdisciplinary field of research in the years to come, SEE countries still have an opportunity to create a knowledge base, which will potentially influence public policy and practices in the area of sustainable development. The emphasis on interdisciplinarity should *"open the eyes and minds"* of both the academic and the general public related to the complexities of today's development. Integrating disciplines facilitates problem-solving by displaying how different researchers deal with the same issue. Complex sustainability topics, broken into environmental and social development issues, ask for the integration of various types of knowledge and their alignment, which is the crucial task of the academic sector [11].

Apart from interdisciplinarity, Alexio, Leal, and Azejteiro [12] recognize two additional issues that determine higher education policies supporting sustainable development: community empowerment and fundraising and funding. The first issue goes hand in hand with the fundamental role HEIs have in every society – particularly with their effect on shaping the narrative and dealing with relevant topics in their communities. In general, the second issue is appropriate both for HEIs and for sustainable development issues. Namely, to boost the effects of their actions and transfer them to practice, HEIs need funding, and they also need to be equipped with relevant skills and expertise to obtain funding. In general, since funding holds significant financial leverage for HEIs, one way to achieve sustainability-related goals is through funding instruments. One of the great examples of such leverage is the Horizon Europe program (the largest research funding program of the EU, which includes other countries) and its recent actions on gender equality. Namely, *"for Horizon Europe calls for proposals with deadlines in 2022 and beyond, applying public bodies, research organizations and higher education institutions, from EU Member States and associated countries, must have a GEP or equivalent strategy in place to be eligible for funding.*" [13].

As related to the educational practice in higher education and the potential policy orientation, it should be noted that Giangrande et al. [14] develop a framework with a set of competencies that institutions should develop with their students to support sustainable development. Those competencies are interpersonal, strategic planning, normative competencies, anticipatory skills, systemic thinking, intrapersonal competency. Furthermore, they outline the applicability of those competencies across various disciplines, such as human rights or global citizenship.

Finally, the sustainable development orientation of HEIs has been recently recognized as a part of the well-known university ranking schemes, such as the SDG-related Impact Rankings, developed by the Times Higher Education (THE). Although criticized

for the commercialization of university data and potential transparency and data validity [15], the Impact Ranking shows the general trend of involving multiple stakeholders in assessing HEI sustainability. With the rankings being also crucial for university funding and international enrollment [16], sustainability research conducted by universities comes into the spotlight. For instance, THE Impact Ranking tracks SDG-related teaching, outreach, and research using different indicators and weights. The research component is measured using the scholarly output and Field-Weighted Citation Impact (FWCI) metrics, computed from Elsevier Scopus data [17].

In terms of the limitations, this study shows constraints of the 'plain' Elsevier Scopus database when reporting and benchmarking research productivity and impact. Although this can be done, it requires both a thorough understanding of the field and bibliometric (scientometric) skills to develop a relevant Scopus query and perform the required analysis. On the other hand, scientometric reporting tools, such as Elsevier SciVal, make this task much more straightforward and accessible to individuals and organizations who do not possess scientometric skills and experience. The same objective can be achieved using the Clarivate Web of Science ecosystem, including the Web of Science referencing products and the Clarivate InCites scientometric tool.

In addition, this study did not analyze the research methods used that dominate the field. An analysis of research methods is crucial because it can point to the limitations of the existing knowledge if it is biased towards a particular methodology and techniques.

References

1. UNDP Sustainable Development Goals. https://www.undp.org/sustainable-development-goals. Accessed 2 Jan 2022
2. Rubens, A., Spigarelli, F., Cavicchi, A., Rinaldi, C.: Universities' third mission and the entrepreneurial university and the challenges they bring to higher education institutions. J. Enterprising Commun. People Places Global Econ. **11**(3), 354–372 (2017)
3. Adomßent, M., et al.: Emerging areas in research on higher education for sustainable development–management education, sustainable consumption and perspectives from Central and Eastern Europe. J. Clean. Prod. **62**, 1–7 (2014)
4. Hallinger, P., Chatpinyakoop, C.: A bibliometric review of research on higher education for sustainable development, 1998–2018. Sustainability **11**(8), 2401 (2019)
5. United Nations Economic Commission for Europe Strategy for Education for Sustainable Development. https://unece.org/esd-strategy. Accessed 2 Jan 2022
6. Wu, Y.C.J., Shen, J.P.: Higher education for sustainable development: a systematic review. Int. J. Sustain. High. Educ. **17**(5), 633–651 (2016)
7. OECD: Frascati Manual 2015: The Measurement of Scientific, Technological and Innovation Activities. In: Guidelines for Collecting and Reporting Data on Research and Experimental Development. OECD Publishing, Paris (2015)
8. Dresbeck, D.R.: SciVal. J. Med. Libr. Assoc. JMLA **103**(3), 164–166 (2015)
9. Alfirević, N., Arslanagić Kalajžić, M., Škokić, V.: Bibliometric data on sustainable education research in South East Europe (2016). Figshare. https://doi.org/10.6084/m9.figshare.17711162
10. Purkayastha, A., Palmaro, E., Falk-Krzesinski, H.J., Baas, J.: Comparison of two article-level, field-independent citation metrics: Field-Weighted Citation Impact (FWCI) and Relative Citation Ratio (RCR). J. Informet. **13**(2), 635–642 (2019)

11. Annan-Diab, F., Molinari, C.: Interdisciplinarity: practical approach to advancing education for sustainability and for the sustainable development goals. Int. J. Manag. Educ. **15**(2), 73–83 (2017)
12. Aleixo, A.M., Leal, S., Azeiteiro, U.M.: Conceptualization of sustainable higher education institutions, roles, barriers, and challenges for sustainability: an exploratory study in Portugal. J. Clean. Prod. **172**, 1664–1673 (2018)
13. European Commission, Directorate-General for Research and Innovation: Horizon Europe guidance on gender equality plans. https://data.europa.eu/doi/10.2777/876509. Accessed 2 Jan 2022
14. Giangrande, N., et al.: A competency framework to assess and activate education for sustainable development: addressing the UN sustainable development goals 4.7 challenge. Sustainability **11**(10), 2832 (2019)
15. Hazelkorn, E.: Are rankings (Still) fit for purpose? In: van't Land, H., Corcoran, A., Iancu, D.-C. (eds.) The Promise of Higher Education, pp. 293–299. Springer, Cham (2021). https://doi.org/10.1007/978-3-030-67245-4_45
16. Bound, J., Braga, B., Khanna, G., Turner, S.: The globalization of postsecondary education: the role of international students in the US higher education system. J. Econ. Perspect. **35**(1), 163–184 (2021)
17. Times Higher Education Impact Rankings Methodology 2022 (Version 1.2). http://www.osm.kmitl.ac.th/osm2020/file/SDG/%E0%B8%84%E0%B8%B9%E0%B9%88%E0%B8%A1%E0%B8%B7%E0%B8%ADTHE.ImpactRankings.METHODOLOGY.2022.pdf. Accessed 2 Jan 2022

Challenges in Implementing Monitoring System for SEE Strategy 2030 [from Perspective of SDGs]

Arslan Umut Ergezer[1], Dusanka Boskovic[2(✉)], and Amina Tihak[2]

[1] Regional Cooperation Council – RCC, Sarajevo, Bosnia and Herzegovina
[2] Faculty of Electrical Engineering, University of Sarajevo, Sarajevo, Bosnia and Herzegovina
dboskovic@etf.unsa.ba

Abstract. This is conceptual article with objective to explore and identify main challenges in implementing adequate monitoring system for global indicators, widely used in Southeast European (SEE) 2030 Strategy. SEE 2030 Strategy is a regionally all-inclusive attempt of thirteen economies of SEE. Their first-sighted heterogeneity deemed to be an obstacle for a joint action. However, the UN SDGs and Agenda 2030 provide a credible platform upon which SEE 2030 was built. SEE2030 through its bottom-up approach and open-to-all consultation with all relevant stakeholders created a homogenous set of policy nexus linking all thirteen economies together and mobilize their political level commitment to work together based UN SDGs oriented targets. SEE 2030's flexibility and national level challenges responsiveness offers an opportunity but also challenge for monitoring. Monitoring is a key element for the success of implementation of strategic goals since SEE 2030 flexibility and responsiveness cannot be sustained if monitoring does not function properly. Significant challenges in achieving the stated objective are: data availability, standardization and appropriateness. Another significant factor of success in SEE 2030's implementation would be balancing the complementarities of both quantitative and qualitative inputs. The design of the paper to present in the beginning how selection of the indicators shapes strategies and activities for their implementation, then to offer a methodology and steps designed for data collection, exploration and presentation based on our experiences with the SEE 2030 Strategy. Then, the challenges in visualizations used for presentation of the monitoring results are critically reviewed and discussed, and guidelines based on theoretical principles and hands-on experience are offered. Finally, conclusions provide a platform for further exploration and debate.

Keywords: Sustainable urban development · Sustainable development goals · Southeast Europe (SEE)

1 Introduction

Agenda for Sustainable Development 2030 established 17 Sustainable Development Goals (SDGs) with objective to chart out a universal, holistic set of objectives on a

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 69–77, 2023.
https://doi.org/10.1007/978-3-031-17767-5_6

path towards sustainable development, and by addressing all three dimensions: economic development, social inclusion, and environmental sustainability [1]. Significant resources are needed both for implementing the changes outlined in the Sustainable Development Solutions Network (SDSN) Report, but also for ensuring effective data collection for monitoring the level of fulfillment of the SDGs. Establishment of the Global Partnership for Sustainable Development Data was proposed in the SDSN report to empower countries around the world to make the SDGs a real management tool for sustainable development [1].

The leaders of the thirteen economies of South East Europe (SEE) adopted the SEE2030 Strategy in June 2021 with clear objective to promote and advance the implementation of UN Sustainable Development Goals within the SEE region [2]. The focus of the Strategy is on quality of life guided by contextualization to the SEE and identified dimensions are further elaborated in detailed breakdown into the corresponding targeted activities and indicators.

The paper presents challenges in selection of indicators for monitoring the achievements of the SEE 2030 Strategy goals, especially those relevant for the Sustainable Urban Development (SUD). There is an apparent link between the SUD and the UN SDG 11 - Sustainable cities and communities, but SDG indicators require to be considered as an integrated package since many important issues transcend across goals and targets. The issue is not specific for the SEE region; it is recognized across the different regions implementing SDG agenda. The SEE 2030 Strategy highlights the following three dimensions of sustainable development: (1) Prosperity, (2) People, and (3) Peace and Partnerships [2], but it is recognized that this elaboration should not be considered as a rigid classification, and significant activities towards sustainability are cross-sectional.

The paper is structured as follows. The second section summarizes conclusions from the state-of-the-art review and discusses how selection of the indicators shapes strategies and activities for their implementation. Section 3 is focused on our methodology and steps designed for data collection, exploration and presentation. In the Sect. 4 we present our framework and describe the list of selected indicators in order to prioritized activities that contribute to governance for sustainable development, and Sect. 5 presents challenges in visualization of results for a case study performed and generally in visualization of indicators values. Results are discussed and conclusions presented in the final section.

2 Background and Motivation

Sustainable urban development is immediately recognized to be linked to the SDG 11 - Sustainable cities and communities. There are several papers exploring the contextualization of the SDG 11 to national level – Germany [3] or to community level – Gothenburg, Sweden [4].

The findings for the German context demonstrated that only a few of the original targets and indicators for SDG 11 are used; the major adjustments have been made according to the main sustainability challenges identified for Germany, and the results showed that the sustainable urban development in Germany were still ongoing, and more changes and commitments needed to be made [3].

The arguments articulated in [3] stem from the results of a pilot study focusing on the relevance and measurability of the proposed targets and indicators for SDG 11,

conducted in early 2015 by Mistra Urban Futures, an international urban sustainability research center in Gothenburg. The authors confront dual nature of the SDG indicators: (1) communicating (reporting) the indicator value, and (2) serving as a management tool. The authors emphasize need to integrate indicators into existing local planning to contribute to ongoing municipal monitoring and evaluation processes, and to influence policy and practice, and recognize the challenge to disaggregate SDGs values into the local scale, especially for SDG 11 [4]. This approach is fundamental for assessing the quality of life, since local context is what matters for individuals, not the national values of SDG indicators in a dashboard measuring and comparing countries performance.

Detailed and comprehensive qualitative analysis of the literature discussing the indicators link with the policy context, especially local policy, and contribution to monitoring and evaluation processes is presented in [4]. The authors conclude that "it is highly likely that urban areas in different countries worldwide will choose, or be directed by their national reporting agencies, to report only on those targets and indicators that fulfil the criteria of ease of measurement or collection, appropriateness, convenience and relevance to prevailing conditions and national and local development policies, priorities and programmes." [4].

A specific research exploring SUD in the context of climate change, positions the following sustainable development goals in the focus: SDG 3 - No poverty, SDG 4 – Quality education, SDG 6 - Clean water and sanitation, and finally SDG 13 – Climate action. This is in line with the authors' observations that links between the SDGs are not immediately obvious and require rigorous content analysis, and more targets and indicators pertaining to immediate urban issues are worth pursuing [5]. It is interesting to highlight the authors' conclusion, that we need new mindsets and new policies, among other issues, and that a more sustainable approach to urbanization requires development of new tools needed to facilitate monitoring and evaluation processes.

3 Methodology

The proposed methodology identifies sequence of activities: (1) identifying indicators corresponding to proposed strategy objectives, (2) scoping data collection, data mapping and collecting and exploring the data, and finally (3) visualizing the results. In this section we will focus on the second activity, more precisely set of activities linked to data collection and preparation for processing.

The scope of quantifiable data, available in historical datasets and through publicly accessible sources, identified per each target, indicator and sub-indicator of SDGs. Geographic scope of data to be processed will be all SEE participant economies.

Primary focus of data collection will be towards the indicators selected. As already stated, the main issues are identifying relevant data sources and availability of data sources for direct measurements. In the case of the data unavailability or of low quality, and alternative methods of data collection should be developed. Alternative methods include, but not limited to: the substitute data as indirect measurement to be collected, data surveys to be designed and conducted. In this process the involvement of key informants–experts from respective field of interest to assist in identifying substitute data sources.

Synchronous proposal of the following: (1) a long list of data based on the set of metadata in accordance with each SDG, and (2) a list of indices and other sets of statistical methodologies appropriate in processing of data. In this regard, the activity of scoping of data collection will be fine-tuned according to the limits of data processing (in particular the ones related to data quality, comparability, objectivity, and time span).

In the context of methodology it is important to note the multidisciplinary, or more precisely transdisciplinary approach. The approach follows hierarchy of abstraction levels starting from abstract global social goals over targeted activities on the regional/national/local policy level down to concrete measurable indicators, as depicted in Fig. 1.

The hierarchy of levels involves different expertise on different levels from social sciences and humanities, policy makers, to statisticians and computer scientist implementing applications to monitor achievements of the strategic goals by measuring identified indicators.

It is obvious that how selection of appropriate indicators with corresponding collection methods is significant for the above mentioned evaluation of achievements. Less obvious is importance of visualization techniques used to convey the message on these achievements, and both activities will be described in more details in the following sections.

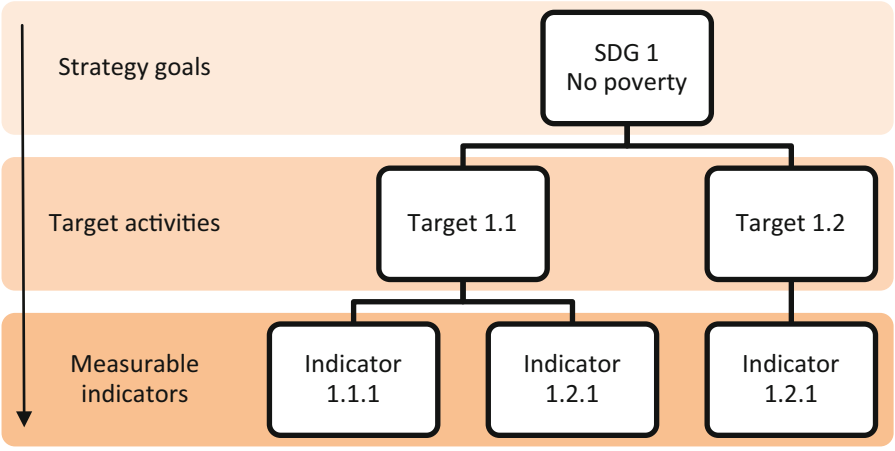

Fig. 1. Hierarchy of abstraction levels – strategy, activity, and measurement

4 Selection of Indicators

The SEE 2030 Strategy will serve as a platform for dialogue and cooperation on sustainable development issues for the SEE economies. Political commitment to regional cooperation will be a cornerstone for the successful and efficient implementation of the Strategy [2].

Preliminary objective of the SEE 2030 is to emphasize reaching regionally sustainable economic growth in order to: reduce poverty, reduce inequalities (empowering women and girls, improving social inclusion), slowing down depopulation of the region through enhancing quality of life, and making smooth transition to a carbon-neutral economy without disrupting competitiveness and private sector development through genuinely regionally owned political process.

SEE 2030 Strategy was developed across three dimensions and additional cross-cutting areas. The three dimensions: 1) Prosperity of the SEE Region, (2) People of the SEE Region, and (3) Peace and Partnerships in the SEE Region, including thirteen priority areas of intervention, providing a scope for an integrated approach to address sustainability issues [2]. The priority areas are presented in Table 1, marked with the number of selected indicators identified for monitoring purposes. It is important to highlight the cross-cutting areas as: poverty, digital transformation, green transition, and private-public partnership.

The UN 2030 Agenda provides the follow-up and review activities for SEE economies, including monitoring their progress towards the SDGs, Hence, the monitoring of the SEE 2030 Strategy fulfillment will build upon that. Evaluation of success in achieving the SEE 2030 Priority Areas would be implemented by monitoring identified SEE 2030 indicators in a systematic and transparent way. The total number of identified indicators is 74, with 41% of the indicators not included in the SDG list of indicators. It is important to note that this extension of indicator list reflects the specific relevance to the SEE regional and national development policies and priorities.

Table 1. SEE 2030 strategy dimensions and priority areas

Dimension	Priority area	Number of indicators
Dimension I	1. Promoting economic growth through trade creation, sustainable and responsible tourism and enhancing transport connectivity	4
	2. Promoting investment, research and innovation in renewable energy to increase the share of carbon free energy supply and improve energy efficiency	2
	3. Enhancing capacity to improve detection and risk reduction of natural disasters to minimize their impact on economic growth	4
	4. Reducing digital divide through better broadband connectivity, development of digital skills and accelerated digitalization of industry and public services	3
	5. Enhancing public-private sector partnership and role of financial sector/financing for development for the implementation of SDGs in SEE	10

(*continued*)

Table 1. (*continued*)

Dimension	Priority area	Number of indicators
Dimension II	6. Better utilization of human capital potential of the SEE Region	5
	7. Supporting diaspora to promote economic activity in the SEE Region	4
	8. Facilitating access to education and supporting improvement of its quality	8
	9. Facilitating access to health and supporting improvement of its quality	10
	10. Improving equal access to and quality of justice and public services in SEE	2
	11. Improving access to and quality of environment/sanitation services and affordable, safer and healthier housing	14
Dimension III	12. Supporting the institutional strengthening for smart implementation of the SEE 2030 Strategy	7
	13. Facilitating creation of sustainable funding mechanisms to support implementation of SEE 2030 Strategy while respecting development cooperation effectiveness principles of transparency and accountability	1

There are 7 indicators labeled "Short survey" that have a True/False values, but actually these are indications that the SEE economy provided some specific qualitative report, examples are: "Adopted and implemented the SEE Diaspora Strategy", "Adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030".

The selected set of indicators, that would include additional disaggregation, should not impose an additional administrative or financial burden if double reporting is avoided, and international data sources would be identified. This approach would also provide for compliance in data collection methodology employed. The main data sources for the indicators are the World Bank, DataBank Sustainable Development Goals[1], World Bank Development Indicators[2], and Eurostat[3]. Even though many relevant sources, including [4], report that monitoring activities manly focus on the indicators that are convenient for collection, additional efforts should be made to initiate collection of some specific indicators, or at least initiate discussions on their relevance and importance. Availability of data for identified indicators is presented in Fig. 2. The presented breakdown should not be interpreted that availability is linked to indicator being part of the SDG list or

[1] https://databank.worldbank.org/source/sustainable-development-goals-(sdgs).
[2] https://datatopics.worldbank.org/world-development-indicators/.
[3] https://ec.europa.eu/eurostat/.

not, since the availability of data for SEE 2030 indicators from the SDG list raise only to 66% of availability.

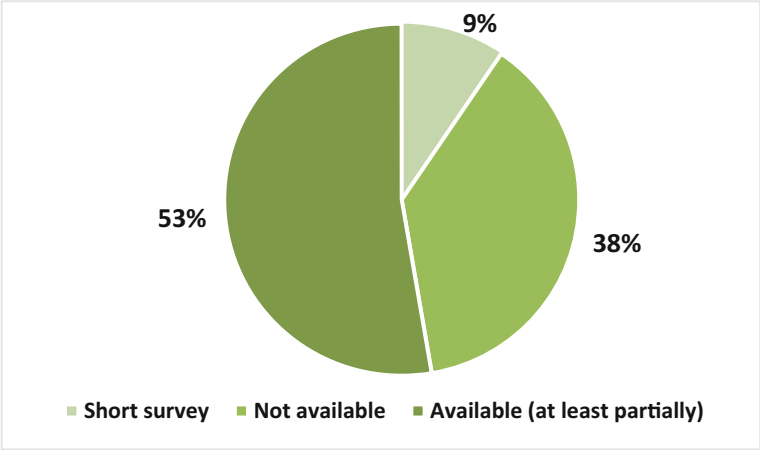

Fig. 2. SEE 2030 indicators availability

Availability of data in above mentioned sources was analysed for the period of the last 10 years, 2010–2019, Eurostat sources include 2020. If data are available for a whole period, the availability is marked 100%, and percentage value indicates number of years when data were reported. For example, indicator (Dimension I, no 5) "Renewable energy share in the total final energy consumption" is 60% for all SEE economies and covers the period 2010–2016. Another example is indicator (Dimension II, no 3) "Proportion of population living below the national poverty line, by sex and age", where percentages differ, but maximal is 80%, since there are no data for 2018 and 2019.

5 Visualization of Results

Recognition of importance of proper and quality visualizations when reporting on SDGs attainment is highlighted by development of specific publicly available data visualization toolkit [6]. The toolkit includes support in data storytelling through infographics, reports, online platforms, presentations, promotion materials and social media. The typical example of visualizations can be found in the Sustainable Development Report 2021 [7] which presents the SDG Index and Dashboards for all UN member states complemented with interactive SDR 2021 Dashboards and interactive maps (see Sustainable Development Report 2021 – Interactive Map https://dashboards.sdgindex.org/map) providing a visual representation of countries' performance by SDG.

The significant challenges in visualizing complex data could not be answered by providing icons and templates, and reducing visualization of monitoring results on graphical design expertise. This is a common mistake to treat visualization as a graphical design or technology issue, instead of employing proper interaction design approach.

The informative and useful visualizations start with knowing the user – the intended reader of the message to be conveyed, and following the principles of information – not only graphical – design. Example of a set of such principles are Principles of Analytic Graphics provided by Edward Tufte in [8, 9]: Show comparisons; Show causality, mechanism, explanation, systematic structure; Show multivariate data; Integrate evidence; Describe and document the evidence; and Know your data.

The challenges in visualizations are linked with the issues of disaggregation of the monitoring indicator values. There is no "one fit all" solution, and selection of charts depends on the objective of comparison and on a message to be conveyed. The visualization needs to be treated as a multidisciplinary exercise.

If objective is to visualize performance for individual citizen – what is interesting in the global charts, even positioning of their country within the region is not reflecting how this is affecting their everyday life. Example could be SDG1 – No Poverty, creating display for corresponding indicators will show difference between SEE countries but the indicators are not equally distributed within the countries, it is easy to look for examples as comparing the urban eastern part of Turkey with rural parts of the EU member state Romania.

Principles linked to comparisons; causality, mechanism demands to analyze Poverty in the context of depopulation, and we need the poverty monitoring map to be linked to the migration data and compared with the mirrored Western Europe data. In order to avoid compartmentalization the monitoring should continue with exploring the relation between Poverty and Education. The most important is the final principle: "Know your data," and more precise: Know your objective and political stand.

6 Conclusions

The selection of indicators for monitoring the achievement in SEE2030 Strategy is predominantly imported from the global indicators for UN SDGs. However, there are still substantial needs to improve the availability of data and their standardization among SEE economies. In addition, significant challenge is appropriateness of selected indicators. These challenges can only be sorted out in time in parallel to the progress in implementation of SEE2030.

As SEE2030 designed as an action oriented document for all-inclusive and bottom-up regional cooperation, strengthening progressively monitoring capacity of SEE2030 will be relying on the implementation success of SEE2030. These make SEE2030 be less bureaucratic as well and achieve its monitoring better embedded into its action oriented style. The availability and quality of data, particularly comparability of data respecting the relevant data standards per SDG and non-SDG indicators is of particular importance for the SEE 2030 monitoring. It is considered that the implementation of SEE 2030 would offer an additional layer of synergy and promote the importance of quality and availability of data [2], thus contributing to the SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

References

1. Sustainable Development Solutions Network – SDSN: Indicators and a monitoring framework for the sustainable development goals: launching a data revolution for the SDGs (2015). https://sustainabledevelopment.un.org/content/documents/2013150612-FINAL-SDSN-Indicator-Report1.pdf
2. Regional Cooperation Council – RCC: Southeast Europe Strategy 2030 (2021). https://www.rcc.int/download/docs/SEE-2030-strategy.pdf/fe0aeab8c719cff3719b583ae1dad446.pdf
3. Koch, F., Krellenberg, K.: How to contextualize SDG 11? Looking at indicators for sustainable urban development in Germany. ISPRS Int. J. Geo-Inf. **7**(12), 464 (2018). https://doi.org/10.3390/ijgi7120464
4. Hansson, S., Arfvidsson, H., Simon, D.: Governance for sustainable urban development: the double function of SDG indicators. Area Dev. Policy **4**(3), 217–235 (2019). https://doi.org/10.1080/23792949.2019.1585192
5. Cheshmehzangi, A., Dawodu, A.: Introduction: climate change and cities—perspectives, planning and people. In: Sustainable Urban Development in the Age of Climate Change, pp. 1–22. Springer, Singapore (2019). https://doi.org/10.1007/978-981-13-1388-2_1
6. United Nations Statistics Division: SDG & COVID-19 Data Visualization Toolkit (2021). https://unstats.un.org/capacity-development/UNSD-FCDO/sdgs-data-visualization-toolkit/
7. Sachs, J., Kroll, C., Lafortune, G., Fuller, G., Woelm, F.: The Decade of Action for the Sustainable Development Goals: Sustainable Development Report 2021. Cambridge: Cambridge University Press (2021). https://s3.amazonaws.com/sustainabledevelopment.report/2021/2021-sustainable-development-report.pdf
8. Tufte, E.: The Visual Display of Quantitative Information, 2nd edn. Graphics Press (2001)
9. Tufte, E.: Beautiful Evidence, 1st edn. Graphics Press (2006)

Cultural Heritage and Sustainable Tourism Development: The Cultural Capital of Sarajevo

Lejla Dizdarević(✉)

University of Sarajevo, 71000 Sarajevo, Bosnia and Herzegovina
lejla.dizdarevic@unsa.ba

Abstract. The study presents the concept of cultural capital with the focus on cultural monuments as the crucial part of city attractiveness and their importance to the tourism sector. The cultural capital is an important element in the process of an overall sustainable development but, still to a large extent, the cultural heritage is neglected as well and is found on the margins of the state budget. The main aim of this study is to discuss the issue of neglecting the cultural heritage in Sarajevo and the lack of its representation in tourism offers. Accordingly, the research question is: Is the cultural and historical heritage sufficiently represented in the tourist offer of Sarajevo? In order to find an answer to the research question, two significant cultural monuments were analysed, as well as their representation in 8 popular tourist tours. By participating in eight tourist tours, it was determined that the two selected monuments are almost not represented at all, which refers to the lack of cooperation among the sectors and lack of an adequate approach to sustainable tourism development. In addition, the tourism and cultural heritage legislation has been analysed. This has provided an understanding of the causes of the problems identified. In accordance with the obtained research results, certain recommendations are proposed.

Keywords: Cultural capital · Sarajevo · Sustainable tourism development · Historical monuments

1 Introduction

Cultural capital is a stock of cultural values in the form of property. The theory of cultural capital was first introduced by Bordiue [1] and explained through the prism of sociological and ideological settings. Until recently, the most of discussions have been focused on other forms of capital, like human capital, financial capital, natural capital, and production of capital. This capital approach as such was based on the idea that sustainable development is contained in changes in a country's stock of assets over time. The significance and application of the theory of the cultural capital to culture and everything that it includes, including architectural heritage, is presented by Throsby [2]. He links the cultural capital to cultural values by explaining it through a system of shared values, where one architectural heritage object can represent an object of historical significance, which connects a particular community or society. Thus he further explains

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 78–95, 2023.
https://doi.org/10.1007/978-3-031-17767-5_7

that although cultural values cannot be equated with economic values, the connection still exists. Falling to sustain the cultural values and failing to preserve and invest in cultural stock maintenance, will eventually cause the breakdown of the cultural system as one of the important elements of overall sustainable development.

Sarajevo, the capital of Bosnia and Herzegovina, is the largest urban, economic, cultural, and traffic centre in the country. The city of Sarajevo is rich in cultural and historical heritage that dates back to ancient times. This heritage originates from different time periods and is the result of the influence of different cultures, as a result of which a unique multinational and multi-religious environment was created [3]. The urban core of the city is a treasure trove of cultural heritage where architectural works from the Middle Ages, Ottoman reign, and the Austro-Hungarian period are located. At the same time, Sarajevo has the largest number of tourist visits. The largest number of tourists in the last few decades was recorded in 2019, just before the beginning of the Corona virus pandemic. Although the tourism sector is completely unregulated, all indicators point to the importance of the tourism sector and its impact on the wider community.

Several historical monuments located in the urban core of Sarajevo, although having the status of monuments of national importance, which at the same time refers to the highest level of protection, are neglected. For this study, the focus will be on two historical monuments considered to be the ones of the oldest examples of the Middle Ages and Ottoman period situated in the urban core of the city. Those two monuments are Bijela Tabija (White bastion) and Isa-begova tekija (Isa-beg's zawijah). In the text that follows, the focus will be on the explanation of the importance of the cultural heritage for city and tourism development, as well as the importance of the aforementioned monuments within the concept of the cultural capital, its importance in the urban development of Sarajevo, and most importantly the current representation in tourism offer.

For the purpose of this study, the main research question was raised, namely: Is the cultural heritage sufficiently represented in the tourist offer of Sarajevo? In order to find an answer to the research question, the role of the two previously mentioned monuments in the urban development of Sarajevo was analysed, which is presented in the paper itself. Furthermore, 8 tourist tours were analysed to gather information on the inclusion of these monuments. In addition, for the purposes of this study and understanding of the problem, a review of legislation regulating the areas of cultural and historical heritage and tourism was performed. This has provided an understanding of the causes of the problems identified. In accordance with the obtained research results, certain recommendations are proposed.

2 Cultural Capital in Form of Historical Monuments

The term *cultural capital* refers to non-financial social capital, which promotes social mobility outside economic resources. Cultural capital (*French: le capital culturel*) is a sociological term that has gained wide popularity since it was first articulated by Pierre Bourdieu in 1986. According to Bourdieu, cultural capital has three subtypes: embodied cultural capital, objectified cultural capital, and institutionalised cultural capital. In particular, the objectified cultural capital consisting of physical objects like heritage buildings, historical sites, writings, artifacts, and different works of art represent the

assets that can also be used for economic gain [2]. In addition, the objectified cultural capital, observed from the capital-based approach, can be easily included under the physical capital, which is supported by the development of different economic techniques that serve to express the value of such objects. From this point of view, it is possible to express their value in economic terms, but at the same time, it is almost impossible to measure and express it in numbers, different intrinsic values, and the meaning they have for different communities.

However, this study will continue within the setting that the cultural capital represents a stock of value in the form of property, and over time this property can encourage the flow of services and goods derived from cultural and economic values. In his work, Throsby [2] presents the importance of the theory of cultural capital by explaining its application to culture and cultural goods. Among other things, he clarifies that the theory of social capital, which is described in Bourdie's work, in certain aspects, is identified with the theory of human capital, as one of the most important economic theories. This supports the allegations that in the economic framework of defining human capital, culture is included as its component. Additionally, in their work, for the first time, Berkes and Folke [4] linked the term cultural capital with the ability of people to adapt and modify the natural environment.

The property that Throsby talks about can appear in two basic forms, the tangible and intangible, where the first form includes buildings, structures, locations, and places that have cultural significance. This includes works of art in the form of paintings, sculptures, and other works of art. These forms of property can encourage the flow of services, where they are consumed directly, or they can contribute to the production of other goods and services by forming new cultural capital. Intangible forms of cultural capital are as follows: ideas, beliefs, traditions, values that connect people in a particular social community. In addition, it includes music, literature, language, and other specific characteristics of a particular community, which can also encourage the usage, consumption, and production and thus contribute to the production of additional cultural goods.

In addition to the fact that the cultural and historical heritage is widely recognized as an important factor in creating the uniqueness of cities and places and its role in improving their competitiveness [5, 6], it is also considered an important element of sustainable development. Cultural and historical heritage is a very broad category that includes various phenomena and is mostly reflected in the importance it has for different groups of people and their sense of cultural identity and belonging. As Tweed and Suterland [7] argued, this characteristic is likely to be very important for the future growth and development of cities, and an important part of sustainable development. In addition, the presence of cultural heritage determines the growth effect through the attraction of tourism, especially in the process of local development [8].

The architectural heritage, in the form of historical buildings, is especially emphasized for its role in promoting economic growth through urban renewal, which was recognized by the Office of the Deputy Prime Minister of the United Kingdom in 2004. Architectural heritage largely contributes to the improvement of the local and national economy in a way that attracts tourists and is the basis for the development of cultural destinations [7]. This is one of the reasons why cultural tourism is seen as a key element

in promoting sustainable urban development and improving the attractiveness of the city. In this context, the improvement of attractiveness and image has several positive results that are reflected in new development opportunities, investments, as well as in development in the real estate sector, which eventually contributes to the urban competitiveness of cities [9]. As Al-Hagla [10] concludes that culture in all its forms is one of the most important elements in the process of urban development and the importance of cultural and historical heritage exceeds the basic values of monuments and handicrafts.

Authors such as Cheng [11], Peacock [12], Towse and Khakee [13], and others also seek to point out and describe the connection of the cultural sector with certain economic laws and principles. Cheng [11] clarifies the process of accumulating cultural capital through the creation of a cultural atmosphere, which is the result of the use of cultural services and cultural capital.

In the context of planning and designing the urban space, cultural and historical heritage is a very important element, which is explained by certain characteristics and features that it possesses. The New Urban Agenda (NUA) [14] recognizes cultural heritage as an important factor for urban sustainable development. There are a lot of points highlighting the role of cultural heritage (both tangible and intangible) in urban sustainable development. Furthermore, NUA highlights the role of cultural heritage in developing vibrant, sustainable, and inclusive urban economies, and in sustaining and supporting urban economies to progressive transition toward higher productivity.

Vasi [15] argues that each individual form of architectural heritage is built to meet the different needs of people while providing a sense of belonging and identity and possessing different architectural values that need to be preserved because ignoring them is contrary to the urban development planning principles. Furthermore, he states that as time passes, the value of cultural and historical heritage grows, and protection and safeguarding are one of the tasks of urban development. As he states, the architectural heritage and other forms of heritage are part of the public values of the places or cities and in that case, it is important not only for organizing and establishing urban places but also in the context of the public life of those cities. Also, he states that cultural values become an important source in the creation of economic values in the modern world. Thus, there is a need for adequate management of cultural and historical heritage and its valorisation in the process of urban development. Throsby [2] also warns that neglecting the cultural capital and allowing its detrition, by failing to sustain intrinsic cultural values, by not securing investments and maintenance of cultural stock, will eventually result in a breakdown of the cultural system and loss of welfare and all potential economic outputs.

As Maroević [16] states, the cultural and historical heritage, and the architectural heritage, in particular, is often a crucial motive for the development of tourism as an economic branch where the architectural heritage attracts tourists, who in turn help strengthen the local and national economy. The cities are those that have the most economic and social benefits from this exchange, which is reflected in a higher employment rate, improved promotion, increased various capacities for rest and recreation, and the restoration of neglected parts of the city.

In some cases, as Timothy and Nyaupane [17] point out, this synergy of tourism and the cultural and historical heritage results in increased opportunities to develop and improve the quality of life by contributing to the quality of roads, airports, and schools.

Broadly speaking, this can also result in the development of those parts of the city and regions that do not enjoy the special attention of local authorities.

According to the European report, *Cultural Heritage Counts for Europe* [18] cultural heritage is recognized as a fundamental element contributing to local sustainable development where four main domains are economic, social, environmental, and cultural interaction with each other creating intersections and crossing. Cultural heritage can be considered the "glue" among the different dimensions of sustainable development [19].

Also Nijkamp & Riganti [20] state that urban development that does not pay special attention to adequate management of cultural assets cannot be sustainable in economic, cultural, and social terms. This aligns with the work of Terkenli and Georgoula [21] who mentioned that during the past decade, culture has been perceived as the fourth pillar of sustainability and plays important role in understanding sustainability itself. They pay special attention to the evaluation of cultural and historical heritage in order to achieve its valorisation and the final outcome which is the improvement of existing and creation of new values.

Besides the mentioned arguments, many different authors have been discussing the value of cultural heritage, its protection, and valorisation, and its role in economic, social, political, and a number of other aspects. However, in this work the discussion is focused on the importance of cultural heritage for tourism development and the opportunities tourism provides for cultural heritage protection. In addition, the discussion will be supported with examples of historical buildings and their current representation in the tourism offer of Sarajevo city.

3 Methodology

For the purpose of this study, different research methods have been conducted based on the qualitative approach where a researcher often focuses on a single phenomenon to gather as much information as possible about that particular phenomenon [22]. Different in respect to quantitative research, in qualitative research, the data collection and analysis are carried out at the same time [23], which was performed in this study as well. To present a literature review, extensive desk research has been performed. In light of that relevant literature related to the interdependence of the cultural and historical heritage has been collected, as well as literature on tourism and city development. In addition, a review of the archive documents related to monuments presented in the paper has been performed. This helped to understand the importance and the role of chosen monuments in the urban development of Sarajevo. In order to present the significance of tourism and the path of its development analysis of the statistical data related to the indicators of tourism growth in Canton Sarajevo is conducted. In addition, a review of the legal framework of the sector of cultural and historical heritage and the sector of tourism has been done, which gave a clearer insight into the situation in which these two sectors find themselves. Such extensive desk research as a method of collecting data from existing resources enabled the understanding of the perceived problem. However, this method solely could not respond to the reach question but supported the process of analysis and formation of answers to the research question.

In order to form an answer to the research question, in addition to the already mentioned methods, field research was approached. More particularly, direct observation is

used which refers to data collection in a natural environment [24]. The advantage of this method is that it offers contextual data on people, situations, interactions, and the surroundings which are particularly suitable for this study. For instance, to get insight into the representation of monuments in tourism offer, the eight most popular tourist tours have been selected and their content analysed. Specifically, the researcher took part in tourist tours in order to collect primary data. In addition, the field research included photographing selected monuments. According to Holm [25] photographing as a method is used for the researcher's interpretation of "reality" that is considered important and the researcher can provide both descriptive meanings as well as stories about each object. This can help a researcher to produce photographs very valuable for understanding processes. For this study, the archive photos are used to introduce the selected monuments and photographs recently taken by the researcher to document the present condition. All results of collected and analysed data are presented in the following sections.

4 Cultural Capital of Sarajevo; Two Cases of National Monuments

Cultural and historical heritage is considered a link to the past [26]. This connection is reflected in the efforts to pass on all that has been inherited to present and future generations and includes all forms of cultural and historical heritage [27]. Tweed and Sutherland [7] describe the architectural heritage as a very important part of the overall cultural and historical heritage of cities that represents a very broad category containing a very different collection of phenomena. Thus, the preservation of cultural heritage contributes to the creation of different values which, in turn, significantly affect the creation, revival, and preservation of the national identity, space, collective memory, and social unity at all levels [27–30].

Sarajevo as a city was officially formed in 1462, although the existence of civilizations in this area is evident in the far more distant past. Confirmations of this past are the sites of the Butmir's culture[1] near the city. The Slavs came to this area in the 7th century after the period of the Neolithic, Illyrian and Roman rule. In the 13th century, Sarajevo was part of the independent Bosnian state called Vrhbosna, as evidenced by the charter from this period and the world's only tombstones known as "stećak". Sarajevo received its first urban functions even before the fall of the medieval Bosnian kingdom [3].

Taking into account these historical facts as well as all the others that were formed later in this area, they have shaped this area into a single wholeness. Although the development of Sarajevo began in the 15th century, the city experienced the greatest territorial and economic development in the 16th century with the arrival of the Ottomans. In the first years of the 16th century, Sarajevo made significant progress in increasing its

[1] Butmir culture is a group of Neolithic period, with a number of local characteristics, which spread in central Bosnia and Herzegovina, the upper reaches of the Bosna River, from Zavidovići to Sarajevo. In the aforesaid territory of central Bosnia, there is a large number of smaller, closed fields along the river streams, which corresponded to the Neolithic communities that lived in smaller closed economic units. It was named after the results from the first and so far the largest (5306 m2) archeological site of Butmir in Ilidža near Sarajevo from the Neolithic era in the territory of Bosnia and Herzegovina.

population, followed by economic and urban development. At that time, Sarajevo was the largest city in Bosnia and one of the most developed in the Balkans [31].

Soon after the arrival of the Ottomans and the founding of Sarajevo, the era of construction, development of crafts, and trade began, which soon turned Sarajevo into one of the richest cities in Europe at the time. This period marks the construction of numerous religious institutions of all denominations and the period of the arrival of the Sephardic Jews, who contributed to the already present multi-religious community. The oriental style of the construction from this period is evident today, which significantly contributes to the authenticity and attractiveness of the city [32].

The modern age began with the arrival of the Austro-Hungarian government in 1878. Forty years of Austro-Hungarian rule brought significant changes. Much attention has been paid to the construction of numerous educational and cultural institutions as well as infrastructure, thus completing the existing oriental style of construction. This modern European influence also left its mark on the customs of that time, ways of conducting business, and other aspects of civilizations, which is evident nowadays even.

Since 1914 and the assassination of the Austrian Crown Prince Franz Ferdinand by Gabriel Princip that marked Sarajevo as the place where the spark ignited the fire and the First World War began, the city was part of a different state formation, and after 1945, it became the administrative, cultural and economic center of FR Bosnia and Herzegovina, as one of the republics of the then SFR Yugoslavia. This period has been marked by significant progress. Educational and cultural institutions were established and the development of industry began. Sarajevo was chosen as the venue for the 14th 1984 Winter Olympics. This sequence of changes and events has significantly contributed to the urban development of the city.

The changes in the composition of the then SFR Yugoslavia left Bosnia and Herzegovina without many choices. With the support of its citizens and the European Community, in 1992 Bosnia and Herzegovina became an independent and sovereign state. This marked the beginning of the aggression against the country by Serbia and Montenegro, where Sarajevo, as the capital, was under a total siege and blockade for almost 4 years, and its population was left without food, water, and electricity. The city suffered massive material destruction, where a large number of buildings were totally destroyed or set on fire. The population of the city suffered numerous losses, thousands of citizens lost their lives. These events in Bosnia and Herzegovina are considered the worst form of human suffering of the 20th century in central Europe [32].

The territory of the city of Sarajevo, after the period 1992–1995, has been divided into four city municipalities: Stari Grad, Centar, Novo Sarajevo, and Novi Grad, while the Sarajevo Canton includes five additional municipalities and is an integral part of the Federation of Bosnia and Herzegovina. The urban part of the city is adorned with numerous sacral buildings of all denominations, which are located next to each other. The unique harmony of religions and cultures is considered the seal of this city. In addition, the urban region of the city is characterized by the fact that in its center numerous cultural and historical buildings that played the most important role in the formation of Sarajevo, like White Bastion and Isa-beg's zawijah tekija that will be the focus of a further discussion.

4.1 White Bastion/Bijela Tabija

White Bastion (Bijela tabija) is a stone fortress overlooking the village of Vratnik in the municipality of Stari Grad (Old City). The word *tabia* comes from the Arabic language, which means a protruding stone fortress, from where cannons fire. Its origin is linked to the late fourteenth and early fifteenth centuries. To this day, different opinions have been expressed about the time of the creation of the White Bastion. According to one, the building was built around 1550 (the opinion is based on the data provided by travel writer Katarino Zeno) and was demolished during the construction of the Vratnica rampart and a new fortress was built in its place, which is recognized by its polygonal shape. Bejtić [33] states that this fortress is actually the town of Hodidjed, a medieval fortified town located on a hill above the composition of Paljanska and Mokranjska Miljacka, east of today's Sarajevo. According to Kreševljaković [34], it is a medieval fortress above the present-day city of Sarajevo, below which was the settlement of Vrhbosna even before the arrival of the Ottomans in 1435.

With the arrival of the Ottomans, the stone fortress became part of a complex of stone walls, chapels, and bastions located nearby. In order to secure the city from the enemy, Gazi Ahmed-pasha Rustempašić, who was appointed governor in 1727, surrounded the city with a wall 1 h long, 2 yards thick, and 10 yards high with four bastions inside it, known as the Old Town of Vratnik. Vratnik was one of the main roads in the Middle Ages and the Ottoman period leading to the east through the Vratnica or today known as Višegrad's Gate. On its territory, Vratnik had about 12 mahalas, which were formed in the 16th century, and each of them had its own mosque. Archaeological excavations carried out in 1991 revealed the foundations of the fortress (El-Fatih) mosque within the White Bastion (see Fig. 1, [35]). The mosques in the Vratnik area are among the oldest in Sarajevo [33].

Fig. 1. White Bastion/Bijela tabija. Source: Komisija za očuvanje nacionalnih spomenika Bosne i Hercegovine, Commission to preserve national monuments, 2022).

In its long history the fortress and the surrounding walls and bastions have been renewed and repaired several times, but never to that extent to serve the wider community in any sense. Although it was subject to protection based on a legal provision in 1971, arranged

by the City Institute for the Protection of Cultural Monuments Sarajevo, it failed to help to save this monument from long-lasting negligence and eventual devaluing. During the 1992–1995 period and massive destruction of the city, this monument suffered severe damage, which worsened the situation. In 1996, the city authorities drafted an extensive analysis of damages and results to evoke for immediate prevention of further destruction of this and many other monuments. According to the available documentation, certain research, and conservation-restoration works were carried out on this and accompanying facilities in 1996, 1997, 1998, 2001, 2002, and 2004. Ever since not much work has been done.

The recent claim inception report has indicated that the facility is overgrown with vegetation, there are numerous graffiti on the walls of the monument, and until 2019 there was no access control to the facility. The actual entrance to the building could be reached by car even. There was a huge concentration of waste around the facility as well as in the facility itself and the overall condition has visibly deteriorated. During the year 2019, the authority over the White Bastion, i.e. the management of the facility, was assigned to the Sarajevo City Administration, after which access to the facility was regulated through the collection of tickets for visitors. However, this did not last for a long time and the current situation can be described as one before 2019. Although this is a facility of exceptional historical importance for the City of Sarajevo, and also one of the most valuable monuments from the medieval period, all levels of the authorities failed to manage to place this monument up until now (see Fig. 2), and other similar ones, including also the overall cultural capital of the city, in the focus of the city development discussion.

Fig. 2. White Bastion in 2021. (Source: Author (2021)).

4.2 Isa-BEG'S Zawijah

In the immediate vicinity of Baščaršija, in the area of Bentbaša, and on the banks of the Miljacka River, Isa-beg Ishaković built a musafirhana[2] and a tekke[3] in the middle of the 15th century (see Fig. 3, [35]). It is considered to be the first musafirhana and tekke built in Sarajevo. According to the allegations, which are based on the available and preserved documents, this facility was originally used for temporary accommodation of occasional travelers, the poor, scholars, and warriors, where food was served for free for three days. In addition to Isa-beg's musafirhana, a Mevlevi tekke was built by Hajji Mahmut before 1650 [36]. Evliya Çelebi wrote about this tekke, stating that it is in a place like a paradise and that the endowment is the tekke of Jalaluddin Rumi. The importance of the construction of these buildings, as well as other architectural units, which Isa-beg had built, is immeasurable. With their construction, the urban development of the city of Sarajevo began.

Fig. 3. Isa-bey's zawijah. (Source: Komisija za očuvanje nacionalnih spomenika Bosne i Hercegovine, Commission to preserve national monuments, 2022).

The Mevlevi tekke and musafirhana were burned down several times and were flooded when the Miljacka River crossed its borders, but each time it was rebuilt, repaired, and restored to function. In the courtyard of the tekke, there was a smaller necropolis with six tombs of dervishes of the Mevlevi order. In the immediate vicinity of the tekke, in the direction of the east, there was also the Mevlevi cemetery, where there were several dervish tombstones. In addition to the musafirhana, tekke, courtyard, necropolis, and the nearby Mevlevi cemetery, various important buildings and sites are mentioned in

[2] Musafirhana is a word of Persian origin and denotes a guest house for occasional travelers.
[3] Tekke is a monastery of dervishes, especially in Ottoman Turkey.

various documents, which were in the capacity of the tekke and an integral part of dervish rites. So the complex of Sheh's bark with zawijah and two dervish graves, the spring of Abu Hayat, Sheh's Cair, Sheh's rock, and several caves, which served the dervishes to conduct erbein[4], are mentioned. The natural environment in which all these buildings and sites were located gave a particularly attractive image and atmosphere [37]. The tekke and its entire complex lasted until 1878, when the Austro-Hungarian government temporarily banned the work of the musafirhana, and thus the tekke. After a short break, it was in function again and remained until 1924 with the help of donations from the endowment of Fadil-pasha Šerifović. By 1902, other important buildings were built there, such as the first Muslim reading room and elementary school, and the folk spa Bentbaša. The authorities made various decisions in 1941, and moves have been made that directly affected the function and survival of these facilities. With the development of the regulatory plan, and its implementation, despite the opposition of experts and citizens, Isa-beg's zawijah was demolished in 1957, and the land was completely leveled [37]. Not a single item that was part of the tekke inventory has been preserved, not even a stick, which according to a legend was given by the last Bosnian grandfather to the first sheikh Isa-beg's bandage, and which was then passed from generation to generation until 1924 when it was lost. There is no evidence that the bodies of the dervishes buried in the Tekke cemetery were exhumed. Buildings were soon built in the same place, which absolutely does not fit into the ambiance of the whole space. In 1990, there were no visible traces of their existence at the site of Isa-beg's zawijah. In 1999, archeological excavations were started for the first time. It was necessary to use old geodetic surveys, photographic material, and written testimonies of people who remember what facilities actually looked like. The works continued in 2000 when the conservation and temporary protection of this area were carried out. After the last archeological research and securing the sites for further excavations in this area, no additional activities were recorded. This indicates an unchanged situation in this locality, which is in visibly poor condition due to water penetration. The site is additionally secured to protect it from garbage disposal and reduce the danger for people. Although Isa-beg's zawijah is marked in the history of Sarajevo city as the first object that marked the beginning of urban development of the city, nowadays there is no valuable evidence to confirm that. Even the board with information about the existence of this facility was largely destroyed (see Fig. 4).

Both monuments presented here, as mentioned previously played important role in the urban development of Sarajevo. In order to present the role and function of these monuments through their historical existence, their urban functions are presented in Table 1. Having in mind the information listed in Table 1 as well as other details related to these monuments, it is clear that they represent the significant cultural capital of Sarajevo.

[4] Erbein involves isolating a dervish for 40 days.

Fig. 4. Isa-beg's zawijah (excavation site in 2021). (Source: Author (2021)).

Table 1. Urban functions of selected monuments throughout historical periods of BiH

Monument	Year/Century of origin	Urban functions				
		1462–1878 Ottoman Empire	1878–1914 Austro-Hungarian Empire	1918–1941 Kingdom of Yugoslavia	1945–1991 Socialist Republic of Bosnia and Herzegovina	1996- Bosnia and Herzegovina
White bastion	Late XIV and early XV century	Military (defense) purpose	Military (defense) purpose	Unknown	Unknown	Cultural property
Isa-beg's zawijah	1462	Sacral/religious building and accommodation/catering facility	Sacral/religious building and accommodation/catering facility	Sacral/religious building and accommodation/catering facility until 1924	In 1957, the building was demolished and lost all its purpose	The object does not exist

Source: Commission to Preserve National Monuments.

5 Results

Until the emergence of the Covid-19 pandemic, tourism was one of the fastest-growing industries in the world. According to UNWTO data, an increase of 4% was achieved in 2019, which represents 1.5 billion tourists in international tourism and cultural tourism was still the leading form of tourism in the world. According to recent data, among the leading industries in the world, tourism experienced the greatest loss which is estimated to be near 80%. Tourism in Sarajevo experienced a huge loss with the break out of the pandemic as well. In 2019 Sarajevo reached the highest number of visitors since the end of the war in 1992–1995 in Bosnia and Herzegovina (see Table 2).

The increase in the number of tourists influenced the increase in accommodation capacities, incoming tourist agencies, transportation services, souvenir shops, bakeries, restaurants, and a number of other related businesses. However, the infrastructure, the legal framework of the tourism sector, and the strategic plan for tourism development remained untouched. This situation was well accepted and used by those who

Table 2. Tourists' arrivals in Sarajevo 1999–2020

Year	Total number of tourists in CS (000)	Foreign tourists in CS (000)	Domestic tourists u CS (000)
1999	60	45	15
2000	75	53	22
2001	73	50	23
2002	80	55	25
2003	94	65	29
2004	105	72	33
2005	116	81	34
2006	130	95	35
2007	167	122	44
2008	166	121	44
2009	170	127	43
2010	205	160	44
2011	225	178	47
2012	268	211	57
2013	318	265	52
2014	301	253	48
2015	364	308	56
2016	407	350	57
2017	483	423	60
2018	570	495	75
2019	668	578	90
2020*	136	85	51

Source: Institute of Informatics and Statistics of the Sarajevo Canton and the Federation Institute of Statistics.
* The emergence of the Covid pandemic.

had capacities to adjust quickly and use different opportunities created by the lack of regulations.

Increased demand for visiting cultural heritage as the main motive to visit Sarajevo encouraged many people to enter the area by creating different city tours without any previous education, consultations with experts, approval from the local authorities, and without limitations above all. As a result of such an approach, the tourist offer of the city is greatly minimized, devalued, and reduced to mere sightseeing that lasts for 2–3 h, without any benefits for the wider community. Cultural heritage, and numerous historical monuments located in the urban core, the center of tourists' activities, are

used only for individual business promotion. This approach to tourism has no effect on the preservation and the continuation of existence for the most of cultural heritage in the city. In addition, it opposes the concept of sustainable development. This is largely due to the lack of a legal framework in the tourism sector as well as the unclear issue of jurisdiction over the cultural heritage throughout the country. The lack of cooperation between the sectors, especially between the tourism and sector of culture, contributes to the worsening situation in which the cultural heritage of Sarajevo is placed.

For the purpose of this study, the eight most popular tourist city tours have been analyzed and information gathered. By joining the tours, it has been found that among the eight tours of different travel agencies, only one includes a visit to White Bastion (see Table 3). The other monument is not included at all.

Table 3. Representation of selected monuments in city tours

Tour Monument	City tour	Times of Misfortune	Sarajevo Walking Tour	War tour	Free of charge tour	Sarajevo grand walking tour	1914 Archduke assassination tour	Eat, pray, love tour
White Bastion	x	y	x	x	x	x	x	x
Isa-beg's zawijah	x	x	x	x	x	x	x	x
Remark	Y-Included; X not included							

Source: Author.

The situation is similar to most of the other monuments in the city, but for this study, these two monuments have been chosen because they played an important role in establishing Sarajevo city, around which the city developed and expanded. They enabled the settlement system to grow into an urban region, which resulted in increased attractiveness, which was accompanied by a constant increase in population, capital, job creation, and improvement of communal and transport infrastructure [32].

To better understand the observed situation, the legal framework of the tourism and cultural heritage sector has been reviewed. The review showed that the applicable legislation is inadequate, and fails to regulate all the required segments. For example, there is no legislation regulating the tourism sector at the state or entity level, while the existing legislation is focused on travel agency operations and the hospitality sector. In addition, there is no strategy for tourism development or so-called Master Plan, where all the priorities and strategies for tourism development would be identified. Also, the review showed that cooperation among the institutions and different stakeholders has not been regulated and is not obligatory, although it is one of the crucial elements for achieving wider tourism benefits. A review of the legislation of these two sectors included the following documents:

- Law on the Protection and Use of the Cultural and Historical Heritage of SRBiH

- Law on the Implementation of the Decisions of the Commission to Protect National Monuments
- Draft law on tourism
- Law on the Protection of the Cultural Heritage of the Canton Sarajevo
- Law on Tourism of the Canton Sarajevo

Cultural and historical heritage legislation is more or less in the same situation. The review showed that there is a great extent of overlapping of competencies, which creates problems in the execution of legal obligations. Also, the applicable legislation is outdated and inconsistent with the current state system. All this creates an environment where the negligence of cultural heritage is an expected result. All this indicates the need to undertake reforms that will improve the work of this sector and positively affect the preservation, protection, valorization, and use of the cultural and historical heritage. An important element in all this is cooperation with other sectors, which needs to be legally established.

6 Conclusion

This study aimed to highlight the importance of cultural heritage in the context of the cultural capital and to emphasize the issue of neglecting the cultural heritage of the urban core of Sarajevo city. As such, cultural heritage is an important factor in the development of cities or areas where it is located. As the values of the cultural heritage can hardly be expressed in monetary terms, tourism represents the perfect means of putting this capital on the market and, in such a way, securing the preservation and protection of the cultural heritage. Different world-leading institutions like the Council of the European Union also emphasize the importance of developing a qualitative synergy of tourism and cultural and historical heritage. For example, at the meeting of the Council on education, youth, culture, and sports held on 20 May 2014 in Brussels, it was concluded that the cultural and historical heritage is a very valuable cultural, environmental, social, and economic resource for society and is considered a strategic choice of 21st century. It was also emphasized that the cultural and historical heritage has an important economic impact, as part of the culture, creative sectors, and especially through cultural tourism, which, among other things, contributes to urban development. Based on that, the Council calls for the promotion of the importance of the cultural and historical heritage, increasing its role in sustainable development with a focus on urban and rural planning. Achieving sustainable tourism is a continuous process and it requires continuing monitoring of impacts, and introducing the necessary preventive and/or corrective measures whenever necessary.

In the context of the previously mentioned, it can be said that tourism, especially cultural tourism is the most appropriate, if not the only tool for cultural and historical heritage protection, while the cultural and historical heritage is a powerful motive that drives people to travel and is considered to be the basis of all travels. Sustainable tourism development requires the strong participation of all relevant stakeholders, as well as strong political leadership to ensure wide participation and consensus building, which is completely missing in Sarajevo and the whole country.

Based on the review of the legal framework as well as the analysis of the two cultural monuments and their representation in the tourist offer, the results showed that there are serious shortcomings in the legislation governing the tourism sector and the cultural heritage sector and there is also a lack of cooperation among the sectors. Such a situation results in poor and insufficiently aware management of both sectors. In the context of the research question, the representation of the monuments in the tourist offer, shortcomings were also recorded in the way that these two monuments are not the subject of the tourist offer, although they represent a turning point in the urban development of Sarajevo. Accordingly, the answer to the research question would be that cultural heritage is not sufficiently represented in the tourist offer. Having in mind that only two monuments were the subject of the analysis of this study, but also eight tourist tours, such a general conclusion cannot be made. However, the situation on the ground, the analysis of all collected data and information, and especially the review of legislation indicate significant shortcomings in the regulation of the tourism and cultural heritage sector.

In order to solve the identified problems, it is necessary to perform a detailed analysis and reform of the legislation; legally regulate the cooperation of the sectors and stakeholders; enact a law on tourism at all levels of government; develop a strategy for tourism development and protection of cultural heritage; provide education and holistic approach in managing these sectors. Finally, it is necessary to regulate the tourist offer of the city in a way that ensures an adequate representation of monuments that will contribute to their active protection and bring benefits to the wider community. Although this requires commitment at the highest levels of government, unlimited financial resources, quality education, will, and commitment, the resulting achievements represent a significant contribution to sustainable development and a future for new generations. The proposed recommendations may serve as starting actions to undertake to bring sustainable development at the center of discussion and further city and tourism development. Conclusively, there is a need to accept the culture as a driver of sustainable development which is in accordance with the UN Sustainable Development Goals [38].

References

1. Bourdieu, P.: The forms of capital. Richardson, J. (eds.) Handbook of Theory and Research for the Sociology of Education. Westport, Greenwood, pp. 241–58 (1986)
2. Throsby, D. Cultural capital. J. Cult. Econ. **23**(1–2), 3–12 (1999)
3. Kurto, N.: Sarajevo: MCDLXII-MCMXCII. Sarajevo, Oko (1997)
4. Berkes, F., Folke, C.: A systems perspective on the interrelations between natural, human-made and cultural capital. Beijer International Institute of Ecological Economics, the Royal Swedish Academy of Sciences (1992)
5. Nurse, K.: Culture as the fourth pillar of sustainable development. Small States Econ. Rev. Basic Stat. **11**, 28–40 (2006)
6. Shmelev, S.E.: Sustainable Cities: Interdisciplinary Perspective. In: Ecological Economics. pp. 175–193. Springer, Dordrecht (2012). https://doi.org/10.1007/978-94-007-1972-9_10
7. Tweed, C., Sutherland, M.: Built cultural heritage and sustainable urban development. Landsc. Urban Plan. **83**(1), 62–69 (2007)
8. Cerisola, S., Camagni, R., Capello, R., Panzera, E.: The cultural heritage – territorial capital nexus: theory and empirics (2020)

9. Kuo, H.P., Wu, K.L.: The Potential of cultural heritage tourism to promote sustainable urban development: the case of Tainan City. Appl. Mech. Mater. **316**, 446–450 (2013)
10. Al-Hagla, K.: Sustainable urban development in historical areas using the tourist trail approach: a case study of the cultural heritage and urban Development (CHUD) project in Saida, Lebanon. Cities **27**, 234–248 (2010)
11. Cheng, S.W.: Cultural goods creation, cultural capital formation, provision of cultural services and cultural atmosphere accumulation. J. Cult. Econ. **30**(4), 263–286 (2006)
12. Peacock, A.: The political economy of heritage. Proc. Br. Acad. **87**, 189–243 (1995)
13. Towse, R., Khakee, A. (eds.). Cultural Economics. Springer, Berlin (1992). https://doi.org/10.1007/978-3-642-77328-0
14. United Nations. Draft Outcome Document of the United Nations Conference on Housing and Sustainable Urban Development (Habitat III), New York, USA (2016)
15. Vasi, I. B.: New heroes, old theories? Toward a sociological perspective on social entrepreneurship. In: Ziegler, R. (ed.), An introduction to social entrepreneurship, Edward Elgar Pub. pp. 155–173 (2009)
16. Maroević, I.: Sadašnjost baštine. Društvo povjesničara umjetnosti SR Hrvatske, Zagreb (1986)
17. Timothy, J.D., Nyaupane, P.G.: Cultural Heritage and Tourism in the Developing World. Routledge (2009)
18. CHCfe, Cultural Heritage Counts for Europe. http://blogs.encatc.org/culturalheritagecountsforeurope/wp-content/uploads/2015/06/CHCfE_FULL-REPORT_v2.pdf. 01 Apr 2022
19. Srakar, A., Vecco, M.: Culture as a Fourth Dimension of Sustainable Development? A Statistical Analysis (2016)
20. Nijkamp, P., Riganti, P.: Assessing cultural heritage benefits for urban sustainable development. Int. J. Serv. Technol. Manag. **10**(1), 29–38 (2008)
21. Terkenli, T.S., Georgoula, V.: Tourism and cultural sustainability: views and prospects from cyclades. Greece. Sustain **14**(1), 307 (2021)
22. Creswell, J.W., Plano Clark, V.L.: Designing and Conducting Mixed Methods Research. Sage Publications, Thousand Oaks (2007)
23. Creswell, J.W., Creswell, J.D.: Mixed methods research: developments, debates, and dilemmas. Res. Organ. Found. Methods Inq. **2**, 315–326 (2005)
24. Ciesielska, M., Boström, K.W., Öhlander, M.: Observation Methods. In: Ciesielska, M., Jemielniak, D. (eds.) Qualitative Methodologies in Organization Studies, pp. 33–52. Springer, Cham (2018). https://doi.org/10.1007/978-3-319-65442-3_2
25. Holm, G.: Photography as a research method. In: The Oxford handbook of qualitative research, pp. 380–402 (2014)
26. Timothy, D. J., Boyd, S.W.: Heritage Tourism. Pearson Education. London (2003)
27. Hardy, D.: Historical geography and heritage studies. Area **20**, 333–338 (1988)
28. Lowenthal, D.: History and memory. Public Hist. **19**(2), 30–39 (1997)
29. Hubbard, P.: The value of conservation: a critical review of behavioural research. Town Plann. Rev. **64**(4), 359–373 (1993)
30. Rowntree, L.: Creating a sense of place: the evolution of historic preservation of Salzburg, Austria. J. Urban Hist. **8**(1), 61–76 (1981). https://doi.org/10.1177/009614428100800103
31. Filipović, N.: Pogled na osmanski feudalizam. Godišnjak Društva istoričara Bosne i Hercegovine, IX/1952. 146 (1952)
32. Donia, R.J.: Sarajevo: biografija grada. Institut za historiju. Sarajevo (2006)
33. Bejtić, A.: Srednjovjekovni grad Hodidjed bio je na Vratniku u Sarajevu. Radovi ANUBIH, knjiga LXIV, Odjeljenje društvenih nauka- knj. 20, Sarajevo. pp. 107–148 (1979)
34. Kreševljaković, H.: Stari bosanski gradovi. Naše starine **I**, 7–45 (1953)
35. Komisija za očuvanje nacionalnih spomenika Bosne i Hercegovine, Commission to preserve national monuments (2022). Gallery of national monuments. http://aplikacija.kons.gov.ba/kons/public/nacionalnispomenici/galerija/2539. Accessed July 2022

36. Sikirić, Š: Sarajevske tekije. Narodne starine **14**(1), 77–79 (1927)
37. Vakufi sa općina Stari Grad i Centar Sarajevo; nekad i sad. Islamska zajednica u Bosni i Hercegovini, Vakufska direkcija Sarajevo, Sarajevo (2014)
38. Culture Indicator 2030. Thematic Indicators for Culture in the 2030 Agenda, The United Nations Educational, Scientific and Cultural Organization (2019)

Subjective Well-Being: Emigration Intention and Its Antecedents

Lejla Turulja, Amra Kapo(✉), and Melika Husić-Mehmedović

School of Economics and Business, University of Sarajevo, Sarajevo, Bosnia and Herzegovina
{lejla.turulja,amra.kapo,melika.husic-mehmedovic}@efsa.unsa.ba

Abstract. The aim of this paper is to analyze the general satisfaction of BiH citizens with the quality of life and general well-being, and to put the results in the context of emigration intention and the desire to leave the country.

Due to the permanent crisis in the social and political development of the Bosnian society and state, the young population is in a very unfavorable social, economic, and psychophysical condition. Therefore, young people are more motivated than other social groups to emigrate to European countries that are members of the European Union. Given that the introduction of Sustainable Development Goals (SDG) has given greater importance to the topic of migration, and this topic is explored in several goals and sub-goals related to reducing inequality, decent work and sustainable cities and resilience to climate change, this paper will contribute to migration through the perspective of young people in Bosnia and Herzegovina.

Keywords: Subjective well-being · Life satisfaction · Affect · Eduaimonic well-being · SDG · Migration · SDG 10

1 Introduction

Migration has been well known to people throughout history, but in the age of globalization, it has become easier, more accessible, and more visible. As the world became increasingly interconnected, migration and other forms of mobilities evolved into one of the defining characteristics of our world [1]. Migrations themselves have been the subject of numerous studies from various aspects, from the reasons for migration to the impact of migration on the development of society as a whole. Although migrations have always existed throughout history and have been the subject of scholarly discourse and part of policymakers' plans, they have been left out of the Millennium Development Goals.

With the advent of the Sustainable Development Goals (SDG), migration is given more importance and is included in several goals and targets. Particular attention has been given through the goal of "enabling orderly, safe, regular and responsible migration and mobility of people" under Goal 10 to reduce inequality. In addition, the situation of migrant workers was addressed in terms of decent work and economic development. Human trafficking is referred to as "modern slavery" that should be abolished, and

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 96–108, 2023.
https://doi.org/10.1007/978-3-031-17767-5_8

the situation of trafficked women and children is particularly recognized [2]. Finally, migration is also important to the goals of sustainable cities and resilience to climate change.

In Bosnia and Herzegovina (BiH), SDG goals have been talked about recently, but mostly through international organizations carrying out their activities and very little through the activities of the government, universities, NGO's and individuals. Problems related to migration but also other goals and targets have been recorded in BiH to a greater or lesser extent.

In drawing conclusions on migration and SDGs in Bosnia and Herzegovina, there are several important points to consider. First, the permanent crisis of political relations between the ruling parliamentary parties in Bosnia and Herzegovina in the post-Dayton period creates an unfavorable climate for foreign investment and for tackling youth unemployment. All this leads to discontent among citizens, especially youth. Citizens no longer give only economic reasons for going abroad to work. They also cite the reasons of general insecurity in Bosnian society and the lack of perspective for the development of the state of BiH [3]. In addition, BiH society experienced unprecedented war destruction in the period from 1992 to 1995. The consequences of the war are numerous. A large number of civilians were displaced and resettled. It is estimated that after the end of the war, about 800,000 inhabitants of BiH were permanently displaced and took citizenship of European and overseas countries [3]. Finally, due to unfavorable privatization of enterprises and low investment of state authorities in private entrepreneurship, i.e., small and medium enterprises, unemployment, especially among young people aged 30, has become the biggest problem of socio-economic and political development of the society and the state of Bosnia and Herzegovina. Since 2015, tens of thousands of young people have found the solution to their existence by leaving Bosnia and Herzegovina to work in developed European countries.

Bosnia and Herzegovina (BiH) has been experiencing continuous negative demographic trends for almost three decades. Mortality and emigration are more dominant than birth rates and immigration, resulting in total depopulation (Čičić et al., 2019). It is obvious that there are two basic demographic problems in Bosnia and Herzegovina that have characterized the end of the 20th century and the beginning of the 21st century: (i) emigration and especially the outflow of young, educated people; (ii) negative vital statistics and depopulation. In the short term, these trends create a negative climate and further contribute to the depression of society; in the long term, they represent the most serious problems society can face [3]. The issue of emigration is a topic that arouses the interest of the public in Bosnia and Herzegovina, but it does not follow the interest to identify, analyze and adequately problematize the factors that determine the emigration of the citizens of Bosnia and Herzegovina. It is particularly interesting that the study of the standard of living and consequently satisfaction with life in Bosnia and Herzegovina. of the population is insufficiently addressed in the public discourse. This interdisciplinary topic is researched in various branches of science, but unfortunately, the relevant data can be read or discussed in public very rarely.

In this context, the main objective of the paper is to analyze the general satisfaction of the citizens of Bosnia and Herzegovina with the quality of life and general well-being, and to put the results in the context of emigration desires and the desire to leave

the country. Gender, education level, and employment status of respondents were also examined as determinants of emigration intention. Considering the fact that the negative demographic image of BiH has long been a problem that requires an appropriate policy response, the results of this study indicate the dimensions of life satisfaction that affect migration intentions, and through which emigration can be demotivated.

2 Literature Review

Recent literature identifies migration drivers, from education and professional opportunities [4], expected income [5], better working conditions [6], social and health services [7], up to overall life quality (e.g., [5, 8]). However, it is important to highlight that research mostly observes the emigration intentions and not the real decision to migrate [5]. For instance, psychological theory on planned behavior suggests that intention reflects final decision and further behavior [9], while a significant number of studies confirmed the correlation between emigration intentions and final decision. Authors [10] conducted large scale research in which they observed emigration intention but later followed the respondents for the next five years to capture their final decision on migration. The results confirmed that behavioral intention is a good predictor of migrations, as 34% of those with high intentions actually migrated in the five-year period. The European migration path is divided into two main dimensions: east-west especially after the "iron curtain" [11] or due to the turbulence of the Balkan region [7, 12], and south-north after the financial crisis in 2008 in Grece, Spain, Portugal and somewhat Italy [13].

Although income and financial situation are strong divers of migrations, often more significant are non-financial, life quality factors [5]. Therefore, it is evident that an unstable political situation increases migrations, so authors state that institutional efficiency is perceived as civic freedom, property protection, corruption, and institutional democracy encourage migrations, disregarding the monetary benefits in the home country. Non-monetary motives for migration are sometimes even unconscious, so the overall satisfaction with life quality is defined as the main driver. In the study of 27 European countries, [5] proved that monetary motives indirectly influence migrations through life satisfaction. Life (un)satisfaction can be influenced by eight factors of total life quality, defined in the model by [14] and described in the following text.

For many years, gross domestic product (GDP) has been the main predictor of overall life satisfaction and well-being. However, traditionally official statistics describe economic trends and are not a sufficient indicator of the general well-being of society because they do not monitor social and environmental progress [14]. However, not only Eurostat but more international organizations have recognized the fact that human development transcends economic growth and that well-being is a multidimensional phenomenon [15]. This discussion has been evolving recently to the extreme where certain politicians in the UK are appealing that quality of life satisfaction measures should replace economic indicators when observing migrations. This attitude was contributed to by the situation caused by the COVID-19 pandemic, i.e., the results of a survey that showed that a significant majority of the public institutions aim to focus on improving health and well-being in relation to economic growth [16].

Research shows that greater absolute wealth does not bring extra happiness [17]. For example, Chinese people are as satisfied with their lives nowadays as they were before

the enormous economic progress experienced in the last few decades. [8], researching the return migrations, found out that income is an insufficient measure of utility when it comes to predicting decisions to return; nevertheless, migrants from high GDP countries intend to return more frequently than migrants do from low GDP countries. Evidence suggests that migration does not bring extra happiness, even after post-migration economic gains [18].

Previous research on the relationship between GDP as an objective indicator of a country's economic progress and overall life satisfaction evaluated through subjective well-being within EU citizens [14] shows that EU citizens are essentially satisfied with their life. Residents of the Nordic countries and Western and Southern Europe are more satisfied than those living in Central Europe, the Balkans and the Baltic countries. This research also shows that life satisfaction does not fully follow GDP growth, thus supporting the thesis that social progress cannot be monitored only through the GDP, but it is necessary to extend the assessment to subjective indicators of satisfaction. Research shows that the income-wellbeing relationship is weak in wealthy countries [18].

However, the focus of the migration literature has typically not been on life satisfaction, especially because the exact predictions regarding life satisfaction are difficult to make [19]. Life satisfaction refers to the cognitive evaluation of one's life, 'global' well-being, happiness and satisfaction with life as a whole [20]. Satisfaction with the quality of life encompasses a number of factors that create life perceptions, including both material and non-material aspects of life. In other words, life quality is a multidimensional concept composed of a set of indicators that represent different complementary aspects of this construct. These indicators are an upgrade of traditional indicators of economic development, such as GDP, and are more focused on social development. [14] defines the quality of life as a concept organized in 9 dimensions, 8 of which represent the ability of people to achieve their self-defined well-being, in accordance with their own values and priorities. The ninth dimension refers to the overall experience and perception of life satisfaction [14].

In this research, authors used life satisfaction dimensions, as defined and measured by Eurostat and described in the following text.

1. Material living conditions – extend beyond the material cost of living, as material resources can often be transformed into well-being in line with each individual's preferences and capabilities. Material living standards should not be viewed exclusively in quantitative monetary terms but as consumption patterns, housing conditions, etc.
2. Productive or main activity – refers to both quantity and quality of employment, but other activities as well i.e., paid work and different unpaid activities (e.g., family work, care activities, volunteering).
3. Health – not only undermines an individual's (and their family's) quality of life, it can shorten their life span. Thus, long and healthy lives are at focus and the perception of own well-being.
4. Education – refers to any act or experience that has a formative effect on an individual's mind, character, or physical ability. Education is the process by which society deliberately transmits its cultural heritage and its accumulated knowledge, values and skills to each generation.

5. Leisure and social interactions - the time that people spend outside their productive activities, and social interactions or interpersonal activities and relationships, have a major impact on their sense of well-being, happiness and life satisfaction.
6. Economic security and physical safety – a variety of risks that may threaten the material conditions, but also the safety of individuals and households, violence and/or crime, which may endanger an individual's physical safety.
7. Governance and basic rights – civil society, respect for human rights and the rule of law, as well as the accountable government are some of the hallmarks of modern democracies which impact the quality of life.
8. Natural and living environment – the environment is usually discussed within the context of sustainability; it is equally important for an individual's quality of life. Environmental conditions affect human health and well-being not only directly but also indirectly through ecosystems, biodiversity, or natural disasters.

Finally, total life satisfaction is thus holistically based on the above-mentioned dimensions and cognitive assessment of each, but also no assessment of the quality of life can be complete without taking into account the overall subjective well-being of persons and finally eudaimonic, or feeling that the life has a meaning [14]. Subjective assessment of well-being proved to be the main element in determining the overall life quality [21].

3 Empirical Research

The population of this research is the adult inhabitants of BiH. The main objective of the research is to model the migration intention of the BiH population, taking into account satisfaction with various dimensions of quality of life.

The study is carried out across Bosnia and Herzegovina utilizing a survey data gathering approach. The research focuses on people's quality of life and well-being as reflected via subjective assessment and perception of the respondents.

Subjective well-being, according to OECD guidelines, includes three distinct but complementary sub-dimensions: life satisfaction, based on overall cognitive assessment; affect or the presence of positive feelings and the absence of negative feelings; and eudaimonic, the feeling that one's life has meaning [21].

A representative sample consists of 1,500 respondents aged 18 to 65 years (standard sampling error is ±2.5%). CAWI (Computer Assisted Web Interviewing) on a sample of the general population of users of the online panel JaZnam.ba was used as a method of data collection. Data collection was conducted during the Covid-19 pandemic (Table 1).

For data analysis, logistic regression was utilized. Logistic regression is a statistical model that, in its most basic form, models a binary dependent variable using a logistic function. The following variables are included in the model:

Independent variables:

– **Life satisfaction:** The following questions are about how satisfied you are with certain aspects of your life, on a scale of 0 to 10. Zero means you feel not at all satisfied, and 10 means completely satisfied.

Table 1. Demographic structure of the sample

		BiH	
		%	*n*
Sex	M	48%	*724*
	F	52%	*783*
Age	to 29	28%	*428*
	30–39	22%	*333*
	40–49	23%	*348*
	50+	26%	*398*
Education	Primary and below	2%	*27*
	High school	76%	*1.147*
	University and above	22%	*327*
	No answer	0%	*6*
Personal income	to 500 km	26%	*397*
	501–1.100 km	36%	*546*
	1.101 km +	26%	*391*
	No answer	11%	*172*
Marital status	Single	31%	*468*
	Married	59%	*883*
	Divorced/Widowed	8%	*128*
	No answer	2%	*28*
Work status	Unemployed	20%	*295*
	Employed	51%	*761*
	Student	11%	*172*
	Retired	10%	*153*
	Other	6%	*97*
	I don't want to answer	2%	*29*
Employment sector	Private sector	65%	*498*
	Public sector	35%	*263*
Type of contract	indefinitely	74%	*566*
	Fixed-term	17%	*128*
	Short-time contract	2%	*19*
	I have no contract	6%	*49*

(*continued*)

Table 1. (*continued*)

		BiH	
		%	*n*
Type of occupation	State administration	13%	*98*
	Healthcare	9%	*70*
	Education	8%	*59*
	IT	8%	*62*
	Building	8%	*65*
	Tourism and catering	7%	*56*
	Craft services	11%	*84*
	Other	35%	*269*

  - Standard: How satisfied are you with your standard of living?
  - Health: How satisfied are you with your health?
  - Achievement: How satisfied are you with what you achieve in life?
  - Relationships: How satisfied are you with your relationships with your closest people?
  - Security: How satisfied are you with the security you feel?
  - Community: How satisfied are you with the feeling you have as part of your community?
  - Future: How satisfied are you with future security?
  - Time: How satisfied are you with the free time you have for the activities you enjoy doing?
  - Environment: How satisfied are you with the quality of your local environment?

- **Affect - the emotional side of well-being**: The following questions relate to how you have felt over the past 3 months (0 - I did not experience the stated experience to 10 - I had the stated feeling).

  - Happiness
  - Concern
  - Depression

- **Eudaimonic well-being**: Below are five statements you may or may not agree with. Use a scale from 1 to 7 to indicate the level of agreement with each item.

  - Ideal: In most respects, my life is close to my ideal
  - Conditions: The conditions of my life are excellent
  - Satisfaction: I am satisfied with my life
  - Achievement: So far, I have gained important things in life
  - Desires: If I lived again, I would change almost nothing

– **Dependent variable**: Are you planning to move to another country from BiH?

  – Emigration intention: 0 – Yes; 1 – No

– **Demographics**:

  – Gender: 1 – M; 2 – F
  – Education: 1 – primary; 2 – high school; 3 – university
  – Employment status: 1 – unemployed; 2 - employed full time; 3 - part-time employee; 4 – entrepreneur; 5 – student; 6 – retired; 7 – housewife; 8 – I do not want to answer.

4 Results and Discussion

Two steps were conducted to analyze the data. First, the most important conclusions concerning the model's variables from the standpoint of frequency statistics are examined. This analysis provided a general understanding of BiH's overall well-being, as well as citizens' life satisfaction and the emotional and eudaimonic experience of well-being. In the second step, a logit model representing BiH inhabitants' emigration ambitions was given.

4.1 Life Quality in BiH

According to World Bank data, Bosnia and Herzegovina's GDP was valued 19.79 billion US dollars in 2020 that equals 0.02 percent of the global economy. However, as previously stated, the examination of life satisfaction, the emotional side of well-being, and the eudaimonic measure of well-being are all part of the formulation of well-being in BiH. Satisfaction with life quality is a cognitive appraisal of one's own life as a whole, encompassing all aspects of existence, and is thus seen as an overall measure of subjective well-being [14]. Life satisfaction is scaled from 0 ("not at all satisfied") to 10 ("completely satisfied") [21]. When it comes to the subjective well-being of BiH people, 70% are content, while the remaining 30% are dissatisfied with life in BiH.

– **Life satisfaction.** In terms of current financial condition, 44% of BiH residents are satisfied, 20% are neutral, and 37% are unhappy. Work and wage determine a person's standard of life, allowing them to achieve their goals and intention. As a result, job satisfaction is a crucial predictor of overall life satisfaction and quality. Over a quarter (28%) of working BiH persons are dissatisfied. Most BiH residents are satisfied with their mental and physical health, and research shows that formal education enhances mental and physical health. More than two-thirds of respondents continued to study after completing their formal degree. The majority of people are happy with their work and leisure time allocations. Social life is an important part of an individual's quality of life. Contributes to life enjoyment through promoting psychological balance and general health. Economic uncertainty dominates the business climate, particularly in the private sector. As a result, many young people aspire to work in the public sector. Aside from economic uncertainty, citizens of BiH feel insecure because they believe crime is rampant in the country.

Most BiH residents believe that democracy is non-existent and that corruption is rampant (90 percent). Notably, half of those questioned are dissatisfied with the number of green places. Moreover, 64% of respondents are dissatisfied with air quality. The average life satisfaction in BiH is 6.7. For example, life satisfaction varies widely within the EU, from 5.4 in Bulgaria to 8.0 in Switzerland, Norway, Denmark, and Finland (2018 data). As a result, Bosnians are less happy than Europeans. In comparison to Bulgaria, Greece, Croatia, Latvia, Lithuania, Hungary, and Portugal (average life satisfaction is higher in Bosnia and Herzegovina).

- **Emotional side of well-being.** Emotional well-being refers to everyday sentiments and moods. This sort of test asks people to think about their sentiments (like happiness) [14]. The general public has not felt more depressed in the recent three months. While most respondents are happy and pleased with their existing lifestyles, a substantial percentage are unhappy.
- **Eudaimonic measure of well-being.** The Eudaimonic element of well-being relates to life values and ambitions. The respondent should analyze what makes his or her life worthwhile [14]. Almost three-quarters (73%) of the population is hopeful about the future and values their work. However, a large percentage of individuals (40%) lack a sense of success and achievement in their work.
- **Emigration intention**. When it comes to the intention to leave Bosnia and Herzegovina, every fourth citizen wishes to migrate to another state. One-third of the population is undecided about leaving, while slightly more than 40% have no plans to leave BiH. Of those who stated their intention to leave Bosnia and Herzegovina, 48 percent aim to start a new life in another country and will not return to Bosnia and Herzegovina. The findings of taking tangible measures to leave Bosnia and Herzegovina are consistent with previously acquired statistics on the intention to leave Bosnia and Herzegovina and reveal that one-fifth is BiH. The populace has already made steps to depart (in the previous half year).

4.2 Logit Model of Emigration Intention

Three major hypotheses addressing the effect of introduced variables on emigration intention are generated in the literature review section. They are validated by introducing each variable group into a subsequent logit model.

The multicollinearity test was acceptable because the maximum VIF was 2.89, which was less than the recommended threshold [22]. The Hosmer-Lemeshow test is used to determine the fit of logistic regression models statistically. P values greater than 0.05 for H-L good fit tests suggest that the model is well fitted. The results indicate that all three models fit well with a significance level greater than 0.05 ($\chi 2_{(8)} = 3.965$, $p = 0.860$; $\chi 2_{(8)} = 7.170$, $p = 0.518$; $\chi 2_{(8)} = 6.431$, $p = 0.599$; $\chi 2_{(8)} = 11.216$, $p = 0.190$).

The Nagelkerke R2 or pseudo-R2 statistics indicate the extent to which the independent variable's variation is explained by the model. In Model 1, life satisfaction accounts for only 11.7 percent of the variance. Following that, as the model incorporates additional variables based on hypotheses, the amount of variance explained grew to 13.4 in model 2, 15.5 in model 3, and 23.7 in model 4.

Table 2 summarizes logit regression results for all five models. First, model 1 includes variables related to life satisfaction. Satisfaction with the standard of living, a sense of

belonging to a community, satisfaction with free time and environment significantly affect emigration intention. Individuals who are content with their standard of living, in particular, are less likely to have emigration desires. Additionally, individuals with a stronger sense of community identity, as well as those who are content with their quantity of free time, are less likely to have emigration intention.

Finally, those who are more content with their environment are less likely to leave the country. Interestingly, those who are more satisfied with their health are more likely to consider leaving the country.

Model 2 includes feelings of happiness, concern, and depression. People who have been anxious in the past 3 months are less likely to have emigration intention, while people who have been depressed are more likely to have emigration intention.

Model 3 includes a eudaimonic measure of well-being of which only the feeling that a person has acquired important things in life contributes to a desire to stay in the country. In other words, a person who is more satisfied with their achievements is more likely to have less intention to leave.

Finally, the fourth model includes the demographic characteristics of the respondents, namely gender, level of education and employment status. Women are less likely to have emigration intentions. In terms of employment status, employed and retired people (compared to the unemployed) are less likely to have emigration intentions. On the other hand, students are more likely to have emigration intentions.

Table 2. Logit results

	Model 1		**Model 2**		**Model 3**		**Model 4**	
	B	Exp(β)	β	Exp(β)	β	Exp(β)	β	Exp(β)
Life satisfaction								
Standard	-0.089**	0.915	-0.078***	0.925	-0.081***	0.922	-0.083***	0.920
Health	0.117*	1.125	0.116*	1.124	0.116*	1.123	0.084*	1.088
Achievement	-0.032	0.968	-0.022	0.978	0.027	1.027	0.049	1.050
Relationships	-0.055	0.946	-0.038	0.962	-0.036	0.965	-0.016	0.985
Security	0.037	1.038	0.029	1.029	0.042	1.043	0.029	1.030
Community	-0.091**	0.913	-0.101*	0.904	-0.103*	0.902	-0.120*	0.887
Future	0.046	1.047	0.049	1.050	0.038	1.039	0.036	1.036
Time	-0.064**	0.938	-0.066**	0.936	-0.074*	0.928	-0.073**	0.929
Environment	-0.100*	0.905	-0.098*	0.907	-0.102*	0.903	-0.104*	0.901
Emotional side of well-being								
Happiness			0.008	1.008	0.014	1.014	0.002	1.002
Anxious			-0.090*	0.914	-0.085*	0.919	-0.076**	0.927
Depression			0.089*	1.093	0.085*	1.089	0.081*	1.085
Eudaimonic measure of well-being								
Ideal					0.075	1.077	0.117	1.124
Conditions					0.072	1.074	0.007	1.007
Satisfaction					-0.043	0.958	-0.034	0.967
Achievement					-0.256*	0.775	-0.187*	0.829
Desires					-0.008	0.992	-0.022	0.978
Demographics								
Gender0(1)							-0.409*	0.664
Educ							0.001	1.001
Job								
Job(1)							-0.478**	0.620
Job(2)							0.178	1.194
Job(3)							-0.544	0.581
Job(4)							0.834*	2.303
Job(5)							-1.679*	0.187
Job(6)							-0.661	0.516
Job(7)							-0.697	0.498
Job(8)							0.031	1.031
Constant	0.666**	.9471	0.589***	1.803	1.052*	2.864	1.540*	4.666
Nagelkerke R Square		0.117		0.134		0.155		0.237

5 Conclusion

We analyzed the people's quality of life and well-being as reflected via subjective assessment and perception of the respondents through four models. Model 1 included variables that are very commonly associated with migration in the literature. The results showed that satisfaction with standard of living, sense of belonging to a community, satisfaction with leisure time, and environment significantly influence emigration desires. A stance has already been established in the literature and a consensus has been reached when it comes to the impact of perceptions of quality of life on emigration desires. It is clear that people who are dissatisfied with their own life in their country are more likely to make the decision to emigrate. (Dis)satisfaction with life is primarily the result of the expectations an individual has and the perception of the situation. As society has evolved, the needs and expectations of individuals have also changed. Our research has shown that people who are satisfied with their quality of life have less need and desire to emigrate. People who are connected to the society in which they live think similarly and have less desire to emigrate, as do those who are satisfied with the leisure time available to them. Similar conclusions and correlations have also been found in previous studies [8, 19, 23, 24].

Our research revealed some intriguing findings about a person's psychological condition. Specifically, those who have experienced anxiety in the recent three months are more likely to have less emigration intentions. These findings corroborate notion of [25] that emigration needs courage and fortitude and those individuals who are drained and desperate are unlikely to do so. On the other hand, our findings indicate that people who have been depressed in the last three months are more likely to have increased emigration plans. This finding should probably be associated to the reasons of depression, which are most likely to be found in dissatisfaction with specific areas of life. In this regard, [26] revealed in their study that nurses who intended to emigrate had a greater prevalence of depression and reported higher levels of overall perceived stress than those who did not. These findings corroborate the previously stated explanation, namely that it is critical to demotivate emigration in order to ensure a decent quality of life, safety, and better working conditions, i.e. to improve conditions for creating a carefree life, as outlined by the European Union's Sustainable Development Goals.,

We also considered the importance of well-being measures and came to the conclusion that if a person has acquired important things in life, this contributes to the desire to stay in the country. In other words, a person who is content with his or her accomplishments is likely to harbor less emigration desires. This conclusion is also consistent with earlier research indicating that the unhappy moves [27].

Finally, we analyzed different demographic characteristics of respondents and their effect on emigration intentions, concluding that women are less likely to intend to emigrate, as are employees and retirees (in comparison to the unemployed). Emphasis should be placed on the conclusion that students had higher emigration intentions..

The contribution of this paper is mainly reflected in the concrete analysis and practical contribution of various government agencies in BiH, which can use the results of this research to create policies that ensure better living conditions in order to reduce the exodus of young people from BiH. However, it is important to note that not all dimensions of quality of life have the same importance in determining an individual's level

of satisfaction. The rule of law, peacekeeping, and democracy are extremely important to the overall satisfaction of the population. For example, [27] writing for the World Economic Forum, notes that living in a peaceful country does not in itself make people happy, but it does eliminate many obvious causes of dissatisfaction. It also finds that specific policies have a major impact on citizen satisfaction, with a focus on mental and physical health and reducing unemployment. There are several practical recommendations that could be implemented in this context: developing a new relationship and practice to support youth entrepreneurship, subsidizing youth housing, scholarships for students, etc. similarly suggested in [3]. In this regard, the findings of this study may help policymakers determine the appropriate mix of push and pull emigration strategies.

References

1. Nijenhuis, G., Leung, M.: Rethinking migration in the 2030 agenda: towards a de-territorialized conceptualization of development. Forum Dev. Stud. **44**, 51–68 (2017)
2. IOM Migration 2030 Agenda. Geneva (2017)
3. Čičić, M., et al.: Pretpostavke i pravci unapređenja kvalitete života i kreiranja stimulativnog okruženja za povratnike. Akademija nauka i umjetnosti Bosne i Hercegovine (2020)
4. Labrianidis, L., Sykas, T.: Why high school students aspire to emigrate: evidence from Greece. J. Int. Migr. Integr. **18**, 107–130 (2017)
5. Otrachshenko, V.: Popova o life (dis)satisfaction and the intention to migrate: evidence from central and Eastern Europe. J. Soc. Econ. **48**, 40–49 (2014)
6. Poudel, C., Ramjan, L., Everett, B., Salamonson, Y.: Exploring migration intention of nursing students in Nepal: a mixed-methods study. Nurse. Educ. Pract. **29**, 95–102 (2018)
7. Zbinden, M., Dahinden, J., Efendic, A.: Rethinking the debate about diversity of migration in South-East Europe. Divers Migr. South-East Eur. Peter. Lang. 7–34 (2016)
8. Schiele, M.: Life satisfaction and return migration: analysing the role of life satisfaction for migrant return intentions in Germany. J. Ethn. Migr. Stud. **47**, 110–129 (2021)
9. Ajzen, I.: The theory of planned behavior. Orgnizational Behav. Hum. Decis. Process **50**, 179–211 (1991)
10. van Dalen, H.P., Henkens, K.: Explaining emigration intentions and behaviour in the Netherlands, 2005–10. Popul. Stud. (NY) **67**, 225–241 (2013)
11. Rhode, B.: Brain drain, brain gain, brain waste: reflections on the emigration of highly educated and scientific personnel from Eastern Europe. New Geogr. Eur. Migr. (1993)
12. Čičić, M., Husić-Mehmedović, M., Efendić, A., Turulja, L., Emirhafizović, M.: Emigration Study BOSNIA AND HERZEGOVINA. Akademija nauka i umjetnosti BiH (2019)
13. Neiva Ganga, R., Silva, J., Gomes, R., et al.: Portuguese scientists' migration: a study on the 2008 crisis aftermath. Int. Migr. **54**, 43–55 (2016)
14. European Commission E Quality of life : facts and views : 2015 edition. (2015)
15. Bérenger, V.: Verdier-chouchane a multidimensional measures of well-being: standard of living and quality of life across countries. World Dev **35**, 1259–1276 (2007)
16. Harvey, F.: Britons want quality of life indicators to take priority over economy. Guard. **10** (2020)
17. Easterlin, R.A.: There are exceptions to the consensus. In comparisons across countries, Diener and his collaborators (1993, 1995) fail to find a significant curvilinear relationship. Schyns too finds only a linear association, pp. 1–19 (2002)
18. Olgiati, A., Calvo, R.: Berkman L are migrants going up a blind alley? Economic migration and life satisfaction around the world: cross-national evidence from Europe, North America and Australia. Soc. Indic. Res. **114**, 383–404 (2013)

19. Lönnqvist, J.E., Leikas, S., Mähönen, T.A., Jasinskaja-Lahti, I.: The mixed blessings of migration -psychological and social well-being over the course of migration. Eur. J. Soc. Psychol. **45**, 496–514 (2015)
20. Andrews, F.M.: Robinson JP measures of subjective well-being. Meas. Pers. Soc. Psychol. Attitudes Meas. Soc. Psychol. Attitudes **1**, 61–114 (1991)
21. OECD OECD Guidelines on Measuring Subjective Well-Being, OECD Guidelines on Measuring Subjective Well-Being (2013)
22. Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E.: Multivariate data analysis, 7th edn. Prentice Hall, Hoboken (2010)
23. Switek, M.: Internal migration and life satisfaction: well-being paths of young adult migrants. Soc Indic. Res. **125**, 191–241(2016)
24. Cardenas, M., Di Maro, V.: Sorkin I migration and life satisfaction: evidence from Latin America. J. Bus. Strateg. **26**, 9–34 (1970)
25. Ivlevs, A.: Happy moves? Assessing the link between life satisfaction and emigration intentions. Kyklos **68**(3), 335–356 (2015)
26. De Castro, A.B., Gee, G., Fujishiro, K., Rue, T.: Examining pre-migration health among Filipino nurses. J. Immigr. Minor. Health **17**(6), 1670–1678 (2015)
27. Aliyev, K., Ismayilov, A., Gasimov, I., Isayeva, A.: Unhappy moves? assessing the link between life (Dis)satisfaction and intention to emigrate from Azerbaijan. Econ. Soc. **14**(3), 127–145 (2021)
28. Mulgan, G.: Can governments make us happier? In: World Econ. Forum. (2015)

Modeling Employee Job Performance Through Organizational Communication, Organizational Commitment and Innovative Behavior

Lejla Turulja and Amra Kožo(✉)

School of Economics and Business, University of Sarajevo, Trg oslobođenja Alija Izetbegović 1, Sarajevo, Bosnia and Herzegovina
{lejla.turulja,amra.kozo}@efsa.unsa.ba

Abstract. This study explores the influence of organizational communication climate and downward communication processes on organizational commitment. In addition, the research investigates the relationships between organizational commitment, innovative behavior, and job performance. The study relies on the social exchange theory and the theory of reasoned action, explaining exchanges and behavioral intention within the organizational context. Empirical research was conducted among 217 employees in companies in Bosnia and Herzegovina. Data analysis was conducted with SEM-PLS. Lastly, study findings and implications were discussed, and directions for further research were recommended.

Keywords: Organizational communication climate · Downward communication · Organizational commitment · Employee innovative behavior · Job performance

1 Introduction

Nowadays, organizations are faced with a hyper-competitive and uncertain environment. Constant changes mainly related to the increased global competitiveness and technological advances require new ways of doing business. In order to achieve competitive advantages and compete in any market, companies need to be flexible and innovative [1]. In such circumstances, what predicts job performance became particularly relevant.

In a business world marked by rapid technological changes, innovation is a critical pillar for sustainable competitive advantage. In recent years, along with innovation, employees' innovative behavior has received much interest since organizations need to prioritize innovative developments [2, 3]. Studies confirmed the relevance of organizational communication climate for organizational performance, apart from the overall organizational climate. Communication has always been an inseparable part of everyday business activities. Effective communication may encourage ideas and knowledge sharing and strengthen the bond between employees and the organization. Moreover, communication enables sharing of organizational goals, values, and beliefs, thus enhancing employees' identification with the organization and employee commitment.

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 109–128, 2023.
https://doi.org/10.1007/978-3-031-17767-5_9

This paper brings together the potential drivers of job performance in a context of an emerging economy. Precisely, the study observes organizational constructs of internal communication, organizational commitment, employee innovative behavior, and job performance. Communication is observed through organizational communication climate and downward (top-down, vertical) communication process. Organizational commitment is conceptualized with affective, continuance, and normative components. First, we provide a literature review and theoretical foundations of the study, and then we present empirical research. Lastly, study findings are discussed.

2 Literature Review

Organizational communication refers to the degree to which information related to job and workplace is transferred by an organization to its members [4]. According to Kalogiannidis [5], communication in business entities is observed as the general process of disseminating business information among employees or different stakeholders. Communication arises among interdependent groups that attempt to reach common goals within organizations [6]. It informs employees about jobs, organization, and environment [7]. The early studies on organizational communication date back to the 1900s [8]. Barnard [9] recognized communication as the heart of management in his work. The human relations movement during the 1940s claimed that organizational communication should be a two-way process. More precisely, human relations scholars recognized upward and downward communication flow [7]. Communication can be observed as a managerial process that comprehends the dissemination of information from managers to employees and *vice versa*. In addition, the communication process includes not just the transfer of information but also the transmission of feelings, meanings, and understandings. Therefore, communication is valuable and effective only when appropriately transmitted and understood by the recipient of information [10]. Morissan [2014; as cited in [11]] discusses that organizations create policies and procedures through communication, define authority and role positions, formal and non-formal communication networks, and the organizational communication climate.

Organizational communication climate is of utmost importance to an organization. Zaremba [12] argues that organizational communication climate is one of the crucial factors contributing to effective organizations. According to Falcione et al. [13], organizational communication climate represents a connection between employees and the organization, while Pace [14] claims that organizational communication climate refers to employees' perception of the information flow and the ambient in which the communication appears. Organizational communication climate can enhance or weaken communication processes within an organization. Hence, a supportive communication climate encourages horizontal, upward, or downward communication processes within an organization. On the other side, a non-supportive communication climate may cause a lack of communication, thus discouraging employees from discussing their needs, ideas, suggestions, and other forms of work-related improvement [15].

Organizational commitment has been recognized as one of the most studied subjects in organizational behavior [16–18]. A commitment was first introduced in the organizational literature in 1960 by Becker [19], who explained commitment as a "mechanism

that produces consistent human behavior.“ In the first book published on this topic in 1956, Whyte W. H. observes organizational employees not just as workers but as part of the organization and as a source of organizational creativity since belongingness represents one of the human needs [20]. Porter et al. [21] observed organizational commitment, job satisfaction, and turnover intentions and defined organizational commitment as the relative strength of an employee's identification with and involvement in one's organization. Since then, various studies related to organizational commitment have been conducted. Marthis and Jackson [22] relate commitment to the level of employees' belief to accept organizational goals and their eagerness to stay in the organization. According to Guler et al. [23], organizational commitment refers to the strength of the bond between employees and their organization. Similarly, Irefin and Mechanic [24] observe commitment as an attachment of employees to the specific aspect of the work in an organization. Despite the numerous definitions, it is generally accepted that organizational commitment links the employee to the organization [25]. Meyer and Allen [26] introduced the three-component model of organizational commitment, clarifying components as affective, continuance, and normative. Affective commitment is based on employees' values and emotional attachment to the organization, continuance commitment is based on a cost-benefit calculation (e.g., of staying or leaving an organization), and normative commitment is based on obligation (e.g., moral principles) [27]. Thus, affective commitment is related to employees who "want to" stay in the organization, continuance commitment describes those who "need to" stay in the organization, and normative commitment is related to the employees who feel they "ought to" stay in the organization.

Innovation is one of the critical pillars for building competitive advantages. According to Dibrell et al. [28], innovation refers to technological development, new products and services, or improving production and other business processes to achieve a competitive advantage. Scholars broadly discuss the positive impact of innovation on business performance [e.g., [29, 30]]. Nguyen et al. [2] particularly recognize the importance of innovation within a developing country context. This is in line with a discussion that innovation policies and programs in developing economies are segregated and ineffectively developed [31]. Bearing this in mind, it is not surprising that literature [e.g., [32, 33]] recognizes employee innovation as a critical predictor of organizational competitiveness and success.

Employee innovative behavior refers to the "intentional generation, promotion, and realization of new ideas" [34]. Innovative work behavior is observed through employees' continuous, dedicated, and genuine effort oriented toward the whole innovation process conducted by employees of an organization [35–37]. Thus, employee innovative behavior is considered as the foundation for organizational innovation. The innovative behavior depends on the work context [38], within which an individual engages personal resources to grow and exhibit innovative behavior [39]. Since innovation activities are related to risk, not all employees are willing to manifest innovative behavior. Therefore, organizations face challenges in including factors that drive innovative behavior among their employees.

Authors observe job performance as the heart of an organizational social system [40]. Deadrick and Gardner [41] argue that job performance is the work outcomes achieved

during a specific period. In their conceptualization of job performance, Campbell and Wiernik [42] argue that individual job performance refers to what employees do and actions they take, thus contributing to organizational goals. According to Borman and Motowidlo [43], job performance can be classified into a task and contextual performance, where task performance is observed as an in-role behavior while contextual performance refers to an extra-role behavior. Motowidlo et al. [44] state that task performance describes employee behavior related to task achievement based on the job description. On the other side, contextual performance is observed through the behavior related to organizational, social, and psychological environments and is in line with organizational goals.

3 Theoretical Background

This research relies upon social exchange theory [45] and the theory of reasoned action [46]. According to Blau [45, p. 91], social exchange "refers to voluntary actions of individuals motivated by the returns they are expected to bring and typically do bring from others." Social exchange underlines the links between individuals as well as between groups. According to Molm et al. [47], social exchange is built on trust and commitment. Due to uncertainty, one involved in the social exchange process does not know whether his/her favor will affect him/her.

The theory of reasoned action can be used to predict behavior within organizations [48]. According to Fishbein and Ajzen [46], one's behavior is the final choice of rational thinking integrated with an individual's own value judgment, social norms, and expectations of others. The theory of reasoned action proposes how an employee's behavior is defined by individual intention to perform the behavior. Consecutively, this intention is a function of attitude towards the behavior and subjective norms [46]. Therefore, the best predictor of behavior is intention (the belief that the behavior leads to the intended outcome).

The assumption of the present study is that information is transmitted to the employees during the communication process, and the communication climate is shaped. If the process of communication and communication climate encourages or discourages employees, commitment might be achieved or omitted. A higher level of commitment induces employee innovative behavior and better job performance. Employees make the final choice about commitment, innovative behavior, and job performance based on the rational analysis of information gained through communication as well as their judgments, norms, and expectations. Through communication, employees exchange information and other support needed by its nature for innovative behavior. Employees' rational behavior depends on attitudes towards specific behavior, so both innovative behavior and job performance could be observed as determined by three different types of commitment (affective, normative, and continuance).

4 Hypotheses Development

Organizational communication is crucial for overall organizational effectiveness and success [7, 49]. It contributes to the competitive advantages of an organization [50]. In the

complex and hyper-competitive environment, communication is a medium for organizational sense-making. Literature offers extensive research on organizational communication and its relationships with different organizational constructs. Thus, organizational communication is related to employee motivation and performance [7]. The study of Giri and Kumar [6] also brings a significant relationship between organizational communication and job satisfaction and job performance which is also confirmed by Kalogiannidis's [5] study where effective business communication contributes to employee performance. Even Purbaningrum [51] suggested how organizational communication climate enhances employee commitment. In the study of Oktora et al. [11], organizational communication climate did not significantly affect affective commitment. Instead, it influenced affective commitment through job satisfaction. Based on the Kivimäki et al. [52], innovative performance is related to multiple aspects of communications. In addition, some studies have explored the role of organizational communication climate in conflict management [15]. Andersson [53] goes a step further and emphasizes the role of communication responsibility introducing a new concept of employee communication responsibility.

Accomplished organizational commitment leads to a broad spectrum of positive organizational outcomes [17], such as employee performance, motivation, and lower turnover intentions [54, 55]. The higher the level of organizational commitment is, the employee more identifies with the organization. In addition, committed employees are more likely to innovate, meaning that organizational commitment enhances employee innovation [56, 57]. This is supported by Xerri and Brunetto [58], who relied upon social exchange theory and explained that more committed employees would be more likely to innovate.

Employee innovation influences employee behaviors in organizations [59] and represents a critical success factor for high-performance organizations [60]. Duy and Tuan [61] argue about the positive relationship between innovation, strategic knowledge management, and firm performance. Employees' innovative behavior is based on the exchanges [62] with coworkers, managers, and other participants in the work processes. Nguyen et al.'s [2] study conducted among employees of IT sectors shows that organizational commitment affects employee innovation. In the end, Khan et al. [63] describe job performance as the quality of employees' working behavior derived from organizational commitment.

Following the discussion related to observed constructs and drawing upon social exchange theory and theory of reasoned action, we propose the following hypotheses. Based on the operationalization of organizational commitment, hypotheses will be examined via the lenses of affective, normative, and continuance commitment.

- H1. Organizational communication climate is related to organizational commitment.
  - H1a. Organizational communication climate is related to affective commitment.
  - H1b. Organizational communication climate is related to normative commitment.
  - H1c. Organizational communication climate is related to continuance commitment.
- H2. Top management-employee communication is related to organizational commitment.

  - H2a. Top management-employee communication is related to affective commitment.
  - H2b. Top management-employee communication is related to normative commitment.
  - H2c. Top management-employee communication is related to continuance commitment.

- H3. Organizational commitment is related to innovative behavior.

  - H3a. Affective commitment is related to innovative behavior.
  - H3b. Normative commitment is related to innovative behavior.
  - H3c. Continuance commitment is related to innovative behavior.

- H4. Organizational commitment is related to job performance.

  - H4a. Affective commitment is related to job performance.
  - H4b. Normative commitment is related to job performance.
  - H4c. Continuance commitment is related to job performance.

- H5. Employee innovative behavior is related to job performance.

5 Empirical Research

The population of this research is employees of companies in Bosnia and Herzegovina. The measurement scales for the variables of interest were adapted from prior research. Before disseminating the questionnaire to the population, we tested it in two phases, with academics in the first phase and industry professionals in the second, to assess the suitability of the scale indicators to the study's specific context. The questionnaire was created in English at first. Then, the questionnaire was translated into the mother tongue to better comprehend and clarify the question. The survey was distributed among the participants using the snowball method. We sent an invitation letter explaining the conditions of participation, where the eliminatory question was that the person was employed in a company in Bosnia and Herzegovina. A convenient sample consisted of 217 respondents, of whom 57% were women, and 43% were men. Most respondents are in the age group of 21 to 30 years (31.5%). Then, 30.5% of respondents are in the age group of 31 to 40 years, followed by 22% of respondents aged 41 to 50 years, and 16% of respondents aged 51 to 65. When it comes to the level of education, most respondents have completed college or university (48%), followed by respondents who have completed high school (34%), and 17% of those who have completed a master's degree, and 1% with PhD level. Finally, in terms of position in the company in which they work, almost 70% of respondents are operational level workers, while 25% are department heads, and about 5% are members of top management.

5.1 Measures

All of the variables were operationalized using multi-item reflective indicators on a seven-point Likert-type scale since these answer categories have been shown to yield reliable and valid results [64]. Internal communication climate openness and top management–employee communication were adapted from Andersson [53]. Affective, normative, and continuance commitments were adapted from Fu et al. [65]. Employee innovative behavior was adapted from Li and Hsu [62], and job performance was adapted from Wu et al. [66]. In addition, age and education were included in the model as control variables.

6 Results

SEM-PLS is used for the data analysis. SEM is often used in business research to evaluate hypotheses and concepts [64]. However, while maximum likelihood-based CB-SEM requires normally distributed data, PLS-SEM is a non-parametric statistical method that responds favorably to departures from normality [67]. The analysis revealed that most of our data variables are not completely normally distributed. The data were analyzed in two steps [68]. The measurement model was evaluated first, followed by the structural model estimation.

6.1 Measurement Model

First, the reliability and validity of the measurement model were assessed (Table 1). Specifically, reflective measurement constructs were tested for reliability of internal consistency, convergent and discriminant validity. The reliability of internal consistency was tested using composite reliability (CR). Outer loadings of indicator variables show acceptable CR values above 0.7. Convergent validity was tested using the average variance extracted (AVE) and showed acceptable values of 0.5 or more [69]. Discriminant validity was tested using the Fornell-Larcker criterion, according to which discriminant validity is confirmed if the square root of AVE is greater than its largest correlation with any other construct [70]. In addition, the heterotrait-monotrait (HTMT) ratio was evaluated with the aim of establishing discriminatory validity [67].

Table 2 shows that the CR values are greater than 0.7, demonstrating the measurement model's reliability. On the other hand, all AVE values are more than 0.5, supporting the measurement model's convergent validity. All square root AVE values on the diagonal are greater than the observed construct's correlations with other constructs (Table 3), demonstrating the discriminative validity of the measurement model.

HTMT is the ratio of the between-trait correlations to the within-trait correlations, and a value above 0.90 suggests a lack of discriminant validity [67]. Table 4 depicts that all values are less than 0.9, thus further confirming discriminant validity.

Table 1. Measures and outer loadings

	Indicator	β
ComClim1	It is possible to submit points of view to management and heads	0.861
ComClim2	I always have access to information about current events in the organization	0.853
ComClim3	I have a clear picture of the organization's general vision and objectives	0.846
ComClim4	Communication between different departments and/or units in the organization works well	0.838
ComClim5	I can rely on the information which comes from the management	0.774
ComClim6	There is a high ceiling in the organization, i.e., I can express my opinions freely	0.830
VertCom1	The top management has good insight into what is happening in the organization	0.883
VertCom2	I keep updated about the work of the top management through the internal channels	0.865
VertCom3	I have considerable confidence in the top management	0.888
Affect1	I do not feel like "part of the family" at my company	0.865
Affect2	I do not feel "emotionally attached" to my company	0.935
Affect3	My company has a great deal of personal meaning for me	0.879
Affect4	I do not feel a strong sense of belonging to my company	0.930
Normat1	Jumping from organization to organization does not seem at all unethical to me	0.695
Normat2	One of the major reasons I continue to work for my company is that I believe that loyalty is important and therefore feel a sense of moral obligation to remain	0.873
Normat3	If I got another offer for a better job elsewhere, I would not feel it was right to leave my company	0.752
Normat4	I was taught to believe in the value of remaining loyal to one organization	0.893
Cont1	Right now, staying with my company is a matter of necessity as much as desire	0.914
Cont2	I think the company I work for is the best option for employment	0.900
Inno1	At work, I constantly have new ideas for solving problems	0.794
Inno2	I am constantly searching for new methods, techniques or instruments for my work	0.873
Inno3	At work, I am constantly looking for support for innovative ideas	0.863
Inno4	I try to come up with original solutions to problems at work	0.836
Inno5	I regularly seek approval for innovative ideas in my work	0.847
Inno6	My superiors are often thrilled with my innovative ideas	0.712
Inno7	I implement and apply my ideas in business	0.742

(*continued*)

Table 1. (*continued*)

	Indicator	β
Inno8	I try to constantly innovate and improve the work I do	0.794
Inno9	I try to contribute to the constant improvement of my company's products and services	0.729
Perf1	I carry out the core parts of my job well	0.832
Perf2	I ensured my tasks were completed properly	0.848
Perf3	I am learning new skills that help me adopt changes related to my workplace	0.770
Perf4	I am ready to do my best to achieve my goals at work	0.816
Perf5	I put a lot of energy into my work	0.764
Perf6	I don't give up until I get the job expected of me	0.788

Table 2. Reliability and convergent validity

	Cronbach's Alpha	rho_A	Composite Reliability (CR)	Average Variance Extracted (AVE)
ComClim	0.912	0.915	0.932	0.696
VertCom	0.853	0.853	0.911	0.773
Affect	0.924	0.928	0.946	0.815
Normat	0.818	0.842	0.881	0.652
Cont	0.784	0.787	0.903	0.823
Inno	0.929	0.931	0.941	0.642
Perf	0.890	0.892	0.916	0.646

Table 3. Discriminant validity – Fornell-Larcker criterion

	ComClim	VertCom	Affect	Normat	Cont	Inno	Perf
ComClim	**0.834**						
VertCom	0.785	**0.879**					
Affect	0.564	0.599	**0.903**				
Normat	0.430	0.501	0.653	**0.808**			
Cont	0.549	0.618	0.747	0.687	**0.907**		
Inno	0.478	0.437	0.422	0.348	0.384	**0.801**	
Perf	0.249	0.346	0.343	0.184	0.359	0.563	**0.804**

The square root of AVE is on diagonal; constructs' correlations are below diagonal.

Table 4. Discriminant validity – HTMT criterion

	ComClim	VertCom	Affect	Normat	Cont	Inno	Perf
ComClim							
VertCom	0.893						
Affect	0.604	0.666					
Normat	0.489	0.592	0.751				
Cont	0.645	0.754	0.879	0.851			
Inno	0.519	0.494	0.451	0.394	0.451		
Perf	0.278	0.398	0.380	0.216	0.432	0.609	

6.2 Structural Model

After confirming that the construction measures are reliable and valid, the next step is to evaluate the results of the structural model. The estimation of the structural model was carried out following the recommendations from Hair et al. [67]. First, an assessment of the structural model for collinearity issues was conducted using VIF. In the second step, an estimate of the significance and relevance of the structural model relationships was made. Then, in the third step, the level of R^2 is assessed, while in the fourth step, the level of f^2 is assessed, and in the fifth, the level of Q^2. The assessment of R^2, f^2, and Q^2 represents measures of the model's predictive power. Instead of assessing model fit using Goodness of fit indices, the structural model in SEM-PLS is primarily assessed on the basis of heuristic criteria determined by the predictive capabilities of the model [67]. In other words, the model is evaluated in terms of how well it predicts endogenous variables (Table 5).

Study results imply that vertical communication significantly affects all three types of employee commitment (affective: $\beta = 0.406$, $p < 0.01$; normative; $\beta = 0.426$, $p < 0.01$; continuance: $\beta = 0.487$, $p < 0.01$). However, when it comes to internal communication climate openness, it only significantly affects the affective commitment of employees ($\beta = 0.245$, $p < 0.05$), while it does not have a significant effect on normative commitment ($\beta = 0.095$, $p > 0.01$) nor continuance commitment ($\beta = 0.167$, $p > 0.01$). In addition, the results indicate that affective commitment influences employee innovative behavior ($\beta = 0.290$, $p < 0.01$), while normative ($\beta = 0.078$, $p > 0.01$) and continuance ($\beta = 0.123$, $p > 0.01$) ones do not have a significant impact, but they do significantly contribute to job performance. However, normative commitment negatively influences job performance ($\beta = -0.223$, $p < 0.01$). Finally, as expected, employee innovative behavior significantly affects work performance. The results show that age negatively affects employee innovative behavior ($\beta = -0.164$, $p < 0.05$).

R^2 value (coefficient of determination) is the most often used measure to evaluate the structural model measuring the model's predictive capacity [67]. R^2 values vary from 0 to 1, with higher values suggesting greater prediction accuracy. It is difficult to offer guidelines for appropriate R^2 values since they vary depending on model complexity and study discipline. In marketing-related academic study, R^2 values of 0.75, 0.50, or

Table 5. Structural relationships

Hypotheses		β	Standard deviation	f^2	T statistics	P values
H1a	ComClim - > Affect	0.245	0.122	0.037	2.013	0.044
H1b	ComClim - > Normat	0.095	0.111	0.005	0.859	0.390
H1c	ComClim - > Cont	0.167	0.125	0.018	1.331	0.183
H2a	VertCom - > Affect	0.406	0.118	0.102	3.449	0.001
H2b	VertCom - > Normat	0.426	0.104	0.093	4.111	0.000
H2c	VertCom - > Cont	0.487	0.121	0.149	4.024	0.000
H3a	Affect - > Inno	0.290	0.096	0.044	3.006	0.003
H3b	Normat - > Inno	0.078	0.092	0.004	0.848	0.396
H3c	Cont - > Inno	0.123	0.104	0.007	1.189	0.234
H4a	Affect - > Perf	0.076	0.110	0.004	0.694	0.488
H4b	Normat - > Perf	−0.223	0.084	0.038	2.640	0.008
H4c	Cont - > Perf	0.254	0.109	0.037	2.324	0.020
H5	Inno - > Perf	0.521	0.061	0.332	8.568	0.000
C	AGE - > Inno	−0.164	0.074	0.033	2.217	0.027
C	AGE - > Perf	0.039	0.058	0.002	0.676	0.499
C	EDUC - > Inno	0.077	0.064	0.007	1.200	0.230
C	EDUC - > Perf	−0.039	0.055	0.002	0.723	0.470

R^2(Affect) = 0.374; R^2(Normat) = 0.246; R^2(Cont) = 0.385; R^2(Inno) = 0.208; R^2(Perf) = 0.348;
Q^2(Affect) = 0.295; Q^2(Normat) = 0.155; Q^2(Cont) = 0.309; Q^2(Inno) = 0.139; Q^2(Perf) = 0.225

0.25 for endogenous latent variables might be defined as substantial, moderate, or weak, respectively [67]. In this regard, this study's model of employee job performance results in a moderate predictive capacity. F^2 effect size is also used to estimate the effect size of the model and represents the change in R^2 value when a specified exogenous construct is omitted from the model. Values of 0.02, 0.15, and 0.35, respectively, reflect small, medium, and large effects when evaluating f^2. The results show that the overall model has a large effect size. However, not all variables have the same effect size but range from a small effect size of commitment to a large effect size of innovative behavior. In addition, the Q^2 value is obtained by using the blindfolding procedure for a specified

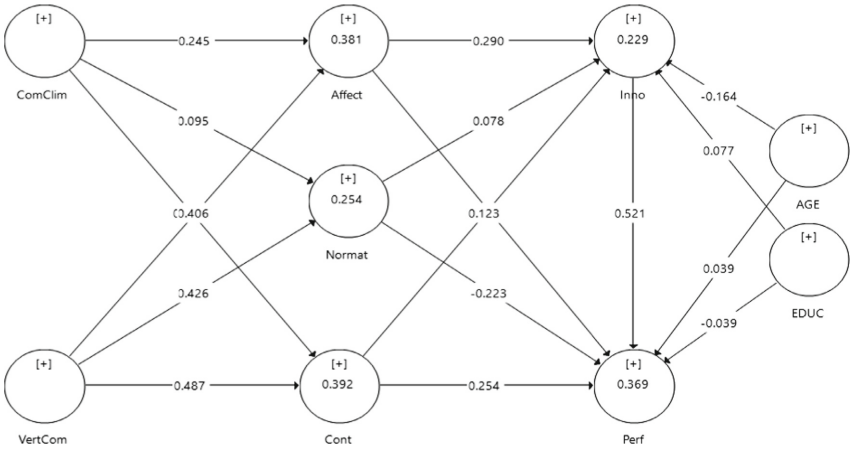

Fig. 1. Model estimation results

omission distance D. Q^2 values greater than zero indicate that the model has predictive validity for a specific endogenous construct [67]. All Q^2 values are greater than 0, which shows that the model has predictive validity for all endogenous constructs.

In addition to the above, the overall effects of the model were estimated (Fig. 1). In particular, it is possible to estimate how strongly each predictor variable ultimately affects a key target variable [67]. In terms of employee job performance, among the five exogenous constructs, innovative behavior has the strongest overall effect on performance (0.521), followed by employee continuance commitment (0.318), affective commitment (0.227), vertical communication (0.169), and communication climate (0.091). It is therefore advisable for companies to focus first on employee innovative behavior. On the other hand, affective commitment has the strongest overall effect on employee innovative behavior (0.290), followed by vertical communication (0.211), employee continuance commitment (0.123), and communication climate (0.099).

7 Discussion

Communication in a variety of forms is an inevitable part of organizational work-life. An open communication climate inspires employees and encourages them to address their needs. Moreover, clear communication content transmitted from senior levels to employees enables employees to understand and accept organizational goals and tasks. Based on the social exchange theory and the theory of reasoned action, exchanges occur in different forms within organizations. They are followed by a synergy of rational thinking and values, norms, and expectations. In this fluid medium, employees achieve and reveal their commitment to organizations.

Study findings suggest that organizational communication climate is a significant predictor of affective commitment. Since affective commitment is related to the emotional tie between employee and organization, and communication climate describes the employees' perception of the whole context in which the communication appears, it is

not surprising that this relationship is confirmed. Thus, study results indicated that open communication ambient contributes to affective commitment. At the same time, communication climate was not found as a significant predictor in a case when employees feel obligations to stay in the organization or employees exhibit continuance commitment. These results are similar to findings from other studies since Welsch and LaVan [71] found strong correlations between the communication dimension of organizational climate and employees' commitment in their study of antecedents of organizational commitment. In addition, Guzley [72] argues that organizational and communication climates are both positively related to organizational commitment. Recently, Oktora et al. [11] found that organizational communication climate does not significantly influence affective commitment. Instead, it influences affective commitment through job satisfaction.

Next, results show that downward communication significantly influences all three dimensions of organizational commitment. These results emphasize the importance of proper managerial communication toward employees. Since for effective communication, the plain transmission of information is not enough but includes the exchange of meanings and feelings as well, managers might increase commitment through honest behavior, integrity, delegation, participative-decision making, organizational justice, and similar. In other words, the findings highlight the significance of overall top management communication with employees in the context of fostering employee organizational commitment. In addition, it is worth mentioning that vertical communication has the most potent predictive power for continuance commitment, followed by normative and affective commitment. These results imply that managerial communication can regulate overall employee commitment by adjusting leverage between continuance, normative and affective commitment. While Kalogiannidis [5] found a positive and significant relationship between downward communication and employee performance, Al-Tokhais [73] discusses how communication between managers and employees enhances problems solving related to employees' commitment. Mazzei [74] argues that internal communication is essential for promoting active communication behaviors. Consequently, active communication behaviors (e.g., knowledge sharing, collaboration, creativity) create a basis for innovative behavior.

Based on the study findings, affective commitment significantly drives employee innovative behavior. Innovative behavior is related to the work context, but also it is based on the personal resources and efforts an employee provides during individual development. However, study results have not revealed a significant relationship between normative and continuance commitment with innovative behavior. Results of the conducted study are in line with Tang et al.'s [3] study where employee innovative behavior was predicted by organizational commitment and Nguyen et al.'s [2] study (conducted in the developing country), which results indicate that employee organizational commitment is positively associated with employee innovation. Moreover, affective commitment has been found to predict employee innovation in a study conducted by Powell and Le [75] in a large technology company.

Study findings suggest that job performance is significantly influenced by normative and continuance commitment, while affective commitment in the observed sample has

not significantly impacted job performances. The negative relationship between normative commitment and job performance implies that job performance might decrease if the employee commitment is based on mere obligation. On the contrary, job performance increases if employee commitment is based on perceived economic value. Literature confirms that organizational commitment causes positive organizational results, including employee performance [54, 55]. However, it should be noted that some studies report a significant effect of affective commitment on job performance [76, 77]. Sungu et al. [78] discuss that even affective organizational commitment is associated in theory and practice with job performance, their relationship varies. Meyer et al. [79] explained that different foci of commitment interact with others and influence behavior. If goals are compatible, different foci of commitment are more likely to complement each other. On the other side, with opposing goals, a conflict may occur so that commitment to one foci supports behaviors related to the corresponding targets but is unfavorable to other foci. Since continuance commitment exhibits the strongest predictive power in the present study compared to normative and affective commitment towards job performance, the employees' focus on continuance commitment might cause a non-significant effect of affective commitment on job performance.

Study findings showed a significant relationship between employee innovative behavior and job performance. Moreover, innovative behavior showed the strongest predictive power to job performance among all observed drivers of job performance, suggesting that organizations should prioritize innovative behavior. The literature supports the study findings. Thus, Hughes et al. [80] confirmed the relationship between employee innovation and employee performance; Wibowo and Christiani [77] discussed the relationship between innovation capability and job performance; Leong and Rasli [81] showed that employees' innovative work behavior is positively related to employee's performance. Finally, results depicted a negative relationship between ages and innovative behavior, suggesting that employee innovative behavior is higher among younger employees.

7.1 Managerial Implications

In terms of managerial implications, the study findings suggest the following. Firstly, different dimensions of organizational commitment differently influence other organizational variables. Since organizational communication climate influences affective commitment and affective commitment impacts employee innovative behavior, managers should promote active and open communication within an organization to establish relationships with employees based on mutual understandings and foster an open organizational climate. Because affective commitment refers to an emotional relationship of employees with an organization and compliance with organizational values, managerial behavior based on integrity and trust could help build a dynamic and creative work environment that will stimulate exchange between an employee and organization that lead to innovative behavior. If managers choose continuance or normative commitment, they might focus on effective downward communication. Clear communication clarifies roles and tasks and facilitates employees' information exchange and active participation, thus encouraging employees to exhibit better job performance.

Second, job performance will not increase based on the sole obligations and normative commitment. On the contrary, when feel obliged to work and stay in the organization without proper understanding of organizational goals, an employee might feel detached from the organization, and job performance might even decrease. Next, in the current business environment, innovative behavior might be one of the strongest predictors of job performance. Since constant innovation keeps the organization competitive in the market, strategic organizational activities should undoubtedly promote innovative behavior. Organizations should promote and celebrate innovative behavior, support experimentation, and create communication and an overall climate where employees feel encouraged to discuss their ideas.

7.2 Limitations and Further Research

This study has a few limitations that might be improved in future studies. First, since study findings implied how affective commitment influences innovative behavior and does not affect job performance, further studies might investigate the mediation effect of innovative behavior among job performance and organizational commitment. Innovative behavior and organizational commitment are fields where employees learn (about behavior, work-related tasks, organizational processes, and similar). Moreover, in a time of changes and uncertainty, employees seek organizational sense-making. Thus, the ground for future studies might be found in the theory of organizational sense-making, where communication can serve as a tool for achieving commitment, innovative behavior, and job performance. Second, comparison among different industries might provide additional insights about observed organizational constructs within developing economies.

8 Conclusion

The relationships explored among observed organizational constructs showed that employee innovative behavior is the strongest predictor of job performance. Innovative behavior is driven by affective commitment, which is predicted by communication climate and downward communication. The study findings revealed that affective commitment does not significantly influence job performance while normative and continuance commitment predicts job performance. This study contributes to managerial practices in a few ways, offering directions for managerial practices, inputs for decisions, and strategic planning. Finally, future research may apply a longitudinal approach in addition to a more comprehensive model that incorporates additional organizational or employee-related variables.

References

1. Martinez-Sanchez, A., Vicente-Oliva, S., Pérez-Pérez, M.: The strategy of human resource flexibility versus absorptive capacity of knowledge: an integrative framework in industrial firms. Eur. J. Innov. Manag. **24**(2), 315–337 (2020). https://doi.org/10.1108/EJIM-10-2019-0314

2. Nguyen, V.T., Siengthai, S., Swierczek, F., Bamel, U.K.: The effects of organizational culture and commitment on employee innovation: evidence from Vietnam's IT industry. J. Asia Bus. Stud. **13**(4), 719–742 (2019). https://doi.org/10.1108/JABS-09-2018-0253
3. Tang, Y., Shao, Y.-F., Chen, Y.-J.: Assessing the mediation mechanism of job satisfaction and organizational commitment on innovative behavior: the perspective of psychological capital. Front. Psychol **10**, 2699 (2019). https://doi.org/10.3389/fpsyg.2019.02699
4. Price, J.L.: Handbook of organizational measurement. Int. J. Manpow. **18**, 305–558 (1997)
5. Kalogiannidis, S.: Impact of effective business communication on employee performance. EJBMR, Eur. J. Bus. Manag. Res. **5**(6), 1–6 (2020). https://doi.org/10.24018/ejbmr.2020.5.6.631
6. Giri, V.N., Kumar, B. P.: Assessing the impact of organizational communication on job satisfaction and job performance. Psychol. Stud. **55**(2), 137–143 (2009). https://doi.org/10.1007/s12646-010-0013-6
7. Rajhans, K.: Effective organizational communication: a key to employee motivation and performance. Intersci. Manag. Rev. **2**(2), 145–149 (2009). Article 13. https://doi.org/10.47893/IMR.2009.1040
8. Carrière, J., Bourque, C.: The effects of organizational communication on job satisfaction and organizational commitment in a land ambulance service and the mediating role of communication satisfaction. Career Dev. Int. **14**(1), 29–49 (2009). https://doi.org/10.1108/13620430910933565
9. Barnard, C.I.: The Functions of the Executive. Harvard University Press, Cambridge (1938)
10. Klepić, Z., Vrdoljak Raguž, I.: Vođenje in Menadžment. In: Alfirević, N., Klepić, Z., Rahimić, Z. (eds.) Ekonomski faultet Univerziteta u Sarajevu, pp. 277–313 (2020). ISBN: 978-9958-25-151-1
11. Oktora, M., Asmony, T., Buana Sakti, D.P.: The influence of organizational communication climate, communication satisfaction on job satisfaction and affective commitment. IJISET – Int. J. Innov. Sci. Eng. Technol. **7**(12), 378–391 (2020)
12. Zaremba, A.J.: Organizational Communication. Thomson Learning, Canada (2003)
13. Falcione, R.L., Sussman, L., Herden, R.P.: Communication climate in organizations. In: Jablin, F.M., Putnam, L.L., Roberts, K.H., Porter, L.W. (eds.) Handbook of Organizational Communication: An Interdisciplinary Perspective, pp. 195–227. Sage, Newbury Park (1987)
14. Pace, W.R.: Organizational Communication: Foundation for Human Resource Development. Prentice-Hall, Eaglewood Cliffs (1983)
15. Nordin, S.M., Sivapalan, S., Bhattacharyya, E., Hashim, H., Wan Ahmad, W.H., Abdulah, A.: Organizational communication climate and conflict management: communications management in an oil and gas company. In: 2nd World Conference On Business, Economics And Management - WCBEM 2013. Procedia - Social and Behavioral Sciences, vol. 109, pp. 1046–1058 (2014). https://doi.org/10.1016/j.sbspro.2013.12.587
16. Cohen, A.: Commitment before and after: an reconceptualization of organizational commitment. Hum. Res. Manag. Rev. **17**, 336–354 (2007). https://doi.org/10.1016/j.hrmr.2007.05.001
17. Hanaysha, J.: Testing the effects of employee engagement, work environment and organizational learning on organizational commitment. Procedia Soc. Behav. Sci. **229**, 289–297 (2016). https://doi.org/10.1016/j.sbspro.2016.07.139
18. Tatlah, I.A., Ali, Z., Saeed, M.: Leadership behavior and organizational commitment: an empirical study of educational professionals. Int. J. Acad. Res. **3**(2), 1293–1298 (2011). Part IV
19. Becker, H.S.: Notes on the concept of commitment. Am. J. Sociol. **66**(1), 32–40 (1960)
20. Randall, D.M.: Commitment and the organization: the organization man revisited. Acad. Manag. Rev. **12**(3), 460–471 (1987). https://doi.org/10.2307/258513

21. Porter, L., Steers, R., Mowday, R., Boulian, P.: Organizational commitment, job satisfaction and turnover among psychiatric technicians. J. Appl. Psychol. **59**(5), 603–609 (1974). https://doi.org/10.1037/h0037335
22. Marthis, R.I., Jackson, J.H.: Human ResourcesManagement. Prentice Hall, Eaglewood Cliffs (2000)
23. Guler, B., Ozmen, A.O., Sarıipek, D.B., Gursoy S.: Labor Psychology Data Bank Project. Rectorate of Kocaeli University vol. 23 (2012)
24. Irefin, P., Mechanic, M.A.: Effect of employee commitment on organizational performance in Coca Cola Nigeria limited Maiduguri, Borno state. IOSR J. Hum. Soc. Sci. **19**(3), 33–41 (2014)
25. Meyer, J.P., Allen, N.J.: Commitment in the Workplace Theory, Research, and Application. Sage Publications, California (1997)
26. Meyer, J.P., Allen, N.J.: A three-component conceptualization of organizational commitment. Hum. Resour. Manag. Rev. **1**(1), 61–89 (1991). https://doi.org/10.1016/1053-4822(91)90011-Z
27. Meyer, J.P., Allen, N.J., Smith, C.A.: Commitment to organizations and occupations: extension and test of a three-component conceptualization. J. Appl. Psychol. **78**(4), 538–551 (1993). https://doi.org/10.1037/0021-9010.78.4.538
28. Dibrell, C., Craig, J.B., Neubaum, D.O.: Linking the formal strategic planning process, planning flexibility, and innovativeness to firm performance. J. Bus. Res. **67**(9), 2000–2007 (2014). https://doi.org/10.1016/j.jbusres.2013.10.011
29. Arranz, N., Arroyabe, M.F., Li, J., de Arroyabe, J.C.F.: An integrated model of organisational innovation and firm performance: generation, persistence and complementarity. J. Bus. Res. **105**, 270–282 (2019). https://doi.org/10.1016/j.jbusres.2019.08.018
30. Ferreira, J.J.M., Fernandes, C.I., Ferreira, F.A.F.: To be or not to be digital, that is the question: firm innovation and performance. J. Bus. Res. **101**, 583–590 (2019). https://doi.org/10.1016/j.jbusres.2018.11.013
31. Aubert, J.E.: Promoting innovation in developing countries: a conceptual framework. World Bank Policy ResearchWorking Paper 3354, World Bank Institute, (2005)
32. Alharbi, I., Jamil, R., Mahmood, N., Shaharoun, A.: Organizational innovation: a review paper. Open J. Bus. Manag. **7**(3), 1196–1206 (2019). https://doi.org/10.4236/ojbm.2019.73084
33. Lukes, M., Stephan, U.: Measuring employee innovation: a review of existing scales and the development of the innovative behavior and innovation support inventories across cultures. Int. J. Entrep. Behav. Res. **23**(1), 136–158 (2017). https://doi.org/10.1108/IJEBR-11-2015-0262
34. Scott, S.G., Bruce, R.A.: Determinants of innovative behavior: a path model of individual innovation in the workplace. Acad. Manag. J. **37**(3), 580–607 (1994). https://doi.org/10.2307/256701
35. Agarwal, U.A.: Linking justice, trust and innovative work behaviour to work engagement. Pers. Rev **43**, 41–73 (2014). https://doi.org/10.1108/PR-02-2012-0019
36. Akram, T., Lei, S., Haider, M.J., Hussain, S.T.: The impact of organizational justice on employee innovative work behavior: mediating role of knowledge sharing. J. Innov. Knowl. **5**, 117–129 (2020). https://doi.org/10.1016/j.jik.2019.10.001
37. Anderson, N., Potocnik, K., Jing, Z.: Innovation and creativity in organizations a state-of-the-science review, prospective commentary, and guiding framework. J. Manag. **40**, 1297–1333 (2014). https://doi.org/10.1177/0149206314527128
38. Amabile, T.M., Conti, R., Coon, H., Lazenby, J., Herron, M.: Assessing the work environment for creativity. Acad. Manag. J. **39**(5), 1154–1184 (1996). https://doi.org/10.2307/256995
39. Walumbwa, F.O., Muchiri, M.K., Misati, E., Wu, C., Meiliani. M.: Inspired to perform: a multilevel investigation of antecedents and consequences of thriving at work. J. Organ. Behav. **39**, 249–261 (2018). https://doi.org/10.1002/job.2216v

40. Katz, D., Kahn, R.L.: The Social Psychology of Organizations, 2nd edn. Wiley, New York (1978)
41. Deadrick, D.L., Gardner, D.G.: Maximal and typical measures of job performance: an analysis of performance variability over time. Hum. Resour. Manag. Rev **18**(3), 133–145 (2008). https://doi.org/10.1016/j.hrmr.2008.07.008
42. Campbell, J.P., Wiernik, B.M.: The modeling and assessment of work performance. Annu. Rev. Organ. Psych. Organ. Behav. **2**, 47–74 (2015). https://doi.org/10.1146/annurev-orgpsych-032414-111427
43. Borman, W.C., Motowidlo, S.J.: Task performance and contextual performance: the meaning for personnel selection research. Hum. Perform **10**, 99–109 (1997). https://doi.org/10.1207/s15327043hup1002_3
44. Motowidlo, S.J., Borman, W.C., Schmit, M.J.: A theory of individual differences in task and contextual performance. Hum. Perform. **10**(2), 71–83 (1997). https://doi.org/10.1207/s15327043hup1002_1
45. Blau, P.M.: Exchange and Power in Social Life. Transaction Publishers, New Brunswick (1964)
46. Fishbein, M., Ajzen, I.: Beliefs, attitude, intention and behavior: an introduction to theory and research. Philos. Rhetoric **10**, 130–132 (1975)
47. Molm, L.D., Takahashi, N., Peterson, G.: Risk and trust in social exchange: an experimental testof a classical proposition. Am. J. Sociol. **105**(5), 1396–1427 (2000). https://doi.org/10.1086/210434
48. Elliott, R., Jobber, D., Sharp, J.: Using the theory of reasoned action to understand organizational behaviour: the role of belief salience. Br. J. Soc. Psychol. **34**, 161–172 (1995). https://doi.org/10.1111/j.2044-8309.1995.tb01055.x
49. Kang, M., Sung, M.: How symmetrical employee communication leads to employee engagement and positive employee communication behaviors: the mediation of employee-organization relationships. J. Commun. Manag. **21**(1), 82–102 (2017). https://doi.org/10.1108/JCOM-04-2016-0026
50. Mazzei, A.: Internal communication for employee enablement: strategies in American and Italian companies. Corp. Commun. Int. J. **19**(1), 82–95 (2014). https://doi.org/10.1108/CCIJ-08-2012-0060
51. Purbaningrum, D.: Organizational Communication, 3rd edn. Open University, Banten - Indonesia (2019)
52. Kivimäki, M., et al.: Communication as a determinant of organizational innovation. R&D Manag. **30**(1), 33–42 (2000). https://doi.org/10.1111/1467-9310.00155
53. Andersson, R.: Employee Communication responsibility: its antecedents and implications for strategic communication management. Int. J. Strateg. Commun. **13**(1), 60–75 (2019). https://doi.org/10.1080/1553118X.2018.1547731
54. Tufail, M., Zia, Y.A., Khan, S., Irfan, M.A.: Glance at organizational commitment, antecedents and consequences (1960–2005). J. Manag. Sci. **6**(1), 73–91 (2012)
55. Naz, G., Ali, A., Afzal, I.: Zia-ur-rehman: developing and testing a model of antecedents and consequences of organization commitment. Glob. J. Manag. Bus. Res. **12**(13), 44–54 (2012)
56. Hakimian, F., Farid, H., Ismail, M.N., Nair, P.K.: Importance of commitment in encouraging employees' innovative behavior. Asia-Pacific J. Bus. Adm. **8**(1), 70–83 (2016). https://doi.org/10.1108/APJBA-06-2015-0054
57. Meyer, J.P., Stanley, D.J., Herscovitch, L., Topolnytsky, L.: Affective, continuance and normative commitment to the organization: a meta-analysis of antecedents, correlates, and consequences. J. Vocat. Behav. **61**(1), 20–52 (2002). https://doi.org/10.1006/jvbe.2001.1842
58. Xerri, M.J., Brunetto, Y.O.: Fostering innovative behavior: the importance of employee commitment and organisational citizenship behavior. Int. J. Hum. Resour. Manag. **24**(16), 3163–3177 (2013). https://doi.org/10.1080/09585192.2013.775033

59. Hartnell, C.A., Ou, A.Y., Kinicki, A.: Organizational culture and organizational effectiveness: a meta-analytic investigation of the competing values framework's theoretical suppositions. J. Appl. Psychol. **96**(4), 677–694 (2011). https://doi.org/10.1037/a0021987
60. Korzilius, H., Bücker, J., Beerlage. S.: Multiculturalism and innovative work behavior: the mediating role of cultural intelligence. Int. J. Intercultural Relat. **56**, 13–24 (2017). https://doi.org/10.1016/j.ijintrel.2016.11.001
61. Duy, N.Q., Tuan, V.H.: Strategic knowledge management, innovation and firm performance: an empirical study in Vietnamese firms. J. Econ. Dev. **16**(1), 60–73 (2014)
62. Li, M., Hsu, C.H.C.: Linking customer-employee exchange and employee innovative behavior. Int. J. Hosp. Manag. **56**, 87–97 (2016). https://doi.org/10.1016/j.ijhm.2016.04.015
63. Khan, T.I., Ziauddin, Z., Jam, F.A., Ramay, M.I.: The impacts of organizational commitment on employee job performance. Eur. J. Soc. Sci. **15**, 292–298 (2010)
64. Limaj, E., Bernroider, E.W.N.: The roles of absorptive capacity and cultural balance for exploratory and exploitative innovation in SMEs. J. Bus. Res. **94**, 137–153 (2019). https://doi.org/10.1016/j.jbusres.2017.10.052
65. Fu, F.Q., Bolander, W., Jones, E.: Managing the drivers of organizational commitment and salesperson effort: an application of meyer and allen's three-component model. J. Mark. Theor. Pract. **17**(4), 335–350 (2009). https://doi.org/10.2753/MTP1069-6679170403
66. Wu, G., Hu, Z., Zheng, J.: Role stress, job burnout, and job performance in construction project managers: the moderating role of career calling. Int. J. Environ. Res. Public Health **16**(13) (2019). https://doi.org/10.3390/ijerph16132394
67. Hair, J., Hult, G.T., Ringle, C., Sarstedt, M.: A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). SAGE Publications, Inc., Thousand Oaks (2017)
68. Anderson, J.C., Gerbing, D.W.: Structural equation modeling in practice : a review and recommended two-step approach. Psychol. Bull. **103**(3), 411–423 (1988)
69. Hair, J.F.J., Black, W.C., Babin, B.J., Anderson, R.E.: Multivariate data. Analysis (2018). https://doi.org/10.1002/9781119409137.ch4
70. Fornell, C., Larcker, D.F.: Evaluating structural equation models with unobservable variables and measurement error. J. Mark. Res. **18**, 39–50 (1981). https://doi.org/10.1017/CBO9781107415324.004
71. Welsch, H.P., LaVan, H.: Inter-relationships between organizational commitment and job characteristics, job satisfaction, professional behavior, and organizational climate. Hum. Relat. **34**(12), 1079–1089 (1981). https://doi.org/10.1177/001872678103401205
72. Guzley, R.M.: Organizational climate and communication climate. Manag. Commun. Q. **5**(4), 379–402 (1992). https://doi.org/10.1177/0893318992005004001
73. Al-Tokhais, A.:The relationship between communication effectiveness and multicultural employees' job outcomes. (Doctoral dissertation, Kent State University) (2016)
74. Mazzei, A.: Promoting active communication behaviours through internal communication. Corp. Commun. **15**(3), 221–234 (2010). https://doi.org/10.1108/13563281011068095
75. Powell, M., Le, L.: Employee commitment in Vietnam: a case study within a large technology company. In: 16th International Conference on Human Resource Development Research and Practice across Europe. University College Cork, Irish Institute of Training and Development, 3–5th June 2015
76. Cobbinah, E., Ntarmah, A.H., Obeng, A.F., Quansah, P.E.: Organizational commitment and job performance: examining the mediating and moderating roles of organizational citizenship behaviour and leadership styles. Int. J. Hum. Resour. Stud. **10**(4), 93–124 (2020). https://doi.org/10.5296/ijhrs.v10i4.17660
77. Wibowo, Y.C., Christiani, N.: The effect of affective organizational commitment towards innovation capability and its impact to job performance in family business. J. Entrepreneur dan Entrepreneurship **9**(2), 143–154 (2020). ISSN 2302–1802 print/ISSN 2580–9393 online

78. Sungu, L.J., Weng, Q., Xu, X.: Organizational commitment and job performance: examining the moderating roles of occupational commitment and transformational leadership. Int. J. Sel. Assess. **27**(3), 280–290 (2019). https://doi.org/10.1111/ijsa.12256
79. Meyer, J. P., Becker, T. E., Vandenberghe, C.: Employee commitment and motivation: a conceptual analysis and integrative model. J. Appl. Psychol. **89**, 991–1007 (2004). https://doi.org/10.1037/0021-9010.89.6.991
80. Hughes, D.J., Lee, A., Tian, A.W., Newman, A., Legood, A.: Leadership, creativity, and innovation: a critical review and practical recommendations. Leadersh. Q. **29**(5), 549–569 (2018). https://doi.org/10.1016/j.leaqua.2018.03.001
81. Leong, C.T., Rasli, A.: The Relationship between innovative work behavior on work role performance: an empirical study. In: International Conference on Innovation, Management and Technology Research (2013). Procedia - Social and Behavioral Sciences, vol. 129, pp. 592–600 (2014). https://doi.org/10.1016/j.sbspro.2014.03.717

Mapping the Sustainable Production and Consumption Literature in South East Europe

Nikša Alfirević[1](✉), Ivica Zdrilić[2], and Darko Rendulić[3]

[1] Faculty of Economics, Business and Tourism, University of Split, Cvite Fiskovića 5, 21000 Split, Croatia
nalf@efst.hr

[2] Department of Economics, University of Zadar, Splitska 1, 23000 Zadar, Croatia
izdrilic@unizd.hr

[3] Karlovac University of Applied Sciences, Trg Josipa Jurja Strossmayera 9, 47000 Karlovac, Croatia
darkorendulic1@gmail.com

Abstract. In this paper, we survey the sustainable production and consumption literature in South East Europe (SEE) in the 2016–2021 period to analyze the structure of the regional research in the field. We further examine if the regional literature incorporates the themes set by the United Nations' Sustainable Development Goal (UN SDG) agenda, especially by the SDG goal 12. SDG 12 is focused on efficient usage of natural resources and energy, ensuring sustainable infrastructure and access to essential social services, employment, and quality of life. Using the science mapping approach, we identify the clusters of regional SEE literature. The bibliometric data are obtained from the Elsevier Scopus database, with most of the Scopus documents being previously mapped to the SDG-related research areas. Scientific data analysis and visualization are conducted with the Elsevier SciVal and Leiden University's VOSviewer science mapping software.

Keywords: Sustainable production · Sustainable consumption · South East Europe · Science mapping

1 Introduction

In 2015, the United Nations formulated the Sustainable Development Goals (SDGs) as a comprehensive global framework to address today's critical economic, social, and environmental challenges [1]. Sustainable development is linked to the need to ensure a better life for all while respecting the limits set by nature [2]. This leads to the need to re-examine current production and consumption patterns, which had emerged when sustainability was not considered an essential part of humanity's agenda. From today's perspective, sustainable development cannot even be imagined without changing current economic and social behaviors that result in production and consumption consistent with the natural environment's capacity.

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 129–146, 2023.
https://doi.org/10.1007/978-3-031-17767-5_10

There are different attempts to map the researchers' contribution to understanding and managing SDGs in general [3], with an emphasis on a specific research field [4] or a specific SDG [5]. However, the typical regional themes and influences in the extant body of knowledge seem somewhat overlooked. We have not been able to identify any studies focusing on mapping the extant, SDG-related body of knowledge from different regional viewpoints.

Therefore, we set the following research questions (RQ) for this study:

- *RQ1: What are the relevant topics in the South East European (SEE) literature related to SDG 12 and their relationships?*
- *RQ2: Is there a difference between the regional and global bodies of knowledge for SDG 12-related literature?*

We contribute to a more comprehensive understanding of regional and international research differences by answering these questions. Although the analysis is currently limited to a single SDG, it could reveal interesting patterns to policymakers, research managers, and educators. Research results and limitations, with a discussion of implications for further development of the SDG-related literature, are presented in Sects. 4 and 5.

2 Methods

There are different ways to map the world's research to SDGs, including the independent development of bibliometric queries based on SDG targets and indicators or the SDG-related Scopus search queries developed by the Elsevier SDG research mapping initiative [6]. This initiative has been coupled with the Times Higher Education (THE) newly produced university impact ranking (as of 2019), based on the development of Scopus bibliometric queries (2019–2020), further improved by the introduction of machine learning algorithms (as of 2021). The 2020 queries and procedure (the 'Elsevier SDG 2020 mapping') have been described by Jayabalasingham et al. [7].

They have been further improved based on the researchers' feedback and the machine learning algorithms, leading to a new set of queries and search procedures, referred to as the 'Elsevier 2021 SDG mapping' [8]. While the new procedure is more accurate, the bibliometric researchers might find the 2020 version convenient, as it can be easily reproduced with the Clarivate Web of Science [6]. Such a research design is also more reproducible by researchers, with access to Elsevier Scopus only. Namely, the 2021 SDG mapping requires can be practically used only by accessing the commercial scientometric reporting tool Elsevier SciVal. This was the rationale behind our choice to utilize the Elsevier 2020 SDG mapping on the Scopus database. The 2020 SDG-12 Scopus query is as follows [7]:

```
TITLE-ABS-KEY ( {environmental pollution} OR {hazardous waste} OR
{hazardous chemical} OR {hazardous chemicals} OR {toxic chemi-
cal} OR {toxic chemicals} OR {chemical pollution} OR {ozone deple-
tion} OR {pesticide pollution} OR {pesticide stress} OR {pesti-
cide reduction} OR {life cycle assessment} OR {life cycle analy-
sis} OR {life cycle analyses} OR {life-cycle analysis} OR {life-
cycle analyses} OR {low carbon economy} OR {low-carbon economy}
OR {environmental footprint} OR {material footprint} OR {harvest
efficiency} OR {solid waste} OR {waste generation} OR {corpo-
rate social responsibility} OR {corporate sustainability} OR {con-
sumer behavior} OR {consumer behaviors} OR {consumer behaviour}
OR {consumer behaviours} OR {waste recycling} OR {resource recy-
cling} OR {resource reuse} OR {biobased economy} OR {zero waste}
OR {sustainability label} OR {sustainability labelling} OR {global
resource extraction} OR {material flow accounting} OR {societal
metabolism} OR {food spill} OR {resource spill} OR {resource effi-
ciency} OR {sustainable food consumption} OR {green consumption}
OR {sustainable supply chain} OR {circular economy} OR {cradle to
cradle} OR {sustainable procurement} OR {sustainable tourism} OR
{fossil-fuel subsidies} OR {fossil-fuel expenditure} OR {sustain-
ability label} OR {sustainability labelling} OR ( consumption AND
( {resource use} OR spill ) ) OR ( production AND ( {resource use}
OR spill ) ) AND NOT ( {wireless sensor network} OR {wireless sensor
networks} OR {wireless network} OR {wireless networks} OR {wire-
less} OR {disease} OR {astrophysics} ) )
```

With the described background in identifying the Sustainable Development Goal (SDG) 12-related studies, we followed the conventional PRISMA guidelines for systematic reviews and meta-analyses [9]. Figure 1 shows the stages of the research workflow, starting with 282,500 Scopus documents representing the global corpus of SDG-12 research.

This corpus has been filtered for the period since 2016, i.e., the full previous five years, from the moment of producing the analysis (early 2022), including the additional two years. Thus, we use the modified arguments provided by Körfgen et al. [10], related to the average scientific project length. Our review focuses on scientific papers and reviews published in peer-reviewed journals, thus, excluding books, book chapters, and conference proceedings, as well as editorials and other editorial material. This approach is often used in bibliometric analyses, including sustainable production [5] and sustainable development education [11]. It captures the core scientific literature of high quality, which certainly advances the state of the discipline. This produces the global corpus of 107,349 Scopus documents, which was further screened for eligibility, as related to research questions of the regional (SEE) literature coverage of the SDG goal 12.

The resulting regional corpus of literature consists of 1,145 journal articles and reviews, with at least one author affiliated to a SEE-based academic institution (i.e., based in Slovenia, Croatia, Bosnia, and Herzegovina, Serbia, Montenegro, or North Macedonia). Kosovo is not included as a separate entity in the Elsevier Scopus database, and its authors and institutions cannot be separately analyzed. Due to the usage of the

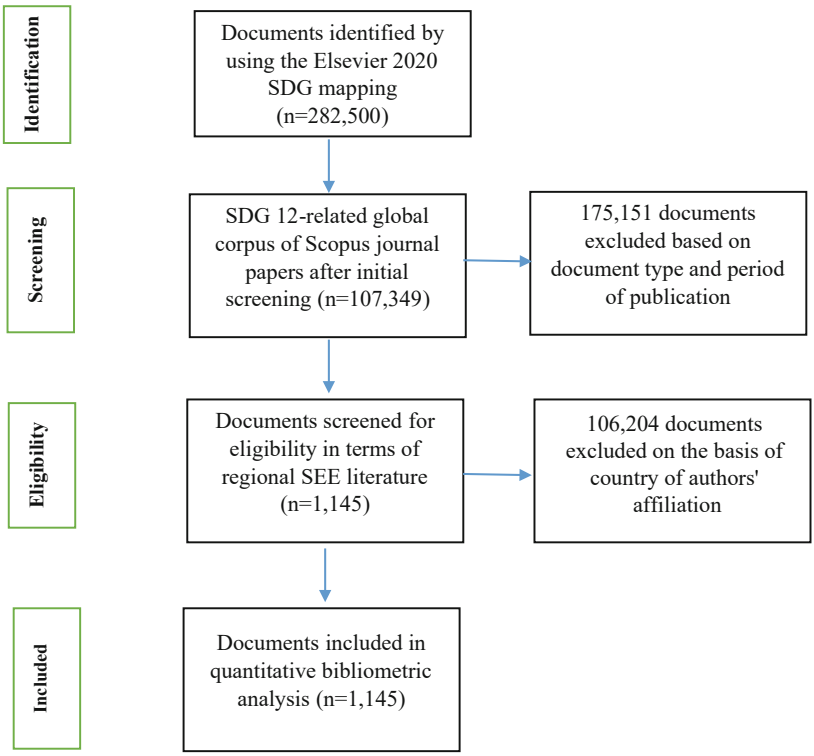

Fig. 1. PRISMA research workflow for the collection, screening, and selection of Scopus documents

previously validated bibliometric query, it was not necessary to manually assess the eligibility of the selected Scopus publications as being related to the SDG goal 12.

All of the 1,145 publications were subjected to quantitative analysis, which could be performed by using different approaches, including co-word, co-citation, and cluster analyses of bibliometric data, using tools, such as SciMAT [12], or Bibexcel and Pajek [13]. However, the most popular approach in science mapping seems to be the visualization of similarities, using the VOSviewer software, developed by the University of Leiden, Centre for Science and Technology Studies. This method involves clustering entities, such as authors, studies, journals, or countries, based on their bibliometric relationships (co-occurrences, co-citations, etc.), represented by the link strength [14]. It has been used in systematic reviews and science mapping exercises of sustainable development research [15], education [16], and innovation [17].

Further analysis could have been performed in Elsevier Scopus, which provides the fundamental tools for bibliometric analysis. However, a much more detailed analysis can be performed with the assistance of a commercial bibliometric solution, such as Elsevier SciVal. Therefore, we used the newly introduced option to export the Scopus results to SciVal, as a static publication set. In addition, we downloaded the complete

Scopus records, including references, in CSV/Excel format, which can be used for science mapping analysis in VOSViewer. The following section reports the fundamental characteristics of the extant SDG-12 literature in SEE and its structure.

3 Results

3.1 Fundamental Bibliometric Indicators for the SDG 12-Related Research in SEE

The most active SEE researchers in the SDG 12-related fields (responsible production and consumption) are affiliated with Serbian academic institutions, with the scientific output of 429 papers since 2016 (see Table 1). Bibliometric indicators, presented in Table 1, include the scientific output in Scopus-referred journals, the total number of citations received, their relative impact in terms of citations, normalized per field, and the type of publication. The normalized impact is measured using the Field-Weighted Citation Impact (FWCI), indicating the received-to-expected Scopus citation ratio, with the global benchmark value of 1.0 [18]. It shows an interesting insight into the scientific activity and the co-authorship patterns of SEE authors in SDG 12-related topics. It is pretty easy to identify the co-authorship of SEE authors with authors affiliated with academic institutions from Italy, Germany, Spain, UK, and Austria, belonging to the top 10 countries, measured by the SDG 12- and SEE-related scientific output.

It is essential to mention that US and European researchers outside of this region achieve a much higher global normalized scientific impact even for the topics relevant for the SEE region. This is not visible from the total citation count. It results from a relatively high scholarly output, with region-specific issues that seem to be cited within the low-impact publications. Therefore, international collaboration appears to drive the quality and impact of SDG-12 research in the region, as international collaborators achieve a much higher impact, in terms of the FWCI value, with a small number of publications co-authored with regional researchers.

The value of international collaboration for the quality and impact of SDG 12-related research in the region is demonstrated in Table 2. It shows that international research groups (with the scholarly output of 44.7% of the analyzed corpus) receive twice as much total citations, with the FWCI value of 2.26, as compared to the national research groups, producing only 15.6% of the corpus, with the FWCI value of 0.72, i.e., quite below the field average of 1.0.

Our proposition on many regionally relevant publications, published and cited in low- to average-impact publications, is confirmed by 32.3% of the analyzed corpus, produced within institutional boundaries and 7.4% of publications with single authorship. It could be surprising that citations per publication and the FWCI increase as one moves from nationally produced publications to institutional collaborations to single authorship. This cannot be easily explained, as quality and impact seem to decrease as national collaborations are pursued. In SEE, national evaluation systems are not focused on research excellence but instead on administrative and formal criteria, which do not motivate most researchers to produce high-quality scientific output.

Table 1. National affiliations, productivity, and impact of SDG 12-related regional research in South East Europe (SEE)

Country/Region	Scholarly output	Field-weighted citation impact (FWCI)	Citation count
1. **Serbia**	429	1.25	3882
2. **Slovenia**	360	1.74	4021
3. **Croatia**	358	1.67	3199
4. Italy	65	1.94	754
5. Germany	60	2.71	834
6. Spain	59	2.13	1003
7. United Kingdom	56	2.62	1201
8. Austria	51	2.08	566
9. **Bosnia and Herzegovina**	50	1.14	380
10. **North Macedonia**	49	1.09	342
11. United States	41	3.57	640
12. France	38	2.36	789
13. China	31	2.52	617
14. Greece	30	2.07	387
15. Russian Federation	29	1.37	207
16. **Montenegro**	28	1.94	258
17. Netherlands	28	2.51	482
18. Sweden	27	2.91	540
19. Czech Republic	26	2.15	459
20. Portugal	26	2.31	381

Source: Authors, based on Elsevier SciVal data (January 2022).

Top SEE institutions in SDG 12-related research are shown in Table 3. The most considerable amount of scientific output is produced by large, public research universities located in the capitals of Croatia, Serbia, and Slovenia. They are followed by a group of regional universities, with research groups focusing on specialized topics. However, in terms of the quality and impact, universities located in Split, Podgorica (Montenegro), Koper (Primorska), Ljubljana, Novi Sad, and Maribor, along with the Jožef Štefan Institute in Ljubljana, have the highest FWCI values of their SDG 12-related research.

The exceptionally high impact has been achieved by the University of Split, Croatia, with several small research groups and individuals, on diverse topics, such as energy efficiency and smart resource utilization, Mediterranean agriculture, ocean shipping, customers' purchase experience during the Covid-19 crisis, etc. However, based on this finding, a more focused approach could improve the already high level of impact, which is currently 5.87 times better than the global average.

Table 2. International collaboration in SEE SDG 12-related research

Metric	% of the corpus	Scholarly output	Citations	Citations per publication	FWCI
International collaboration	44.7%	512	6345	12.4	2.26
Only national collaboration	15.6%	178	1202	6.8	0.72
Only institutional collaboration	32.3%	370	2736	7.4	1.04
Single authorship (no collaboration)	7.4%	85	673	7.9	1.06

Source: Authors, based on Elsevier SciVal data (January 2022).

3.2 Science Mapping of the SDG-12 Related Research in SEE

The first step in the SDG-12 science mapping exercise has been the analysis of keywords, both in the SEE and the global literature. With the corpus of extant SEE literature identified as a Scopus document list, it is easy to export the entire document records (including references) as a CSV file to be imported into Microsoft Excel and VOSviewer. The list of SEE keywords has been produced by analyzing keyword co-occurrences, i.e., co-occurring in publication pairs [19]. The top 20 keywords from the SEE corpus are presented in Table 4, where the link strength depends on the number of publications in which the keywords co-occur.

Elsevier Fingerprint Engine (EFE) has been used to produce the word cloud, describing the global SDG 12-related research. EFE is based on text mining algorithms, using natural language processing on the titles, abstracts, and keywords of research publications and public researchers' and research organizations' profiles. Their impact is further evaluated to identify the key phrases and aggregate them on the level of the analyzed entity. We used the Elsevier SciVal to access the word cloud for the global SDG 12-related research, defined using the Elsevier SDG 2020 mapping.

The top 20 keywords in the global literature, as visualized by the previously presented word cloud, are shown in Table 5.

Due to the restrictions of the Scopus reporting engine, it is not possible to download more than 280,000 records and perform the local bibliometric analyses. In this case, Elsevier SciVal is the only available route for the bibliometric study of the global SDG 12 literature. Alternatively, access to the raw Scopus data could be used for such an analysis, but the authors did not have such access. Although the methods used do not directly compare the keywords, they can provide a provisional sense of research interests on the global and regional levels.

After accounting for the generic terms (article, analysis) and geographical names (Serbia, Croatia), there seem to be several topics in the SEE literature. Those revolve around general environmental impact and monitoring, product life cycles and their assessment (LCA), pollution, recycling, and waste management. On the other hand,

Table 3. Most productive SEE institutions in SDG 12-related research

Institution	Country/ Region	Scholarly output	Citations	Authors	Citations per publication	FWCI
University of Zagreb	Croatia	182	1837	314	10.1	1.13
University of Belgrade	Serbia	176	1776	361	10.1	1.12
University of Ljubljana	Slovenia	150	1667	193	11.1	2.03
University of Novi Sad	Serbia	116	1406	237	12.1	1.55
University of Maribor	Slovenia	83	690	133	8.3	1.48
University of Split	Croatia	46	532	54	11.6	5.87
University of Rijeka	Croatia	37	297	58	8	0.99
University of Kragujevac	Serbia	30	224	47	7.5	1.06
SS Cyril and Methodius University in Skopje	Macedonia	27	247	41	9.1	1.04
University of Nis	Serbia	24	185	42	7.7	0.49
University of Montenegro	Montenegro	23	152	37	6.6	1.98
University of Primorska	Slovenia	23	239	27	10.4	1.96
Ruđer Bošković Institute	Croatia	21	151	31	7.2	0.89
University of Prishtina "Hasan Prishtina"	Kosovo*	18	25	35	1.4	0.18
Josip Juraj Strossmayer University of Osijek	Croatia	17	82	26	4.8	0.8

(*continued*)

Table 3. (*continued*)

Institution	Country/ Region	Scholarly output	Citations	Authors	Citations per publication	FWCI
J. Stefan Institute	Slovenia	17	506	23	29.8	2.19
University of Sarajevo	Bosnia and Herzegovina	14	144	28	10.3	0.91
South Ural State University	Russian Federation	14	100	8	7.1	1.68
INRAE	France	12	353	21	29.4	2.76
Mathematical Institute of the Serbian Academy of Sciences and Arts	Serbia	11	60	15	5.5	1.44

* Elsevier SciVal does not recognize the Kosovar institutions due to the lack of international consensus in the International Organization for Standardization (ISO) and counts their output as belonging to Serbian affiliations.
Source: Authors, based on Elsevier SciVal data (January 2022).

the global literature also focuses on LCA and the waste management and recycling topics. However, the regional literature does not pay significant attention circular economy, which experiences exceptional global growth as an SDG 12-related topic. In addition, there also seems to be a lack of interest in the Corporate Social Responsibility topics in the regional literature. It proves to be the most relevant keyphrase, selected by the Elsevier EFE and reported by SciVal, for the extant global literature related to SDG 12.

The intellectual structure of the regional SEE body of literature has been visualized using the keyword co-occurrence while filtering out the keywords, co-occurring less than five times, which is the default VOSviewer value and the convention in similar research [4]. This condition has been met by 716 keywords, being initially grouped into seven clusters. Following the procedure applied by Hallinger & Chatpinyakoop [16] to co-citation analysis, where they set the cluster citation threshold to 50 citations per author, we updated the clustering solution. With three relatively small clusters (consisting of 25, 34, and 39 items) overlapping with the larger clusters' keywords, we set the minimum number of cluster items to 50, producing a science map presented in Fig. 2.

The resulting four clusters are represented by different colors and can be used to describe the intellectual structure of the regional literature related to SDG 12:

- The blue cluster (140 items) represents a group of studies related to environmental pollution and monitoring, focusing on different polluting agents and sources.
- The yellow cluster concerns the influence of environmental pollution on human and animal health, with a very small sub-cluster related to the research of consumer

Table 4. Keyphrases in the regional SDG 12-related literature

Keyword	Number of co-occurrences	Total link strength
Article	155	3799
Sustainable development	127	1062
Pollution	112	2568
Sustainability	112	821
Life cycle	111	1142
Environmental impact	110	1472
Environmental pollution	98	2226
Serbia	97	1676
Life cycle assessment (LCA)	89	892
Human	86	1846
Circular economy	84	522
Nonhuman	81	2040
Waste management	79	1038
Recycling	77	808
Chemistry	75	1946
Environmental monitoring	74	1968
Croatia	69	914
Animals	68	1467
Humans	67	1557
Analysis	64	1696

Source: Authors.

attitudes and preferences, especially food preference. This is the smallest cluster, consisting of 73 items only.

- The green cluster, consisting of 178 items, focuses on environmentally relevant chemistry topics, including the analysis of chemical pollutants, their biological influence on organisms, and different environments, including the sea.
- The red cluster is the largest, with 325 items comprising several subtopics. Almost all of them are connected to the central topics of sustainability, sustainable development, circular economy, environmental impact, product life cycle (assessment), and waste management. The subclusters, representing the subtopics, focus on sustainable tourism, generic analysis of sustainable development/sustainability, and, specifically, the product LCA, in the context of recycling and waste management; waste disposal and management practices, including their environmental impact. Some smaller and less connected topics include sustainable consumer behavior, energy efficiency, and clean production.

Table 5. Keyphrases in the global SDG 12-related literature and their dynamics (2016–2020)

Keyphrase	Relevance (max value = 1.00)	Scholarly Output (growth %, over the period 2016–2020)
Corporate social responsibility	1	57.9
Life cycle assessment	0.94	35.9
Municipal solid waste	0.63	36.4
Circular economy	0.56	687.2
Consumer behavior	0.42	35.8
Solid waste	0.41	28.8
Waste	0.33	95.2
Soil pollution	0.3	111.7
Recycling	0.27	106.4
Waste management	0.27	58.8
Waste disposal facilities	0.25	42.4
Sustainability	0.24	114.9
Sustainable	0.22	131
Heavy metal	0.21	56.5
Solid waste management	0.2	83.1
Community participation	0.19	53
Greenhouse gas emission	0.19	40.7
Coal ash	0.19	69.3
Tourism	0.18	133.8
Food waste	0.17	77

Source: Authors, based on Elsevier SciVal data (January 2022).

The temporal overlay of the co-occurrence keyword map (see Fig. 3) shows the keyword evolution during the analyzed period and illustrates the recent developments in the regional literature. Keywords and topics, visualized by blue shades, have been dominant in 2017–2018, while green shades represent the topics and keywords from 2018–2019. Yellow shades represent the recent topics emerging since 2019.

We have emphasized two sub-clusters by looking into the specific branches associated with the particular nodes in the science map, previously done by In, Lee & Eccles [20]. Figure 4 singles out the older (ca. 2016–2018) literature sub-cluster, focusing on waste management, recycling, and environmental impact. A somewhat more recent

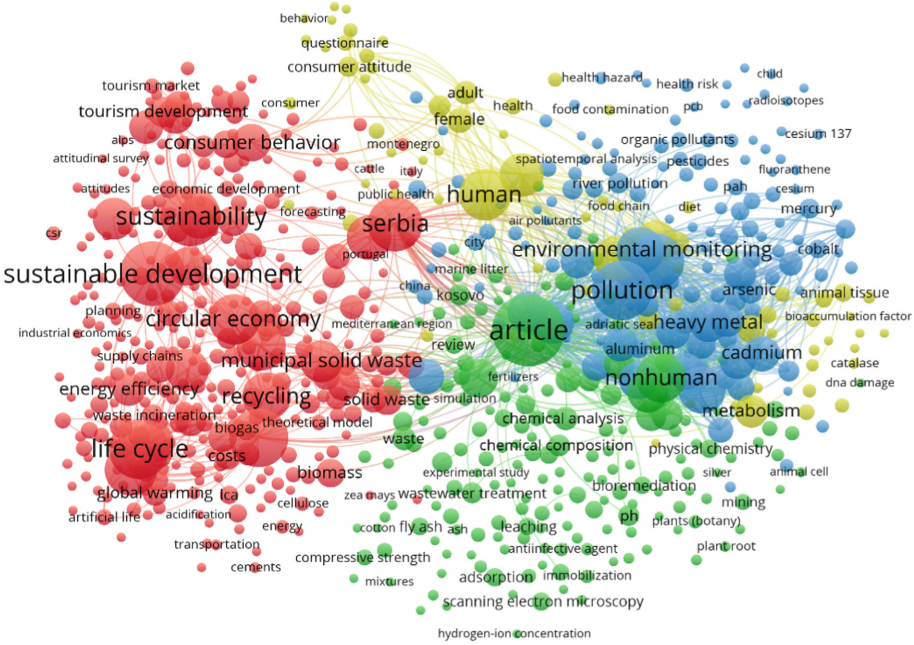

Fig. 2. Keyword co-occurrence map of the SEE literature on SDG 12 (2016–2022). Source: Authors, based on VOSviewer visualization engine.

(ca. 2017–2018) sub-cluster, presented by Fig. 5, groups the regional scientific output related to environmental pollution, sources, and different pollutants. A separate analysis, emerging as of 2018–2021, related to product life cycle (analysis), seems to be isolated from the previous regional literature on pollution, waste, and their environmental impact/management (see Fig. 6).

The recent developments in the SEE literature focus (as of 2018) on the topics of pro-environmental consumer attitudes and behaviors (Fig. 7), environmentally friendly tourism (Fig. 8), and, most recently (as of 2019), on circular economy (Fig. 9). This venue of analysis seems to be emerging rather late compared to the growth of the topic in the global SDG 12-related literature since 2016. There are no links among the three more recent regional literature sub-clusters, which indicates a significant weakness related to the lack of transdiciplinarity. It is required to solve the complex problems of sustainable development [21] and teach the responsible approach to sustainable development in higher education [22].

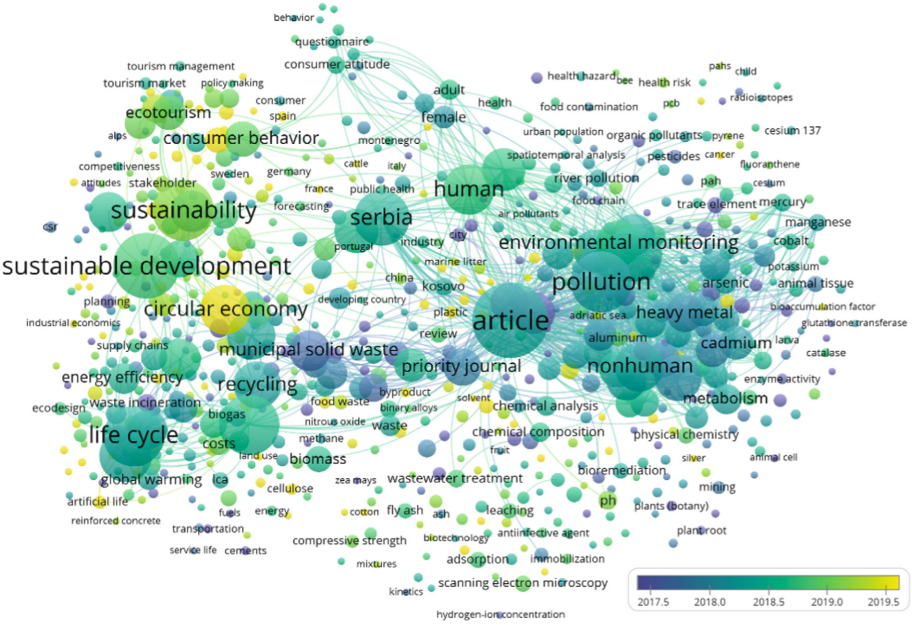

Fig. 3. Keyword evolution the SEE literature on SDG 12 (2016–2022). Source: Authors, based on VOSviewer visualization engine.

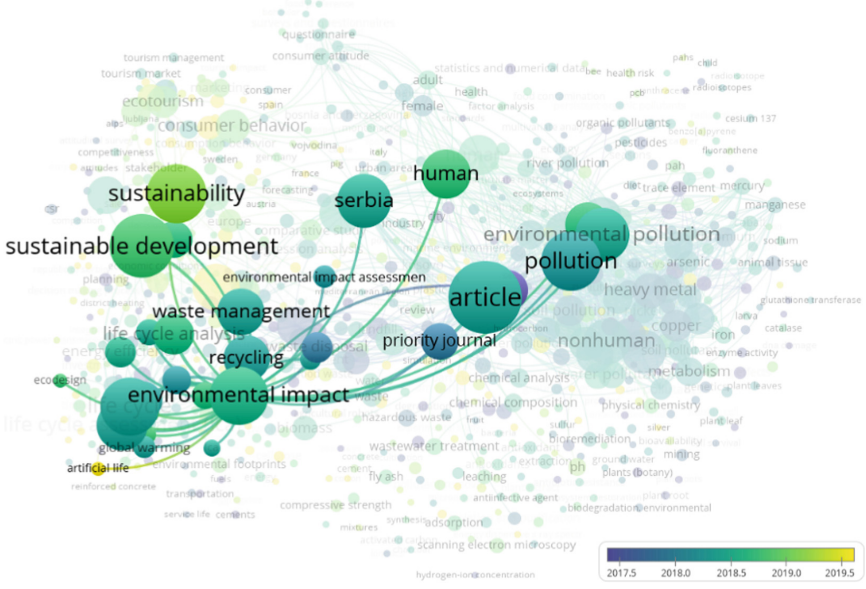

Fig. 4. Waste management, recycling and environmental impact regional literature sub-cluster. Source: Authors, based on VOSviewer visualization engine.

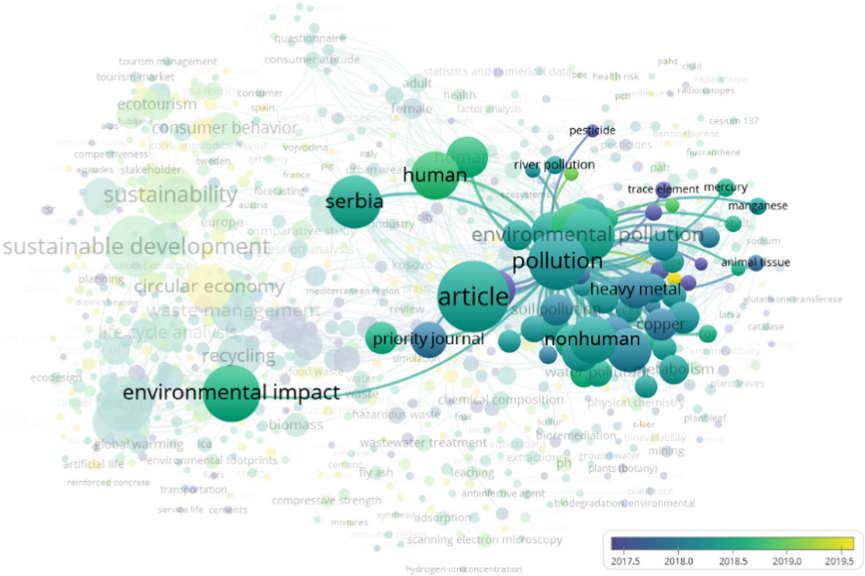

Fig. 5. Environmental pollution regional literature sub-cluster. Source: Authors, based on VOSviewer visualization engine.

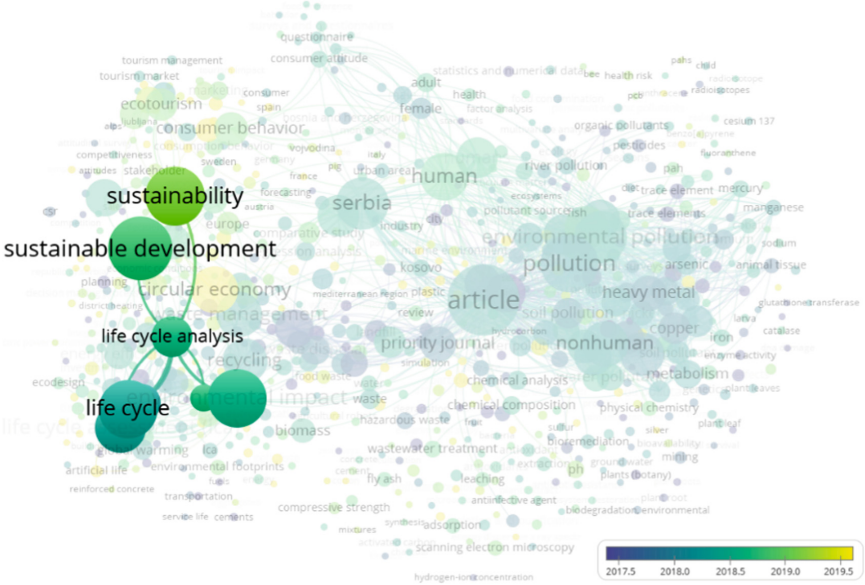

Fig. 6. Life cycle (analysis) regional literature sub-cluster. Source: Authors, based on VOSviewer visualization engine.

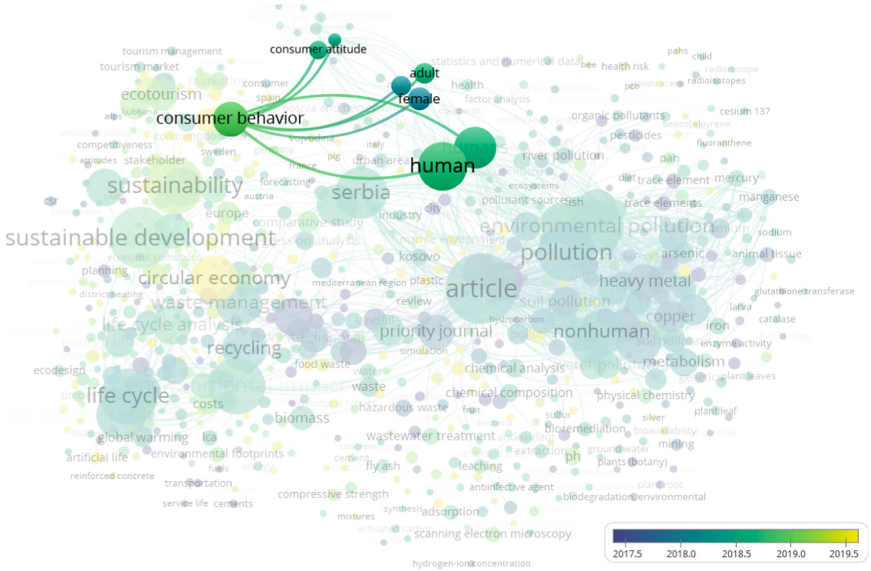

Fig. 7. Pro-environmental consumer attitudes and behavior regional literature sub-cluster. Source: Authors, based on VOSviewer visualization engine.

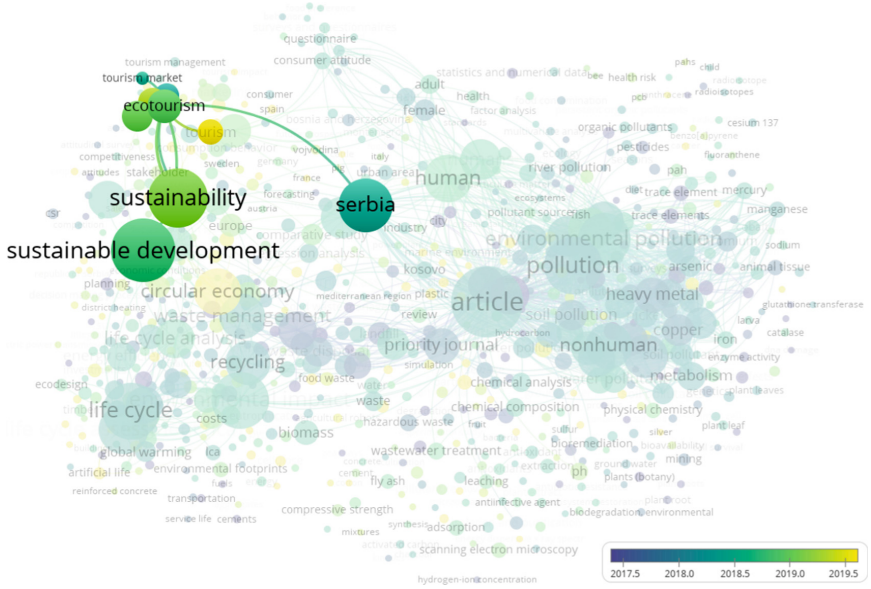

Fig. 8. Sustainable tourism regional literature sub-cluster. Source: Authors, based on VOSviewer visualization engine.

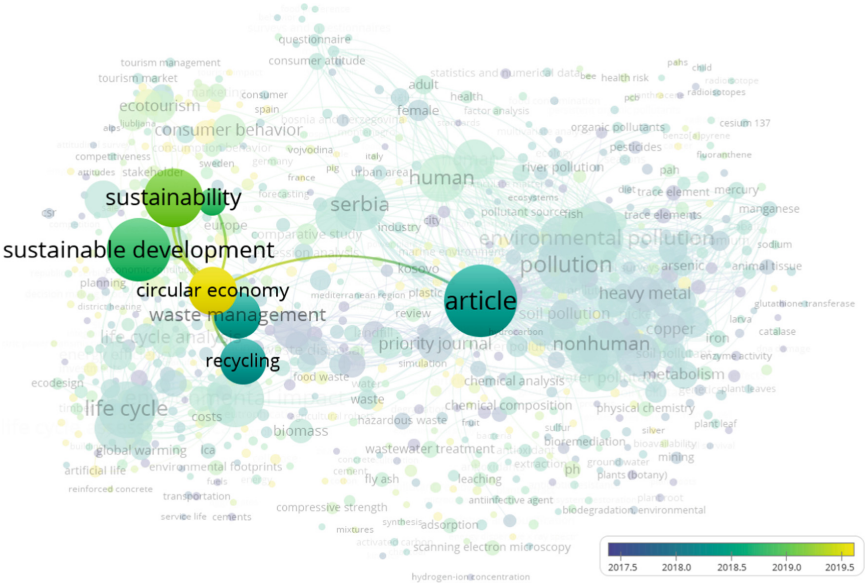

Fig. 9. Circular economy regional literature sub-cluster. Source: Authors, based on VOSviewer visualization engine.

4 Discussion

Concerning RQ1, a clear science map has been identified for the SDG 12-related topics in the SEE region. Based on the keyword co-occurrence, several smaller subclusters have been identified, with the discussion focusing on specific pollutants, human and animal health, and a range of topics from the business and economics fields. Two issues could be mentioned as limitations of the regional literature. Firstly, there is a lack of attention to the concept of circular economy and undeveloped relationships between the research subtopics. The latter could be interpreted as individual researchers, and small research groups are primarily driven by their international research partners rather than the comprehensive and well-prepared local and regional research agendas and policies.

Based on results related to a much higher impact of publications involving international co-operation and the disappointing impact of national co-operation, it could be suggested that the national research evaluation frameworks in the region do not follow or support the sustainable development agenda. The resulting impact of researchers, who do not belong to the global networks, is disappointing. At the same time, the lack of coordination seems to be reflected in a low level of transdisciplinarity. Such conclusions can be supported by a recent analysis of Polish and Croatian research evaluation systems, showing their short-term and bureaucratic orientations [23].

As related to RQ2, keyword analysis shows that some global trends are followed. However, the already mentioned lack of attention on circular economy topics is coupled with the absence of SDG 12-related research focusing on Corporate Social Responsibility (CSR). This could point to the low interest of business researchers for the issues of

sustainable business practices and the lack of relationships of the technically oriented regional SDG literature to the Responsible Management Education (RME) topics.

Since the observed trends have been identified in the literature analysis related to a single SDG, they should be verified by future research on an extended scope, with coverage of multiple regions or the global literature.

5 Conclusion

This study presents the science map of the SDG 12-related literature in the SEE region, with an additional focus on the differences with the extant global research on this specific topic. The obtained results can be associated with the overall research practices and the functioning of the research evaluation systems in this region. However, they might be of interest to the research managers at the department, university, and national levels, since it is indicated that regional research of SDG-related topics should be encouraged and supported, with a particular emphasis on transdisciplinarity and internationalization.

Lack of focus on CSR and related fields and a low level of interconnectedness among the research clusters indicate that the regional business schools and their researchers have not yet perceived sustainable development and SDGs as a relevant research topic. This could be corrected with the additional encouragement provided by research support programs on the institutional and university levels.

This study covers a single SDG and the related body of extant literature produced in a single region as a matter of limitations. A more comprehensive analysis, both in terms of literature and geographical coverage, is needed to reveal additional relevant issues and enable the regional bibliometric comparisons within Europe or globally.

References

1. Bengtsson, M., Alfredsson, E., Cohen, M., Lorek, S., Schroeder, P.: Transforming systems of consumption and production for achieving the sustainable development goals: moving beyond efficiency. Sustain. Sci. **13**(6), 1533–1547 (2018). https://doi.org/10.1007/s11625-018-0582-1
2. Fonseca, L.M., Domingues, J.P., Dima, A.M.: Mapping the sustainable development goals relationships. Sustainability **12**(8), 3359 (2020). https://doi.org/10.3390/su12083359
3. Meschede, C.: The sustainable development goals in scientific literature: a bibliometric overview at the meta-level. Sustainability **12**(11), 4461 (2020). https://doi.org/10.3390/su12114461
4. Pizzi, S., Caputo, A., Corvino, A., Venturelli, A.: Management research and the UN sustainable development goals (SDGs): a bibliometric investigation and systematic review. J. Clean. Prod. **124033** (2020). https://doi.org/10.1016/j.jclepro.2020.124033
5. Bhatt, Y., Ghuman, K., Dhir, A.: Sustainable manufacturing. Bibliometrics and content analysis. J. Clean. Prod. **260**, 120988 (2020). https://doi.org/10.1016/j.jclepro.2020.120988
6. Armitage, C.S., Lorenz, M., Mikki, S.: Mapping scholarly publications related to the sustainable development goals: do independent bibliometric approaches get the same results? Quant. Sci. Stud. **1**(3), 1092–1108 (2020). https://doi.org/10.1162/qss_a_00071SD
7. Jayabalasingham, B., Boverhof, R., Agnew, K., Klein, L.: Identifying research supporting the United Nations sustainable development goals (Version 1). Mendeley Data (2019). https://doi.org/10.17632/87txkw7khs.1

8. Rivest, M., et al. Improving the scopus and aurora queries to identify research that supports the United Nations sustainable development goals (SDGs) 2021 (Version 4). Mendeley Data (2021). https://doi.org/10.17632/9sxdykm8s4.4
9. Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., & Prisma Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med. **6**(7), e1000097 (2009). https://doi.org/10.1371/journal.pmed.1000097
10. Körfgen, A., et al.: (It's a Hit! Mapping austrian research contributions to the sustainable development goals. Sustainability. **10**(9), 3295 (2018). https://doi.org/10.3390/su10093295
11. Figueiró, P.S., Raufflet, E.: Sustainability in higher education: a systematic review with focus on management education. J. Clean. Prod. **106**, 22–33 (2015). https://doi.org/10.1016/j.jclepro.2015.04.118
12. Sánchez-Camacho, C., Carranza, R., Martín-Consuegra, D., Díaz, E.: Evolution, trends and future research lines in corporate social responsibility and tourism: a bibliometric analysis and science mapping. Sustain. Dev. (2021). https://doi.org/10.1002/sd.2260
13. Wichaisri, S., Sopadang, A.: Trends and future directions in sustainable development. Sustain. Dev. **26**(1), 1–17 (2018). https://doi.org/10.1002/sd.1687
14. Chandra, Y.: Mapping the evolution of entrepreneurship as a field of research (1990–2013): A scientometric analysis. PLoS ONE **13**(1), e0190228 (2018). https://doi.org/10.1371/journal.pone.0190228
15. Farrukh, M., Meng, F., Raza, A., Tahir, M.S.: Twenty-seven years of sustainable development journal: a bibliometric analysis. Sustain. Dev. **28**(6), 1725–1737 (2020). https://doi.org/10.1002/sd.2120
16. Hallinger, P., Chatpinyakoop, C.: A bibliometric review of research on higher education for sustainable development, 1998–2018. Sustainability **11**(8), 2401 (2019). https://doi.org/10.3390/su11082401
17. Vatananan-Thesenvitz, R., Schaller, A.A., Shannon, R.: A bibliometric review of the knowledge base for innovation in sustainable development. Sustainability **11**(20), 5783 (2019). https://doi.org/10.3390/su11205783
18. Purkayastha, A., Palmaro, E., Falk-Krzesinski, H.J., Baas, J.: Comparison of two article-level, field-independent citation metrics: field-weighted citation Impact (FWCI) and relative citation ratio (RCR). J. Informet. **13**(2), 635–642 (2019). https://doi.org/10.1016/j.joi.2019.03.012
19. Radhakrishnan, S., Erbis, S., Isaacs, J.A., Kamarthi, S.: Novel keyword co-occurrence network-based methods to foster systematic reviews of scientific literature. PLoS ONE **12**(3), e0172778 (2017). https://doi.org/10.1371/journal.pone.0172778
20. In, S.Y., Lee, Y.J., Eccles, R.G.: Looking back, looking forward: scientometric analysis of 47 years of sustainability research, SSRN Working Paper (2020). https://doi.org/10.2139/ssrn.3693254
21. Jahn, T., Bergmann, M., Keil, F.: Transdisciplinarity: between mainstreaming and marginalization. Ecol. Econ. **79**, 1 (2012). https://doi.org/10.1016/j.ecolecon.2012.04.017
22. Parkes, C., Blewitt, J.: Ignorance was bliss, now I'm not ignorant and that is far more difficult: transdisciplinary learning and reflexivity in responsible management education. J. Glob. Responsib. **2**(2), 206–221 (2011). https://doi.org/10.1108/20412561111166058
23. Ciurak, P., Mijač, T., Wierczyński, G.: An overview of science evaluation in Poland and Croatia. Manag. J. Contemp. Manag. **26**(2), 229–244 (2021). https://doi.org/10.30924/mjcmi.26.2.13

Usage of Social Marketing for Stimulating Volunteerism Amongst Young People: The MOA Model

Adi Alić(✉), Denis Berberović, and Amra Ćatić

University of Sarajevo, 71000 Sarajevo, Bosnia and Herzegovina
{adi.alic,denis.berberovic}@efsa.unsa.ba

Abstract. There has been growing recognition of the importance of volunteerism in achieving goals of sustainable development. This has led to increasing interest in academic research focused at understanding motivational factors which actuate individuals to engage in volunteerism. Of particular interest is the question how to stimulate young individuals to engage in volunteerism. Therefore, this paper discusses the application of the social marketing framework of: motivation, opportunity and ability (MOA) amongst non-governmental organizations in Bosnia and Herzegovina. Explorative qualitative research design was applied, with semi-structured interviews as data collection method. The sample consisted of nine volunteers who performed volunteer activities at the Center for Promotion of Civil Society (CPCS). Research findings show that a plethora of motives, opportunities and abilities could be used as recommendations for organizing volunteering activities, but also as values in communication campaigns for the purpose of recruiting new volunteers.

Keywords: Social marketing · Volunteerism · Young people · NGOs · MOA model

1 Introduction

In 2015, the United Nations General Assembly adopted the 2030 Agenda for Sustainable Development [1], in which volunteer groups were explicitly identified as stakeholders in the achievement of the 17 Sustainable Development Goals (SDGs). This collection of 17 Sustainable Development Goals (SDGs, also known as the Global Goals) aims to end poverty, inequality, injustice and climate change by 2030.

Volunteering is a part of every civilization and society and comes in all forms, from traditional mutual aid practices to organized community action in times of crisis. Today, given the prevalent global problems, the need for organized volunteering is greater than ever. Volunteering is an essential element of civil society initiatives, and volunteers are an important human resource for third-sector organizations. One of the key principles on which volunteering is based is the belief that global change begins with local change, that economic and social progress does not begin at the top, but at the local and at the broadest level. In volunteer projects, the focus is on achieving positive change at the local

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 147–162, 2023.
https://doi.org/10.1007/978-3-031-17767-5_11

level, addressing specific and concrete problems in the community, especially involving citizens, community residents in the project: from conception to implementation.

Examples of volunteer activities can be found in all sectors of society in almost all sociodemographic categories [2]. Since there is no monetary compensation, it is important to understand volunteer motivation as the key to organization's success and effectiveness. Altruistic motives are characteristic of volunteers who are not interested in personal benefits obtained by providing unpaid services [3]. Basically, altruism is the contribution of time, energy and resources to an organization with the sole purpose of helping others. While altruism is often cited as the primary motivation for volunteering, it is widely believed that serving others is mutually beneficial for both the provider and recipient [4].

The peculiarity of volunteering is that it is not limited by external factors, such as earning a salary, gaining prestige or social status, or earning job rewards, but rather by internal motivations and causes. Accepting the responsibility of volunteering is different from accepting paid work because the volunteer does the work of his choice according to his kinship, decides to volunteer voluntarily, there is no coercion, there is no authorization, and it is not done to secure their interests and their own existence. Precisely because volunteering is based on freedom of choice, the basic premise of which is free will, which, among other things, is a very personal thing.

Bussell and Forbes [5] suggest that additional research is needed to improve understanding of volunteer motivation. Previous research has shown that individuals are willing to engage in volunteering, but there is still insufficient understanding of the motivational factors that motivate individuals and culturally diverse groups to serve their communities [6].

With regards to the previously mentioned, it is clear that research into the possibility of motivating volunteers to approach and perform various activities is a very challenging phenomenon, with significant practical, theoretical and social contributions. One of the very much established theoretical models within social marketing, which can serve as a fundamental model for studying volunteer motivation is the Motivation-Opportunity-Ability (MOA) model. The MOA model is a well-established framework used as a theoretical basis for explaining job performance in employee behavior [4, 7], consumer choice [8], and decision-making [9].

The MOA model is a useful framework in the context of social marketing. It has been suggested that social marketing and MOA approaches provide a useful complementary approach to interventions targeting social issues. The proposal advocates the MOA approach as an overarching guiding model for social marketing programs and provides the basis for a comprehensive strategy for interventions targeting social issues, including volunteerism [10].

The fundamental study challenge that this paper begins with is the subject of how social marketing motivates young people to volunteer, and whether using the MOA model of social marketing is important for increasing the number of young volunteers. In this regard, the study's goals are to examine the characteristics of social marketing strategies (MOA model) used by NGOs in Bosnia and Herzegovina, as well as to determine how and to what degree their implementation influences the number of volunteers.

As an important stakeholder in the development of civil society in Bosnia and Herzegovina, civil society operates in an inactive economy. The community's attitude toward problems is passive. Politics, government, and economics are now in charge. Civil society organizations represent and promote the values and norms of modern democratic societies in a society with a relatively low level of trust. Despite their dedication to improving the lives of those they work with and successfully contributing to the public good, these organizations have little influence in the process of drafting, deciding, and implementing legislation for the benefit of their members.

The presented MOA model study poses a useful explorative research about volunteering activities in Bosnia and Herzegovina, providing a good starting point in understanding motivation for young people's engagement in volunteerism.

2 Literature Review

The role and significance of non-profit organizations in society became interesting in the late twentieth century as part of a more intensive study of the relationship between the three fundamental determinants of any modern society: state (government), community of people, and markets, as seen through their tasks and responsibilities [11]. Civil society was defined as a normatively privileged arena or sphere outside the state in which organizations and individuals interact independently and apart from political and economic logics. Civil society was a privileged arena for social critique and dissent, which needed to be nurtured not only as a democratizing force in authoritarian regimes, but also to keep democracy alive in Western Europe. A thriving civil society became the defining feature of a well-functioning liberal, representative, parliamentary democracy [12].

This shift, driven by the donor agencies' neoliberal project, also privileges the type of role that NGOs as civil society organizations are expected to play, the type of engagement they are to have with other civil society formations, the state, and the market. As a result, the name change has the potential to promote a depoliticized version of social action while weakening civil society's ability to pursue radical ideas of social change; striking at the fundamental structure of society or the way the state relates to its people [13]. As they began to subscribe to the notions of civil society associated with this concept in its neoliberal incarnation, non-governmental organizations (NGOs) began to refer to themselves as civil society organizations. According to Walzer [14], these organizations exist in an unforced realm of human existence where social affairs are conducted without reference to or interference from the state or market. Thus, civil society organizations are accepted as a sphere in which communitarian spirits are grown and nurtured, where differences - structural, cultural, ideological - are dissolved, boundaries are blurred, and human beings come to share fellow feeling and warmth of togetherness and unforced sociability [13].

The definition of non-profit organizations provided by John Hopkins University's Centre for Civil Society Studies, a pioneer in the study of non-profit organizations, states that NPOs have five indicators. All of the indicators mentioned here are related to the organizational dimensions of civil society rather than the process or value-oriented dimensions [15]:

- They are organized, i.e. they possess some institutional reality.

- They are private, i.e. they are institutionally separate from the government.
- They are non-profit distributing, i.e. they do not return the money that has been generated to their owners or directors.
- They are self-governing, i.e. they are capable of controlling their own activities.
- They are at least partially voluntary, implying a significant degree of voluntary participation, either in the actual conduct of the agency's activities or in the management of its affairs.

The authors of this report, also noted that "Quite clearly, this definition of the non-profit sector goes well beyond the NGOs concept in common usage within the development world. It comes closer to what more recently come to be referred as "civil society organizations", i.e. organizations that function outside the market and the state, though this latter concept is far less widely utilized or understood" [13, p. 21].

According to the above comprehensive definition of NGOs, one of the most important aspects of their work is based on voluntary participation. In fact, non-profit organizations rely on volunteers to reach a larger population than they could with a limited number of employees alone [16]. Volunteers frequently assist nonprofits in providing needed programs and services. The diversity and complexity of non-profit organizations available among communities represents the need for volunteers to be skilled, trained and experienced in a number of aspects. Therefore, nonprofit managers should understand the important role of volunteers in a nonprofit organization and have the necessary knowledge on how to hire, manage, and retain them. The right approach to volunteers can mean the difference between active, committed volunteers or constant change that disrupts the organization's programs and morale. Volunteerism research has academic and practical value because the nature of volunteerism is perceived as a vehicle for achieving sustainable development. Volunteering allows people to participate in their own development and peacekeeping, while also strengthening social cohesion and trust by encouraging individual and collective action, resulting in long-term development for people by people. Volunteering's contribution to sustainable development is especially striking in the context of the new SDGs because it allows people to become responsible actors in their own development as well as being active models of change.

2.1 Volunteerism

Because religion, politics, and culture all have a strong influence on the concept of volunteerism [17], there is no universally accepted definition of volunteerism in the existing literature. Furthermore, despite the fact that volunteerism has been the subject of numerous studies, an integrated theory of volunteering has yet to emerge [18]. According to Wilson [19], the lack of a theory of volunteering can be explained by the fact that the generic term "volunteering" encompasses a wide range of very different activities, ranging from voluntary participation in sports associations or schools to helping people with disabilities or the elderly, preventing an attempt to explain all of these activities by the same theory. Volunteering is essentially a commitment to a specific goal without the expectation of monetary compensation. According to the definition of volunteerism provided by the United Nations General Assembly [20], first, the action should be performed voluntarily, according to an individual's own free will, rather than

as an obligation imposed by law, contract, or academic requirement. Second, the action should not be undertaken solely for monetary gain. Third, the action should be for the common good, benefiting people outside the family or household directly or indirectly, or a cause, even if the person volunteering usually benefits as well. In addition, two other factors should be mentioned [21]: (1) Volunteering implies active participation, implying that the act of volunteering entails active participation or contributions of time, energy, or talents. It is never seen as a donation or sponsorship of financial or material resources. (2) Volunteering is voluntary. Individuals freely give their time, energy, and talents for whatever reason they choose.

According to Shah et al. [22] there are two types of volunteerism: informal and formal volunteerism. Formal volunteering is carried out by a group or organization and is structured and embedded in NGO programs. Individuals engage in informal volunteering to assist a fellow community member in need. Govo [23] defines informal volunteerism as "participating in some activities outside of the purview of a formal organization." Structured or formal volunteerism makes a significant contribution to development [24].

Regardless of the differences in definitions and types of volunteerism, it is important to note that the modern view of volunteering is characterized by a two-way process in which each party involved receives certain benefits, and it can be said that volunteering is the creator of human and social capital, i.e. an important factor influencing the improvement of social cohesion and one of the strongest elements contributing to the development of society. The 2011 UNV (United Nations Volunteers) report confirms this, stating that volunteering contributes to sustainable development by engaging people at all levels of society, influencing major changes in the community, and promoting social inclusion and the environment for sustainable development. According to the report, societies that value diversity show signs of social and societal development [25].

The EU Commission declared 2011 the European Year of Volunteering, emphasizing the importance of volunteering today. Citizens volunteer in various organizations, including civil society organizations, youth clubs, hospitals, schools, and sports clubs, among others. The EU Commission acknowledged the value of volunteering, emphasizing that it is an active expression of civic participation that strengthens common European values such as solidarity and social cohesion. Furthermore, volunteering provides significant learning opportunities, as participation in volunteering activities can help people develop new skills and abilities, as well as improve their employability. Volunteering has been recognized by the EU Commission, which has included volunteering in the Europe 2020 strategy - a strategy for smart, sustainable, and inclusive development [26].

Recognizing and legitimizing the importance and impact of volunteers is critical for analyzing and understanding their activity, as well as the factors that may influence them in the future. Understanding this process could lead to more efficient design of volunteer attraction and retention policies and statements in non-profit organizations [27]. It is critical to consider the opportunity that each organization provides volunteers to capitalize their skills and abilities in order to meet their expectations, which are shaped to a large extent by their motivations [28, 29]. A better understanding of volunteers' motivations will simplify task definitions, allowing motivations to be fulfilled [30], and may also serve as an important attraction factor [31]. There are many studies on motivation in

general and its applications to work, but there are fewer on motivation for volunteerism, and their findings indicate a need for more empirical research [32].

2.2 Volunteer Motivation

Volunteer motivation is defined as an individual's desire to seek out volunteer opportunities, commit to voluntary service, and stay involved in volunteerism for extended periods of time [28, 33]. A motive is something that motivates or guides a person to complete a task or achieve a goal. Motives can range from awards and recognition to self-actualization, and it all depends on the individual. Some people are more motivated by self-realization, while others are more motivated by social acceptance. There are many reasons why people volunteer, from having too much free time to feeling useful (helping those who are less fortunate and dealing with various social and life problems), to gaining personal benefits from volunteering (work experience, travel, acquaintances, etc.), so volunteering appears to them to be an ideal activity to fill that time.

As a result of the application of various theories (e.g., Maslow's Needs Theory, Vroom's Expectancy Theory, Herzberg's Two-factor Motivational Model, Hackman and Oldham's Job Characteristic Model) that have been proposed to explain why people spend time and effort on volunteer tasks, a wide variety of volunteer motivations have been identified in the volunteer literature [e.g. 28, 33–38]. Clary et al. [28] and Lai et al. [37] identify six motivations for volunteering in one of the most comprehensive classifications in the literature: 1) values (to express values related to altruistic and humanitarian concerns for others); 2) understanding (to acquire new learning experiences and/or exercise skills that might otherwise go unused); 3) social (to strengthen social relationships); 4) career (to gain career-related experience); 5) protection (to reduce negative feelings about oneself or address personal problems); 6) self-enhancement (to grow and develop psychologically). Other dimensions of motivation have been identified, such as patriotism [e.g. 39–41], security [e.g. 42, 43], reciprocity, reactivity, and recognition [e.g. 44], religion [e.g. 45], etc. Furthermore, these motivations are classified as intrinsic (e.g., self-expression) or extrinsic (discrete outcome) desires [46]. The social environment is also credited with modifying inherent tendencies [46, 47].

2.3 Social Marketing and Volunteering

There is a lot of research related to understanding the motives for getting involved in volunteer activities, which are, in essence, the result of answering the question: Why do people volunteer? The other side of the coin, however, addresses the question: How to influence people to volunteer? According to Rothschild [48], the answer to this question can be found in marketing. Utilizing marketing in the recruitment of young volunteers is, thus, an effective strategy [49]. This primarily refers to social marketing, as a new form of marketing, which emerged in the 1970's, which applies traditional marketing theories on selling ideas, attitudes and behavior [50]. While commercial marketers engage in marketing activities to increase profit and benefit shareholders, social marketers aim to transform society for the better, in terms of the creation of capable, free, fair and sustainable societies [51]. Social marketing does not only help to build a better society, it is also a strategic tool for planning cost-effective and sustainable projects and ensuring

their long-run impact [52]. Since volunteering has a positive impact both on a societal and individual level, marketing the activity is beneficial.

Boehm [53] discussed social marketing as a tool for developing a volunteer program and recruiting volunteers, recognizing the potential of using social marketing for this purpose and calling for additional research on the subject. Several articles highlight the voluntary behavior change involved in social marketing [e.g. 10, 48, 54, 55], but this is not the same as encouraging young people to volunteer through social marketing. Young people are becoming more interested in ethical and environmentally responsible behavior [56, 57]. They prefer businesses that are socially responsible, work to improve society, solve social problems, and have a positive impact on the world. Companies must therefore be transparent and authentic in their sustainable and ethical business practices, and their marketing should be socially responsible [56]. According to Polsa [54], encouraging students to volunteer through social marketing could have a particularly positive impact on both society and students' lives.

Social marketing also has educational value: in addition to highlighting problems that most people are already aware of (such as the dangers of drunk driving and drug use), it effectively raises public awareness of topics that they might not otherwise be aware of [55]. Having in mind the primary role of influencing behavior, Andreasen [10] discusses three different societal levels of social change: "individual change", "community mobilization" and "structural change". Citizens contribute to a change on individual level, whereas, targeting policy makers and stakeholders create change on an institutional and social level [58]. Yet, as Polsa [50] argues, it is the individual who ultimately decides on behavior change.

Although social marketing programs are increasing [10], according to Binney, Hall and Oppenheim [59] there are some difficulties guiding social marketing programs, and consequently, increasing the need for a well-defined theoretical framework for social marketing. According to Gordon [60], when it comes to social marketing projects, the marketing mix is no longer sufficient. As a result, this paper proposes an expansion of social marketing tools through the use of the MOA framework, which has proven to be appropriate for social change programs [10, 48, 59].

The MOA model that has been introduced by MacInnis and Jaworski [61] was originally applied to information processing and advertising effectiveness. According to the model, motivation and ability are important factors in individuals' information processing and the formation of their attitudes as consumers. The MOA model is also a well-developed framework that can be used as a theoretical foundation to explain employee behavior [7, 62].

Rothschild [48] was the first to apply the MOA model to social marketing, implying that motivation, ability, and opportunity can help determine whether a person is inclined, resilient, or incapable of acting in accordance with desired marketing preferences In this context, motivation is defined as the desire to behave or act, ability is defined as the possession of a skill or expertise to act (for example, the ability to overcome addiction), and opportunity is defined as the absence of environmental barriers to action. Rothschild proposes that social marketers can use education, marketing, or law in various combinations to change consumer motivation, ability, and opportunity, transforming consumers who cannot behave or are resilient into consumers who are prone to behaving in ways that

the marketer desires. According to this, first aim of this study was to analyze motives of young individuals to engage in volunteering activities through the MOA model, within the NGO sector of Bosnia and Herzegovina. Therefore, following research question was defined:

RQ1: What motivates young individuals to engage in volunteerism?

According to Andreasen [10], social issues can be classified as motivational, opportunity, or ability problems, and complementary interventions can be designed for the individual, community, or overall program level. Lockstone-Binney, Binney, and Baum [63] applied the MOA model to a pro-environmental behavior change intervention and discovered that it provided insight into the interactions that can lead to long-term behavior change. Volunteering is the socially desirable behavior being promoted in the current paper. As a result, there is reason to believe that using the MOA framework has the potential to assist in the promotion of volunteering as an activity and the desirable benefits associated with this prosocial behavior. Accordingly, another research aim was set, in order to determine how the implementation of social marketing strategies can increase the number of volunteers. Hence, following research question has been proposed:

RQ2: How are young individuals stimulated through social marketing to volunteer?

3 Methodology

Given the previous discussion and the fact that there is a lack of publicly available data on volunteering activities in Bosnia and Herzegovina, an exploratory research design appears to be appropriate [64]. Therefore, this research has applied qualitative exploratory design in investigating the importance of application of social marketing aimed at increasing the number of young volunteers.

The Centre for Promotion of Civil Society (CPCS) has been used as case study since it is one of the rare non-governmental organizations that is actively working on involvement of young people in volunteering activities in Bosnia and Herzegovina. Young people who have volunteered or are still volunteering in CPCS have been found to be an appropriate group of research participants. In total nine volunteers participated in the research. In-depth semi-structured interviews have been used as method of collecting primary data [65]. The interview guide was adapted from a study by Rodrigues Simoes and Jaehn [66] and is based on a theoretical framework, being divided into four main sections. Section 1, basic questions about the respondent; Sect. 2, specific questions about volunteering through the prism of social marketing's 4 Ps; Sect. 3, specific questions about motivation, opportunities and abilities (MOA model); Sect. 4, concluding remarks about volunteering. All individual interviews with research participants were conducted within a month. Each interview lasted between 40 and 70 min, resulting in a total of 5 h of interviews. Transcriptions were made and analysis was conducted using the qualitative data analysis software Atlas.ti [67].

Complementary data were collected through revising organization documents. Written reports of volunteers from previous years were reviewed and the obligations and responsibilities of volunteers on various projects were determined. This made it possible to envisage certain prescribed volunteering practices at the organizational level.

The analysis was performed using ATLAS.ti qualitative data analysis software. Collected data was analyzed using an open coding structure with various related topics

within the framework of theoretical categories suggested by the previously discussed MOA model. In the initial phase of analysis, the software simplifies the encryption process, while in the final phase it provides networks and relationships.

The first phase of data analysis was open coding; reading and understanding all the data found and searching for certain terms to be repeated in order to eventually mark them in the ATLAS.ti software. Subsequently, a second analysis is performed through a coding scheme based on the literature, which is associated with the first open coding results.

The second phase of coding is axial coding. Axial coding is part of an analytical process in which the researcher reconnects parts of the data identified and separated in open coding in new ways to establish a link between categories or codes.

The final, third phase of the analysis was selective coding. ATLAS.ti provided the ability to create multiple code chains and link citations to create networks that are key to coding in the third phase. Concepts, topics, and patterns emerged from network diagrams.

4 Results

Research findings suggests that CPCS was a vital organization in the lives of research respondents as it helped them achieve the development of professional and personal goals, as well as to contribute to positive changes at the community level. Furthermore, the CPCS has enabled the building of trust and independence between male and female volunteers. By establishing contacts, organizing events and actively participating in project activities, CPCS volunteers acquired the skills of empathy, tolerance, understanding and development of interpersonal relationships.

In general, the idea of life goals motivated volunteers to have a positive impact on the lives of others by volunteering, and the concept of setting goals was eventually achieved through lived experiences in communities. It is important to recognize and understand the influences that young people intend to create, and the motivation to achieve them is also often discussed in the literature.

Research shows that thinking about personal change is an innate quality that helps volunteers act as agents of change in the community involved. Through their efforts to solve problems, volunteers gain self-confidence, which further helps them to have a positive impact on society.

Although all three dimensions of the model are relevant to volunteers, each dimension may be different in relation to paid staff. While ability, motivation and opportunity are equally important to foster positive attitudes and behaviors in employees, skills improvement practices, especially recruitment, are likely to be relatively more important for volunteers.

This research highlights that MOA model practices designed to improve skills, motivation and opportunities can have a positive impact on increasing the number of volunteers and helping non-profit organizations to manage their volunteer workforce more effectively. The research emphasized that volunteers are demotivated by bureaucratic, transactional approaches, which is especially important in the operational environment of non-profit organizations. Figure 1 presents main categories, belonging codes and quotes from which they were extracted.

Category	*Codes*	*Quotes*
Motivation	Changing social behavior	*„I believe that by volunteering I support the development of the society. The thing that really motivated me to volunteer is the need to bring change first of all to my personal life, and then to influence change in my community.“*
	Team work	*„Team work is a dream work. If the work context is positive, then volunteering is also positive.“*
	Impact on society	*„I perceive volunteering as contribution to society and community.“*
	Network building	*„By volunteering we expand the circle of contacts, which is very important, especially if we want to build a career in the non-governmental sector.“*
	Desire for work experience	*„Volunteering in CPCS has helped me to realize what I want to do in life, which is why I chose my master studies in line with that.“*
	Gaining work experience	*„What I like the most is that I this engagement carries a chance to get work experience without much stress.“*
	Desire for practical experience	*„Gained experience and knowledge during my engagement in CPCS has enabled me to carry on my professional development according to world trends in technical and IT sphere.“*
	Community service	*„If, on the other hand, we volunteer for a humanitarian organization, that kind of volunteerism reminds us all of the good things that we have now, and enables us to help those who need our help.“*
Opportunity	Dedicated volunteering	*„If I hadn't volunteered I would have never acquire knowledge and skills which I have gained in a NGO;*

Fig. 1. Categories, codes and quotes

		nor would I have gained contacts with experts, from whom I can learn, and people who with time become friends and colleagues."
	New experience	*„I didn't have earlier the chance to volunteer, therefore CPCS has helped me to look at volunteering in a different way."*
	New perception of volunteering	*„I believe that through volunteering I have learned a lot about myself. I have gained new opportunities, I have gained different experiences through volunteering which has made me the person I am today."*
	Self-development	*„I think that volunteering has a strong positive influence on individuals and community because it increases the level of empathy, it improves human relationships but gives also the chance for gaining experience. Volunteering has increased my responsibility, the feeling for the community."*
	Professional competitiveness	*„CPCS has supported me in many ways to develop my responsibilities, and it has also made me more competitive on the 'volunteering' market."*
Ability	Activism	*„Now I would much readily accept to be a volunteer for a company, project or organization in which I see myself in the future."*
	Personal skills	*„Volunteerism develops communication skills, empathy, responsibility and many other skills which we don't have the chance to learn during formal education."*
	Productivity	*„Volunteerism is a chance to use our free time in a productive way."*
	Organizational skills	*„I have much more obligations before the time I started volunteering, therefore I had to sort out my everyday life."*

Fig. 1. continued

As previously presented, complementary data from organizational documents and reports were used. After inspecting these written reports, it emerged that volunteers, regardless of the project they worked on, had several common obligations and responsibilities, and tasks they were obliged to perform as part of their volunteer engagement. These tasks are: being reliable and responsible, performing duties as assigned and directed, accepting and following the instructions of the volunteer mentor and/or mentor, be willing to learn and participate in orientation, training programs and meetings, maintaining a healthy working relationship with employees, keeping confidential sensitive organizational information, adhering to rules and procedures of the organization. Some of the project activities, which coincided in different projects, and were an integral part of volunteer engagement were: assisting in organizing events, creating volunteer reports and keeping records of arrivals and departures (creating shifts), keeping reports on social networks, writing monthly articles and blogs for the organization's page on project-related topics, photography at organized events, and contacting participants at organized events.

In order to answer the research questions, it follows from the previous discussion that young individuals are motivated to engage in volunteering activities if it includes changing social behavior, team work, impact on society, network building, desire to gain work experience, gaining work experience, desire for practical experience, and community service. They are also motivated by opportunities that rise by engaging in volunteerism, such as dedicated volunteering, new experience, new perception of volunteering, self-development, and professional competitiveness. When it comes to abilities, young individuals feel motivated to engage in volunteerism as it enables them for activism, personal skills, productivity, and organizational skills. From the perspective of social marketing [68], the MOA model categories from this research could be used for the purpose of ensuring that volunteering activities include these motives, opportunities and abilities [69]. If that would be the case, then the same categories could be used as values which are to be communicated for the purpose of attracting and recruiting new volunteers.

While this research has suggested motivational factors for engaging in volunteering activities, further research should focus on factors which demotivate such engagement. It would be also revealing to identify obstacles faced by those who are motivated to engage in volunteerism. Finally, it could further be explored how developed abilities get applied in the future and whether they get employed for volunteering activities or some other purposes.

5 Conclusions

In Bosnia and Herzegovina, there is still no systematic and comprehensive research on volunteering and volunteers. There particularly a lack of studies focusing on different aspects of volunteering, such as types of volunteering, volunteering of a specific demographic group, motivation to volunteer, etc. This study aimed at enlightening some of these aspects in the context of Bosnia and Herzegovina. An explorative qualitative research design was applied in order to investigate how the MOA model could be applied through social marketing activities in order to stimulate young individuals to

engage in volunteerism. Research findings clearly point to a set of motives (changing social behavior, team work, impact on society, network building, desire to gain work experience, gaining work experience, desire for practical experience, and community service), opportunities (dedicated volunteering, new experience, new perception of volunteering, self-development, and professional competitiveness) and abilities (activism, personal skills, productivity, and organizational skills) which young volunteers perceive as valuable enrichments to their personal and professional lives, as well as to the community and overall society they are members of. These findings pose valuable insights for decision makers in volunteerism and social marketing, as they can be used for the purpose of organizing and promoting volunteerism amongst young individuals [68–70].

References

1. UN Homepage. https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981. Accessed 26 Jan 2022
2. Liao-Troth, M.A., Dunn, C.P.: Social constructs and human service: managerial sensemaking of volunteer motivation. Voluntas: Int. J. Voluntary Nonprofit Organ. **10**(4), 345–361 (1999). https://doi.org/10.1023/A:1021486408619
3. Wilson, J., Musick, M.: The effects of volunteering on the volunteer. Law Contemp. Probl. **62**(4), 141–168 (1999). https://doi.org/10.2307/1192270
4. Blumberg, M., Pringle, C.D.: The missing opportunity in organizational research: some implications for a theory of work performance. Acad. Manag. Rev. **7**, 560–569 (1982). https://doi.org/10.5465/amr.1982.4285240
5. Bussell, H., Forbes, D.: Understanding the volunteer market: the what, where, who and why of volunteering. Int. J. Nonprofit Volunteer Sect. Market. **7**(3), 244–257 (2002). https://doi.org/10.1002/nvsm.183
6. Phillips, H., Phillips, C.: Volunteer motivation and reward preference: an empirical study of volunteerism in a large, not-for-profit organization. SAM Adv. Manag. J. **75**(4), 12–39 (2010)
7. Boudreau, J.W., Hopp, W.J., McClain, J.O., Thomas, L.J.: On the interface between operations and human resources management. Manuf. Serv. Oper. Manag. **5**(3), 179–202 (2003). https://doi.org/10.1287/msom.5.3.179.16032
8. Maclnnis, D.J., Moorman, C., Jaworski, B.J.: Enhancing and measuring consumers' motivation, opportunity, and ability to process brand information from ads. J. Mark. **55**(4), 32–53 (1991). https://doi.org/10.1177/002224299105500403
9. Wu, Y., Balasubramanian, S., Mahajan, V.: When is a preannounced new product likely to be delayed? J. Mark. **68**(2), 101–113 (2004). https://doi.org/10.1509/jmkg.68.2.101.27792
10. Andreasen, A.R.: Marketing social marketing in the social change marketplace. J. Public Policy Mark. **21**(1), 3–13 (2002). https://doi.org/10.1509/jppm.21.1.3.17602
11. Cohen, J., Arato, A.: Political Theory and Civil Society. MIT Press, Cambridge (1992)
12. Jessen, M.H.: The separation between state, market and civil society in capitalism: a cultural political economy approach to civil society in (Neoliberal) Capitalism. Paper presented at Third International Conference on Cultural Political Economy, Lancaster, United Kingdom (2017)
13. Mohanty, R.: Civil society and NGOs. Indian J. Polit. Sci. **63**(2/3), 213–232 (2002)
14. Walzer, M.: The civil society argument. In: Mouffe, C. (ed.) Dimensions of Radical Democracy, pp. 89–107. Verso, London (1992)
15. Anheier, H.K., Salamon, L.M.: Introduction: the non profit sector in the developing world. In: Anheier, H.K., Salamon, L.M. (eds.) The Non profit sector in the Developing Countries, pp. 1–53. Manchester University Press, Manchester (1998)

16. Fisher, J.C., Kathleen, M.C.: Leadership and Management of Volunteer Programs. Jossey-Bass, San Francisco (1993)
17. Smith, J.D.: Volunteering and Social Development: A Background Paper for Discussion at an Expert Group Meeting. United Nations Volunteers. New York, 29–30 November 1999
18. Handy, F., et al.: A cross-cultural examination of student volunteering: Is it all about résumé building? Nonprofit Volunt. Sect. Q. **39**(3), 498–523 (2010). https://doi.org/10.1177/0899764009344353
19. Wilson, J.: Volunteering. Ann. Rev. Sociol. **26**(1), 215–240 (2000). https://doi.org/10.1146/annurev.soc.26.1.215
20. United nations general assembly (UNGA): further initiatives for social development (A/RES/S-24/2) (Resolution adopted by the General Assembly at Twenty-fourth special session – Agenda item 9) (2002)
21. Merrill, M.V., Safrit, D.: In search of contemporary definition of volunteerism. Voice Volunteer Ohio **3**, 1–4 (1995)
22. Shah, J.A., Saundi, T., Hamzah, A., Ismail, I.A.: Why youths choose to become volunteers: from the perspective of belief. Athens J. Soc. Sci. **2**(1), 51–64 (2014). https://doi.org/10.30958/ajss.2-1-4
23. Govo, F.D.: The contribution of volunteerism to social development: the case of Zamdela community volunteers at child welfare South Africa. University of Witwatersrand, Sasolburg (2015). Master's Thesis
24. Burns, D., Picken, A., Hacker, E., Aked, J., Turner, K., Lewis, S.: Valuing volunteering: The Role of Volunteering in Sustainable Development. VSO, London (2015)
25. United Nations Volunteers (UNV): Annual Report 2011: Volunteering for our Future. Communications Section, UNV (2012). https://www.unv.org/sites/default/files/UNV_Annual_report_2011_en_web.pdf
26. EU Commission: European Year of Volunteering 2011. European Commission (2011). https://ec.europa.eu/citizenship/european-year-of-volunteering/index_en.htm
27. Hidalgo, M.C., Moreno, P.: Organizational socialization of volunteers: the effect on their intention to remain. J. Commun. Psychol. **37**(5), 594–601 (2009). https://doi.org/10.1002/jcop.20317
28. Clary, E.G., et al.: Understanding and assessing the motivations of volunteers: a functional approach. J. Pers. Soc. Psychol. **74**(6), 1516–1530 (1998). https://doi.org/10.1037/0022-3514.74.6.1516
29. Stukas, A.A., Worth, K.A., Clary, E.G., Snyder, M.: The matching of motivations to affordances in the volunteer environment: an index for assessing the impact of multiple matches on volunteer outcomes. Nonprofit Volunt. Sect. Q. **38**(1), 5–28 (2009). https://doi.org/10.1177/0899764008314810
30. Finkelstein, M.A.: Volunteer satisfaction and volunteer action: afunctional approach. Soc. Behav. Pers. **36**(1), 9–18 (2008). https://doi.org/10.2224/sbp.2008.36.1.9
31. Trogdon S.E.: A study of parks and recreation citizen board members in North Carolina and their Motivation for Participation. 2005. North Carolina State University, North Carolina. PhD Thesis
32. Kulik, L.: Volunteering during an emergency: a life stage perspective. Nonprofit Volunt. Sect. Q. **46**(2), 419–441 (2017). https://doi.org/10.1177/0899764016655621
33. Pearce, J.L.: Job attitude and motivation differences between volunteers and employees from comparable organizations. J. Appl. Psychol. **68**(4), 646–652 (1983). https://doi.org/10.1037/0021-9010.68.4.646
34. Tapp, J.T., Spanier, D.: Personal characteristics of volunteer phone counselors. J. Consult. Clin. Psychol. **41**(2), 245–250 (1973). https://doi.org/10.1037/h0035137
35. Howarth, E.: Personality characteristics of volunteers. Psychol. Rep. **38**(3), 855–858 (1976). https://doi.org/10.2466/pr0.1976.38.3.855

36. Khoo, S., Engelhorn, R.: Volunteer motivations at a national special olympics event. Adapt. Phys. Activ. Q. **28**(1), 27–39 (2011). https://doi.org/10.1123/apaq.28.1.27
37. Lai, M.H.C., Ren, M.Y.W., Wu, A.M.S., Hung, E.P.W.: Motivation as mediator between national identity and intention to volunteer. J. Commun. Appl. Soc. Psychol. **23**(2), 128–142 (2013). https://doi.org/10.1002/casp.2108
38. Warner, S., Newland, B.L., Green, B.C.: More than motivation: reconsidering volunteer management tools. J. Sport Manag. **25**(5), 391–407 (2011). https://doi.org/10.3390/su132212454
39. Bang, H., Alexandris, K., Ross, S.D.: Validation of the revised volunteer motivations scale for international sporting events (VMS-ISE) at the Athens 2004 olympic games. Event Manag. **12**(3/4), 119–131 (2009). https://doi.org/10.3727/152599509789659759
40. Mummendey, A., Klink, A., Brown, R.: Nationalism and patriotism: national identification and out-group rejection. Br. J. Soc. Psychol. **40**(2), 159–172 (2001). https://doi.org/10.1348/014466601164740
41. Yang, Y., et al.: Effects of boundary-permeated self and patriotism on social participation in the Beijing Olympic games. Asian J. Soc. Psychol. **13**(2), 109–117 (2010). https://doi.org/10.1111/j.1467-839X.2010.01306.x
42. Kooij, D.T., De Lange, A.H., Jansen, P.G., Kanfer, R., Dikkers, J.S.: Age and work-related motives: results of a meta-analysis. J. Organ. Behav. **32**(2), 197–225 (2011). https://doi.org/10.1002/job.665
43. Aranda, M.B., Zappalà, S., Topa, G.: Motivations for volunteerism, satisfaction, and emotional exhaustion: the moderating effect of volunteers' age. Sustainability **11**(16), 1–16 (2019). https://doi.org/10.3390/su11164477
44. Esmond, J., Dunlop, P.: Developing the volunteer motivation inventory to assess the underlying motivation drives of volunteers in western Australia. A research project funded by Lotterywest Social Research Grant and Undertaken by CLAN WA Inc., 1–81 (2004)
45. Erasmus, B., Morey, P.J.: Faith-based volunteer motivation: exploring the applicability of the volunteer functions inventory to the motivations and satisfaction levels of volunteers in an australian faith-based organization. Voluntas **27**(3), 1343–1360 (2016). https://doi.org/10.1007/s11266-016-9717-0
46. Finkelstein, M.A.: Intrinsic vs. extrinsic motivational orientations and the volunteer process. Pers. Individ. Differ. **46**(5/6), 653–658 (2009). https://doi.org/10.1016/j.paid.2009.01.010
47. Amabile, T.M.: Motivational synergy: toward new conceptualizations of intrinsic and extrinsic motivation in the workplace. Hum. Resour. Manag. Rev. **3**(3), 185–201 (1993). https://doi.org/10.1016/1053-4822(93)90012-S
48. Rothschild, M.: Carrots, sticks, and promises: a conceptual framework for the management of public health and social issues behaviour. J. Mark. **63**(4), 24–37 (1999). https://doi.org/10.2307/1251972
49. Allred, A.T., King, S., Valentin, E.K.: Does victim responsibility influence nonprofit volunteerism? J. Nonprofit Public Sect. Mark. **26**(1), 62–79 (2014). https://doi.org/10.1080/10495142.2013.857253
50. Polsa, P.: Future research in social marketing: can the people's republic of china benefit? J. Chin. Mark. **2**(2), 85–89 (2009)
51. Saunders, S.G., Barrington, D.J., Sridharan, S.: Redefining social marketing: beyond behavioural change. J. Soc. Mark. **5**(2), 160–168 (2015). https://doi.org/10.1108/JSOCM-03-2014-0021
52. Hopwood, T., Merrit, R.: Sosiaalisen markkinoinnin ABC. National Social Marketing Center, Tampete (2011). https://www.julkari.fi/bitstream/handle/10024/90857/URN_ISBN_978-952-245-513-0.pdf?sequence=1. Accessed 31 Jan 2022
53. Boehm, A.: Applying social marketing in the development of a volunteer program. Soc. Mark. Q. **15**(3), 67–84 (2009). https://doi.org/10.1080/15245000903131376

54. Polsa, P.: Marketing thought follows the circle of consumption. Australas. Mark. J. **24**(3), 252–253 (2016). https://doi.org/10.1016/j.ausmj.2016.08.009
55. Lee, N.R., Kotler, P.: Social Marketing: Influencing behaviors for Good, 5th edn. Sage, Los Angeles (2016)
56. Landrum, S.: Millennials driving brands to practice socially responsible marketing. Forbes, March 17 (2017). https://www.forbes.com/sites/sarahlandrum/2017/03/17/millennials-drivingbrands-to-practice-socially-responsible-marketing/#2c2c0a094990. Accessed 31 Jan 2020
57. Birdwell, J., Bani, M.: Introducing Generation Citizen. Demos, London (2014)
58. Hastings, G.: Relational paradigms in social marketing. J. Macromark. **23**(1), 6–15 (2003). https://doi.org/10.1177/0276146703023001006
59. Binney, W., Hall, J., Oppenheim, P.: The nature and influence of motivation within the MOA framework: implications for social marketing. Int. J. Nonprofit Voluntary Sect. Mark. **11**(4), 289–301 (2006). https://doi.org/10.1002/nvsm.280
60. Gordon, R.: Re-thinking and re-tooling the social marketing mix. Australas. Mark. J. **20**(2), 122–126 (2012). https://doi.org/10.1016/j.ausmj.2011.10.005
61. MacInnis, D.J., Jaworski, B.J.: Information processing from advertisements: toward an integrative framework. J. Mark. **53**(4), 1–23 (1989). https://doi.org/10.1177/002224298905300401
62. Blumberg, M., Pringle, C.D.: The missing opportunity in organizational research: some implications for a theory of work performance. Acad. Manag. Rev. **7**(4), 560–569 (1982). https://doi.org/10.5465/amr.1982.4285240
63. Lockstone-Binney, L., Binney, W., Baum, T.: Is a social marketing framework the key to promoting volunteer participation. In: Sustainable management and marketing; proceedings of ANZMAC 2009 Australian & New Zealand Marketing Academy Conference, pp. 1–10. Australian & New Zealand Marketing Academy (ANZMAC), Melbourne (2009)
64. Halmi, A.: Strategije kvalitativnih istraživanja u primijenjenim društvenim znanostima. Naklada Slap, Zagreb (2005)
65. Brinkmann, S., Kvale, S.: InterViews: Learning the Craft of Qualitative Research Interviewing, 3rd edn. Sage, Los Angeles (2015)
66. Jaehn, T., Rodrigues Simoes. F.: What do line managers in a large-scale transformation need to perform well in their role? A case study of a R&D department during an agile transformation. University of Gothenburg (2018). 30hp.
67. Patton, M.Q.: Qualitative Research & Evaluation Methods, 4th edn. Sage, Los Angeles (2015)
68. Miller, K.L.: The Nonprofit Marketing Guide: High Impact, Low-Cost Ways to Build Support for your Good Cause, 2nd edn. Wiley, New Jersey (2021)
69. Grau, S.L.: Marketing for Nonprofit Organizations: Insights and Innovations, 2nd edn. Oxford Unversity Press, New York (2021)
70. Bennet, R.: Nonprofit Marketing and Fundraising: A Research Overview. Routledge, London (2019)

Predicting Sustainable Consumption Practices by Value-Attitude-Behavior Theory

Merima Činjarević, Amra Kapo(✉), and Lejla Turulja

School of Economics and Business, University of Sarajevo, Sarajevo, Bosnia and Herzegovina
{merima.cinjarevic,amra.kapo,lejla.turulja}@efsa.unsa.ba

Abstract. The purpose of the present research is to explore how altruistic and traditional values shape students' attitudes toward four aspects of sustainable development (environmental, economic, educational, social), and consequently students' sustainable consumption practices. The present study used a quantitative approach based on cross-sectional data to estimate the proposed conceptual model and test formulated research hypotheses. Participants were students enrolled in the first cycle of studies in economics and business at one of the largest public HEIs in Bosnia and Herzegovina. The online survey was conducted during the winter semester, the academic year 2021/2022. Sample includes 148 usable responses. Partial least square structural equation modelling was employed to examine proposed relationships. Our finding suggest that altruistic values are positively related to all four facets of attitudes toward sustainable development (environmental, economics, educational and social). Furthermore, it was shown that traditional values were positively associated with the attitudes toward environmental care, sensitivity to social issues, and the belief that education is critical for promoting SD and enhancing the capacity of the individuals to address environmental and development issues. Furthermore, the findings show that the relationship between personal values and sustainable consumption practices is mediated only by pro-environmental attitudes.

Keywords: Education for sustainability · Attitudes · Personal values · Sustainable consumption practices · University students

1 Introduction

Higher education institutions (HEIs) have a social responsibility to create new knowledge on sustainable development (SD), share existing knowledge on SD, and promote the values and principles of SD among future leaders. Since the Stockholm Conference in 1972, HEIs have become crucial players in building sustainable societies by embracing and institutionalizing sustainability in their systems. Declarations and charters, curricular redesign, community-university partnerships, and sustainable initiatives within the so-called quadruple/quintuple Helix model have all been used to promote SD in HEIs [1–3]. Increased public pressure on HEIs to engage more in sustainability practices has transformed these institutions into agents of change [2, 4]. The myriad of HEIs worldwide

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 163–178, 2023.
https://doi.org/10.1007/978-3-031-17767-5_12

is taking the lead in implementing sustainable practices and initiatives, acknowledging that HEIs have the potential to speed up sustainable development [5].

As a result of the main challenges faced by HEIs in their endeavor to provide a sustainable future, the paradigm of Education for Sustainable Development (ESD) or Education for Sustainability (EfS) has emerged. ESD was coined at the United Nations' 21st Agenda for Sustainable Development (1992, Rio de Janeiro) and emphasized at the UNESCO 2015 World Education Forum as well as at the UN Sustainable Development Summit in New York in 2015, where Agenda 2030 was announced. ESD aims to encourage and strengthen lifelong learning towards developing and acquiring sustainability-related knowledge, skills, and values and raise public awareness of SD and its challenges [6]. ESD involves professors as architects, keepers, communicators of a sustainable culture, and students as prospective practitioners of this culture, encouraging global societal changes. Since university students represent the future generation of professionals and leaders in a variety of sectors such as science, politics, education, business, to name a few, they must be aware of sustainability issues as well as obtain knowledge and develop skills needed to create a just and sustainable future [7].

The topic of ESD has gained tremendous attention among scholars in recent years. The search in Web of Knowledge with the search string "education for sustainability" AND "education for sustainable development" to titles in academic databases in February 2022 resulted in 1,162 records. Out of the total number of records, 662 were published after 2018, indicating tremendous recent interest among scholars in this topic. However, only limited attention has been dedicated to the students themselves, whose values, attitudes, and behaviors will shape our future [3, 8–10]. The present study, thereby, explores the role of altruistic and traditional values in shaping students' attitudes toward SD and their engagement in sustainable consumption practices. Grounded in value-attitude-behavior (VAB) theory, we posit that altruistic and traditional values are positively associated with sustainable consumption practices via students' attitudes toward four aspects of SD (environmental, economic, educational, social). Since our research is conducted in the post-transitional economy (Bosnia and Herzegovina), it brings new insights into the value-attitude-behavior link in the sustainable consumption context from the perspective of Z-ers, born and raised in the transformed economic and social landscapes of this country.

2 Literature Review

2.1 Theoretical Framework

Sustainable Consumption Practices. The concept of sustainable consumption (SC) and sustainable consumption practices (SCPs) have gained considerable attention over the last decade [11, 12]. National research programs in developed countries and international policy organizations acknowledge that existing patterns and consumption levels are not environmentally sustainable. Furthermore, numerous scholars, prominent leaders within non-governmental organizations, and business leaders have argued persuasively and firmly that existing levels of natural resources and consumption practices are unsustainable [13]. Despite the efforts of academics, businesses, governments, and

non-governmental organizations to identify and alter unsustainable consumption practices, these practices continue to exist, and they are being intensified by the continuous expansion of the global economy.

Defining SC and SCP is not an easy task since these concepts have a plethora of meanings [11, 14]. Bearing in mind that different scholars and institutions interpret these concepts differently, it is vital to comprehend the idea of SC and SCPs. Kaman Lee, for instance, describes SC as consumption characterized by an individual's awareness of environmental issues and a willingness to make responsible choices in personal consumption [15]. However, some scholars argue that SC goes beyond the impact of consumption on the environment, pointing out that SC focuses on preserving and managing existing resources so that they may fulfill the current demand while also meeting the needs of future generations [11, 13, 14]. In a nutshell, the concept of SC calls for responsible consumption practices that will improve the quality of life, assure environmental protection, enhance resource use efficiency, and meet the needs of future generations [11, 13]. In the present study, we placed focus on four facets of SCPs, namely quality of life (spending leisure time at natural landscape), environmental protection (using reusable shopping bags), meeting needs of future generations (reusing goods as much as possible), and resource efficiency (avoiding unnecessary printing).

Attitudes Toward Sustainable Development (SD). Attitudes toward SD are individuals' feelings and beliefs about SD [16, 17]. Individuals' attitudes toward sustainability have been found to be positively associated with participation in sustainability, environmentally friendly behavior, and proactive orientation towards environmental sustainability [17]. Although three dimensions of SD (environment, economy, and society) are used as common ground in SD research [17], proponents of ESD paradigm argue that education should be considered as the fourth dimension of SD [16, 17], since education is essential means of disseminating information and raising people's understanding or consciousness about the sustainability. According to Biasutti and Frate, there are four facets of attitudes toward SD: environmental, economic, educational, and social [16]. Considering that ESD aims to shape students' attitudes towards the SD and help them build resilient societies, several studies explored university students' attitudes towards the SD and the need for the implementation of ESD [16–18].

Value-Attitude-Behavior Theory. It has long been recognized that personal values may serve as a basis for behavior. Individuals' behaviors or the range of actions are considered means of achieving desired end-states or values. While examining a straightforward relationship between values and behavior has its advantages, it also has drawbacks. Since values are abstract, they are often considered peripheral predictors of behavior, implying that they can only influence behavior through less abstract or more proximal predictors, such as attitudes. In line with this reasoning, Value – Attitude - Behavior (VAB) theory posits that the influence of value on specific behavior is mediated by attitude toward the behavior, demonstrating that influence should potentially go from abstract values via midrange attitudes to specific behaviors [19]. The VAB theory has also been validated in the context of the sustainability behaviors of individuals [19–22]. For instance, it has been shown that an individual's environmental value influences green purchase behavior indirectly through environmental attitudes [20]. In addition, previous

research indicates that the value of sustainability drives the individual's attitude toward sustainability crowdfunding and participation in sustainability crowdfunding [21]. Also, recent studies suggest that biospheric value is positively related to recycling behavior and sustainable energy consumption, while adherence to altruistic, traditional, and openness to change values has a positive effect on sustainable energy consumption [22].

2.2 Conceptual Model and Research Hypotheses

Based on the VAB theory, we assumed that personal values (altruistic and traditional values) positively affect attitudes toward SD and indirectly affect SCPs. Our conceptual model presents the hypothesized relationships between personal values, attitudes toward SD, and SCPs (Fig. 1).

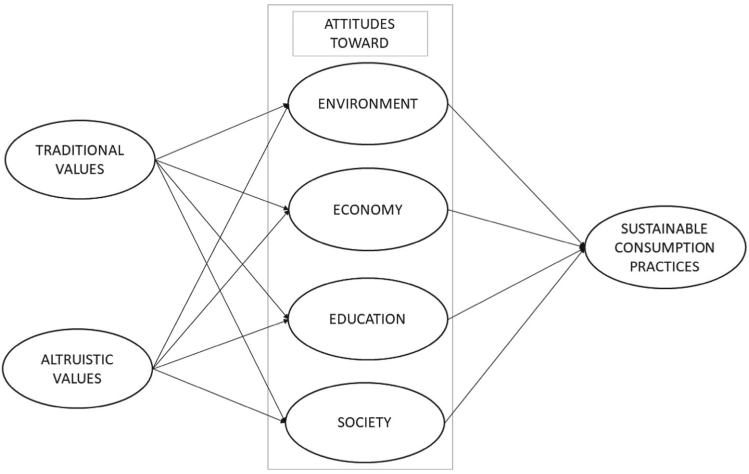

Fig. 1. Conceptual model

In the existing literature, personal values and their impact on individual attitudes and behaviors are extensively studied; yet, the conclusions are inconsistent [23]. Individuals' mental pictures of objects are shaped by the values they accept and the priorities they assign to those values. Adherence to values can influence the way individuals assess and rationalize their attitudes toward an object, resulting in particular behaviors. Previous research suggests that personal values (altruistic, egoistic, biospheric, traditional, and openness to change) considerably impact their attitudes toward SD, its underlying dimensions, and SC/SCPs [13, 22]. Since self-transcendent values, opposite to self-enhancement values, are more likely to lead toward more favorable attitudes toward SD and SC/SCPs [22, 24, 25], in the current study, we focused on two self-transcendent values (altruistic values and traditional values).

Altruistic values are characterized by a genuine concern for the well-being of society and others [26]. In other words, altruistic values refer to an individual's commitment to doing good for others without expecting anything in return. In the context of

SC, research indicates that self-transcendent (i.e., biospheric and altruistic) values are positively related to pro-social, pro-environmental, and pro-sustainability attitudes and behavior [22, 27]. People with strong altruistic values are more prone to develop favorable attitudes toward SD, and they are more inclined to engage in SC/SCPs [22, 28]. Therefore, the following hypotheses are formulated:

H1: Adherence to altruistic values is positively related to attitudes toward sustainable development.
H1a: Adherence to altruistic values is positively related to pro-economic attitudes.
H1b: Adherence to altruistic values is positively related to pro-educational attitudes.
H1c: Adherence to altruistic values is positively related to pro-environmental attitudes.
H1d: Adherence to altruistic values is positively related to pro-social attitudes.

Values guide people toward objectives, shape their attitudes, and serve as a standard for judging the sustainable behavior of individuals and society [29]. Previous research suggests that altruistic values /i.e., concern for the welfare of others), are the most important driving principles of pro-sustainable attitudes [21, 30]. Thus, the following set of hypotheses is formulated:

H2: Pro-economic attitudes (H2a), pro-educational attitudes (H2b), pro-environment attitudes (H2c), and pro-social attitudes (H2d) have positive effect on sustainable consumption practice (SCPs).

The consumer behavior literature postulates that attitudes are the core concept upon which behavior is explained [21, 31]. In addition, VAB theory postulates that values serve as background factors that indirectly impact behavior via their effect on attitudes, suggesting that attitudes are considered to be the primary mediator of the value-behavior relationship [19]. Therefore, we formulated the following set of hypotheses:

H3: The relationship between adherence to altruistic values and sustainable consumption practices (SCPs) is mediated by the pro-economics attitudes (H3a). Pro-educational attitudes (H3b), pro-environmental attitudes (H3c), and pro-social attitudes (H3d).

People holding dominant conservative values (security, conformity, and tradition) are seeking safety and stability, and they are more inclined to serve the collective rather than individual interests. In terms of SC/SCPs, the previous research has produced ambiguous findings regarding the effect of traditional values on attitudes toward SD and SCPs [23]. For instance, Whitley et al. found that people who adhere to traditional values are less prone to make an environmental consciousness choice in the context of food consumption [22]. In addition, people who adhere to traditional values are less likely to decide to use sustainable modes of transportation (e.g., public transport, walking, cycling), and they are less likely to engage in recycling behavior [22]. However, some scholars argue that traditional values are positively related to anthropocentric concerns [32]. Besides, it has been suggested that people from traditional collectivist nations tend to exhibit more favorable attitudes toward SD, and they are more able to transform these attitudes into sustainable actions than their counterparts in individualist cultures

[23, 33]. Considering that the present study involves members of collectivist culture (Bosnia and Herzegovina)[34], we posted that traditional values are positively related to attitudes toward SD and that these values indirectly impact SCPs. Thus, the following set of hypotheses is formulated:

H4: Adherence to traditional values is positively related to attitudes toward sustainable development:

H4a: Adherence to traditional values is positively related to pro-economic attitudes.
H4b: Adherence to traditional values is positively related to pro-educational attitudes.
H4c: Adherence to traditional values is positively related to pro-environmental attitudes.
H4d: Adherence to traditional values is positively related to pro-social attitudes.

Previous studies have extensively studied the relationship between personal values and SC/SCPs. Overall, the traditional values of compassion, self-direction, honesty, and responsibility have been shown to be associated with SC/SCPs [35]. Since VAB theory suggests that values drive behavior via their effect on attitudes [19], the following set of hypotheses is formulated:

H5: The relationship between adherence to traditional values and sustainable consumption practices is mediated by pro-economic attitudes (H5a), pro-educational attitudes (H5b), pro-environmental attitudes (H5c), and pro-social attitudes (5d).

3 Methodology

The present study used a quantitative approach based on cross-sectional data to estimate the proposed conceptual model and test formulated research hypotheses. Participants were students enrolled in the first cycle of studies in economics and business at one of the largest public HEIs in BiH. The e-mail invitation to participate in the survey was sent to 500 students enrolled in five courses during the winter semester, the academic year 2021/2022. An e-mail invitation included a summary of the research's goals and a link to the questionnaire accessible online. A total of 180 students (36%) completed the questionnaire. We removed all cases with more than 30 percent of the data missing, resulting in 148 usable questionnaires for further analysis. Students had a mean age of 20.8 years, and 56.5 percent were female. The sample breakdown in terms of year of studies is as follows: 52.0 percent of respondents are students of the first year of studies, 29.1 percent were students enrolled in the second year of the studies, and 18.9 were students of the third year of studies.

The first part of the e-questionnaire included values, attitudes toward SD, and SCPs. The commitment to altruistic and traditional values and engagement in SCPs were measured using items adapted from previous research [13, 22]. Regarding the commitment to altruistic values, respondents were asked to indicate how important are the social justice/correcting injustice, equality, and a world of peace, free of war and conflict as guiding principles in their lives [22]. SCPs were measured by four items ("I occasionally spend recreation time at natural landscapes, parks or forest "; "I bring my own reusable bags when shopping (e.g., grocery or retail shopping)"; "I utilize things they cannot be used anymore", and "I reuse empty back pages of used paper") derived from

previous research [13]. Also, respondents were asked to indicate the importance of traditional values (honoring parents and elders, showing respect to others, family security, and self-discipline) as guiding principles in their lives [22]. The attitudes toward SD were measured using 20 items on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree) drawn from a scale developed by Biasutti and Frate [16]. The second part of the e-questionnaire includes questions about the demographic characteristics of respondents.

4 Results

4.1 Measurement Model

4.1.1 Validity and Reliability

For data analysis, we followed a two-step procedure recommended by [36]. In a first step, we examined the validity of the measurement model by testing reliability, convergent validity, and discriminant validity.

Content validity is ensured by adopting items from the existing literature, while convergent validity is confirmed by checking the standardized factor loadings. The degree of reliability was checked using the common coefficient of internal consistency test [37, 38], whose value should not be lower than 0.5 according to [39] ($\alpha > 0.5$). In our case, the loading coefficients range from 0.585 to 0.920, indicating the internal consistency and reliability of the measures, as they exceed the threshold of 0.50, which is given in Table 1.

Table 1 shows the final results of the confirmatory factor analysis of the model to check the reliability and validity of the tested model. The composite reliability measure (CR) is used to confirm the theoretical assumptions. According to [39], the value of composite reliability (CR) should not be lower than 0.6, while values above 0.7 adequately measure reliability. Our results confirm the reliability of the measurement model when we look at the composite reliability results for all constructs. In addition to reliability, the validity of the measurement model was tested by convergent and discriminant validity. We checked convergent validity, which tests the relationship between latent constructs and the manifest variables associated with that construct, by using the values of average variance extracted (AVE) and factor loadings as the most common measures of convergent validity. Adequate convergent validity exists when standardized factor loadings are greater than 0.50 [39] and AVE is greater than 0.5. Based on the defined threshold and the results of our research, we can confirm that all values of the average variance extracted (AVE) are greater than 0.5 and that the values of all standardized factor loadings are greater than 0.50. Meeting these criteria confirms the convergent validity of the measurement model.

Finally, discriminant validity was tested, which aims to determine the diversity of constructs within the model. Two recommended criteria were used for testing [40, 41].

According to [40], the square root of the average derived variance must be greater than the correlations between constructs. Table 2 shows the correlation matrix below the diagonal, while the values of the square root of AVE are shown on the diagonal. It can be concluded that all constructs satisfy the discriminant validity condition. The measure of

Table 1. Loadings, reliability and validity

Construct	Item	St. Loadings	Cronbach's alpha	CR	AVE
Altruistic values (ALTVAL)	VAL_ALTV1	0.840	0.809	0.887	0.724
	VAL_ALTV2	0.891			
	VAL_ALTV3	0.819			
Pro-economic attitudes (ATT_ECON)	ATT_ECON1	0.715	0.659	0.813	0.593
	ATT_ECON2	0.855			
	ATT_ECON2	0.732			
Pro-educational attitudes (ATT_EDU)	ATT_EDU1	0.779	0.863	0.901	0.646
	ATT_EDU2	0.842			
	ATT_EDU3	0.831			
	ATT_EDU4	0.787			
	ATT_EDU5	0.779			
Pro-environmental attitudes (ATT-ENV)	ATT_ENV1	0.873	0.658	0.818	0.606
	ATT_ENV2	0.844			
	ATT_ENV3	0.585			
Pro-social attitudes (ATT_SOC)	ATT_SOC1	0.749	0.865	0.902	0.649
	ATT_SOC2	0.788			
	ATT_SOC3	0.844			
	ATT_SOC4	0.864			
	ATT_SOC5	0.777			
Sustainable consumption practices (SCPs)	SCP1	0.771	0.709	0.820	0.532
	SCP2	0.725			
	SCP3	0.716			
	SCP4	0.704			
Traditional values (TRAD_VAL)	VAL_TRADV1	0.920	0.835	0.901	0.754
	VAL_TRADV2	0.916			
	VAL_TRADV3	0.760			

Source: Author's own research and analysis.

discriminant validity was also evaluated using the correlations of the Hetrotrait Monotrait Ratio (HTMT ratio). According to [41], all values must be below the acceptable threshold of 0.9. This also confirms that we have no problems with discriminant validity (Table 3).

Table 2. Discriminant validity

Construct	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ALTVAL (1)	**0.851**						
ATT-ECON (2)	0.465	**0.770**					
ATT_EDU (3)	0.481	0.620	**0.804**				
ATT_ENV (4)	0.603	0.562	0.545	**0.778**			
ATT_SOC (5)	0.636	0.534	0.589	0.580	**0.806**		
SCPs (6)	0.301	0.330	0.337	0.364	0.265	**0.730**	
TRADVAL (7)	0.590	0.269	0.391	0.479	0.465	0.161	**0.869**

Note: Bold values represent Square-root of AVE.
Source: Author's own research and analysis.

Table 3. HTMT

Construct	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ALTVAL (1)							
ATT_ECON (2)	0.620						
ATTT_EDU (3)	0.564	0.815					
ATT_ENV (4)	0.820	0.865	0.732				
ATT_SOC (5)	0.748	0.702	0.667	0.759			
SCPs (6)	0.387	0.458	0.428	0.533	0.345		
TRADVAL (7)	0.714	0.348	0.446	0.634	0.528	0.211	

Source: Author's own research and analysis.

4.2 Structural Model

To test the collected data, we used the partial least squares (PLS) method. This method is particularly useful for identifying variance and validating cause-and-effect relationships between latent variables that contain complex theoretical and measurement models [42]. The structural model is evaluated using the values of R^2 and Q^2. The value for R^2 should be greater than or equal to 0.1 [43], while the value for Q^2 should be greater than 0. The results in Table 4 show that all R^2 values are above 0.1, confirming that predictability has been established. Also, the values of Q^2 are above zero, which also confirms significance in prediction of constructs. In addition, the model fit is estimated SRMR, and according to [39], the SRMR values must be lower than 0.1. In our model, the SRMR values are 0.076. Table 4 shows several indicators that give us more information about the tested relationships: standardized coefficients, t-value, and significance level. The standardized coefficient shows the change in the dependent variable relative to the change in the standard deviation of the independent variable, while the t-value indicates whether a particular parameter in the population is significantly different from zero.

Table 4. Hypotheses testing

	Hypotheses	β	St. Dev	t-value	p-value
H1a	Altruistic values - > Pro-economic attitudes	0.482	0.082	5.756	0.000**
H1b	Altruistic values - > Pro-educational attitudes	0.388	0.094	4.094	0.000**
H1c	Altruistic values - > Pro-environmental attitudes	0.494	0.080	6.138	0.000**
H1d	Altruistic values - > Pro-society attitudes	0.564	0.097	5.721	0.000**
H2a	Pro-economic attitudes - > SCPs	0.125	0.108	1.098	0.136
H2b	Pro-educational attitudes - > SCPs	0.159	0.104	1.462	0.072*
H2c	Pro-environmental attitudes - > SCPs	0.226	0.131	1.717	0.043**
H2d	Pro-social attitudes - > SCPs	−0.018	0.139	0.130	0.448
H3a	Altruistic values - > Pro-economic attitudes - > SCPs	0.060	0.054	1.035	0.150
H3b	Altruistic values - > Pro-educational attitudes - > SCPs	0.062	0.044	1.313	0.095*
H3c	Altruistic values - > Pro-environmental attitudes - > SCPs	0.113	0.069	1.597	0.055*
H3d	Altruistic attitudes- > Pro-social attitudes - > SCPs	−0.009	0.079	0.127	0.449
H4a	Traditional values - > Pro-economics attitudes	−0.01	0.083	0.092	0.463
H4b	Traditional values - > Pro-educational attitudes	0.166	0.109	1.511	0.065*
H4c	Traditional values - > Pro-environmental attitudes	0.184	0.081	2.318	0.010**
H4d	Traditional values - > Pro-social attitudes	0.136	0.095	1.448	0.074*
H5a	Traditional values - > Pro-economic attitudes - > SCPs	0.001	0.014	0.067	0.473
H5b	Traditional values - > Pro-educational attitudes - > SCPs	0.027	0.027	0.940	0.174
H5c	Traditional values - > Pro-environment. Attitudes - > SCPs	0.040	0.030	1.398	0.081*
H5d	Traditional values - > Pro-social attitudes - > SCPs	−0.005	0.023	0.109	0.456
		R^2	**Q^2**		
	Pro-economics attitudes	0.206	0.113		
	Pro-educational attitudes	0.238	0.150		
	Pro-environmental attitudes	0.379	0.219		
	Pro-social attitudes	0.409	0.260		
	Sustainable consumption practices (SCPs)	0.144	0.072		

Source: Author's own research and analysis

Analysis of data leads to the conclusion that altruistic values have a positive and significant influence on the pro-economic attitudes ($\beta = 0.482$, $t = 5.756$, $p = 0.000$), pro-educational attitudes ($\beta = 0.388$, $t = 4.094$, $p = 0.000$), pro-environmental attitudes ($\beta = 0.494$, $t = 6.138$, $p = 0.000$), and pro-social attitudes ($\beta = 0.564$, $t = 5.721$, $p = 0.000$). We further examined the influence of attitudes towards economy, education, environment, and society on SCPs and confirmed the significant impact of pro-environmental attitudes on SCPs ($\beta = 0.226$, $t = 1.717$, $p = 0.043$) and the positive significant influence at 10% significance level for the impact of pro-educational attitudes on SCPs ($\beta = 0.159$, $t = 1.462$, $p = 0.072$). The hypotheses addressing the influence of pro-economic and pro-social attitudes on SCPs have not been confirmed. Finally, in addition to altruistic values, we also tested the influence of traditional values on four facets of attitudes toward SD (economic, educational, environmental, and social). There is an insignificant relationship between traditional values and pro-economic attitudes. Positive relationships were confirmed for the impact of traditional values on the pro-environmental attitudes ($\beta = 0.184$, $t = 2.318$, $p = 0.010$) and with 10 impacts on pro-educational ($\beta = 0.166$, $t = 1.511$, $p = 0.065$) and pro-social attitudes ($\beta = 0.136$, $t = 1.448$ $p = 0.074$). Regarding the role of attitudes toward SD as a mediator in the relationship between altruistic values and SCPs, we verified that this relationship is mediated by pro-environmental and pro-educational attitudes. Alo, we found that pro-environmental attitudes mediate the link between traditional values and SCPs. The coefficient of determination for the dependent variables is 0.206 for pro-economic attitudes, 0.238 for pro-educational attitudes, 0.379 for attitude toward the environment. 0.409 for attitude toward society, and 0.144 for sustainable consumption practices.

Table 5 summarizes the outcomes of hypotheses testing. Our findings fully support the hypothesis H1: Adherence to altruistic values is positively related to attitudes toward sustainable development. On the other hand, hypothesis H4: Adherence to traditional values is positively related to attitudes toward sustainable development, is partially supported. The set of hypotheses (H2a–H2d) related to the link between different facets of attitudes toward SD and SCPs, is partially supported. Also, the set of hypotheses (H3a–H3d) related to the role of pro-economic, pro-educational, pro-environmental, and pro-social attitudes toward SD as mediators in the link between altruistic values and SCPs, is partially supported. However, the set of hypotheses (H5a–H5d) regarding the role of role of pro-economic, pro-educational, pro-environmental, and pro-social attitudes toward SD as mediators in the link between traditional values and SCPs, is not supported.

Table 5. Summary of findings

Hypothesis	Findings
H1: Adherence to altruistic values is positively related to attitudes toward sustainable development	Fully supported H1a, H1b, H1c, H1d supported
H2: Pro-economic attitudes (H2a), pro-educational attitudes (H2b), pro-environment attitudes (H2c), and pro-social attitudes (H2d) have positive effect on sustainable consumption practice (SCPs)	Partially supported H2a not supported H2b supported H2c supported H2d not supported
H3: The relationship between adherence to altruistic values and sustainable consumption practices (SCPs) is mediated by the pro-economics attitudes (H3a), pro-educational attitudes (H3b), pro-environmental attitudes (H3c), and pro-social attitudes (H3d)	Partially supported H3a not supported H3b supported H3c supported H3d not supported
H4: Adherence to traditional values is positively related to attitudes toward sustainable development	Partially supported H4a not supported H4b, H4c, and H4d supported
H5: The relationship between adherence to traditional values and sustainable consumption practices is mediated by pro-economic attitudes (H5a), pro-educational attitudes (H5b), pro- environmental attitudes (H5c), and pro-social attitudes (5d)	Not supported H5a Not supported H5b not supported H5c supported H5d not supported

Source: Author's own research and analysis

5 Discussion and Conclusion

The present study reveals that altruistic values are positively related to all four facets of attitudes toward SD. The findings imply that students holding strong altruistic values are more like to exhibit more favorable attitudes toward the environmental, economic, educational, and social dimensions of SD. Furthermore, we showed that traditional values are positively associated with attitudes toward environmental care, sensitivity to social issues, and the belief that education is critical for promoting SD and enhancing the capacity of individuals to address environmental and development issues. However, we found that traditional values are not a significant predictor of an individual's attitudes toward the idea that 'the only and only one government's responsibility is to achieve economic growth. This finding is consistent with the assumption that individuals who hold strong traditional values are more likely to express care for the well-being of others, for nature, and for the environment than those who do not adhere to traditional values [23]. Considering the effect of attitudes toward SD, our findings indicate that pro-environmental attitudes and pro-educational attitudes are positively related to the SCPs. Our results suggest that students who have a higher level of environmental consciousness and believe that SD can "make a difference" for the well-being of future generations are more likely to engage in SCPs. On the other hand, concerns about economics and social issues were not significant predictors of SCPs. However, we should highlight that our

results do not suggest that the economic and social aspects of SD do not matter. More precisely, our results imply that an individual's sensitivity to social and economic issues is not a prerequisite for taking SCPs.

Concerning the indirect effect of personal (altruistic and traditional) values on SCPs, the current study verified the VAB framework in the context of SCPs. Our findings suggest that altruistic and traditional values shape attitudes toward SD, consequently leading to individual engagement in SCPs. However, we should note that the relationship between altruistic and traditional values and SCPs is mediated only by pro-environmental attitudes, suggesting that concerns for environmental issues have the dominant role in influencing SCPs.

The present study contributes to the ongoing discussion over the role of personal values (altruistic and traditional values) as significant predictors of sustainable consumption behaviors. By proposing and testing a conceptual model of SC/SCPs, the study provides a fresh perspective on the underlying mechanism by which altruistic and traditional values impact individuals' engagement in SCPs. Therefore, the findings of this study enhance the current knowledge of VAB theory [19]. Another significant aspect of this research is its emphasis on post-transition society and economy in the Southeast Europe (i.e., Bosnia and Herzegovina). Since post-transition economies and societies have undergone a shift from socialist, planned to market-driven economies, it is vital to understand how the personal values of members of a new generation (Gen Z), who were born in new economic and social landscapes, shape attitudes toward SD, and consequently their engagement in SCPs. From the practice perspective, the present study indicates that HEIs should collaborate to develop innovative solutions to shape students' values, attitudes, and behaviors toward SD. HEIs should create strategic marketing plans and campaigns that will sway students' values from self-interest to self-transcendence and reshape their attitudes and behaviors in the SD domain. Also, HEIs are encouraged to collaborate with other stakeholders and engage themselves in the quadruple/quintuple Helix model aiming to foster SD.

The present study has a few limitations that we should highlight. First, the sample includes only students enrolled in one HEIs, studying filed of economics and business. Therefore, future research about values and attitudes toward SD and SCPs among students from other HEIs in B&H and other countries is welcomed. Furthermore, other variables affecting students' attitudes toward SD (subjective knowledge, objective knowledge, the content of the study program) could improve our understanding of underlying factors influencing students' engagement in SCPs.

References

1. Aleixo, A.M., Azeiteiro, U., Leal, S.: The implementation of sustainability practices in Portuguese higher education institution. Int. J. Sustain. High. Educ. **19**(1), 146–178 (2018). https://doi.org/10.1108/IJSHE-02-2017-0016
2. Berchin, I.I., Grando, V.D.S., Marcon, G.A., Corseuil, L., Guerra, J.B.S.O.D.A.: Strategies to promote sustainability in higher education institutions: a case study of a federal institute of higher education in Brazil. Int. J. Sustain. High. Educ. **18**(7), 1018–1038 (2017). https://doi.org/10.1108/IJSHE-06-2016-0102

3. Dasgupta, H., Pawar, S.K.: Impact of higher education imparted by Indian universities on the pro-sustainability orientation of students. J. Appl. Res. High. Educ. **13**(4), 1110–1132 (2021). https://doi.org/10.1108/JARHE-12-2019-0318
4. Sánchez-Carracedo, F., Romero-Portillo, D., Sureda Carbonell, B., Moreno-Pino, F.M.: Education for sustainable development in Spanish higher education: an assessment of sustainability competencies in engineering and education degrees. Int. J. Sustain. High. Educ. (2021). https://doi.org/10.1108/IJSHE-02-2021-0060
5. Hueske, A.-K., Pontoppidan, C.A.: GEROCO: a model for integrating sustainability in management education at HEIs. In: Sengupta, E., Blessinger, P., Mahoney, C. (ed.) Leadership Strategies for Promoting Social Responsibility in Higher Education (Innovations in Higher Education Teaching and Learning, vol. 24), Emerald Publishing Limited, Bingley, pp. 93–109 (2020). https://doi.org/10.1108/S2055-364120200000024009
6. Berchin, I.I., de Aguiar Dutra, A.R., Guerra, J.B.S.O.A.: How do higher education institutions promote sustainable development? A literature review. Sustain. Dev. **29**(6), 1202–1222 (2021). https://doi.org/10.1002/sd.2219
7. Cortese, D.A.: The critical role of higher education in creating a sustainable future. Plan. High. Educ. **31**, 15–22 (2003)
8. Alsaati, T., El-Nakla, S., El-Nakla, D.: Level of sustainability awareness among university students in the eastern province of Saudi Arabia. Sustainability **12**(8), 3159 (2020). https://doi.org/10.3390/su12083159
9. Bask, A., Halme, M., Kallio, M., Kuula, M.: Business students' value priorities and attitudes towards sustainable development. J. Clean. Prod. **264**, 121711 (2020). https://doi.org/10.1016/j.jclepro.2020.121711
10. Tang, K.H.D.: Correlation between sustainability education and engineering students' attitudes towards sustainability. Int. J. Sustain. High. Educ. **19**(3), 459–472 (2018). https://doi.org/10.1108/IJSHE-08-2017-0139
11. Lim, W.M.: Inside the sustainable consumption theoretical toolbox: critical concepts for sustainability, consumption, and marketing. J. Bus. Res. **78**, 69–80 (2017). https://doi.org/10.1016/j.jbusres.2017.05.001
12. Wang, C., Ghadimi, P., Lim, M.K., Tseng, M.L.: A literature review of sustainable consumption and production: a comparative analysis in developed and developing economies. J. Clean. Prod. **206**, 741–754 (2019). https://doi.org/10.1016/j.jclepro.2018.09.172
13. Ahamad, N.R., Ariffin, M.: Assessment of knowledge, attitude and practice towards sustainable consumption among university students in Selangor, Malaysia. Sustain. Prod. Consumption **16**, 88–98 (2018). https://doi.org/10.1016/j.spc.2018.06.006
14. Quoquab, F., Mohammad, J., Sukari, N.N.: A multiple-item scale for measuring "sustainable consumption behaviour" construct: development and psychometric evaluation. Asia Pac. J. Mark. Logist. **31**(4), 791–816 (2019). https://doi.org/10.1108/APJML-02-2018-0047
15. Lee, K.: Predictors of sustainable consumption among young educated consumers in Hong Kong. J. Int. Consum. Mark. **26**(3), 217–238 (2014). https://doi.org/10.1080/08961530.2014.900249
16. Biasutti, M., Frate, S.: A validity and reliability study of the attitudes toward sustainable development scale. Environ. Educ. Res. **23**(2), 214–230 (2017). https://doi.org/10.1080/13504622.2016.1146660
17. Liu, X., et al.: Understanding vocational accounting students' attitudes towards sustainable development. J. Vocat. Educ. Training **74**(2), 249–269 (2022). https://doi.org/10.1080/13636820.2020.1760333
18. Nikolic, V., Vukic, T., Maletaski, T., Andevski, M.: Students' attitudes towards sustainable development in Serbia. Int. J. Sustain. High. Educ. **21**(4), 733–755 (2020). https://doi.org/10.1108/IJSHE-11-2019-0336

19. Homer, P.M., Kahle, L.R.: A structural equation test of the value-attitude-behavior hierarchy. J. Pers. Soc. Psychol. **54**(4), 638–646 (1988). https://doi.org/10.1037/0022-3514.54.4.638
20. Cheung, M.F.Y., To, W.M.: An extended model of value-attitude-behavior to explain Chinese consumers' green purchase behavior. J. Retail. Consum. Serv. **50**, 145–153 (2019). https://doi.org/10.1016/j.jretconser.2019.04.006
21. Kim, M.J., Hall, C.M.: Do value-attitude-behavior and personality affect sustainability crowdfunding initiatives? J. Environ. Manag. **280**(15), 111827 (2021). https://doi.org/10.1016/j.jenvman.2020.1118272021
22. Whitley, C.T., Takahashi, B., Zwickle, A., Besley, J.C., Lertpratchya, A.P.: Sustainability behaviors among college students: an application of the VBN theory. Environ. Educ. Res. **24**(2), 245–262 (2018). https://doi.org/10.1080/13504622.2016.1250151
23. Le, A.N.H., Tran, M.D., Nguyen, D.P., Cheng, J.M.S.: Heterogeneity in a dual personal values–dual purchase consequences–green consumption commitment framework. Asia Pac. J. Mark. Logist. **V31**(2), 480–498 (2019). https://doi.org/10.1108/APJML-12-2017-0303
24. McCarty, J.A., Shrum, L.J.: Value orientations, and attitudes about recycling as antecedents of recycling behavior. J. Bus. Res. **30**(1), 53–62 (1994). https://doi.org/10.1016/0148-2963(94)90068-X
25. Milfont, T.L.: The psychology of environmental attitudes: conceptual and empirical insights from New Zealand. Ecopsychology **4**(4), 269–276 (2012). https://doi.org/10.1089/eco.2012.0058
26. Wang, L., Wong, P.P.W., Narayanan, A.E.: Antecedents of green purchase behaviour: an examination of altruism and environmental knowledge. Int. J. Cult. Tourism Hospitality Res. **14**(1), 63–82 (2020). https://doi.org/10.1108/IJCTHR-02-2019-0034
27. Thelken, H.N., de Jong, G.: The impact of values and future orientation on intention formation within sustainable entrepreneurship. J. Clean. Prod. **266**, 122052 (2020). https://doi.org/10.1016/j.jclepro.2020.122052
28. Nguyen, T.N., Lobo, A., Greenland, S.: The influence of Vietnamese consumers' altruistic values on their purchase of energy efficient appliances. Asia Pac. J. Mark. Logist. **29**(4), 759–777 (2017). https://doi.org/10.1108/APJML-08-2016-0151
29. Leiserowitz, A.A., Kates, R.W., Parris, T.M.: Sustainability values, attitudes, and behaviors: a review of multinational and global trends. Annu. Rev. Environ. Resour. **31**(1), 413–444 (2006). https://doi.org/10.1146/annurev.energy.31.102505.133552
30. Rahman, I., Reynolds, D.: Predicting green hotel behavioral intentions using a theory of environmental commitment and sacrifice for the environment. Int. J. Hosp. Manag. **52**, 107–116 (2016). https://doi.org/10.1016/j.ijhm.2015.09.007
31. Stern, P.C.: Toward a coherent theory of environmentally significant behavior. J. Soc. Issues **56**(3), 407–424 (2020). https://doi.org/10.1111/0022-4537.00175
32. Schultz, W.P., Zelezny, L.: Values as predictors of environmental attitudes: evidence for consistency across 14 countries. J. Environ. Psychol. **19**(3), 255–265 (1999). https://doi.org/10.1006/jevp.1999.0129
33. Ur Rahman, S., Chwialkowska, A., Hussain, N., et al.: Cross-cultural perspective on sustainable consumption: implications for consumer motivations and promotion. Environ. Dev. Sustain. (2021). https://doi.org/10.1007/s10668-021-02059-8
34. Dapo-Kulenović, J., Smigoc, J.B.: Values in Bosnia and Hercegovina: overview of the main findings of the 2019 European Values Study. by Friedrich-Ebert Stiftung BiH and the Faculty of Philosophy in Sarajevo, Sarajevo (2020)
35. Vermeir, I., Verbeke, W.: Sustainable food consumption: exploring the consumer "attitude - Behavioral intention" gap. J. Agric. Environ. Ethics **19**, 169–194 (2006). https://doi.org/10.1007/s10806-005-5485-3

36. Anderson, J.C., Gerbing, D.W.: Structural equation modeling in practice: a review and recommended two-step approach. Psychol. Bull. **103**(3), 411–423 (1988). https://doi.org/10.1037/0033-2909.103.3.411
37. Bollen, K.A., Long, J.S.: Testing Structural Equation Models. Sage, Newbury Park (1993)
38. Garson, G.D.: Structural Equation Modeling. Statistical Associates Publishers, Asheboro (2015)
39. Hair, J.F., Black, W.C., Babin, B.J., Anderson R.E.: Multivariate Data Analysis (7th edn). 7 edn, Prentice Hall, Hoboken (2010)
40. Fornell, C., Larcker, D.F.: Evaluating structural equation models with unobservable variables and measurement error. J. Mark. Res. **18**, 39–50 (1981). https://doi.org/10.2307/3151312
41. Henseler, J., Ringle, C.M., Sarstedt, M.: A new criterion for assessing discriminant validity in variance-based structural equation modeling. J. Acad. Mark. Sci. **43**(1), 115–135 (2014). https://doi.org/10.1007/s11747-014-0403-8
42. Chin, W.W.: The partial least squares approach for structural equation modeling. In: Marcoulides, G.A. (ed.), Modern methods for business research, pp. 295–336 (1998). Lawrence Erlbaum Associates Publishers
43. Falk, R.F., Miller, N.B.: A Primer for Soft Modeling. University of Akron Press, Akron (1992)

The Impact of Corporate Social Responsibility Through Social, Economic, Environmental and Political Responsibility as a Factor in Creating Value Added Companies

Valentina Vinšalek Stipić(✉)

Polytechnic Nikola Tesla in Gospic, Bana Ivana Karlovića 16, 53000 Gospic, Croatia
valentinavinsalek@gmail.com

Abstract. The strategy of corporate social responsibility is based on the fact that the joint efforts of all influential groups of society will contribute to long-term sustainable development. Companies play an important role because the success of the company leads to the progress of the economy. The main goal of this paper is to prove that the implementation of the corporate social responsibility strategy contributes to the creation of value added of companies, and thus the achievement of goals and meeting the needs of all stakeholders. The main research hypothesis and four auxiliary hypotheses were set up to prove that corporate social responsibility strategy, by implementing social, economic, environmental and political-social responsibility, contribute to the creation of value added of companies. A survey and interview protocols on a sample of 613 respondents conducted a survey on the implementation of socially responsible business for 162 large and medium-sized companies registered or operating in the Republic of Croatia. Statistical analysis and data processing resulted in the implementation of a corporate social responsibility strategy significantly related to the creation of value added of companies. It is concluded that the concept of corporate social responsibility strategy significantly contributes to the sustainable development of enterprises by meeting the needs of all stakeholders in the wider community.

Keywords: Corporate social responsibility · Aspects of CSR · Value added of companies

1 Introduction

Globalization and the growing demands for the implementation of corporate social responsibility have posed a great challenge to companies to implement the strategy of sustainable development and social responsibility towards the wider community. Corporate social responsibility is a concept whose fundamental determinant is the concern of corporate influence on society and the environment. It is necessary to harmonize corporate goals with the goals of sustainable development through the implementation of the corporate social responsibility strategy towards the environment and society. Paying

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 179–198, 2023.
https://doi.org/10.1007/978-3-031-17767-5_13

more and more attention to the implementation of CSR is in the problems of harmful impact on the environment that affect the quality of life in industrialized countries, but also the emergence of major social differences between developed and underdeveloped countries. Today, corporate management is aware of the importance of implementing the corporate social responsibility strategy from the social, economic, environmental and political-social aspects for survival and progress in the global market.

Sustainability is evolving to become one of the most prominent issues of the global economy to achieve sustainable development of the wider community [1]. Corporate social responsibility for sustainable development recognizes the importance of growth, development and profitability of companies together with achieving the goals of sustainable development [2] but also increases their competitiveness and ensures a better strategic position in the market [3]. Although many advantages of implementing corporate social responsibility have been highlighted, there is also a dilemma that implementing a CSR initiative can be a very expensive and time-consuming process [4]. It should be noted that the implementation of the CSR initiative certainly needs some financial support. It can be seen that companies implementing a CSR strategy involving all stakeholders to achieve sustainable development are usually large companies that have the financial strength to promote and implement social interests [5]. Most small and medium-sized enterprises do not apply the CSR strategy, but are primarily focused on the economic aspects of business [6]. There is often a conflicting view on the relationship between corporate social performance and the financial performance of companies. Many promoters of corporate social responsibility state that companies will ultimately make higher profits by implementing CSR initiatives [7]. While corporate social responsibility has been debated for forty years, interest in the subject has not waned today. The concept of corporate social responsibility is constantly adapting to the needs of global business. Development of corporate social responsibility strategy and ideology of sustainability on the weak, together with methodologies and criteria used to meet the standards of a responsible company. However, the connotation of corporate social responsibility is still not uniform, although norms and standards related to CSR are constantly evolving. Today, companies are expected not only to be accountable to their shareholders but also to the wider community in general. Margolis and Walsh provided about ninety-five empirical evidence of the financial contributions to the implementation of Corporate Social Responsibility. In these studies, CSR was an independent variable while financial performance was a dependent variable while only empirical findings from 1972 to 2001 were tabulated [8]. By implementing a socially responsible business strategy, every company aims to achieve long-term profitability, while creating value added of the company, but also creating a higher standard of living for all stakeholders for the benefit of the wider community [9]. Effective corporate governance implies satisfying the interests of all stakeholders for the sustainable profitable operation of the company and the long-term creation of value added [10]. After studying numerous studies on the implementation of socially responsible business, the development of the concept as a long-term business strategy that contributes to the betterment of all stakeholders and the community, and the company in turn has a better business reputation that leads to long-term profitability [11]. By conducting his research, Vogel observes that the strategy of socially responsible business is implemented mostly by private companies, going beyond legal frameworks

and regulations as a reaction and way of acting to increasing pressures from customers and consumers, but also the community [12]. Corporate social responsibility used to focus more on social responsibility and environmental responsibility, but now it also includes an economic perspective, economic and social responsibility towards the wider community. Through socially responsible thinking, a company is able to integrate its social aspects as well as care for the environment into its business plans, and thus promote social responsibility for its stakeholders. This paper seeks to prove the importance of implementing the CSR strategy, from all aspects (social, economic, environmental and political-social) in order to achieve long-term financial success by creating value added of companies. The research covered influential groups of large and medium-sized companies in the Republic of Croatia: employees, customers and suppliers, management of companies and leaders of local public authorities. Stakeholders were surveyed using four survey questionnaires (SDOP, SOCO, EKONO, EKOLO) and an interview protocol (POLO), which were designed according to the GRI Standards for each stakeholder group individually.

2 Literature Review of Previous Research and Problem Statement

The roots of the concept of corporate social responsibility we know today have a long and wide history, the first roots of the first half of the twentieth century, especially from the early 1950s until today, the concept of corporate social responsibility has not stopped developing. In 1991, Wood defined corporate social responsibility as a combination of the principles of social responsibility, social responsibility processes, policies, programs, and visible outcomes of how business organizations relate to society [14]. The main features of such practices include focusing on discretionary activities, not those imposed by legislation. The economy will also have to take over part of social work, base business on fair principles and a revised value system [15]. Eberstadt noted that business might never have turned to accountability and obligations to society had it not been for the peak of corporate irresponsibility that caused the collapse of the economic system [16]. Margolis and Walsh analyzed data from 1972 to 2001 in a study of the impact of corporate social responsibility on the financial efficiency of companies, fifty-three percent showed a positive relationship between them, twenty-four percent showed no relationship between them, nineteen percent showed a mixed relationship with them, and five percent showed a negative relationship between them [8]. A significant survey was conducted by Orlitzky on a total sample size of 33,878, it was noted that companies have developed a special business policy that deals specifically with the topic of social responsibility. The implementation of corporate social responsibility as a long-term strategy goes beyond legal regulations and norms and is implemented mostly by private companies [11]. Conducted research in 2013 using data from The KLD Stats database constructed by KLD Research and Analytics, Inc. on a sample of 900 companies, the activities of socially responsible business and its impact on the value of the company were measured. Research has shown that there is a high correlation between customer awareness of the implementation of corporate social responsibility strategy with the value of the companies [17]. Hirigoyen and Poulain-Rehm conducted research on the causal links between different dimensions of corporate social responsibility (human resources,

human rights in the workplace, social commitment, environmental protection, market behavior and management) and financial performance (return on capital, return on assets, ratio market and book values). The survey was based on 329 companies listed in three geographical areas (United States, Europe and Asia-Pacific) for 2009 and 2010. The results show not only that greater social responsibility does not result in better financial results, but also that financial results negatively affect corporate social responsibility [18]. A survey conducted on a sample of 5,859 companies for which data were taken from the MSCI and FactSet database for 2005–2009, found that corporate social responsibility has a negative impact on equity structure, but the implementation of CSR reduces dependence on market conditions, and thus directly affects the cost of capital, reducing the cost of capital leads to a lower debt ratio, which directly affects the profitability of operations [19]. In 2017, research was conducted through empirical testing by analyzing corporate social responsibility, on the implementation of CSR strategy and the impact of CSR on the creation of Economic Value Added. The obtained correlation coefficient between CSR and EVA showed a very high correlation, while the correlation between CSR and Profit is very small [20]. The 2020 survey on the impact of the responsibility of financing the social rights of workers on the business performance of the company, observed from the aspect of corporate social responsibility, and the impact on the profitability of companies. The obtained research results showed that the correlation between the financing of social rights of workers is small with the value added of companies (0.200), net profit margin (0.061), return on equity (0.208), and a statistical correlation with the Earnings Strength indicator does not exist [10]. The research on the impact of environmental and social sustainability on corporate profitability and the creation of Economic Value Added, the results of the research show a very small correlation between social sustainability 0.212 and environmental sustainability 0.243 with the profitability of companies [21]. Uhlig et al. (2020) conducted a study on 544 consumers in Brazil and the results show that of the four dimensions of CSR (philanthropic, legal, organizational and ethical), only the philanthropic dimension indicates the impact on consumer intent with socially responsible companies, suggesting that the Brazilian consumer understands CSR as synonymous with philanthropy [22].

By implementing their business policies, companies seek to maximize value for all stakeholders by implementing a CSR strategy, while CSR promoters require maximizing value for all stakeholders. In the context of this issue, the problem of research is being developed, the contribution of the implementation of the strategy of corporate social responsibility to the creation of value added companies.

3 The Aim and Hypotheses of Research

Turker points out the issue of measuring CSR while several methods are available to measure corporate social activities, almost all of which have some limitations. It is necessary to measure the social and non-social dimensions of CSR, including stakeholders, employees, customers and government [23]. Some authors use Wood's CSP model as an organizational tool to present and discuss studies that use CSP measures. The conclusions emphasize the need for CSP scientists to focus on stakeholders and society, and to include relevant literature from other scientific fields [24]. The explosive growth in

demand for corporate social responsibility ratings has resulted in a significant increase in the number of groups that provide CSR ratings to investors and consumers. The purpose of measuring CSR is to show how important all stakeholders are for the implementation of corporate social responsibility, trends in the implementation of CSR, and the value added of CSR implementation through assessing the credibility of business with investors and consumers [25].

This research is based on measuring the implementation of corporate social responsibility strategy through certain aspects of corporate social responsibility such as social responsibility towards employees and the wider community, and the aspect of economic, environmental and political-social responsibility of sustainable development, as fundamental determinants of profitability companies. Based on this, the main goal of the research is to determine that the implementation of a socially responsible business strategy, including all aspects of CSR, contributes to long-term profitability by creating value added of companies and scientifically set the following research tasks:

- to determine to what extent the social aspect of CSR through responsibility towards employees is related to the profitability of companies
- determine how much the economic aspect of CSR through responsibility to customers and suppliers is related to the profitability of companies
- determine how the environmental aspect of CSR through environmental responsibility, responsible management and implementation of environmental norms and standards is related to the profitability of companies
- to determine how much the political and social aspect of CSR through social responsibility towards the local community is related to the profitability of companies

This research aims to highlight the positive effects of the implementation of corporate social responsibility strategy for management and business owners as a factor in long-term sustainable development and profitability of companies. Based on the previously defined scientific problem, goal and tasks of the research, the main scientific hypothesis was adopted:

H1: Corporate social responsibility strategy is a factor in creating value added companies

Based on the set main hypotheses and in accordance with the presented research tasks, auxiliary research hypotheses were set. Berman et al. (1999) provided results indicating that some dimensions of CSR may affect short-term profitability of firms differently. They found significant positive effects of employee relations and product quality dimensions, but insignificant effects from the other three dimensions of CSR [26]. The issue of social responsibility (social behavior) towards employees and achieving business goals has initiated theoretical debates about the nature of the correlation between ethical principles and financial results [10], while organizational attractiveness is greater when companies show responsibility towards employees [27]. Therefore, the question arises about the impact of social responsibility on the long-term financial performance by creating value added of companies.

H2: Social aspect of corporate social responsibility significantly contributes to the creation of value added companies

The economic aspect of corporate social responsibility includes direct and indirect economic impacts on stakeholders of companies and the wider community, resulting from the business activities of companies, and includes the following economic aspects: economic performance, market presence, indirect economic impact [28]. A study of several research studies shows that customers and business partners mostly respond positively to the efforts of companies in implementing socially responsible business, so the question arises about the impact of the economic aspect of CSR on long-term financial performance of companies.

H3: Economic aspect of corporate social responsibility significantly contributes to the creation of value added companies

High corporate environmental awareness has a significant impact on business operations and their profitability. Environmental responsibility of companies is directly related to reducing operating costs through environmental taxes, penalties and sanctions [29]. Non-compliance with environmental norms and regulations is severely punished by legislation and raises the question of the impact of the implementation of environmental responsibility on long-term profitability by creating value added of companies.

H4: Environmental aspect of corporate social responsibility significantly contributes to the creation of value added companies

The political impact on business operations and the impact of companies on the local community is a serious problem worldwide. Previous reports from the Global Reporting Initiative (GRI) show many shortcomings in the transparency of these data and the impact of the political-social aspect of CSR on the financial performance of companies is unclear [30]. Indicators of the political and social aspect of CSR identifies key areas activity of companies for the benefit of the community, which includes the following social aspects: local community, fight against corruption, public policies, conduct against the principle of free competition, compliance with regulations, assessment of suppliers with regard to impacts on society, mechanisms for resolving disputes related to impacts on society. So the social impacts of companies are related to the interaction with market structures and social structures within the environment of the social community in which the companies operates. Such interaction of companies with all stakeholders of the local and regional community is an important component of the impact of social responsibility.

H5: Political-social aspect of corporate social responsibility significantly contributes to the creation of value added companies

The logical derivation of hypotheses for this research aims at empirical verification of all defined hypotheses. Testing the defined hypotheses leads to concrete scientific knowledge and conclusions about the effectiveness of the CSR strategy, as well as certain aspects of CSR, contributes to long-term profitability by creating value added of companies.

4 Materials and Methods of Research

The research described in this paper is based on empirical testing on a total sample of 613 respondents, of which 159 were all stakeholders, 136 employees of companies, 159 customers and suppliers, 121 management of companies and 38 heads of local public authorities in the area which the sampled companies operates. In accordance with the

type of data that needed to be collected for the purposes of this research, external (secondary) data were used financial statements of companies for the business year 2019, and own (primary) data obtained from four questionnaires ($_{SDOP, SOCO, EKONO, EKOLO}$) and interview protocols ($_{POLO}$). Survey questionnaires were developed for each independent variable individually - four survey questionnaires: all stakeholders of companies; employees; customers and suppliers; management of companies. They were created using the web tool Google Docs, through which survey questionnaires were sent to the e-mail addresses of potential respondents, and to more social and business networks in order to obtain a more representative sample. The questions in the survey questionnaires and the interview protocol were constructed and conceived on the base of the GRI Standard [31] for the implementation of corporate social responsibility in all aspects of CSR. The survey using four survey questionnaires and interview protocols was conducted in the period from March 1, 2021 to April 30, 2021. To test the hypotheses, the data from the research were processed in the statistical program SPSS Statistics 26.0. The following variables were defined in this study:

a) Dependent VAR VA – Value Added => this feature is determined from the financial statements for 2019 of large and medium-sized Croatian companies, based on the following calculation [32]:

$$VA = Sales\ revenues - Material\ costs - Production\ costs \tag{1}$$

b) Independent variables:

- VAR SDOP – corporate social responsibility strategy => this feature is determined by the weighted average value (arithmetic mean) of responses from survey questionnaire$_{SDOP}$ of all stakeholders (n = 159) on the level of implementation and application of corporate social responsibility strategy observed through four dimensions: social, economic, environmental and political-social dimension of the concept of corporate social responsibility. Survey questionnaire$_{SDOP}$ includes fourteen questions about the coherence of the company strategy with all aspects of CSR, the comprehensiveness of sustainability reports, the involvement of all stakeholders in the adoption of CSR strategy, corruption risk analysis, continuity of the sustainable development strategy and the company impact on society based on all aspects of CSR.
- VAR SOCO – degree of corporate social responsibility => this feature is determined by the weighted average value (arithmetic mean) obtained from the employee survey (n = 136) on social responsibility companies towards its employees. Survey questionnaire$_{SOCO}$ includes fourteen questions about identifying and assisting socially vulnerable groups, transparency in social, health and human rights, transparency in employment and retirement plans, employee representation in formulating company strategy, transparency in the implementation of social and labor rights, transparency in human rights protection and exclusion of forced labor and juvenile labor.
- VAR EKONO – degree of economic responsibility of companies => this feature is determined by the weighted average value (arithmetic mean) obtained from the survey questionnaire by surveying customers and suppliers (n = 159) on the economic responsibility of companies. Survey questionnaire$_{EKONO}$ includes fourteen questions about the impact of companies on economic trends in society, transparency towards

customers and suppliers and priorities for implementing economic sustainability, transparency on management and business owners, and changes in management and owners, transparency of costs and revenues by regions and countries, transparency of economic impact on the wider community and assistance to government and state institutions, investing in infrastructure to benefit the economic progress of the community, transparency of penalties for non-compliance, transparency with affiliation with political parties and public policies and the use of external auditors to verify sustainability reports as recommended by the GRI Standards.

- VAR EKOLO – degree of environmental responsibility of companies => this feature is determined by the weighted average value (arithmetic mean) obtained was a questionnaire survey of the companies management (n = 121) on the parameters of the ecological impact of the companies on the environment. Survey questionnaire$_{EKOLO}$ includes sixteen questions about clearly and transparently stated strategy of ecological responsibility and impact of the company on the ecosystem (land, air and water), transparency on the use of renewable and non-renewable materials, transparency of managerial ecological responsibility, transparency of managerial ecological responsibility and implementation of training on environmental standards, monitoring the implementation of environmental standards and policies of business partners and suppliers, transparency of required certificates related to environmental performance, regularly records direct and indirect quantitative energy consumption by type, transparency of data on the use of recycled materials, transparency of drinking water consumption and adequate environmental wastewater management, implementation of policies in accordance with protected area management regulations, transparency of data on greenhouse gas emissions and initiatives to mitigate the impact of products (services) on the environment, as well as the scope of mitigation of environmental impact due to transport of products and other goods and materials.
- VAR POLO – degree of political-social responsibility of companies => this feature is determined by the weighted average value (arithmetic mean) obtained by conducting an interview protocol by examining local public authorities at all levels of government in the environment in which the sample companies operate (n = 38). The Interview protocol$_{POLO}$ consists of eight questions on regular reporting of companies on stakeholder involvement in the implementation of socially responsible activities, presenting the effects of socially responsible business in regional publications, assisting companies in the work of local (regional) self-government units, implementation of an active policy of care for vulnerable (social) groups in local community and civil society, active participation in solving economic, environmental, social and community problems of the local region, caring for all stakeholders, endangering the political-social life of the local community, possession of key components that directly contribute to sustainable development of local and regional communities.

The elimination of the problem of multicorrelation of independent variables and reliability of measuring instruments with the Cronbach's alpha coefficient is shown in Table 2. Transformation of the dependent variable was not performed because there is no problem of normality, obtained values of VA whose values in the analyzed interval are not integer countable [33] and Fig. 1 shows the normal distribution for the roundness measure for SPSS software while the scatter plots showed a positive linear association

of the independent variables with the dependent variable VA, which is a prerequisite for performing correlation and regression analysis.

Testing of previously defined dependent and independent variables was performed by the following regression model:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 \quad (2)$$

where is:

Y_i – value added of companies (VA).

X_1 – degree of implementation of the corporate social responsibility strategy (SDOP).

X_2 – degree of social responsibility (SOCO).

X_3 – degree of corporate economic responsibility (EKONO).

X_4 – degree of corporate environmental responsibility (EKOLO).

X_5 – degree of political-social responsibility (POLO).

β – explanatory variable coefficient (constant).

e_i – the difference between the estimated and observed value of the level of environmental reporting for the i-th company (term error).

A regression model was used to determine the impact of independent variables on the value added of the enterprise, and the value of Pearson's correlation between dependent and independent variables was calculated. The existence or non-existence of a problem of multicorrelation between independent variables was examined. The elimination of the problem of multicorrelation of independent variables was determined based on the calculation of the variation inflation factor (VIF). To test the hypotheses, independent variables were obtained from questionnaires and interview protocols and data collected using the Likert scale were used in the factor analysis, first the internal consistency of the scale reliability was calculated by calculating the Cronbach's alpha coefficient.

5 Results of the Research

This empirical research was conducted to prove the impact of the implementation of the corporate social responsibility strategy on the creation value added of companies. The data analysis included 613 respondents who provided answers on the implementation of the corporate social responsibility strategy for 162 large and medium-sized Croatian companies. Of these, 57.41% are large enterprises and 42.59% are medium-sized enterprises. Of the companies included in the sample of research, most are those that belong to trade, 38%, followed by companies that belong to industry 33%. Companies belonging to the service industry is 20%, which is preceded by companies of other activities 9%. Respondents independently and voluntarily selected companies for which to fill out questionnaires with the previous indication that the survey covers large and medium-sized Croatian companies.

To meet the assumptions of further research, descriptive statistics of all variables were first made, which is shown in Table 1. The presentation of descriptive statistics shows the basic statistical values for each variable: arithmetic mean, median, mode, standard deviation, variance, percentiles, minimum and maximum value.

From the data of descriptive analysis of independent variables, there are generally differences that are the result of observing and recording the implementation of corporate

Table 1. Descriptive statistics of independent variables of the regression model.

		SDOP	SOCO	EKONO	EKOLO	POLO	VA
N	Valid answers	159	136	159	121	38	162
Mean		3.9883	3.9817	3.8356	4.2865	4.1382	3.2514
Median		4.0700	4.1400	4.0000	4.4400	4.1900	2.7550
Mode		5.00	5.00	5.00	5.00	5.00	6.81
Std. Deviation		.78149	.86848	.98358	.64553	.81859	12.0262
Variance		.611	.754	.967	.417	.670	144.630
Percentiles	25	3.4300	3.1475	3.4300	3.9400	.2400	3.6875
	50	4.1400	4.0000	4.1400	4.4400	2.7550	4.1900
	75	4.7900	4.6700	4.7900	4.8100	6.5675	4.8800

social responsibility from different aspects, and including all stakeholders. The average score is the highest in the variable EKOLO, in the analysis of the environmental aspect of corporate social responsibility (4.2865), and the lowest value (3.2514) is in the value added of companies as a result of financial performance of the sampled companies. This is in line with the previous statements of the theoretical analysis, the fact that companies pay the most attention to the environmental aspect by implementing a strategy of corporate social responsibility.

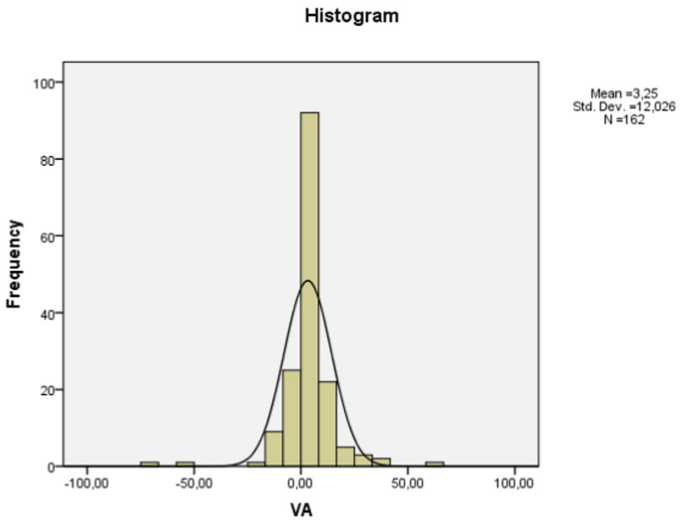

Fig. 1. Demonstration of symmetry of the distribution of the dependent variable VA.

The normal distribution of the dependent variable shown by the Gaussian curve, histogram, apart from the symmetry of the distribution from the rounding coefficient,

shows a more elongated peak compared to the normal distribution, and the sample is a double exponential distribution, shown in Fig. 1. To statistically test hypotheses, it is first necessary to carry out the rejection of null-hypotheses. The null hypothesis predicts no effect, no relationship between the tested variables, which is contrary to the set alternative hypotheses [34]. P-value (Sig.) is an important indicator and if the p-value is less than 0.05, the null-hypothesis of the t-test is rejected while there is a prerequisite for confirming the alternative hypothesis [33]. It is concluded that there is enough evidence to reject all null-hypotheses according to which the strategy of socially responsible business in all aspects does not contribute to the creation value added of companies. The validity of the set hypotheses is confirmed, while the validation testing for the measuring instruments was performed using the Cronbach's alpha coefficient for each individual independent variable.

Table 2. Inflation variance factor (VIF) and Cronbach's alpha coefficient.

Model		Collinearity statistics		Cronbach's
		Tolerance	VIF	Alpha
1	SDOP	.857	1.167	.968
	EKONO	.711	1.406	.962
	SOCO	.602	1.661	.980
	EKOLO	.789	1.268	.968
	POLO	.768	1.302	.942

a. Dependent Variable: VA

Elimination of the problem of multicorrelation of variables was performed by factor analysis of variance (VIF), and the obtained values are shown in Table 2. When performing factor analysis of variance, the preferred value of VIF up to 2.50 is considered an acceptable level. Considering the obtained values of the inflation factor of variation of dependent variables defined in this research, it is concluded that multicorrelation of variables does not exist. It is evident from the tolerance indicator that the collinearity of the independent variables is not disturbed because the tolerance indicator is less than 0.2. For the independent variables obtained by the Likert measurement scale from the questionnaires and interview protocols from the Cronbach's alpha coefficient on the internal consistency of the reliability of the scales, the acceptable reliability of the measuring instruments is visible.

5.1 Confirmation of Research Hypotheses

The presentation of the correlation coefficients of all variables is shown in Table 3, where ** the correlation of statistical significance at the significance level of 0.01 is extremely significant. Pearson's correlation coefficients of the variables indicate that there is a statistically significant association where the correlation is greatest between the SDOP and POLO variables. Other correlation coefficients also indicate a high correlation (r >

0.4; $p < 0.001$) between dependent and independent variables, but predictive analysis using regression analysis will certainly be performed to prove the hypotheses.

Table 3. Pearson correlation analysis of all variables.

		SDOP	EKONO	SOCO	EKOLO	POLO	VA
SDOP	r	1					
	Sig. (2-tailed)						
EKONO	r	.647**	1				
	Sig. (2-tailed)	.000					
SOCO	r	.631**	.649**	1			
	Sig. (2-tailed)	.000	.000				
EKOLO	r	.565**	.614**	.467**	1		
	Sig. (2-tailed)	.000	.000	.004			
POLO	r	.916**	.612**	.529**	.511**	1	
	Sig. (2-tailed)	.000	.000	.001	.001		
VA	r	.438**	.227	.262	.227	.425**	1
	Sig. (2-tailed)	.006	.204	.118	.177	.008	

** Correlation is significant at the 0.01 level (2-tailed)

After conducting descriptive statistics, rejecting null hypotheses, defining positive linear correlation of independents with dependent variable, and rejecting the possibility of multicorrelation, it was necessary to conduct multiple regression analysis to define the level of predictive ability of the research model and assess its overall statistical significance. As all the above assumptions were met, a multiple regression analysis was performed, which is shown in Tables 4, 5 and 6. Regression models for each aspect of CSR and the value added shown in Table 7.

Table 4. Multiple regression analysis – 1st part.

Model summary				
Model	R	R square	Adjusted R square	Std. error of the estimate
1	.468[a]	.219	.063	13.73440

a. Predictors: (Constant), POLO, EKOLO, EKONO, SOCO, SDOP
b. Dependent Variable: VA

From the multiple regression model in Table 4, the multiple correlation coefficient (R) of 0.468 is visible, which is a high positive correlation dependent with independent variables. That is, the strategy of socially responsible business with all aspects (social, economic, environmental and political-social) is positively and significantly statistically

related to the creation value added of the companies. The coefficient of determination is 0.219, which means that 21.9% of the variations in the dependent variable VA (value added of the companies) are the result of variations of the independent variables SDOP, SOCO, EKONO, EKOLO and POLO. The adjusted R2 of 0.063 is an indicator of the predictive capability of the set model.

Table 5. Multiple regression analysis ANOVA – 2nd part.

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1323.084	5	264,617	1.403	.257[b]
	Residual	4715.846	25	188,634		
	Total	6038.930	30			

a. Dependent Variable: VA
b. Predictors: (Constant), POLO, EKOLO, EKONO, SOCO, SDOP
Sig. > 0.001

Multiple regression analysis with ANOVA table shows an F ratio greater than 0.05 and the number of degrees of freedom ($F_{5, 25} = 1.403$; $p > 0.001$) indicates that independent variables do not predict a statistically significant dependent variable, and that variations in the regression model are random. As this is a multiple regression model, it does not necessarily mean that not all variables contribute statistically significantly to the explanation of variations in the regression model which is proved by individual regression models.

Table 6. Multiple regression analysis – 3rd part.

Coefficients[a]						
Model		Unstandardized coefficients		Standardized coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	−18.438	15.297		−1.205	.239
	SDOP	7.961	8.672	.547	.918	.367
	SOCO	−2.637	4.850	−.151	−.544	.591
	EKONO	.575	4.773	.033	.121	.905
	EKOLO	−.152	2.397	−.015	−.063	.950
	POLO	−.085	8.926	−.005	−.009	.993

a. Dependent Variable: VA; Sig. > 0.001

In order to complete the interpretation of the multiple regression model, the data obtained in Table 6, which is the third part of the mentioned regression model, were

analyzed. Since the independent variables were measured in different units of measurement in relation to the dependent variable, are interpreted the standardized coefficients, thus ensuring the comparability of the variables of the multiple regression model. The variable SDOP shows the highest predictive power in the context of creating value added of companies, but with little statistical significance (ß = 0.547; t = 0.918; p > 0.001). For other variables from the predictive ability of all independent variables of the analyzed multiple regression model, the variables do not show much contribution to the model, but the previously obtained multiple correlation coefficient (R) 0.468 indicates a significant positive correlation dependent with independent variables. After conducting a multi-regression analysis for all independent variables with VA, the processing of simple regression models for testing the set hypotheses of this research was started. In the following, Table 7 summarizes the data of all five simple regression models (for five set hypotheses) and describes the results of the second and third parts of the mentioned regression models.

Table 7. Summary of simple regression analyzes of independent variables with VA.

Model summary[b]					
Model	R	R square	Adjusted R square	Std. Error of the estimate	Durbin-Watson
SDOP	.507[a]	.257	.254	3.48577	1.084
SOCO	.363a	.132	.126	11.16374	1.364
EKONO	.421a	.177	.171	11.92015	1.845
EKOLO	.396a	.156	.149	11.56478	1.452
POLO	.516a	.267	.246	4.86836	1.799

b. Dependent Variable: VA

The analysis of the regression model for hypothesis H1 from the correlation coefficient (0.507) shows a significant statistical correlation between the implementation of the CSR strategy and the creation of value added – VA, with an appropriate level of significance (r = 0.507; p < 0.001). From the coefficient of determination of 25.7%, it can be said about the relatively good representativeness of the model. The obtained F ratio with the number of degrees of freedom confirms that there is a statistically significant contribution, the independent variable predicts a dependent variable ($F_{1, 157}$ = 431,991; Sig. < 0.001), and that the implementation of corporate social responsibility strategy predicts value added of companies. When the CSR strategy is not implemented, the value added of the companies is not created (a = −6,338; SDOP = 0; p < 0.001). By analyzing the standard coefficient because the independent and dependent variables are obtained from different measurement scales, the value added of companies is an indicator obtained from the financial statements of companies, while the SDOP variable is obtained from the interval scale. β shows a positive direction of the regression line 0.507, while a statistically significant contribution to the regression model was determined for the independent SDOP variable (t = 9.957; p < 0.001). The overall analysis of

the SDOP and VA regression model shows that the implementation of corporate social responsibility strategy is significantly statistically related to the creation value added of companies, therefore confirmed the main scientific hypothesis H1 – Corporate social responsibility strategy is a factor in creating value added companies.

The regression model on the statistical significance of the correlation between social responsibility and value added of companies from the correlation coefficient (0.363) shows a positive and significantly moderate correlation with the coefficient of determination (0.132) with a significance level of $p < 0.001$. Durbin-Watson (1,364) indicates the absence of autocorrelation of relation errors. Analysis of the regression model (ANOVA) from the F ratio, with the number of degrees of freedom (1,157) and the appropriate level of significance, confirms that there is a statistical significance of the contribution of social responsibility to value added ($F_{1, 157} = 23{,}813$; $p < 0.001$). This is supported by the obtained constant ($a = -15{,}417$; SOCO = 0; Sig. < 0,001) from which it is evident that not implementing the social responsibility of companies results in financial losses, not creating value added of companies. As the independent variable SOCO was obtained from the Likert scale and the dependent variable VA, the standard coefficient ($\beta = 0.363$) was analyzed by calculation from the financial statements of companies from the regression model, which shows a positive direction of the regression line ($t = 4.880$; $p < 0.001$). Based on the above H2 – Social aspect of corporate social responsibility significantly contributes to the creation of value added companies is confirmed.

Demonstration of hypothesis H3 was performed by a regression model to examine the connection between the implementation of economic responsibility and the creation of value added companies. The correlation coefficient R shows a positive significant correlation between the variables EKONO and VA (0.421). The coefficient of determination is closer to zero and this significant statistical correlation is shown by 17.7% of variations in the dependent variable with the result of variations of the independent variable. Durbin-Watson has a value closer to 2 which indicates the absence of autocorrelation of relation errors. Analysis of the variance of the regression model (ANOVA) on the existence or non-existence of differences between the population averages, with the determined level of significance $p < 0.001$ less than the default 0.05 and the number of degrees of freedom ($F_{1, 134} = 28.101$) regression model is statistically significant. If companies do not exercise economic responsibility towards interest groups, then they do not created the value added of companies ($a = -15{,}914$; EKONO = 0; Sig. < 0.001). The analysis of the standardized coefficient because it is a different scale for the dependent variable VA and the independent variable EKONO, shows a positive direction of the regression line. The indicator β is statistically significant ($t = 15.367$; $p < 0.001$) and concludes that the contribution of the independent variable to regression statistically significant model. Statistical processing and analysis of data for the variables EKONO and VA showed a positive significant statistical correlation between economic responsibility and value added of companies (0.421), and hypothesis H3 was confirmed.

The regression model of the independent variable EKOLO and the dependent variable VA shows a positive moderately significant statistical correlation, while the coefficient of determination shows relatively weak strength, as seen 15.6% of variations in the dependent variable is the result of variations of the independent variable. However, with

the level of significance ($p < 0.001$) it can be said that the statistical correlation is significant. The ratio with the number of degrees of freedom and the corresponding level of significance ($F_{1, 119} = 22{,}069$; $p < 0.001$) confirms that there is a statistically significant contribution that the independent variable EKOLO predicts the dependent variable VA, the implementation of environmental responsibility significantly contributes to creating value added. The study of the regression model shows that when a company does not implement environmental responsibility, it does not created the value added of companies ($a = -25.874$; EKOLO = 0; $p < 0.001$). By analyzing the standard coefficient ($\beta = 0.396$), because these are variables obtained by different measurement scales, the positive direction of the regression line is visible. For the independent variable EKOLO with a given level of significance ($t = 4.698$; $p < 0.001$), a statistically significant contribution to the regression model was determined. The overall analysis of the regression model of the independent variable (EKOLO) environmental responsibility of companies and the dependent variable (VA) value added companies shows their positive statistically significant correlation. Hypothesis H4 Environmental aspect of corporate social responsibility significantly contributes to the creation of value added companies confirmed.

The correlation coefficient R of the regression model POLO and VA shows a significant positive correlation between the independent variable political-social responsibility and the dependent variable value added of companies. The coefficient of determination shows that 26.7% of variations in the dependent variable are the result of variations of the independent variable, which shows a relatively good representativeness of the model. Durbin-Watson (1,799) means that the existence of autocorrelation of relation errors was not determined in the sample. Given the correlation coefficient and the coefficient of determination, statistical significance from the regression model with the level of significance and the number of degrees of freedom ($F_{1, 36} = 13.087$; $p < 0.001$) shows a statistically significant prediction of creating value added of companies. Also, if companies do not implement political-social responsibility, they do not achieve value added ($a = -10.696$; POLO = 0; $p < 0.001$). Analysis of the standardized coefficient, because different variables are used to obtain variables, shows β (0.516) which means a positive direction of the regression line, while for the independent variable POLO good statistical significance is determined ($t = 3.618$; $p < 0.001$). The analysis of the entire regression model shows a significant positive statistical correlation between the independent variable POLO and the dependent variable VA, which confirms hypothesis H5. Political-social aspect of corporate social responsibility significantly contributes to the creation of value added companies.

6 Discussion

With this research the impact of the implementation of corporate social responsibility strategy was analyzed, the separation of CSR into all dimensions (social, economic, environmental and political-social) on the creation of value added of the companies. As can be seen from the results of the research, the contribution of the implementation of the CSR strategy to the creation of value added companies is significant. By analyzing the impact of certain aspects of CSR as defined by GRI standards, the individual impact of all aspects of CSR on the creation of value added of companies is visible. This

confirms the assumption that not only caring for the environment is sufficient for the implementation of social responsibility, but also the impact of companies on the wider community. These results are not consistent with the conclusions of the study, drawn from the resource-based view [35] and the neoclassical economic view [36] that all dimensions of CSR have positive effects on short-term and future profitability. Still, the findings of the study can be explained by the idea that firms could gain different degrees of financial benefit and competitiveness by involving primary stakeholders [37–39]. Peloza and Papania (2008) conclude that the financial effects of different dimensions of CSR may be different for companies in different industries based on the level of importance assigned to each primary stakeholder for the industry. Porter and Kramer's (2006) view is that the strategic implications of CSR depend on the degree of connection between a company's business and a particular social issue. CSR classifies initiatives into strategic CSR and responsible CSR. Specifically, strategic CSR encompasses activities focused on social issues closely related to the company, an operational context that allows companies to generate competitive advantages. Responsible CSR, by contrast, refers to corporate actions designed to improve indirectly related social issues and is less likely to have a positive effect on a company's performance [39]. This is unacceptable because it is high time that the CSR strategy is implemented in the context of all aspects of CSR, taking into account the concern for all stakeholders and the impact on the entire community in which the company operates.

By studying the dimensions of social care and environmental care, the results of the research indicated that both dimensions do not have positive effects on financial indicators [40, 41], which is in contradiction with the results of this research. Engagement in these dimensions of CSR is usually motivated by meeting normative expectations rather than achieving instrumental goals [42] and the direct financial benefits associated with these activities are expected to be low [40]. The results of this research, in contrast to the above, have proven a direct link between long-term profitability by creating added value of the company with the social, economic and environmental aspects of CSR. Because these dimensions have an ambiguous relationship with profitability, investors are less likely to positively rate companies that do not implement CSR initiatives in these two areas because corporate attention to the environment and social responsibility issues can create negative effects on reputations and positive consumer ratings [43, 44]. However, these are important empirical issues that need to be further explored on an ongoing basis, and include issues on corruption, discrimination, recycling, the use of renewable energy sources, etc.

7 Conclusion and Recommendations for Future Research

Although the beginnings of the study of corporate social responsibility date from the 1950s until today, the study of corporate social responsibility is not in sight, primarily due to the development of the social community and increasing demands of influential groups. The biggest problem in implementing the concept of corporate social responsibility is finding common interests of companies and its management with the interests of external and internal stakeholders of companies. Modern implementation of corporate social responsibility represents a deviation from the unilateral promotional process

by companies and the acceptance of activism for all stakeholders. This means that the focus of interest in corporate social responsibility is not only on business owners and managers, but also on other stakeholders.

The conclusions reached by conducting this research, testing hypotheses, show that the implementation of corporate social responsibility strategy contributes to the creation of value added companies. By breaking down the concept of corporate social responsibility into individual aspects, social, economic, environmental and political responsibility, it was determined that each of them separately contributes to the creation value added of companies.

Due to the need to survive in a competitive market, a significant number of companies will have to meet the requirements of stakeholders and pay more attention to the implementation of corporate social responsibility and reporting on it. This is the source of future research as well as monitoring the possible development of legislation and its implementation. A significant number companies of public sector do not sufficiently implement their CSR strategy or compile sustainability reports. Further research can be conducted in the direction of defining common goals of all stakeholders and conceptualizing common models of corporate social responsibility. All of the above is a significant source for conducting future research.

References

1. Isaksson, R., Steimle, U.: What does GRI reporting tell us about corporate sustainability? TQM J. **21**, 168–181 (2009)
2. Wilson, M.: Corporate sustainability: what is it and where does it come from? Ivey Bus. J. **67**(6), 1–5 (2003)
3. Pitelis, C., Boulouta, I.: CSR-Based Positioning Strategies, National Competitive Advantage, and the Role of Innovation (2011)
4. Charitoudi, G., Giannarakis, G., Lazarides, T.G.: Corporate social responsibility performance in periods of financial crisis. Eur. J. Sci. Res. 447–455 (2011)
5. Elhauge, E.: Corporate Managers' Operational Discretion to Sacrifice Corporate Profits in the Public Interest. Environmental Protection and the Social Responsibility of Firms (2005)
6. Vinšalek Stipić, V.: Corporate social responsibility of SMEs in the republic Croatia. BH Ekonomski Forum **11**(2), 75–90 (2019). https://doi.org/10.5937/bhekofor1902075V
7. Carp, M., Pavaloaia, L., Afrăsinei, M.-B., Georgescu, I.E.: Is sustainability reporting a business strategy for firm's growth? Empirical study on the Romanian capital market. Sustainability **11**, no. 658 (2019). https://doi.org/10.3390/su11030658
8. Margolis, J.D., Walsh, J.P.: People and Profits? The Search for a Link between a Company's Social and Financial Performance. Psychology Press, New York (2001)
9. Hopkins, M.: What is corporate social responsibility all about. J. Public Aff. **6**(3–4), 171–316 (2006)
10. Vinšalek Stipić, V.: Social responsibility towards employees as a factor of company profitability. J. Account. Manage. **10**(2), 115–126 (2020)
11. Orlitzky, M.: Corporate social performance and financial performance – research synthesis, Perspectives on CSR (2009). https://www.researchgate.net/publication/281656725_Corporate_Social_Performance_and_Financial_Performance_A_Research_Synthesis. Accessed 08 Feb 2022
12. Vogel, D.: The Market for Virtue – The Potential and Limits of Corporate Social Responsibility. Brookings Institution Press, Washington DC (2005)

13. Carroll, A.B.: A History of Corporate Social Responsibility: Concepts and Practices, Oxford Handbooks Online, pp. 1–20 (2008)
14. Wood, D.J.: Corporate social performance revisited. Acad. Manage. Rev. **16**, 691–718 (1991)
15. Kotler, P., Lee, N.: Društveno odgovorno poslovanje. M.E.P. d.o.o., Zagreb (2009)
16. Eberstadt, N.: What history tells us about corporate responsibilities. Business and Society Review/Innovation, pp. 76–81 (1973)
17. Servaes, H., Tamayou, A.: The impact of corporate social responsibility on firm value: the role of customer awareness. Manage. Sci. **59**(5), 1045–1061 (2013)
18. Hirigoyen, G., Poulain-Rehm, T.: Ralationships between corporate social responsibility and financial perfotmance: what is the causality? J. Bus. Manage. **4**(1), 18–40 (2015)
19. Pijourlet, G.: Does Corportea Social Responsibility Have an Impact on Financing Decisions? EconPapers: Bankers, Markets & Investors, pp. 5–16 (2015)
20. Vinšalek Stipić, V.: Društveno odgovorno poslovanje kao preduvjet stvaranja vrijednosti poduzeća, Zbornik radova 18. međunarodna znanstvena i stručna konferencija "Računovodstvo i menadžment". Svezak I., Zagreb, pp. 189–201 (2017)
21. Vinšalek Stipić, V.: Social and environmental sustainability a prerequisite for company profitability and creation of economic value added. In: Proceedings of the 36th International Business Information Management Association Conference (IBIMA). Granada, Spain, pp. 12587–12593 (2020)
22. Uhlig, M.R.H., Mainardes, W.E., Nossa, V.: Corporate social responsibility and consumers relationship intemtion. Corp. Soc. Responsib. Environ. Manage. **27**(1), 313–324 (2020)
23. Turker, D.: Measuring corporate social responsibility: a scale development study. J. Bus. Ethics **85**, 411–427 (2009)
24. Wood, D.J.: Measuring corporate social performance: a review. Acad. Manage. Rev. **16**, 691–718 (2009)
25. Márquez, A., Fombrun, C.: Measuring corporate social responsibility. Corp. Reput. Rev. **7**, 304–308 (2005)
26. Berman, S.L., Wicks, A.C., Jones, T.M.: Does stakeholder orientation matter? The relationship between stakeholder management models and firm financial performance. Acad. Manage. J. **42**(5), 488–506 (1999)
27. Carballo-Penela, A.: Enhancing social sustainability at a business level: organizational attractiveness is higher when organizations show responsibility towards employees. Bus. Strategy Dev. **2**(4), 372–383 (2019)
28. Schreck, P.: The Business Case for Corporate Social Responsibility. Physica-Verlag HD, pp. 1–3 (2009)
29. Waddock, S.A., Graves, S.B.: The corporate social performance-financial performance link. Strateg. Manage. J. **18**(4), 303–310 (1997)
30. Joseph, C., et al.: A comparative study of anti-corruption practice disclosure among Malaysian and Indonesian Corporate Social Responsibility (CSR) best practice companies. J. Clean. Prod. **112**(4), 2896–2906 (2016)
31. GRI Standards. https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/
32. Bontempi, F.: System-base Vision for Strategic and Creative Design. Swets&Zeitlinger B. V, Lisse, The Netherlands (2003)
33. Horvat, J., Mijoč, J.: Istraživački SPSS. Ljevak, Zagreb (2019)
34. Anderson, D., Burnham, K., Thompson, W.: Null hypothesis testing: problems, prevalence, and an alternative. J. Wildl. Manage. **64**, 912–923 (2000)
35. Barney, J.: Firm resources and sustained competitive advantage. J. Manage. **17**(1), 99–121 (1991)
36. McWilliams, A., Siegel, D.: Corporate social responsibility and financial performance: correlation or misspecification? Strateg. Manag. J. **21**(5), 603–609 (2000)

37. Godfrey, P.C., Hatch, N.W.: Researching corporate social responsibility: an agenda for the 21st century. J. Bus. Ethics **70**, 87–98 (2007)
38. Peloza, J., Papania, L.: The missing link between corporate social responsibility and financial performance: stakeholder salience and identification. Corp. Reput. Rev. **11**, 169–181 (2008)
39. Porter, M.E., Kramer, M.R.: Strategy and society: the link between competitive advantage and corporate social responsibility. Harv. Bus. Rev. **84**(12), 78–92 (2006)
40. Kacperczyk, A.: With greater power comes greater responsibility? Takeover protection and corporate attention to stakeholders. Strateg. Manag. J. **30**, 261–285 (2009)
41. Mattingly, J.E., Berman, S.L.: Measurement of corporate social action: discovering taxonomy in the Kinder Lydenburg Domini rating data. Bus. Soc. **45**(1), 20–46 (2006)
42. Donaldson, T., Preston, L.E.: The stakeholder theory of the corporation: concepts, evidence, and implications. Acad. Manage. Rev. **20**(1), 65–91 (1995)
43. Brammer, S., Millington, A.: Does it pay to be different? An analysis of the relationship between corporate social and financial performance. Strateg. Manag. J. **29**, 1325–1343 (2008)
44. Sen, S., Bhattacharya, B.: Does doing good always lead to doing better? Consumer reactions to corporate social responsibility. J. Mark. Res. **38**(2), 225–243 (2001)

Sustainable Urban Development: Designing Smart, Inclusive and Resilient Cities

Transforming Power Relations in Urban Mobility Systems

Ruud van Diepen(✉)

Department of Human Geography, Planning and International Development, University of Amsterdam, 1018 WV Amsterdam, The Netherlands
ruud.van.diepen@student.uva.nl

Abstract. In order to make mobility more sustainable, it is necessary to discover how its complex systems work and how power relations within them interact. Systems thinking, multi-level perspective analyses and empirical case studies from China and Spain provide examples of mobility systems and power relations in practice. This paper analyzes various interlinked transport taboos, post-politics and asymmetrical power relations. In addition, possible directions for overcoming difficult transformational change in future mobility systems are outlined. These can be found through democratic decision-making and activism in alternative political spaces outside formal institutions. In conclusion, it is argued that communication power and storytelling are useful tools to eventually get through to formal sustainable governance practices.

Keywords: Sustainable mobility · Transport taboos · Power relations · Post-politics · Transformational change

1 Introduction

"You are the witness of change. And to counteract, we gotta take the power back," Zack de la Rocha raps in "Take the Power Back" (Rage Against the Machine 1992). His lyrics are a protest against a system that, according to him, cares about only one culture. Could this quote also be applied when rethinking urban transportation planning? Whereby the current system focuses too much on one culture: a car-dependent mobility culture (Mattioli et al. 2020; Sattlegger and Rau 2016). The following provides insight into problem and system analysis and possible ways to change the structure of mobility systems. Case studies in China and Spain present examples of power relations in urban mobility systems and give possible directions for producing more of what we want and less of what is undesirable (Meadows 2008).

2 Problem Definition

Current patterns of mobility are unsustainable due to high levels in energy use, oil dependence and associated greenhouse gas emissions (Berger et al. 2014; Kimbrell 2021).

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 201–209, 2023.
https://doi.org/10.1007/978-3-031-17767-5_14

Although, there is no political or scientific agreement on what sustainable mobility exactly is, there are scientifically known measures that are of significant importance for reducing transport emissions. For cars, these include speed limits, congestion charges and road tolls/vignettes (Gössling and Cohen 2014). Despite this knowledge, there is often a lack of political will. In the European Union, significant mitigation policies for transport are non-existent, because of various interlinked transport taboos (Gössling and Cohen 2014; Kębłowski and Bassens 2018). These form barriers to sustainable policies that remain unaddressed, as they constitute political risk. To touch a taboo creates a violation of norms, and implies a danger for the transgressor to become marginalized and to 'die' politically (Gössling and Cohen 2014). Lobbyism by the car and oil industry also influences transport policy (Mattioli et al. 2020). This affects, amongst other things: taxation, speed limits, emission trading, congestion charges and toll roads. Bridging the gap between science and politics would require fundamental changes in the neoliberal structures of transport provision that facilitate mobility growth.

According to Mattioli et al. (2020) research on car dependency exposes the complexity of moving away from car-dominated, high-carbon mobility systems, but neglects the political-economic factors underpinning car-dependent societies. Nevertheless, these factors form key constraints to attempts to 'decouple' human wellbeing from energy use and climate change emissions. Mattioli et al. (2020) identify five key elements of car-dependent transport system: 1) the automotive industry; 2) the provision of car infrastructure; 3) the political economy of urban sprawl; 4) the provision of public transport; and 5) cultures of car consumption. Each of these elements influences dynamic processes in 'systems of provision' within the political economy. Such processes include political-economic relations, industrial structure, the built environment and cultural feedback loops. Current links between these processes maintain a carbon lock-in.

Main characteristics of car-dependent mobility systems include: socio-technical aspects of provision, conflicting economic arguments that serve industrial agendas, and the creation of an apolitical facade around pro-car decision-making (Mattioli et al. 2020). The latter enables the 'capture' of the state within the car-dependent mobility system. According to Mattioli et al. (2020), an overt and historically aware political program of research and action is needed to break free from the automotive age. In doing so, the elements, processes and characteristics of car-dependent mobility systems must be uncovered.

3 Systems

According to Meadows (2008) a system is *"an interconnected set of elements that is coherently organized in a way that achieves something."* It must consist of three things: elements, interconnections, and a function or purpose. Elements are usually more visible and tangible than the other two. Meadows (2008) indicates that systems exist within systems and purposes within purposes. It should be noted that the purpose of a system is not always a human purpose. Changing elements of the system usually has the least effect. This is different for changes in interconnections, function or purpose. These can have significant consequences for the overall system. The most crucial determinant of a system's behaviour is its function or purpose. However, this is the least visible

part in systems. Changing interconnections (i.e. relationships) usually changes system behaviour as well. The elements, the most noticeable parts of the system, are often (not always) least important. However, they do become important when this leads to changes in interconnections or purpose.

The remainder of this paper discusses the elements, interconnections, and purposes of urban mobility systems, using the multi-level perspective as a theoretical framework.

4 Theoretical Framework

Based on the reviewed literature, multi-level perspective (MLP) is a useful tool for analysing complex mobility systems. MLP serves as a heuristic framework to analyse multi-dimensional interactions within processes (Geels 2012). This involves interactions between industry, markets, technology, policies, culture and civil society at the niche, regime and landscape level. Novelties emerge in niches, where actors hope that their novelties are eventually used in the regime or even replace it. This is not easy since existing regimes are stabilized by many lock-in mechanisms and path dependencies. Therefore, innovation in existing regimes is mostly incremental. However, niches are crucial seeds for systemic change (Geels 2012). They are potential new elements in a system.

Socio-technical regimes are deep-structural rules that coordinate and guide actor's perceptions and actions (Giddens 1984). The socio-technical landscape is the wider context that influences niches and regimes (Fig. 1). According to Geels (2012) transitions arise through process-based interactions at three different levels: 1) niche innovations build up internal momentum; 2) changes at the landscape level create pressure on the regime, and; 3) destabilisation of the regime creates windows of opportunity for niche innovations. There is no simple causality in transitions. Instead, processes at different levels influence each other (circular causality). MLP is well suited to study complex and uncertain processes, such as urban mobility transitions.

Whitmarsh (2012) argues that MLP proves to be a useful analytical framework for understanding transitions, which highlights the precursors, dynamics and complexity of both incremental and radical innovations. Nevertheless, she suggests improving MLP by integrating natural, behavioural and political science insights. This is essential for transport research because of its expressed and observed public resistance to changing travel behaviour (Whitmarsh 2012). Transitions in MLP enable niches (i.e. new elements) to infiltrate regimes and thereby change interconnections and the function or purpose of a system.

5 Methodology

This paper is based on a literature review of urban mobility systems and illustrative case studies highlighting different power relations in practice. The criteria for the case study selection were an unsuccessful and a successful example. It enabled an in-depth examination of problems, responses to innovations and strategies related to (un)sustainable mobility systems. Since the context of the cases differs greatly, one may wonder to what extent comparison can be made. However, in this paper it is argued that sometimes a

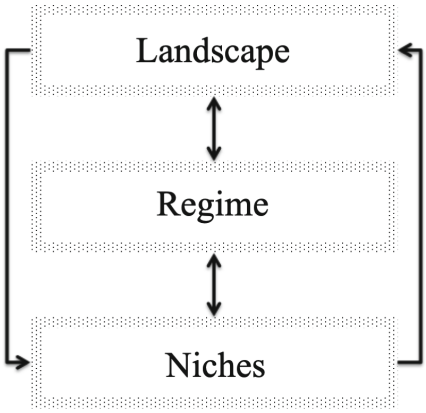

Fig. 1. Multi-level perspective of transitions (Source: Author's own elaboration).

change of the wider context, the socio-technical landscape in MLP, is necessary to bring about transformational change at the regime level. In other words, the initial context may actually be (part of) the problem, which influences the level of (un)sustainability. For this reason, the selected cases illustrate contrasting situations. Since the present study only uses data from existing literature, it is necessary for further research to supplement this with original data and empirical research. A comparison of cases in a more equivalent context is certainly interesting and useful as well.

6 Case Study

Tyfield (2014) analysed E-mobility transitions in China using MLP, supplemented by a Foucauldian-inspired cultural political economy (CPE). China is the world's largest car market and will grow dramatically in the coming decades, due to the size of its population and the increasing income of Chinese households. This is expected to cause major environmental problems. Therefore, the 'greening' of China's mobility is an issue of urgent and global significance. At the same time, this is a very complex and multi-layered challenge. Despite government and business support, a significant shift towards electronic vehicles (EV) is not visible in China. The underlying nature of this problem is analysed using a socio-technical perspective of MLP.

Tyfield (2014) explains that transition can arise through disruptive innovations that appear peripheral. Disruptive innovations redefine existing technologies by cheaper, more convenient alternatives to existing products or services. They are often produced by non-traditional actors that target: previously ignored customers; their use in new contexts; or a combination of both. Such innovation can disrupt an entire market when it develops further. Examples are the digital camera and the free downloading of media via the Internet (Kask and Öberg 2019; Riemer and Johnston 2019).

In MLP (disruptive) innovations are formed in the niches. From the perspective of the incumbent regime these innovations may seem minor or unpromising. Tyfield (2014) argues that Chinese businesses have a lot of potential for disruptive innovation, including

low-carbon innovations and regarding automobility, especially for electric two-wheelers (E2W). This is in stark contrast with the failure of the high-tech EV, supported by the Chinese government.

In 2010 there were around 120 million E2Ws on the Chinese roads. The best sellers in this huge 'spontaneous' market are in fact Chinese brands. Their appeal lies in its low cost, agility, relative speed and energy efficiency. In this regard, the E2W has significant low-carbon benefits over the car, including the EV. Moreover, this has been achieved without government support. Instead, this innovation is thwarted by increased regulation and penalties from the regime. In several major Chinese cities (e.g. Beijing, Shenzhen or Fuzhou) the E2W is now officially banned.

According to Tyfield (2014) the most important consideration regarding the E2W case is the potential for social redefinition of the 'car'. This enables innovators to explore disruptive possibilities, rather than starting from the current design of the car. As new knowledge-power technologies, mobility innovations can potentially change power relations and emergent coalitions and self-identified subjectivities. Therefore, an interesting question is how disruptive innovations contribute to a political and cultural transition as a key aspect of socio-technical transition.

The E2W case reveals that the existing power of the regime opposes innovation instead of supporting it. Tyfield (2014) argues that contemporary Chinese politics have the problem of circulation. This is a problem of governing and managing 'freedom' vis-à-vis 'security'. It is clear that E2W does not fit China's policy imagination and existing power networks as a 'small' and 'insignificant' technology, set against the continuing commitment to the global neoliberal (hi-tech) innovation model. More importantly, E2W as a cheap, agile, and diverse form of transport, available to all, does not fit within this existing model. While the incumbent regime is fundamentally committed to automobility, E2W is not seen as a useful spread of automobility, but rather as a knowledge-power technology that enables potential danger and uncontrollable automobility. Hence, the justification by both state officials and citizens of measures against E2W, in terms of 'public security'. This corresponds to the Foucauldian vocabulary of security and control of the population (Fox 2000; Kashmeery 2016; Tyfield 2014). The Chinese government considers E2W a transport taboo and it is seen as a threat to the systemic functioning of circulation.

7 Discussion

To achieve transformation in power relations, Meadows (2008) argues that we need to look for leverage points. These are places in a system where a small change could lead to a large shift in behaviour. Leverage points are points of power and in order to influence power relations, a change in one of the other (preferably higher) leverage points is necessary.

In the E2W case study, one of the problems is concentrated around rules of the system. They define the scope, boundaries, and the degrees of freedom (Meadows 2008). Disruptive innovations, such as E2W are constraint by stricter rules and punishments from the regime. This exposes the tension between democracy and late capitalist economics and confirms that global market forces are increasingly taking control of politics

(Mouffe 2006). Philosopher and sociologist Jürgen Habermas calls such a takeover of social and political life by power (administration) and money (economy) the colonization of politics by economics (Verovšek 2021). In neoliberal regimes contemporary policy-making is depoliticized through rescaling political authority (Copley and Giraudo 2019; Kenis et al. 2016; Mouffe 2006; Swyngedouw 2007). By removing accountability mechanisms from government, policymakers can isolate themselves from popular backlash when an economic crisis demonstrates the failure of their re-territorialized regulations. In doing so, they change the interconnections of systems in a relatively invisible way. This makes it increasingly complicated for 'ordinary' citizens to understand the political stakes of sustainability transitions and to identify themselves as possible actors of change in these processes. Citizens are often seen only as consumers and their role is limited (Kenis et al. 2016). Possible actors of change are almost exclusively situated within a market framework. Therefore, Habermas argues that markets should become subject to social control and more heavily regulated to ensure that they serve the citizens, not the other way around (Verovšek 2021). Democracy starts by making power, conflict and decision visible and contestable. This requires more space for new forms of 'governance' at all MLP-levels, based on a consensus-driven multi-actor model (Berkhout et al. 2004; Smith and Stirling 2010). This may eventually lead to a new interconnected set of elements that serves a more sustainable purpose.

The post-political turn (Legacy 2016) does not make urban mobility planning apolitical, but rather the opposite. Alternative political spaces are increasingly created outside formal institutions, at the niche and landscape levels, and represent a re-democratization of citizen-led city building. In view of climate change, oil and energy scarcity, it is likely that this trend will only continue. Actors both within and outside formal institutions need to cooperate better to change the urban mobility debate and to inspire politics. This should not be constrained by the limits of institutional and post-political dispositions and existing interconnections. In such a situation paradigms may be transcended, the highest leverage point in systems (Meadows 2008). This means that actors are unattached to a paradigm and that they remain flexible. In doing so, no paradigm is true. Actors can choose any paradigm that allows them to achieve their goal.

Since changing and transcending paradigms are the most difficult points to change in systems, sustainable mobility advocates will continue to point at the anomalies and failures in the 'old' paradigm. Through alternative political and democratic spaces (e.g. networks, platforms, physical places) they will speak and act loudly, with assurance from a new paradigm (Kuhn 1962). They feel the need to repoliticize post-politics and develop collective governance arrangements (Kaika and Swyngedouw 2010).

An example of how alternative democratic spaces are created, resulting in a change in formal institutions, is a case study by Baron (2019) in Valencia, Spain. Here various media networks kept pointing at the failures of the incumbent pro-car regime. This caused disruptions at the landscape level (Geels 2012), creating space for a new pro-bicycle leftist ecological party. New elections brought this party into the coalition, partly shifting power to a new actor in the system. This changed the political 'reality' and with it the regime in Valencia. Due to active support from the new regime, more bicycles were visible in the streets. This creates new relationships between people and bicycles, which increases bicycle use. It shows that alternative practices are possible and how

mobilities can be used as an instrument for the transformation of space, of society and of local political models. Social actors actively pushed to rethink the social impacts of movement, its representations, or the meaning of relationships on the move (Nikolaeva et al. 2019; Te Brömmelstroet et al. 2017). In addition, it demonstrates the potential for radical democratic decision-making and activism, at niche and landscape levels, that influences change at the regime level.

The Valencia case is an example of how communication power (Castells 2009; Innes and Booher 2015) works in practice. It shows that participants can rethink their positions, interests, and values in the course of dialogue (Barabas 2004). Castells (2009) argues that planning not only takes place in formal government but throughout various kinds of networks, including public and private actors. Since every situation is unique, there are no established guidelines or handbooks for communicative practices. The focus is mainly on pragmatic interaction and mutual learning in a specific time and place. Through this, (new) elements can be interconnected in alternative ways, with sustainable urban mobility systems as its purpose.

Deliberative planning is criticized (Barabas 2004; Innes and Booher 2015; Kaika and Swyngedouw 2010) because of poor implementation and the standard ways societies engage in public decision-making. In addition, the process is often central rather than theories about good outcomes. Critical questions about how planning practices enable the neoliberal state remain unanswered. Nevertheless, communication is powerful in today's network society as it shapes shared meaning, points of view, and accordingly influences action (Castells 2009; Habermas 1996). Democracy is shaped by dialogue and debate in the public sphere and creates the conditions for legitimate exercise of power as a representation of the values and interests of citizens. When communication is interactive, authentic dialogues can take place and many problems may be addressed. Learning from differences requires mutual respect and avoiding misinterpretations or oversimplifications.

Storytelling proved to be an important part of communication in the Valencia case and it was used as a catalyst for change (Sandercock 2003). Repeated stories criticized transport taboos, the flaws of unsustainable discourses, and possible solutions for more sustainable urban mobility practices. They uncovered part of the elements, processes and characteristics of car-dependent mobility systems (Mattioli et al. 2020). In addition, they created counter-narratives that opened up space for alternative values, designs, and models (Sadowski and Bendor 2019). Although the power of stories has its limitations, it turns out that they can serve several purposes, including widening the circle of democratic discourse, and shifting participants in such discourses out of their entrenched positions and into more receptive or open frames of mind (Sandercock 2003). According to Holden et al. (2019) we need narratives that we can believe in, such as fighting for freedom, democracy, and equality. Further research will have to show how new political narratives can be stitched together to yield theory. Additional empirical research may provide more clarity on the role of communication in planning practices. A research question that arises from this is: to what extent do new political mobility narratives provide for policy implementation?

8 Conclusion

The above gives insight into the complexity of problem and system analysis from the perspective of urban mobility. To make mobility more sustainable, it is necessary to expose transport taboos, to analyze how mobility systems work and how power relations within these systems interact. Changes in leverage points in systems (Meadows 2008) can open up power relation transformations. The case studies and discussion section give examples of power relations in urban mobility systems and provide possible directions for overcoming difficult transformational change in future mobility systems. This can be found through democratic decision-making and activism in alternative political spaces outside formal institutions. Communication power and storytelling are useful tools to eventually get through to formal sustainable governance practices. In this way, power is and will be taken back!

References

Barabas, J.: How deliberation affects policy opinions. Am. Political Sci. Rev. **98**(4), 687–701 (2004)

Baron, N.: Bike monilities, democratic revival and the local fix: Valencia, from corruption epicentre to Mediterranean cycle capital. Belgeo **4** (2019). https://journals.openedition.org/belgeo/36436. Accessed 07 Feb 2022

Berger, G., Feindt, P., Holden, E., Rubik, F.: Sustainable mobility-challenges for a complex transition. J. Environ. Policy Plan. **16**(3), 303–320 (2014)

Berkhout, F., Smith, A., Stirling, A.: Socio-technological regimes and transition contexts. In: Elzen, B., Geels, F.W., Green, K. (eds.) System Innovation and the Transition to Sustainability. Theory, Evidence and Policy, pp. 48–75. Edward Elgar, Cheltenham (2004)

Castells, M.: Communication Power. Oxford University Press, Oxford (2009)

Copley, J., Giraudo, M.E.: Depoliticizing space: the politics of governing global finance. EPC: Politics and Space **37**(3), 442–460 (2019)

Fox, S.: Communities of practice, Foucault and actor-network theory. J. Manage. Stud. **37**(6), 853–868 (2000)

Geels, F.W.: Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Res. Policy **31**(8–9), 1257–1274 (2002)

Geels, F.W.: A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. J. Transp. Geogr. **24**, 471–482 (2012)

Giddens, A.: The Constitution of Society: Outline of the Theory of Structuration. University of California Press, Berkeley (1984)

Gössling, S., Cohen, S.: Why sustainable transport policies will fail: EU climate policy in the light of transport taboos. J. Transp. Geogr. **39**, 197–207 (2014)

Habermas, J.: Between Facts and Norms: Contributions to a Discourse Theory of Law and Democracy. Beacon Press, Cambridge (1996)

Holden, E., Gilpin, G., Banister, D.: Sustainable mobility at thirty. Sustainability **11**(7), 1965 (2019)

Innes, J.E., Booher, D.E.: A turning point for planning theory? Overcoming dividing planning discourses. Plan. Theory **14**(2), 195–213 (2015)

Kaika, M., Swyngedouw, E.: The urbanization of nature: great promises, impasse, and new beginnings. In: Bridge, G., Watson, S. (eds) The New Blackwell Companion to the City. Wiley/Blackwell, Oxford (2010)

Kashmeery, T.: Investigating the effects of power relations on the implementation of Enterprise Resource Planning through the lens of Actor Network Theory: the case of MESAIR. University of Salford (2016)
Kask, J., Öberg, C.: Why "majors" surge in the post-disruptive recording industry. Eur. J. Mark. **53**(3), 442–462 (2019)
Kębłowski, W., Bassens, D.: "All transport problems are essentially mathematical": the uneven resonance of academic transport and mobility knowledge in Brussels. Urban Geogr. **9**(3), 413–437 (2018)
Kenis, A., Bono, F., Mathijs, E.: Unravelling the (post-)political in transition management: interrogating pathways towards sustainable change. J. Environ. Policy Plan. **18**(5), 568–584 (2016)
Kimbrell, C.M.: Electric carsharing and the sustainable mobility transition: conflict and contestation in a Czech actor-network. Energy Res. Soc. Sci. **74**, 101971 (2021)
Kuhn, T.: The Structure of Scientific Revolutions. University of Chicago, Chicago (1962)
Legacy, C.: Transforming transport planning in the postpolitical era. Urban Stud. **53**(14), 3108–3124 (2016)
Mattioli, G., Roberts, C., Steinberger, J.K., Brown, A.: The political economy of car dependence: a systems of provision approach. Energy Res. Soc. Sci. **66**, 101486 (2020)
Meadows, D.: Thinking in Systems: A Primer. Wright, D. (ed.) Chelsea Green Publishing, White River Junction, Vermont. Chapter 1, pp. 11–34, and Chapter 6, pp. 145–165 (2008)
Mouffe, C.: On the Political. Routledge, London (2006)
Nikolaeva, A., Adey, P., Cresswell, T., Lee, J.Y., Novoa, A., Temenos, C.: Commoning mobility: towards a new politics of mobility transitions. Trans. Inst. Br. Geogr. **44**, 346–360 (2019)
Rage Against the Machine: Rage Against the Machine. Sony Music Entertainment. CD (1992)
Riemer, K., Johnston, R.B.: Disruption as worldview change: a Kuhnian analysis of the digital music revolution. J. Inf. Technol. **34**(4), 350–370 (2019)
Sadowski, J., Bendor, R.: Selling smartness: corporate narratives and the smart city as a sociotechnical imaginary. Sci. Technol. Hum. Values **44**(3), 540–563 (2019)
Sandercock, L.: Out of the closet: the importance of stories and storytelling in planning practice. Plan. Theory Pract. **4**(1), 11–28 (2003)
Sattlegger, L., Rau, H.: Carlessness in a car-centric world: a reconstructive approach to qualitative mobility biographies research. J. Transp. Geogr. **53**, 22–31 (2016)
Smith, A., Stirling, A.: The politics of social-ecological resilience and sustainable socio-technical transitions. Ecol. Soc. **15**(1), 11 (2010)
Swyngedouw, E.: Impossible "sustainability" and the postpolitical condition. In: Krueger, R., Gibbs, D. (eds.) The Sustainable Development Paradox, pp. 185–205. The Guilford Press, London (2007)
Te Brömmelstroet, M., Nikolaeva, A., Glaser, M., Nicolaisen, M.S., Chan, C.: Travelling together alone and alone together: mobility and potential exposure to diversity. Appl. Mobilities **2**, 1–15 (2017)
Tyfield, D.: Putting the power in 'socio-technical regimes' – E-mobility transition in China as political process. Mobilities **9**(4), 585–603 (2014)
Verovšek, P.J.: Taking back control over markets: Jürgen Habermas on the colonization of politics by economics. Polit. Stud. **00**, 1–20 (2021)
Whitmarsh, L.: How useful is the multi-level perspective for transport and sustainability research? J. Transp. Geogr. **24**, 483–487 (2012)

Critical Appraisal of Inclusive Urban Heritage Revitalization Strategies for Old Historic Centers in Asia: Case Example of Indian Cities

Mohit Dhingra(✉)

Jindal School of Art and Architecture, OP Jindal Global University, Sonipat, Haryana, India
mdhingra@jgu.edu.in

Abstract. A city's heritage represents significant physical and socioeconomic capital that is accumulated through the knowledge, investments, and labor of past generations. This so-called "cultural capital" not only confers a distinctive identity to cities, but, if managed properly, also represents an important component of their wealth through a variety of uses essential to economic [7] social, and environmental sustainability and advancement [9] Today in most historic cities in India, heritage assets are not yielding all of their potential benefits to their populations. Despite containing diverse and dynamic economic activities, a lack of investment in these heritage assets and the benefits they can generate has contributed to sometimes irreversible processes of heritage decay, abandonment, or destruction. Such processes have led to major losses of cultural, physical, and socioeconomic capital for the cities. In order to test the above argument this research adopts an evidence based methodology in critically examining revitalization strategies carried out in two very culturally rich and rapidly transforming cities- Delhi and Jodhpur. While Delhi, the pivot of golden triangle with multiple ethnicities will be studied for urban renewal initiative by Aga Khan Trust for Culture (AKTC), that act as a catalyst for socio economic development and improving their quality of life; Jodhpur which is at the harbinger of being characterized as the cultural capital next to Jaipur has diverse cultural heritage is studied for its policy level interventions implemented under World Bank (WB) - Cities Alliance (CA), Technical Assistance in the state of Rajasthan. The discussion and learning's from this research would provide national policy makers, state governments, urban local bodies and sector professionals with a refined methodology, to make their historic centers inclusive, resilient and sustainable.

Keywords: Inclusive revitalization · Urban heritage · Indian cities

1 Introduction

1.1 Urban Heritage in Asia

Urban heritage refers to tangible and intangible cultural and natural assets, landscapes and practices that give cities their distinctive forms, identities, and meanings. It includes, but extends beyond, historic monuments and sites. It thus also has much in common

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 210–226, 2023.
https://doi.org/10.1007/978-3-031-17767-5_15

with the concept of historic urban landscapes [1] which outlines the latest thinking and processes for urban heritage conservation in an integrated manner. Referring to the international conventions and guidelines, it was only after Venice charter which was drawn up in the year 1964, clearly showed the interest displayed by the governments and international institutes in the preservation and enhancement of urban heritage followed by, The International Council on Monuments and Sites (ICOMOS) Deschambault Charter for the preservation in 1982 followed by ICOMOS Washington Charter on the conservation of Historic Towns and Urban areas in 1987, ICOMOS Nara document of Authenticity in the year 1994, ICOMOS Burra Charter in 1999 and United Nations Educational, Scientific and Cultural Organization (UNESCO) convention for Safeguarding the Intangible Cultural Heritage in 2003, Quebec declaration of 2008 on the preservation of the Spirit of the Place and more concentrated approach of Historic Urban Landscape introduced in November 2011 started seeing urban heritage as a social, cultural and economic asset for the development of cities [6].

In Asia, the significance of the urban heritage is different to that of in Europe and where the acceleration and the volume of the urban growth is unprecedented [4], today in most historic cities from: Indonesia, Afghanistan, India, Pakistan, Nepal Tajikistan etc. heritage assets are not yielding all of their potential benefits to their populations. Despite containing diverse and dynamic economic activities, a lack of investment in these heritage assets and the benefits they can generate has contributed to sometimes irreversible processes of heritage decay, abandonment, or destruction. Such processes have led to major losses of cultural, physical, and socioeconomic capital for the cities. Local communities are faced on the one hand with lowered living standards, and on the other hand with rising land values, both of which push local inhabitants and traditional economic activities to the peripheries of cities. Subsequent processes of urban sprawl further damage cities and towns and in particular leading to deterioration and impoverishment of number of its urban historic centers.

For settlement government agencies both at national and state level are adopting various urban development models. But these so called urban development models are in fact the cause of further urban problems and acts as drivers to standardize culture together with a desire to 'modernize' the built environment and has further resulted into irreparable loss of important cultural characteristics in these urban historic centers. The highly distinctive cultural features of these societies are getting eroded and new environments are being created which are dysfunctional. The situation now requires a broad based approach that would find support amongst the communities and nations concerned. The urban historic centers, with its opportunities and contradictions, is the place where the battle for a sustainable development needs to be won through the process called Inclusive urban heritage revitalization.

1.1.1 Situation in India and Need for Inclusive Approach

Indian cities are endowed with rich cultural heritage including historic landscapes and cultural practices that over the centuries have not only defined their identities but also represented an important component of their wealth through a variety of uses essential to social, economic and environmental sustainability [9]. In India, today like many other

countries urban revitalization activities have been compartmentalized in city development planning with sectoral approach to historic preservation as a separate rather than integral part of city wide socio economic development. Neglect of urban heritage assets is fast becoming engrained as a result, Indian cities which once played an exceptional role in contributing to knowledge of the world's development of urban planning and infrastructure development are at a threshold.

Indian cities today, and especially their inner 'historic' areas, are becoming pockets of entrenched poverty not only compromising on quality of life but also reducing socio economic development of local communities. For instance, the Walled City of Delhi was classified as a slum by the Slum Areas Act, since its buildings are unfit for human habitation and detrimental to safety and health due to dilapidation, overcrowding, and lack of ventilation, light and sanitation facilities. This trend shows that the heritage legacy of Indian cities has been vastly underutilized for their contemporary social and economic development. They are also being detached from the wider economic development and physical transformation-taking place in cities. 'Urban renewal' activities have been compartmentalized both in city development planning and in investment. The past decade has witnessed new modes and levels of urban infrastructure investment. Innovative heritage conservation programs are also developing, but are not well integrated with urban development planning. It is therefore a prevalent need to tweak old approaches via cross disciplinary interface of urban conservation with urban geography, environmental sustainability, governance, architecture and planning, urban economy and socio economy.

Inclusive urban heritage revitalization involves all members of society, particularly those who have been impoverished, marginalized, or not yet benefitted by urbanization [4]. In its wider perspective it balances, and broadens the different variables such as: class, caste, gender inclusion etc. with specific attention to processes of gentrification. Though significant but Inclusive urban heritage revitalization faces a number of common challenges in developing countries today, World Bank in its report describes [9] issues from the perspective of policy level, planning level and investment level whereas UNESCO report of 2016 [8] identifies main challenges with urban heritage primarily confines with issues at policy level, lack of awareness about cultural urban heritage and limited citizens' participation in local governance, unplanned and mismanaged tourism, lack of skills on cultural urban heritage. In addition to the above identified issues author's firsthand experience at project level working with various organizations namely AKTC, World Monument Fund (WMF), Archaeological Survey of India (ASI) etc. while implementing community lead conservation initiatives in historic cities of Delhi, Punjab, Haryana, Madhya Pradesh etc. from year 2006 till date and as a policy making role working with Directorate of Local Bodies, Rajasthan as a State coordinator on WB - CA Technical Assistance on Rajasthan State Heritage Program in Rajasthan, India from year 2018–2020 indicates following factors leading to plight of historic cities which are elucidated below:

1. Developing dynamics-intense pressure on infrastructure, real-estate/redevelopment.
2. Weak implementation, monitoring and penalizing mechanisms.
3. Lack of government vision/policy and incentives to private parties for revitalization.
4. Definition, boundary, legal issues.

5. Lot of bureaucracy, multi-decision making agencies.
6. Lack of interest and funds by corporate, private sector.
7. Outmigration of original inhabitants, loss of identity and sense of place.
8. Gender exclusion.

2 Research Methodology

In order to finely assess the safeguarding and sustenance of urban heritage in rapidly transforming context, this research adopts an evidence based methodology in documenting and critically examining demonstrated approaches in two very culturally rich, fast-developing cities- Delhi and Jodhpur. In doing so, the study investigates the role of different variables and methods/strategies applied in cultural revival of these cities. While Delhi, the pivot of golden triangle with multiple ethnicities will be studied in Sect. 3 for urban renewal initiative by AKTC, that act as a catalyst for socio economic development and improving their quality of life; data for the same is a culmination of author's first hand project level experience as a site conservation architect with AKTC, New Delhi office from year 2008–2012 leading community lead conservation initiative: Humayun's Tomb Sunder Nursery Nizamuddin Basti urban renewal initiative' and a desk based research through various documents from Aga Khan Historic Cities Network and Annual reports on Humayun's Tomb Sunder Nursery Nizamuddin Basti urban renewal project.

Jodhpur on the other hand which is at the harbinger of being characterized as the cultural capital next to UNESCO Creative city of Jaipur has diverse cultural heritage and has been studied for implementation of integrated approach formulated under WB-CA Technical Assistance, Rajasthan State Heritage program in Sect. 4. Policy level interventions implemented through an exhaustive baseline survey from 49 historic towns and cities of Rajasthan conducted by author and his team from year 2018–2019 in the state of Rajasthan followed by the learning from demonstration project in the historic city of Jodhpur in the year 2019–2020 formed the basis of data and analytical insights shared in the research.

Both the cities substantially vary in their size, economic, political, and social characteristics, nature of urban spaces, tourism potential and local governance, thus making an interesting comparison, demonstrating how they have differently leveraged their cultural heritage in sustainable development and improving the quality of life of their communities. The discussion and learning's established through multi desk research, stakeholder consultations and first hand project and policy level implementation experience gathered from 2006–till date are elucidated in Sect. 5 that would help in synthesizing and deriving holistic and practical strategies to make their historic centers inclusive, resilient and sustainable.

3 Humayun's Tomb, Sunder Nursery, Nizamuddin Basti Urban Renewal Initiative- Delhi

3.1 Background

Humayun's Tomb, Sunder Nursery, Nizamuddin Basti urban renewal initiative is a flagship project of AKTC under Aga Khan Historic Cities Program in India. Project was commenced in the year 2007 based on Public Private Partnership (PPP) signed between various stakeholders including, the Archaeological Survey of India, Central Public Works Department, Municipal Corporation of Delhi, the Aga Khan Foundation and the Aga Khan Trust for Culture. This is a conservation, socio economic and environmental program with key project components included conservation of Mughal era monuments of Humayun's Tomb World Heritage Site (WHS) and associated monuments in Nizamuddin Basti and the creation of City Park with Delhi's first arboretum at Sunder Nursery. Performance spaces, documentation and training in storytelling, music traditions, revival of lost crafts skills, strengthening of municipal education programs and health infrastructure were undertaken. Program also initiated setting up of vocational training centers, building of public toilets, gymnasium and library along with scalable urban improvements in Hazrat Nizamuddin Basti. By unifying Humayun's Tomb, Nizamuddin Basti, and the Sunder Nursery into an Historic Urban Landscape (HUL) of considerable breadth and cultural significance, while also improving the quality of life for resident populations, the project has made a significant contribution towards socio-economic development and environmental conservation in the local area and beyond which can be elucidated as below:

3.1.1 Humayun's Tomb World Heritage Site - Revival of Traditional Crafts Based Conservation Initiatives

Humayun's Tomb WHS conservation initiative is in line with methods of Historic Cities program which leverages on the material wealth and tangible heritage and it's adjacent areas. In reference to which the conservation works aimed at enhancing the historic character of WHS and ensuring long term preservation were undertaken and lasting for more than a decade since 2007. Project through building conservation, landscape preservation focused on enhancing the setting of WHS and also lead to the expansion of WHS boundaries taking into consideration the significance of associated sites. Apart from monument and landscape conservation the most significant aspect associated with works is the revival of Islamic glazed tile conservation traditions, lime based craftsmanship and intricate stone works making thing project a model for revival of traditional crafts based conservation initiatives (Fig. 1).

3.1.2 Nizamuddin Urban Renewal Initiative - People Based Conservation Initiative

Hazrat Nizamuddin Basti is located in the heart of New Delhi adjacent to the Humayun's Tomb WHS complex and is named after the revered saint Hazrat Nizamuddin Auliya, who lived here in the 14th century, a settlement developed at this location during the

Fig. 1. View of Humayun's tomb complex. Source: Sheikh Intekhab Alam

saint's lifetime and it has been inhabited till date. The densely populated area of Basti which has more than 1500 is immensely visited by tourists and pilgrims in large numbers. Over the years the historic urban landscape of Nizamuddin basti was in state of decay, However the situated started to improve with the commencement of Nizamuddin Urban Renewal initiative in the year 2008. The Nizamuddin renewal initiative has from the onset laid equal emphasis on the three principal project objectives: Conservation of the built heritage, Environmental development and creation of a recreational green spaces and the improvements in quality of life for residents of Hazrat Nizamuddin through socio economic development. Socio economic developments as the part of Aga Khan Historic Cities Program aimed at improving quality of life for the residents of Hazrat Nizamuddin Basti through interventions in the five key areas: education health, vocational training initiatives, urban improvements, cultural revival initiatives which are elucidated below (Fig. 2).

Education. Key interventions under the education program resulted in 150% increase in students enrollment in just one year and still strongly going on till date. Moreover interventions on one hand aimed at enhancing physical infrastructure through refurbishment of classrooms, providing drinking water toilet facilities and creating pupil friendly environment by incorporating 'Building as a learning aid' concept'. Whereas on the other enabling teachers with on job training programs, developing career development centre with National Institute of Information Technology, giving students access to micro scholarship program co funded by U.S. embassy.

Health. Interventions under the health sector not only aimed at improving the physical manifestation of municipal polyclinic but also enhancing the workforce and improved

Fig. 2. Restored indigenous cultural practices in Nizamuddin basti. Source: Sheikh Intekhab Alam

accessibility of preventive clinical tests. As on date thousands of people have benefitted from the improved facilities and addition of Gynecology, ENT and Eye care centre within the premise.

Vocational Training Initiatives. Vocational training programmes, career development centers and employability programmes were developed based on need based assessment and financial viability surveys. Vocational training programs in field of language, building services, traditional craftsmanship, tourism, music and storytelling were provided to youth to translate their skill set into livelihood. A platform in form of *'Apni Basti Mela'* an annual affair in the heart of Delhi gave these young entrepreneurs a platform not only to display their craft but also provided women's of basti an independent identity and financial stability of lifetime.

Urban Improvements. In the year 2009 socio physical and socio cultural survey of Hazrat Nizamuddin Basti was undertaken to implement the 'Area based Development' approach of planning sensitive urban improvements. Urban improvement initiative helped in reclaiming community spaces and nodes of civic life back to arena and improve pedestrian circulation through Basti. Streets and square, designated festive cultural routes, open parks, improved toilet and sewerage network facilities, housing improvement program not only uplifted the way people live but also provided visiting pilgrims a highly curated experience of the this place called 'Hazrat Nizamuddin Basti'.

Cultural Revival. Conservation works in Nizamuddin Basti were initiated in 2008 following the partial collapse of the eastern wall of 14th century Hazrat Nizamuddin Baoli, the only step well in Delhi still led with underwater springs, conservation carried out by state of the art ground penetrating radar system, 3D laser scanning, geotechnical assessments was a community lead initiative generating over 8000 man days of work.

The initiative on one hand brought back the water spine of settlement but on the other also displaced the 13 families residing over the southern edge of the *baoli*/stepped well to suburban areas much away from the charm of old historic centre and more importantly from their livelihoods. Other significant efforts were conservation interventions at Barakhamba (12 pillared tomb), Tilanganis Tomb and Kalan Masjid. Regeneration of Chaunsath Khamba, a Mughal tomb on the eastern edge of Basti together with tomb enclosure of Mirza Ghalib - most renowned poet from South East Asia not only restored the dignity of historic character but also created performance spaces for revival of lost Music traditions and storytelling or *Dastangoi* as well (Fig. 3).

Fig. 3. Various interventions in Hazrart Nizamuddin Basti. Source: Author

3.1.3 Sunder Nursery and Ecological Revival Initiative

> Creating green spaces in urban areas constitutes a significant improvement in the quality of the environment and people's living conditions. They are leisure spaces and meeting places for all ages and all social categories, encouraging different sectors of the population to mix and integrate. And they have proved to be catalysts for economic activity and a source of employment, both directly and indirectly, particularly through the services provided for visitors [8].
>
> – His Highness The Aga Khan

The parks and open space portfolio of Aga Khan Historic Cities Program in Al-Azhar Park Cairo and Bagh-e-Babur Afghanistan successfully demonstrated the role of environmental rehabilitation program in rehabilitation and enhancement of historic districts. Drawing precedents from Egypt and Afghanistan, Aga Khan trust for culture started the creation of City Park with Delhi's first arboretum at Sunder Nursery in the year 2008. Sunder Nursery, originally established in 1912 when the Imperial Delhi complex was being planned and constructed. It was used as a place for propagating trees and other plants to be used in the new capital city, and also for testing species brought from other parts of India and from overseas, to pick those which successfully thrive in Delhi's harsh climate. The nursery which is flanked by the World Heritage Site of Humayun's Tomb on the South and the historic Purana Qila on the North and aligned to the historic Grand Trunk Road on the West was originally an archaeological site – there are scattered remains of Mughal period structures including three nationally protected monuments, together with pavilions, tombs, grave platforms, wells, and a mosque platform. Spread over 90 acres, less than 10% of Sunder Nursery was utilized as an active nursery at the onset of this Urban Renewal project. In close consultation with the Central Public Works Department (CPWD), a master plan for the area was prepared in 2008 to strengthen nursery functions and blend it's heritage, landscape and ecological assets into a veritable combination of cultural offerings. 20 acres within Sunder Nursery are dedicated to plant propagation and display of plants by the CPWD, making this the largest nursery in Central Delhi. As a part of the program 70 acres of area was landscapes, 9 historic monuments were restored and 4 specialized gardens were created. City park once in shambles now houses a designated Wilderness zone, Habitat zones for Bees, Birds and Butterflies, Garden house, Lake front along with socially responsible activities like farmers market and designated area for public art display.

Since it's opening in February 2018, Sunder Nursery is highly visited by locals and national and international tourists and was awarded 2 UNESCO awards from the 2020 cycle with the Special Recognition for Sustainable Development for its transformative impact in turning a barren site into an urban oasis in the heart of New Delhi (Fig. 4).

4 Rajasthan State Heritage Program

Rajasthan's cities and towns have an unparalleled inventory of heritage resources-both tangible and intangible. Fast urbanization in the recent decades and sectoral approach to city development has resulted in the neglect of heritage assets and surrounding historic areas. Decaying city environments over a prolonged period not only compromise quality of life but also reduce the opportunities for use of heritage for income-generating activities such as crafts and tourism—further reducing prospects for socio-economic development of local communities and municipal revenue generation. The WB – CA, at the request of Government of Rajasthan, Department of Local Self Government in 2018, initiated a "State Heritage Programme" focusing on 49 towns and cities in Rajasthan with an aim to device mechanism to conserve, manage and capitalize on the optimum potential of heritage assets and contribute towards the economic development of the state. Baseline survey of 49 town and cities of Rajasthan was carried out based on which following broad strategies were proposed for Inclusive revitalization of town and cities

Fig. 4. Various interventions in Sunder Nursery. Source: Author

of Rajasthan which are elucidated in Sect. 4.1. Moreover, The programme through its demonstrative approach created Heritage Management Plan (HMP) for city of Jodhpur with following objectives: Policy Mainstreaming & Knowledge Management, Technical Assistance & Capacity Support, Technical Assistance & Advisory Support, The Program Management. Key findings of the same would be discussed in Sect. 4.1.1.

4.1 Key Strategies Under Rajasthan State Heritage Program [5]

Inclusive urban heritage revitalization involves all members of society, particularly those who have been impoverished, marginalized, or not yet benefitted by urbanization [9]. In reference to above and achieving the desired objectives a strategic approach was adopted on the State of Rajasthan based on evidence based planning and multistakeholder consultations in 49 historic towns and cities of Rajasthan between the year 2017 and 2018. Further in order to implement these strategies a 'State Heritage centre' within the department of Local Self government in Jaipur and 'City Heritage Cell' within the

historic city of Jodhpur was established as a single window facilitation centre to carry forward the agenda of Inclusive revitalization both at state and local level. Following formulated strategies are explained as below:

Strategy 1: Integrate heritage management in the legislative and institutional framework.

This strategy is proposed to strengthen the institutional system in the state and build a database for promotion, funding and initiation of improvement works. By incorporating this activity in the legislative framework, it will be easier to identify relevant projects around tangible heritage assets and intangible heritage economies prevalent in the towns, cities and regions in the state.

Strategy 2: Develop communication and knowledge haring platforms to build ownership and facilitate heritage management.

The actions proposed under this strategy are envisaged with a view of building partnerships, generating awareness and building ownership amongst the stakeholders. Key actions taken under this strategy were State level workshops engaging senior stakeholders, City wide awareness campaigns in the historic city of Jodhpur spearheaded by elected representatives and Capacity building workshops and exposure visits for city officials.

Strategy 3: Strategies and plan for historic cities and regions.

For the towns and cities to manage their assets, both tangible and intangible, in an enhanced way, it is recommended to have a tool through which certain actions can be initiated. The outcomes envisaged by strategizing and planning for historic cities and towns and subsequently the regions are as below:

- Local economic development of the town and cities and the respective regions.
- Safeguard the World Heritage Site status of heritage assets in the state by better management of the assets and the premise around it Extend the tourism footprint beyond the few well represented towns on the tourist circuits to other unexplored areas and strengthen the existing linkages between historic towns in various regions.
- Overcome threats of mass tourism by distributing tourists in lesser visited towns and cities.

Strategy 4: Support, sustain and enhance livelihoods in cultural economies.

Supporting and strengthening Local Economic Development is one of the fundamental objectives of the State Heritage Program. The State Heritage Centre and the City/Town Heritage Cells have an important role in this. They will initiate and develop networks and partnerships with Institutions, individuals and the civil society. They will also facilitate periodic workshops to bring together relevant stakeholder to support, sustain and enhance livelihoods in the cultural economy.

Strategy 5: Promote and empower civil society.

This strategy is envisioned with the outcome of making the State Heritage Programme self-sustainable. Establishing connections of the Urban Local Bodies (ULB) with the existing civil society organizations and NGO's that are working in the sector of heritage management will ensure long-term sustainability, ownership amongst

stakeholders and success of the programme. This may be achieved through community outreach, participatory planning, vision formulation and beneficiary engagement activities.

Strategy 6: Finance heritage management and attract investments.

The first step in the process of inclusive revitalization is the preparation of Heritage Management Plans for towns and cities that would lay out the vision for the town and identify projects. A focus area should be identified for each of the towns and cities that the HMP will emphasize on. A preliminary focus area identification for prioritized towns can be referred to in Strategy 3. The preparation of these HMPs may be supported through the funds of the ULB or engaging external investment.

4.1.1 Actions Taken in the Pilot City of Jodhpur Through Implementation of 6 Strategies [10]

In reference to above framework, Urban Management Centre, was appointed as an external agency for preparation of Heritage Management Plan for the city of Jodhpur in the year 2018–2019, based on the 6 strategies identified under the Rajasthan State Heritage program, the existing situation assessment, mapping and stakeholder consultations with multiple institutions and other individual stakeholders, there is an array of projects which are identified under the program, which are categorized primarily into four categories which are explained as below refer Table 1 (Figs. 5, 6 and 7).

1. Institutional strengthening and Capacity Building of Urban local body
2. Integration of heritage based development in city planning
3. Protection and management of heritage assets
4. Strengthening cultural economy and partnership building

5 Discussion

This research started with the premise that urban heritage forms a very significant part of Indian cities though it has for long remained on the periphery with very little attention being paid to it while developing frameworks for city planning. In order to test the above argument this research adopted an evidence based methodology in critically examining two very culturally rich and rapidly transforming cities- Delhi and Jodhpur to investigate the role of different variables in Inclusive revitalization of old historic centers. In doing so, some interesting and key findings come to the fore, that are discussed below.

Neither bottom-up, Nor top-down it's always a both ways approach.

Current global practices and on ground learning's in the sector of Inclusive revitalization suggests a paradigm shift in roles and responsibilities of urban stakeholders is required to make Asian cities inclusive, resilient and sustainable, In case of Jodhpur though a significant effort was made in this regards but many of the proposed projects were not implemented either due to lack of political will, administrative constraints or at time due to vested interest of the concerned community. On the other hand in case of Delhi an Memorandum of Understanding with the concerned government agencies was

Table 1. Proposed intervention in pilot city Jodhpur under Rajasthan State Heritage Program

Category	Projects	Stakeholders
Institutional strengthening and Capacity Building of Urban local body	– Training need assessment and exposure visit for municipal and concerned officials – Develop and conduct e-learning modules on heritage management – Empanelment of Conservation Architects and dedicated staff within municipal department – Establish helpdesk for heritage property owners within municipal department to enable them to access govt. Funding for conservation	Jodhpur Municipal Corporation External training agencies and experts Rajasthan State Institute of Public Administration
Integration of heritage based development in city planning	– Amendment of Jodhpur Master Plan for transferable/tradable development rights – Dossier – Destination development and environment improvement – Deploy a Public Bicycle Sharing (PBS) System – Prepare a city level street vending plan as per the Street Vending Act – Initiate '*nukkad*' development – Prepare Solid Waste Management plan as per the Swaach Bharat Misson guidelines	Jodhpur Municipal Corporation Public Private Partnership Jodhpur Traffic Police Department
Protection and management of heritage assets	– Protection and incentivization of heritage properties – Rejuvenation and adaptive re-use of step-wells of Jodhpur – Delineation of heritage zones and development of heritage conservation guidelines for properties within the zones – Heritage walks for Jodhpur walled city – City gates restoration and improvements – Creation of heritage fund for heritage zones – Preparation of World Heritage City Nomination dossier	Jodhpur Municipal Corporation Businesses Jodhpur Development Authority Town Planning Department Event management companies Resident Welfare association Youth groups Civil society Partner Banking institution
Strengthening cultural economy and partnership building	– Publicity of the local fairs and festivals – Market enhancement for traditional arts and crafts – Entrepreneurship development support to craftsperson's – Technical support for green handicrafts	Department of Tourism Private Businesses Directorate Commissioner Handicrafts

made where in the role of government agencies was limited to monitoring, the ownership building for the project and the zeal to carry it forward to the national scale was not prevalent within them. Therefore, a shift in thought process is required at all levels

Fig. 5. View of project demonstration site, Ghantaghar. Source: Author

Fig. 6. Bangle making craft, Jodhpur. Source: HMP Jodhpur

Fig. 7. Mojdi craft, Jodhpur. Source: Author

to take the agenda of Inclusive revitalization forward, a suggested matrix reflecting the same is elucidated in Table 2:

A strong leadership at local level and integrated institutional mechanism aids in revitalizing old historic centers.

Table 2. Suggested stakeholder matrix for Inclusive revitalization

Stakeholder	Roles and responsibilities
Government/administrators	Instead of being a sole financer and responsible for the rehabilitation and maintenance of heritage assets, would perform the role of a facilitator for stakeholder participation, regulator for incentives and providers of essential public services and goods
Community/residents	Rather than being a passive beneficiary, would actively participate in identifying, valuing and mapping their cultural heritage and would sensitively preserve/conserve /reuse it with incentives and support from the Government
Private sector	Rather than being opportunistic riders, would become an active investor and collaborate with the government and community for the conservation and the reuse of public and private assets
Experts	Instead of carrying detached approach would advise the government, communities, the private sector, and philanthropic organizations to provide knowledge and information and advocate effective management

Unlike protection of isolated historic monuments, revitalization in urban precincts requires greater, regular and strong involvement from people, moreover from their elected representatives. The leadership and collaborative effort at the state and local level are critical in design and implementation of Inclusive revitalization framework. Likewise 'State Heritage Centre' at the State level and 'City Heritage Cells' at the local level were critical in taking forward the agenda of Inclusive revitalization in the city of Jodhpur and similar cells were institutionalized in other historic cities of Rajasthan It is critical to understand in this case that these institutional mechanism at the local level should have representation from all levels of society and would be responsible for documentation, mapping, capacity building, building partnerships, facilitating investments, amongst others. Though in case of Delhi, Nizamuddin urban renewal initiative similar participatory approach was carried out while conducting urban improvement projects but no such body has been institutionalized within the local framework to scale up the initiatives in other urban heritage precincts of Delhi.

A state level framework and city specific tools like Heritage Management Plan, toolkits are the guiding documents.

A state level framework is a significant tool that draws a direction for holistic Inclusive revitalization process. Framework is significant at two levels-firstly it creates a statewide perspective in identifying the statewide unique qualities and potential of identified cities and secondly it envisages the mode of intervention and the types of investments that would be required to capitalize on the aforesaid vision. In case of Jodhpur state wide framework was formulated to achieve a multiplier effect across the state of Rajasthan supplemented by the Heritage Management Plan which is the action document. Whereas in case of Delhi Local Area plan was formulated which strengthened

the designated zone but a larger vision to make it a multiplier effect for other historic centers within Delhi was missing.

Multidisciplinary Area based development approach taking one step at a time is a key.

Inclusive revitalization, requires a multi-disciplinary approach to deal with urban heritage issues at the ground level through a project oriented approach. The case of Nizamuddin Basti revival demonstrates the taking up of Area Development Program as a pilot project that understood the local phenomenon first and then took a more thorough and project driven approach one hand catering the basics like urban improvements, education, healthcare and creating opportunities by vocational accessibility, holistic model is tested in a particular designated zone which made a lasting impact, whereas the case of Jodhpur approach was more spread out and aimed at scaling up initiatives in the earlier phase which though connected large scale funding with few project but impact was thin primarily at the ground level. Therefore it can be concluded a strong on ground demonstration first followed by endorsement from government bodies is the key.

Convergence and collaborative working is an important tool for the financing and implementation strategy.

Due to various development and up gradation aspects being covered under large schemes at the national and state level in Asian cities, today convergence is an important mechanism that needs to been identified by the government of India for financing projects. Heritage led development projects were identified under the Heritage management plan for Jodhpur which were converged under sectoral ongoing schemes and in partnership with private businesses which one hand aimed at upgrading the basic infrastructure and on the other strengthening the cultural economy. Whereas in case of Nizamuddin urban renewal initiative project funding was primarily dependent on private players, philanthropic organizations or funds from Aga Khan Development Network though these works well with Area based approach but converging with National level schemes would enable in scaling up the project and making it a model to be practiced in other historic urban settlements which are evenly potential but are dilapidating due to lack of perspective more than funds.

6 Conclusion

In reference to above discussions, new theoretical insights emerge from this research. The paper establishes how there is an urgent need to shift the role of stakeholders at all levels to carry forward the process of Inclusive revitalization in India, wherein a constant force from stakeholders at the top is required to scale up the on ground process established at the grassroots, a circular rather than one-way approach is the need of the hour. Second, an emphasis on establishment of an institutional mechanism both at the state ministerial level and local municipal level is required, Moreover it is equally significant to draw a clear holistic roadmap for a broader vision at state level which then should be implemented through an action based guiding documents like Heritage management plan, local area plans, city toolkits etc. in every city under the concerned state. Lastly, area based multi-disciplinary approach tested on ground is crucial which should then be endorsed by the government bodies to make it scalable in convergence

with large scale schemes. As palpable, the above findings based on case studies of two quite diverse yet culturally rich Indian cities have local and specific policy imperative, yet the learning therein are equally vital in formulating holistic and practical strategies for Inclusive revitalization of other cities in India. Moreover, historic cities in India are still in an early phase of urbanization, they have a unique opportunity to shift this paradigm to the ultimate benefit of all of their citizens. Despite general neglect and encroachment, many existing areas in historic cities in India can be revitalized to provide and receive critical services in the city to make them inclusive, resilient and sustainable.

Acknowledgment. The author would like to acknowledge Aga Khan Development Network and National Institute of Urban Affairs, World Bank Group and Cities Alliance for drawing from their works. Author is also indebted by the opportunity provided by the above organizations to lead these model programs in challenging environments, the learning's from which formed the basis of this research.

References

1. Bandarin, F., Oers, R.V.: The Historic Urban Landscape: Managing Heritage in an Urban Century. Wiley, UK (2012)
2. Bigio, A.G., Guido, L.: Open Knowledge Repository (2010). https://openknowledge.worldbank.org/handle/10986/17382. Accessed 05 Feb 2022
3. Culture, Aga Khan Trust: Sunder Nursery. https://www.sundernursery.org/home.php. Accessed 25 Mar 2022
4. Sonkoly, G.: Between-preservation and development: the problems of contemporary urban heritage. Megalopoles-villes-musees-bidonvilles-la-ville-au-xxie-siecle **3** (2019)
5. National Institute of Urban Affairs, World Bank, Cities Alliance. Open KnowledgeRepository. https://documents1.worldbank.org/curated/en/179761563443651430/pdf/Inclusive-6.Revitalisation-of-Historic-Towns-and-Cities-Strategic-Framework-for-Rajasthan-State-Heritage-Programme.pdf. Accessed 11 Nov 2021
6. Sethi, M., Dhingra, M.: A critical appraisal of conceptual themes and presentation methods in cultural revival and placemaking in cities. Indian Anthropologist **48**, 21–38 (2018)
7. Throsby, D.: Cultural capital. J. Cult. Econ. **23**, 3–12 (1999)
8. UNESCO: UNESDOC. https://unesdoc.unesco.org/ark:/48223/pf000024599. Accessed 03 Feb 2022
9. World Bank Group, Cities Alliance: Open Knowledge Repository. https://openknowledge.worldbank.org/handle/10986/20800. Accessed 31 Mar 2022
10. World Bank, Cities Alliance, National Institute of Urban Affairs, Urban Management Centre. Urban Managment Centre. https://umcasia.org/what-we-do/heritage-management-plan-of-jodhpur-rajasthan. Accessed 15 Oct 2021

Heritage Conservation as Key Potential for Mostar Sustainable Development Partizan Sport Ground Mostar

Senada Demirović Habibija[1(✉)], Emina Isić[2], and Amra Šarančić Logo[3]

[1] Džemal Bijedić University of Mostar, 88 000 Mostar, Bosnia and Herzegovina
senada.demirovic@unmo.ba
[2] Urban House IDEAA, 88 000 Mostar, Bosnia and Herzegovina
[3] Sarajevo, Bosnia and Herzegovina

Abstract. The modern urban development of the cities of Bosnia and Herzegovina after the war destruction from 1992 to 1995, coincides with the transition of the social order from socialist to capitalist, which makes this process particularly complex. The post-war period in Bosnia and Herzegovina, with the cessation of hostilities and the establishment of peace, as a prerequisite for the normal development of life and social flows, economic and cultural development, is still a reflection of inherited negative social and cultural stereotypes from the war.

However, many examples have shown that it is possible to create an opportunity for the future development of the city by introducing the concept of sustainability as a benchmark in this process. Mostar has one particularity, considering that it is a city of extraordinary possibilities, but it has been stopped in time due to the burden it carries and which constantly hinders it in its development processes. The devastation of the war in Mostar left a huge fund of ruined buildings, especially in the historic area of the city. These are objects of significant value as historical monuments. With the right process of conservation and reconstruction, it is possible to change the paradigm of the "victim city", to a city that self-consciously and on positive historical values generates a model of sustainable development aimed at integrating space and society values paving the path for a new experience of Mostar.

Keywords: Sustainable development · Heritage conservation · Experience

1 Introduction

Historic urban core of Mostar has been recognized as heritage site soon after WW II. During seventies of the 20th century, numerous efforts and projects were implemented in order to conserve area and establish adequate managements system. All good work of the Conservation of Mostar Old Town project has resulted in receiving Aga Khan Award for Architecture in 1984–1986 Cycle [7].

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 227–236, 2023.
https://doi.org/10.1007/978-3-031-17767-5_16

City of Mostar, and especially its historic urban core, has suffered severe destruction during 1992–1995 war in Bosnia and Herzegovina. Destruction of heritage was particularly visible in the historic urban core – most visible wound of all was destruction and collapse of the Old Bridge.

Already in 1996 conservation and restoration works on buildings within historical core have started. During next ten years intensive conservation works were done. Most of the buildings were restored and given old or some new but adequate function. The area of the historic urban core, recognized as a cultural monument in the middle of the 20th century, has been revalorised in the last 15 years from the point of view of cultural and historical heritage protection, and appropriate protection measures have been defined by national heritage protection institution. Part of the area of the historic core, Old Bridge Area of the Old City of Mostar was inscribed on the UNESCO World Heritage List in 2005 [8].[1]

Unfortunately, today, almost 30 years after the war has ended, Mostar historical core is still faced with problem of ruined historical buildings and abandoned heritage places. Historical urban core has all prerequisites for success – master plan adopted in 2012 (a new Master plan should be prepared in the following months), Management Plan adopted in 2005, Agency for implementation of the Management plan founded and operating since 2005. But, the fact is that today, new generations are faced with mostly ghosts streets, while few crowded promenades are oriented sole on tourist. Ruins and signs of danger are becoming part of inherited memory, erasing pictures of glorious times and splendid historic buildings.

Historic urban core, although being only a small part of urban area of the city of Mostar, plays a fundamental role in the formation of local identity as place of memory, traditional and social value.

With passage of time and turbulent changes going on in the World regarding climate changes that consequently influence conservation of the heritage (conservation meaning general approach and not particular technique), health and way of people's life (COVID 19 situation), it is time to reconsider our approach toward conservation work and management of the historical urban core.

Some efforts have already been made in Mostar, with 2019 revalorization of the site and landscape approach in identifying and setting up new protection measures for both conservation and management of the historic area within its broader urban context.

"On the bases of the better integration and framing urban heritage conservation strategies within the larger goals of overall sustainable development" (UNESCO. 2011. Recommendation on the Historic Urban Landscape, art. 5.), the present paper aims to discuss the relationship between heritage conservation and sustainable planning through the analysis of the case of Partizan playground – site located within the boundaries of the historic urban landscape of Mostar, on the very boarder of the UNESCO inscribed zone.

[1] Inscriprtion criteria was Criterion (vi): "With the renaissance" of the Old Bridge and its surroundings, the symbolic power and meaning of the City of Mostar - as an exceptional and universal symbol of coexistence of communities from diverse cultural, ethnic and religious backgrounds - has been reinforced and strengthened, underlining the unlimited efforts of human solidarity for peace and powerful cooperation in the face of overwhelming catastrophes".

2 Heritage Conservation and Sustainable Development

Sustainable development is a complex concept, seen as the essential imperative of our time.

Brundtland Report, also called *Our Common Future*, publication released in 1987 by the World Commission on Environment and Development was the publication that has introduced the concept of sustainable development. Sustainable development was not a new concept, but it marked the urgency of a new awareness because it highlighted the responsibility of humans for their descendants. The definition of sustainable development given in the Bruntland report can be considered the starting point of a new era: the era of sustainability [2].

Sustainability is originally based on three pillars, environmental, economic and social dimensions. It has evolved through time into more complex and holistic concept thanks to the contribution of international debates and meetings. According to some authors, today there are four pillars of sustainability, including human in addition to these three. But fourth pillar seems to be flexible yet very important and always connected to human beings.

During the Johannesburg Earth Summit of 2002 culture was introduced as the fourth pillar of sustainable development. It was further recognized as such during the World Summit of Local and Regional Leaders of 2010. Despite this, cultural aspects were historically marginalized in sustainable development goals [3].

Viewed through the practice, especially construction, sustainability is directly linked with durability. Furthermore, in many languages, term "sustainable" is translated as "durable". This confusion between sustainability and durability makes sense, because "one way of extending resource productivity is by extending the useful life of products" [4].

Conservation of heritage is, in reality, extension of useful life of buildings. It also provides few "upgrades" of the concept – linking present with past, transmitting past to the future, nursing and strengthening the identity and more.

As stated in the Preamble of the UNESCO's Recommendation on the Historic Urban Landscape adopted in 2011, the principle of sustainable development provides for the preservation of existing resources, the active protection of urban heritage and its sustainable management is a *conditio sine qua non* of development.

Therefore, we come to the point that durability on the urban scale is achievable through conservation of heritage. Conservation of heritage, on urban scale and in general, is not just about preservation of material structure and authentic material. It is about social, environmental and economic sustainability that provides preservation and continuation of the identity in its tangible and intangible forms.

In the last twenty years, the cultural heritage's role in urban management has evolved from institutionalizing conservation efforts to placing heritage at the focus of strategic planning. Most of the recent urban policy discourses increasingly highlight the potential of integrated landscape approaches and the social-economic value of heritage conservation for urban development.

As underlined by UNESCO in the Recommendation on HUL 2011, "urban growth is transforming the essence of many historic urban areas. Global processes have a deep impact on the values attributed by communities to urban areas and their settings, and on

the perceptions and realities of their inhabitants and users. On the one hand, urbanization provides economic, social and cultural opportunities that can enhance the quality of life and traditional character of urban areas; on the other hand, the unmanaged changes in urban density and growth can undermine the sense of place, the integrity of the urban fabric, and the identity of communities. Some historic urban areas are losing their functionality, traditional role and populations" [1].

In this framework, paper here aims to present the case of Partizan sport ground in Mostar historic urban core as a possible good practice. Project is not implemented and is still only on design level. Project presents possible approach toward environmentally and socially aware heritage conservation.

3 Partizan Sport Ground

Association for sport and recreation "Partizan" was founded in 1950s. A thousands of youth of Mostar and surrounding settlements have grown up with this sport society since its establishment, making it an important element in both the spatial and social context of Mostar. The site is roughly 2500 sqm and sits on high ground on the eastern bank of the Neretva, in a very central position close to the Old Bridge that has a potentially stunning view of the old town of Mostar (Fig. 1).

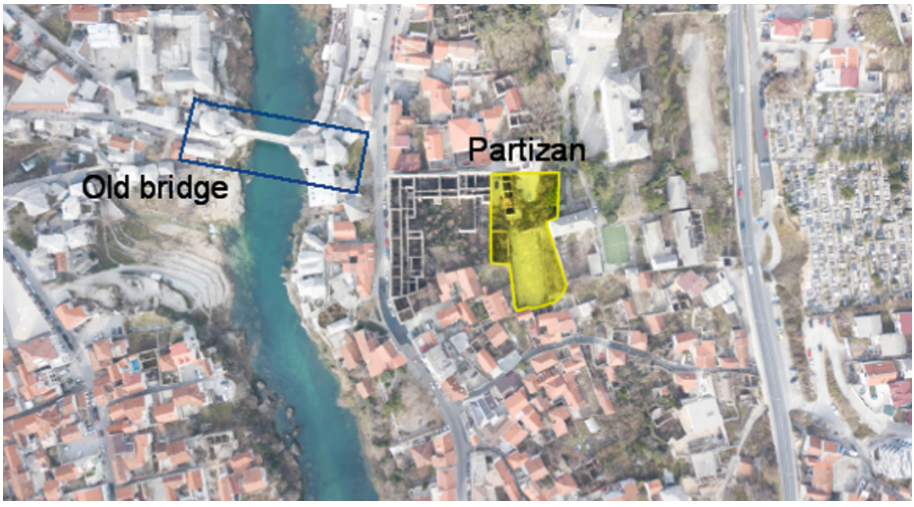

Fig. 1. Partizan sport ground – the site position

The sports ground and its surroundings are in a rundown state, although huge potential for the city and the community still lies in its ruined features. Having obtained all clearance to proceed within the plot's boundaries, we have developed a new plan for its reactivation, comprised of different gradual phases. Also part of the plot are buildings that prior to the war were used as offices, changing rooms and other facilities for the sports area. For its strategic position and rich past, the site is bound to become once again a focal

point within the city's life. Partizan is a society for recreation and physical education. As mentioned, association was established in the 1950s and then briefly revitalized after the recent war (Fig. 2).

Fig. 2. Partizan sport ground – existing situation

For more than a decade, it has been in need of reactivation and this is a great moment to do so, as it is one of the most important reminders of the city's positive past. The plot, named after the society, is a place for everyone, a space of freedom and an opportunity to improve livelihood. What was recently done with the site is the result of a bottom-up approach that sees in particular local society as bearer of change. Partizan is just one of Mostar's unique sites to hold unparalleled potential and the project is a way of bringing all people under the spotlight. The work on this site is a paradigmatic example of what can be done with potential sites using few resources and an initiative that can trigger positive change (Fig. 3).

4 Urban Heritage Management and Valorization of the Partizan Site

"Partizan" sports ground is not a site of major significance if one takes into account only well-known and current "values-led" categories in evaluation of the built heritage (usually aesthetic, historic, scientific and social, also including attributes of authenticity and integrity). Yet, the site possess the importance and is one of the key locations for rehabilitation of the historic zone and its preservation as the living city.

The UNESCO rehabilitation plan, from 1997, has classified the Partizan sport ground site within a priority group of facilities planned for future restoration and adaptation.

Within the UNESCO management plan (2005) Partizan site was leaned onto Girls High School building that was defined as one of the Priority buildings for the rehabilitation.

Fig. 3. Partizan sport ground – activities at the site

Boundaries of the UNESCO zone (Old Bridge Area of the Old City of Mostar) lies just on the western border of the Partizan site.

Commission to Preserve National Monuments adopted a decision declaring the Historic Area of the of Mostar as a National Monument of Bosnia and Herzegovina during the session held from 6th to 10th July, 2004. Decision was revalorised in 2019 and has redefined national monument as Historic Urban Landscape of Mostar, setting up protection measures more in line with recent UNESCO recommendations. Partizan site is placed within the boundaries of the national monument.

According to the Decision of the Commission, as well as according to Law, measures for the protection and rehabilitation established by the Law on the Implementation of Decisions of the Commission to Protect National Monuments established pursuant to Annex 8 of the General Framework Agreement for Peace in Bosnia and Herzegovina (Official Gazette of the Federation of BiH No. 2/02, 27/02 and 6/04) shall apply to the National Monument. Additionally, the Government of the Federation of Bosnia and Herzegovina shall be responsible for ensuring and providing the legal, scientific, technical, administrative and financial measures necessary to protect, conserve, display and rehabilitate the National Monument.

Within all mentioned documents, Partizan site was not valorised as individual monument. This was due to the fact that the site itself is not of architectural importance and does not possess aesthetic nor scientific value. But, it importance lies in some other values that are still not recognized as such.

As Shetabi states, at a time when climate, change is threatening all aspects of human life, "environmental sustainability" is a value missing from the discourse of heritage assessment. A value that can serve in two important ways; first as an additional tool in the retaining of built heritage, and second as a common language between conservationists and other professionals such as architects and urban planners in the discussion of sustainable adaptive reuse [5].

Seen from that perspective, Partizan site possesses great importance. Not just it is already built site that needs just a moderate scale works to be in use again; but it is also a site with big open area that can be green oases with the historical core of the city. Furthermore, it is a site built for gathering of people and sports activities. Therefore, with Mostar historical core falling into trap of becoming touristic museum city, sites like Partizan are becoming even more valuable.

5 Partizan – A Sustainable Vision for Future

With the goal of repurposing this specific area close to the city's famous sights, the project finds its guiding principle in a low-key, bottom-up approach, that seeks to tackle the complexities of the situation through a series of small-scale interventions and aims at fostering a process of physical and social reconciliation within the community. The project is based on three guiding principles: sustainability, awareness, and experience. The driving idea behind these principles is to combine them to weave a network of interdisciplinary actors that together concur to one joint goal. In this sense, sustainability is not only economic but also, and especially, social – an aware approach to a sustainable accomplishment, which is achieved with a participatory process and manifests itself through an experience-based design that can answer to the varied needs that different users may have. It seeks to demonstrate how any place can reach its full potential once it has collectively been experienced. In that sense this site becomes an active space for interaction of people through cultural exchange and recreation. The reuse of Partizan, whilst respecting and enhancing its historical value, stands out for its positive impact on the area: a place of aggregation, sharing and gathering, accessible to all.

To be able to identify potentials of the site and adequate conservation approaches to be applied to fulfill the potentials it was necessary to do a SWOT analysis (Fig. 4).

Based on the SWOT analysis, it can be concluded that it is necessary to:

- Retain the sports function of the complex, as it largely defines the cultural significance of the place.
- The sports ground should be multifunctional so it can host different activities, e.g. concerts.
- Accompanying facilities to be adapted for the following functions:
- Exhibitions
- Workshops
- Urban gardening
- Local artisans' shop

Fig. 4. SWOT analysis – Partizan sport ground

Therefore, the Complatible use[2] of "Partizan" sports ground should be retained. But before that, the complex will be adapted[3] for new functions. As described by Plevoets and Prina (2017) the adaptation of heritage for contemporary uses is one of the major issues in sustainable development of the built environment, and it has long been recognized that the continuing appropriate use of historic buildings is one of the best ways of ensuring their survival.

In the case of Partizan, the new functions complement its core function and thus contribute to the sustainability of the complex. During the years, it has been proven that this specific location can host festival (e.g., Street Art Festivals) or workshop activities (different workshops organized by Urban House IDEAA), while at the same time retaining its original function as a sports ground. So, these new functions would contribute to increasing cultural and social value of the sports ground "Partizan", since the complex

[2] Compatible use means a use which respects the cultural significance of a place. Such a use involves no, or minimal, impact on cultural significance (The Burra Charter 3).

[3] Adaptation means changing a place to suit the existing use or a proposed use (The Burra Charter 2).

could thus become a new cultural and recreational hub in a unique and attractive location within the City of Mostar.

6 Perspectives

Mostar currently is taking, again and after few decades, big steps regarding its spatial perspectives and documentation – active work is being done on defining the Spatial plan for the administrative area of the City and preparation process for the Master plan of the historic urban landscape has started. These documents will define future development of the city including its sustainability and environmentally friendly surrounding for economic bust and happiness of the inhabitants.

Plans, although still in working stage, have become more ambitious in terms of sustainable development. Heritage conservation, re-established with Old Bridge reconstruction and historic urban core rehabilitation, has matured and is firmly incorporating itself into (sustainable) urban planning.

UNESCO Management plan has paved way for conservation and enhancement of heritage. Decision on designation of historical urban landscape of Mostar as national document is further more insisting on that enhancement and sustainability, also giving focus on need for preservation of green open areas along with their identity and adequate use in everyday life.

Further research works on Mostar have identified Maršala Tita street as an urban patchwork of cultural institutions and small urban parks – eco museum of Mostar that posses all five senses. Partizan, in that scheme, is one of the ancillary sites with strong potential for reaffirmation of the local identity and enrichment of social and cultural life of the inhabitants. One more, very important issue, lies in potential of the site for reconnection; proper conservation and use can provide reasons to the inhabitants to use the site and part of the historic urban core for their everyday activities. This is very important for Mostar since its historical core has become, in past twenty years, exclusively tourist area.

7 Conclusions

Cultural heritage has become, as proven in many cases, a driver for sustainability.

Still today, conservation heritage actors are sometimes making mistakes in their approach, not securing transfer of authenticity, values and significance, of certain site to future generations. This, of course, is compromising continuation of identity and sustainable development of the local community.

But, we are becoming more and more aware of the possibilities how to minimise those risks.

In historic urban contexts, the key factor for the conservation of historic cities as dynamic and living organisms is the integration of conservation and sustainability aims, policies, actors and tools. The starting point is awareness of the inseparability of the urban planning and urban conservation which must work in tandem. Unfortunately, this is still, and not only in Mostar but worldwide, quite rare in practice weather during planning and even rarer in implementation.

The work on Partizan, although still in design stage and taken in very small and slow steps, could be a step forward. This case is presenting efforts to re-live Mostar historical core as a living city, despite the high level of protection, increased by UNESCO label, and despite fact that Mostar has already fallen into trap of tourist site and "museificated" historical core.

Acknowledgments. The presented research is a part of the research project "Assessment and strengthening strategies of historical buildings – "Partizan" sport ground a case study", developed through Erasmus+ CBHE project "Promoting academia-industry alliances for R&D through collaborative and open innovation platform (All4R&D)".

References

1. Recommendation on the Historic Urban Landscape UNESCO (2011)
2. Conte, E.: The era of sustainability: promises, pitfalls and prospects for sustainable buildings and the built environment. Sustainability **10**, 2092 (2018). https://doi.org/10.3390/su10062092
3. Appendino, F.: Balancing heritage conservation and sustainable development – the case of Bordeaux. IOP Conf. 2017. Ser.: Mater. Sci. Eng. 245 062002
4. DeSimone, L.D., Poppoff, F.: Eco-Efficiency: The Business Link to Sustainable Development (1998)
5. Shetabi, L.: Heritage conservation and environmental sustainability: revisiting the evaluation criteria for built heritage. In: Proceedings of FABRIC, the Threads of conservation. Australia ICOMOS Conference (2015)
6. The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance (2013)
7. https://www.akdn.org/architecture/project/conservation-mostar-old-town
8. https://whc.unesco.org/

Sustainable Retrofit Strategies for an Existing and Historically Significant Residential Complex: Environmental Response and Facade Performance Analysis

Suncica Milosevic(✉) and Ajla Aksamija(✉)

University of Utah, Salt Lake City, UT 84301, USA
{suncica.milosevic,ajla.aksamija}@utah.edu

Abstract. This paper presents preliminary research of a case study that focuses on sustainable retrofit strategies of an existing Brutalist style residential complex, "*Djuro Djakovic*" (more commonly referred to as "*Ciglane*"), located in Sarajevo, Bosnia and Herzegovina. Once part of the former Yugoslavia, this case study is an example of a historically, culturally, and politically significant architectural style and movement of its time, unique to this part of the world. As is the case with many similar examples of Brutalist buildings, the existing state of this urban complex is in desperate need of renovation, yet careful restoration methods for such examples of buildings are often perceived as economically unattainable and as undesirable due to stigmatized social attitudes ascribed to their Brutalist formal style of architecture.

The primary objective of this paper was to evaluate the present state performance of several modules of a single building within this large-scale residential complex. The overarching objective of this research is to highlight the importance of such examples of buildings in hopes that quantitative data, which demonstrates ways through which such buildings can be sustained and restored for future generations, can help instigate their ultimate protection and preservation while improving building performance.

Research methods included analysis of archival data and empirical data, and computational software modeling and simulations. Using original construction drawings and current state photographs, a full 3D BIM model of two typical residential building modules was developed for analysis. Building's formal and spatial qualities were analyzed and then, the building's response to environmental conditions was evaluated using Revit and Insight 360 simulations. Next, the thermal and moisture resistance performance of a typical facade system was manually evaluated based on available construction drawings at this preliminary stage of ongoing research.

Results showed that the urban and architectural designs paid careful attention to social and environmental factors and that although the environmental response of the hillside residential buildings was missed, the implemented enclosure systems were highly advanced for this time.

Keywords: Historical preservation · Brutalism · Retrofit strategies · Building performance · Energy efficiency

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 237–252, 2023.
https://doi.org/10.1007/978-3-031-17767-5_17

1 Introduction and Background of the Case Study

1.1 Historical Context of the Proposed Case Study

"*Djuro Djakovic*" Housing Complex, more commonly known as "*Ciglane*" (literal translation "*Brickyards*") was an example of modern housing construction in the late 1970s of the then socialist state of Yugoslavia (see Fig. 1). This urban complex was built between 1976 and 1989 and was designed by the Bosnian architect Namik Muftić and the Croatian architect Radovan Dellale [1]. Its formal name "*Djuro Djakovic*" refers to the local Sarajevan communist and revolutionary, whom the main street bordering this complex was originally named after. Its informal name, "*Ciglane,*" refers to the site's previous function and location in the city's brick industry.

Fig. 1. Ciglane residential complex photographs of current exterior conditions.

The project was rooted in historic significance and the city's dire need to provide more housing for its growing population [1, 2], while it projected values of a new political ideology and ambitious development through the creation of flexible, multifunctional, and environmentally conscious social housing [3].

Upon termination of the *Ciglane* industry's operations, this site was neglected and in dire need of reparation both aesthetically and functionally. Initially, a simple, green public park area was planned. However, due to severe degradation of the natural site which had required too high of an investment, restoration was left unrealized [3]. Next, the city had planned to adapt the site into commercial, fairgrounds, later followed by plans for a youth hall for which a public competition was held [3]. It was not until 1965, that the first residential plans were being developed for this location [3]. Since WWII, Sarajevo had grown exponentially and unexpectedly quickly due to exceptional socio-economic development, the fast growth of industrial manufacturing and the ever-ongoing construction to accommodate a growing population [3]. The city was in a shortage of at least 80,000 residential units, not accounting for future growth and influx from more regional areas [3]. To prevent overcrowding and degradation of the traditional city center, Sarajevo's planning strategy was to sprawl and for *Ciglane* to be an integral junction point between downtown and the surrounding neighborhoods [3]. The available site and its steep hillside offered both a challenge and an opportunity. This previously undeveloped open area and void would complete the urban puzzle and prevent overcrowding and

promote policies to prevent future high-rise construction, helping preserve the old city center's identity [3].

The formal design of this complex originated through editions of several local and national design competitions. Initially, an internal competition was held among four author groups for the development of this challenging but critically adjacent site. In valuing specific aspects of each proposal, the jury had suggested that the four groups merge their strongest design components for an integrated proposal; specifically requesting an omission of the proposed stand-alone skyscrapers on the flat portion of the site and to re-iterate the integration of the site's steep hillside which had included draping low-rises [1, 3]. The joint effort resulted in the playfully cascading and connected high-rises over the site, with stacked terraces overlooking a large public park and the city center (see Fig. 1). The project was accepted by the then urban council of the city municipality. However, after some site studies by the commissioned construction company, the realization of the project was deemed too difficult for the then available construction technologies [1, 3]. The city, thus, reinitiated a new, federally-wide, open competition in 1974 for the same residential complex [3]. Accidentally hearing of this new competition, two of the original authors, Muftic and Delalle, re-joined and recycled some of their previous ideas, ultimately winning the context among 57 national proposals, and finally going forward with construction [1, 3].

1.2 Cultural and Ideological Significance

To honor the historic significance of the site, architects presented a dense, terraced, hill-cascading residential megastructure veneered in several hues of brick and exposed concrete. This urban-architectural complex mimics a densely and diversely populated traditional urban core, much like a "mahala", that is equipped with a wide array of supporting program facilities and heavily focused on pedestrian use, access, and circulation [4].

This approach was heavily influenced by the then-novel, western publications on architectural and urban theory, such as writings by the American urban planner Kevin Lynch, specifically focusing on concepts of "urban image and identity", "urban utilities" and "urban visual communication" [3]. These theories were further combined with the socialist urban ideologies, such as the then domestically influential writings by the French Marxist philosopher and sociologist, Henri Lefebvre, assigning urban neighborhoods as "socio-political", "self-governed", and "self-maintained organizations" [3]. The architects proposed a project that intentionally contradicted the then observationally "cold" modernist architecture, specifically Brutalist style, residential high-rises which were resulting in universal residential neighborhoods among urbanely developed countries without continuity with their contextual, existing, traditional urban character. They sought to challenge those ongoing trends with questions such as: "what are the real conditions for humane shaping of the human environment in which we live and work every day", "how to turn residential settlements from dormitories into living urban tissues", and "how to restore the city to its human scale and values?" [3].

To address those questions, they based the formal and spatial design of *Ciglane* based on the following nine principles [3]:

1. **Revaluation of open parcels**
   Reducing automobile-oriented expansion within open parcels of residential communities, and providing safe, pedestrian-only public zones and plazas.
2. **Continuity of space**
   Uninterrupted pedestrian experience and circulation between different elements of the neighborhood, and maintenance of overarching identifiable, design gestures including signage and wayfinding.
3. **Human and environmental scale**
   Segmentation of a monolithic whole through modular volumes, colors, and building materials; offering a variety of views; purposing of interspaces between buildings; and maintaining human scale ambiances that cater to all ages of residents.
4. **New aesthetic values**
   The formal aesthetic quality of individual buildings is secondary to the relationship between objects of different program and customization by community members and owners; built elements are a canvas for individual identity and flexible for future interventions.
5. **Communicative spaces**
   Easy orientation and wayfinding, visibility and views, and specific characteristics of architectural forms that become visual markers and integral to resident memory and daily ritual experience.
6. **Revalorization of inheritance**
   Ground-level construction to provide an extension of the old city center and its traditional ambient values and rhythm of urban elements.
7. **Flexibility of constructed space**
   The adaptability of both interior and exterior spaces for long-term use and future growth, such as utilizing apartment wide spans with no loadbearing interior partitions in each unit and allowing for adaptations and architectural interventions on outdoor terraces.
8. **New conception of urban circulation**
   Separation of vehicular and pedestrian circulation throughout the neighborhood for pedestrian peace, safety, and freedom of movement in outdoor space. Controlled traffic streets to only allow for public transit, taxi, maintenance, and emergency access to residential buildings.
9. **Self-managed planning**
   The community is the basis of a socio-political organization for planning, maintenance, and use of spaces – the development of a homeowner association.

These merged urban planning theories, along with examples of their translated physical manifestations for the neighborhood, at wholistic and individual building scales, were revolutionary and novel for their time. Muftic and Dellale had developed a concept that closely integrated urban planning with formal and spatial architectural principles. They coined this term "*urbarchitecture*", representative of a large-scale project and a megastructure customized and designed specifically to the site, its history, its time, and for the specific needs of the people for whom it was being designed and built [1, 4].

Moreover, they placed a high value on the participation of users across all stages of urban and architectural design phases - from initial design, present state use, and their

future growth. These social values, where the Architect, as the famed figure, and the formal focus of the modernist isolated objects are removed for joint participation that is in the best interest and of most value to the users. This approach was highly reflective of the political ideology of its time, one which teeter-totted between democratization and freedom of expression on an individual user and a utopian, self-governed, and self-managed organization of community, city, republic, and nation. Even though this political system is no longer intact, the design principles unique to this region, its development, and culture transcend time and hold value for present and future design strategies, as global cities continue to face challenges with automobile dependence, accessibility, sprawl, and pedestrian scale experience.

2 Research Questions and Methods

The purpose of this research was to analyze the residential complex's original design features, to evaluate the typical residential building's design features and current physical state, and to evaluate broad-scale building performance. Future research will conduct an in-depth computer-simulated analysis of a sample residential building's thermal and moisture performance compared to the original design intent and propose renovation strategies that would improve the building's performance while striving to maintain the integrity of the original design of the exterior enclosure. This paper focuses on the preliminary archival and empirical research to evaluate formal and spatial design qualities, evaluate design response to environmental conditions and review the enclosure assemblies.

This case study focused on the following research questions:

1. How were the buildings of this residential complex originally designed? What was their original design intent, and what were their significant formal features?
2. What was their programmatic and spatial organization?
3. What is the current physical state and function of these buildings?
4. What is the current performance of these buildings? Do they respond to environmental conditions? What are their enclosure systems and how do they perform?

Research methods applied to answer the research questions began with the archival and observational research of original architects' documentation, construction drawings, and published literature to analyze the original design intent, the key architectural features, and to assess the building's current state and functions. Results of archival and observational research were used to develop a BIM model of a single residential building, *Building B-3*, of the *Ciglane* complex, using Revit software, to represent the original spatial organization and the exterior shell.

This model was used to evaluate building performance and the implemented passive design strategies, such as the building's response to solar radiation, shading, window-to-wall ratio, and building skin performance. Revit and Insight 360 were used for this analysis. Consequently, a manual calculation was used to analyze and quantify the thermal performance of typical solid facade systems. These results were then compared against the American Society of Heating, Refrigerating and Air-Conditioning Engineers

(ASHRAE) Standard 90.1 energy performance requirements and recommendations for this specific climatic region [5].

3 Analysis of Original Design and Present State Conditions

3.1 Formal and Spatial Overview

The *Ciglane* residential community is situated in close, walkable proximity to the old city center, just north of the city center along the west part of Kosevo Valley, aligning with Alipasina Street. The distance from the community's entrance point near residential building A1 to the main city's street, Street Marshal Tito, is about 600 m (2,000 ft).

The settlement's main orientation is due east, overlooking Kosevo Park, the city center, and the old city center *Bascarsija.* To secure such views, the stepped volumes of *Ciglane's* residential buildings are specific to prevent any obstructions at the pedestrian level. The height of plane level residential buildings does not exceed 4 stories (Buildings A1, A2, and A4), while the height of the settlement gradually rises to an average of 6 stories (Buildings A1 and A5), reaching a maximum of 9 stories (Buildings B1 and B2) (see Fig. 2) [3].

The entire site of this residential complex was 15.86 metric hectares (39.17 acres) and included the following general program per the original design intent [1, 3]:

(1) 10 Residential building blocks for a total of **1,451** residential units,
(2) Elementary/junior high school and Kindergarten/Preschool,
(3) *Universal Hall* convention center which included a theater for 400 spectators, youth center for 100 visitors, art exhibition spaces, a disco club, a library, a bank, and a post office,
(4) Department store with a grocery store component,
(5) Public market,
(6) Summer performance theater,
(7) Urgent care facility with a pharmacy,
(8) Community and a public parking garage with an underground component,
(9) Parks and recreation surfaces, and
(10) Public pedestrian spaces.

Informal community spaces were integrated into the residential buildings and those included: game rooms, daycares, and home-owner association administrative offices.

However, this ambitious proposal was re-adapted due to budget restraints. Its program was reduced by omitting the *Universal Hall* convention center, the large department store, the summer performance theater, the kindergarten/preschool, the elementary/middle school with its outdoor recreation spaces, the entire underground component including the underground road, parking, and storage facilities [1, 3]. Instead, upon the flat portion of the site, a public market – culturally referred to as "*čaršija*" (a Turkish style bazaar) was formed, and supplemented by additional pedestrian streets, a public square, playgrounds for children, and green spaces [1]. Figure 2 illustrates the original design intent components for the *Ciglane* complex and overlays the constructed elements

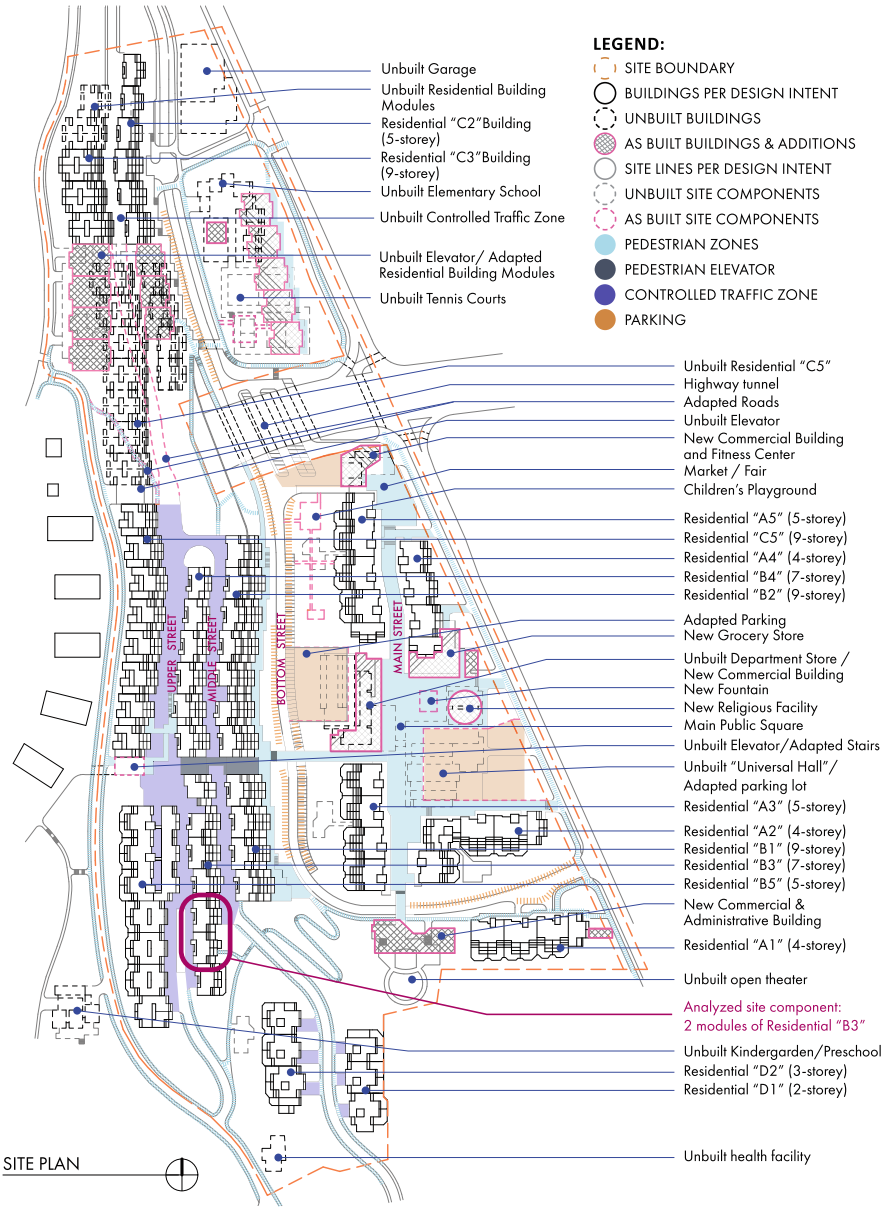

Fig. 2. Site Plan of *Ciglan*e residential complex, illustrating design intent, actually constructed elements, and recent adaptations.

and recent adaptations. Some inaccuracies may be present due to the limited quality of satellite imagery across different source websites with mapping information.

Despite these adaptations and deviations from the original design intent, the site was developed according to cultural and traditional programmatic needs and scale, a "*mahala*", a characteristic Bosnian and Herzegovinian exclusively residential quarter with small shops, restaurants, schools, and religious edifices to support daily culture and life activities [1].

Of high significance, and novel for its time, was the separation of pedestrian and vehicular traffic. As shown in Fig. 2, pedestrian streets and squares were integrated to connect the diverse building program volumes and to encourage socialization, gathering, and a sense of community, while vehicular transportation was separated, controlled, and connected to remote parking garage access. To help support pedestrian and bicycle access, hillside lifts were included; although, of the three planned elevators, only one was fully realized (see Fig. 2). Following the Bosnian War, it had fallen out of function and was not restored until 2019 [4]. Thus, for several decades residents had to commute by exterior stairs. Perhaps, due to its long unavailability, the intended pedestrian zones with controlled, temporary vehicular access between buildings had become adapted to more permanent outdoor parking. Figure 3 and Fig. 4 show the sloped elevator and the unfortunate adaptation of open parcels between buildings into permanent vehicular parking locations, contradictory to the design intent.

Fig. 3. The Exterior hillside elevator and supporting exterior stairs at the *Ciglan*e residential complex illustrate a unique and technologically advanced feature for its time.

Looking at the residential building modules, the most emphasized elements were the communal and private terraces, intended to foster socialization and a sense of community, and to provide equal outdoor living areas to all residents with equally valuable panoramic views (see Fig. 5). Each unit has at least one terrace, with some units having two: a 10 m^2 (100 ft^2) terrace along the east facade, adjoining the living room, and a 6 m^2 (70 ft^2) terrace facing the bedroom along the west facade. All of the outdoor terraces were equipped with prebuilt, concrete planters that also served as guardrails to support wines and small trees. Ground Level units had larger patios facing east, with taller guardrail planters. The vision was that, aside from the dense repopulation of trees and vegetation on the previously degraded site, the residential units would be filled with flowers and vegetation cascading down the hillside [1, 3].

Architects had also provided the city's governing association a manual of permissible adaptations and space uses of the open terraces, which outlined permitted additions of

Fig. 4. Adaptation of as-intended pedestrian-only, outdoor space to permanent parking at the *Ciglan*e residential complex.

wooden pergolas for growing grapes and wines, or wooden and metal enclosures with glass roofs to create enclosed and protected greenhouses [1, 3]. This flexibility was controlled through the city's urban department and had to be approved by the architects, which had functioned for several years, until about 1992 and the onset of the Bosnian War [1]. Figure 6 shows how these exterior terraces and patios have been adapted over time.

An additional aspect of flexibility offered included the construction of all interior partitions within units as non-loadbearing assemblies to allow users freedom of adapting and customizing the interior of their homes. Also, several ventilation shafts were integrated into each unit, to offer users an option of incorporating fireplaces and wood-burning methods for emergency or additional heat in winter. The dividing partitions between each unit were double concrete walls with sandwiched Styrofoam insulation for the sound barrier. Floor and roof constructions also integrated double concrete slabs with integrated insulation (see Fig. 8).

3.2 Present State Conditions

As intended, *Ciglane* had become an active, thriving neighborhood upon its completion, and is still one of the most vibrant and popular neighborhoods of the city. However, its buildings are in great need of restoration. The Bosnian War and the Siege of Sarajevo had begun just a few years after the *Ciglane* residential complex was completed, resulting in broad-scale destruction and hardships on a national scale. Numerous artillery attacks had struck the neighborhood and significant flat areas of the site which were designed as public green spaces were used as impromptu cemeteries during the war to bury the city's many casualties [2]. This residential complex has not only undergone significant damage but has been left to vandalism, unsupervised interventions, and make-shift repairs by individual owners, as can be seen in multiple foreshown figures. Aside from continuous facade interventions and eclectic additions to the previously open terraces, the additional formal changes to the complex include an addition of a mosque with a public square [1].

To express its historic, political, and cultural significance, this complex was intended to be represented at the Museum of Modern Art (MOMA) New York exhibit, "*Toward a*

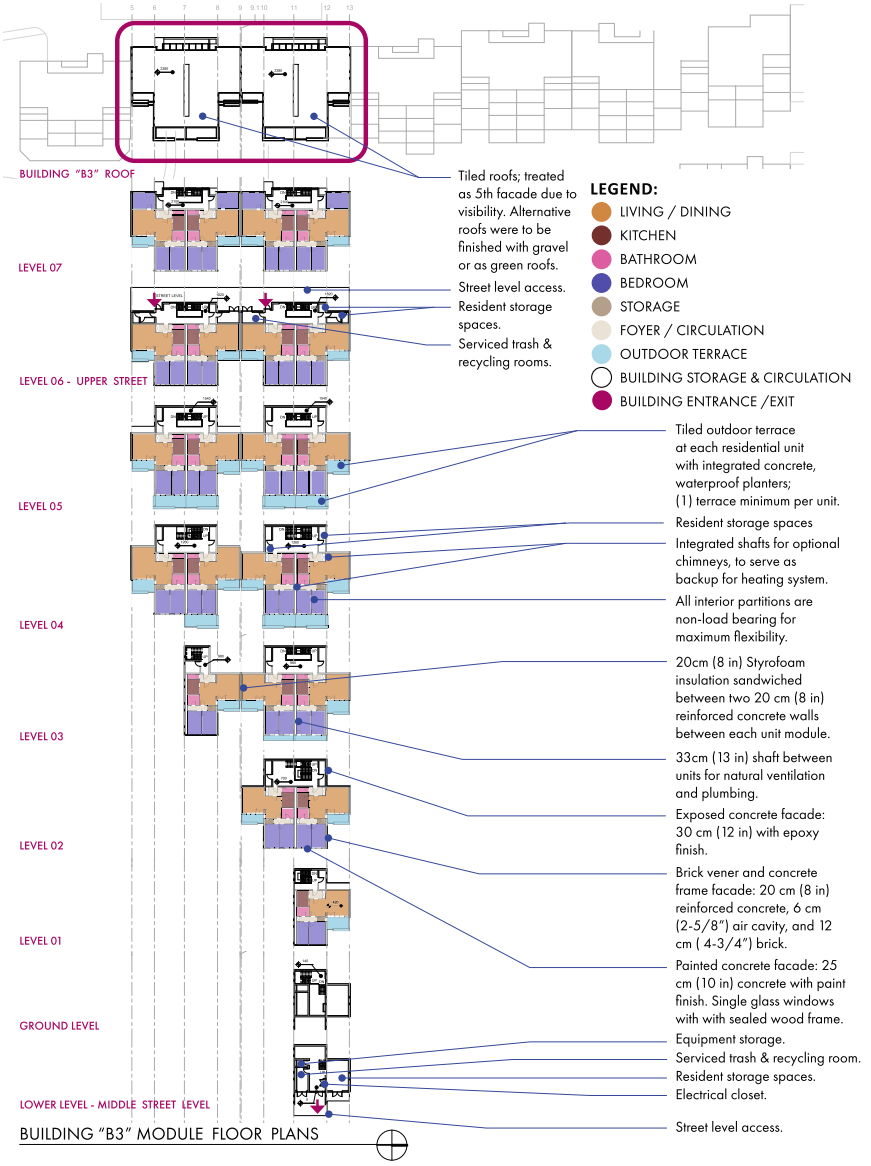

Fig. 5. Spatial analysis of typical residential, modular units of *Building B3* at the *Ciglan*e residential complex, illustrating integrated flexibilities of user adaptations to the interior and exterior spaces and noting the different wall construction assemblies.

Concrete Utopia" in 2018 as one of the highly significant architectural developments of former Yugoslavia [4, 6]. This exhibit, the first of its kind in the United States, highlighted many of the Brutalist-style buildings of this period on an internationally well-regarded stage. However, due to the lack of original construction drawings and documentation at

Fig. 6. The versatility of function and adaptations of exterior terraces and patios at the *Ciglane* residential complex.

the time, this project was not able to meet the required criteria for that exhibit [1]. Thus, it remains one of the not widely known historically significant, residential examples of Brutalist architecture of former Yugoslavia.

To initiate refurbishment efforts, in 2019, the city of Sarajevo hosted a public architectural design competition for the best architectural-urbanistic conceptual idea for a public square and viewpoint at the hilltop of this residential complex [4]. The stated purpose was to help improve and activate this urban micro-location, to encourage participation and engagement by both local and tourist pedestrians for this site and the city [4]. Sarajevo's competition focuses on the improvement of the living conditions of this residential complex and ways to make it a place of collective, friendly living, as well as a place for new experiences for its residents and visitors. Through the revitalization and reconstruction of the pedestrian elevator, progress toward this goal was made. These recently initiated efforts indicate that the city of Sarajevo is interested in seeking retrofit solutions for this site and they speak to the city's cultural and historic values held by this site.

4 Results and Analysis

4.1 Environmental Response and Passive Design Strategies

During the conceptualization of this residential complex, architects had considered environmental factors, which was generally atypical for this time when Brutalist, poorly insulated buildings were commonplace. They considered the then available 5-year average climate data and had considered the predominant east exposure as very desirable concerning insolation [3]. Sarajevo's climate is unusual, however, due to its mountainous and valley terrain, and it falls under two ASHRAE climate zone classifications – 4A and 5A [5]. This makes Sarajevo a predominantly cold, rainy, and humid environment. Architects noted that the city was predominantly foggy and rainy and had felt that the

east exposure would guarantee desirable, unobstructed sun exposure at each unit due to the modular stacking and setbacks of volumes. They also noted that this predominant east exposure would shield the window openings from the strong north-south winds [3].

However, the general orientation of the slope-side residential buildings is not ideal for this location, as both climate zones benefit more from maximized south orientation, not east. Solar radiation and solar shadow analysis of the BIM model illustrate these less-than-ideal site conditions and the implemented design response (Fig. 7 and Fig. 8).

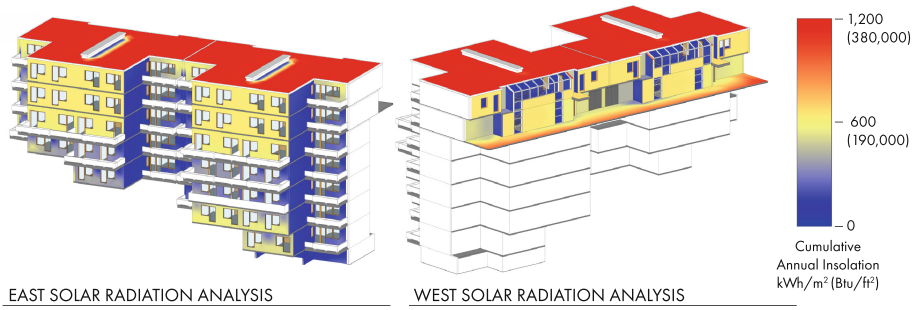

Fig. 7. Solar radiation analysis of typical residential, modular units of *Building B3* at the *Ciglane* residential complex using Revit and Insight 360 software simulations.

Simulated analysis shows that despite east orientation, cumulative annual solar radiation is very low, with roof surfaces experiencing maximal exposure and the setback living room balconies experiencing nearly no radiation. Similar results are at the west orientation, where only some units have an additional bedroom. Otherwise, the west side of *Building B3* and similar residential buildings on site are designated for corridor circulation and stair shafts. This is less than ideal for this climate zone, as contrary to design intent, the residents do not benefit from maximal solar exposure, and the limited insolation places an additional burden on the mechanical systems during predominantly cold and rainy days in a year. This is also illustrated in the left image of Fig. 6, where a picture from one of these balconies of *Building B3* was taken mid-day, during the late summer season.

Additionally, solar shadow analysis (see Fig. 8) shows that only the east-facing bedrooms and their terraces face the direct sun in the early morning hours, and that, otherwise, these cascading volumes are completely in shade regardless of the season. The west side has more direct sun exposure from mid-day to afternoon in both seasons. However, as mentioned above, the spaces that access direct sun are common circulation spaces and not actual residential units.

4.2 Facade Performance Analysis

Despite these challenging site conditions and suboptimal orientation of hill-side residential buildings, the typical enclosure systems of the facades, floors, and roof were robust in their implementation of insulation and moisture drainage components. These implemented technologies were advanced for this time, especially for the Brutalist style

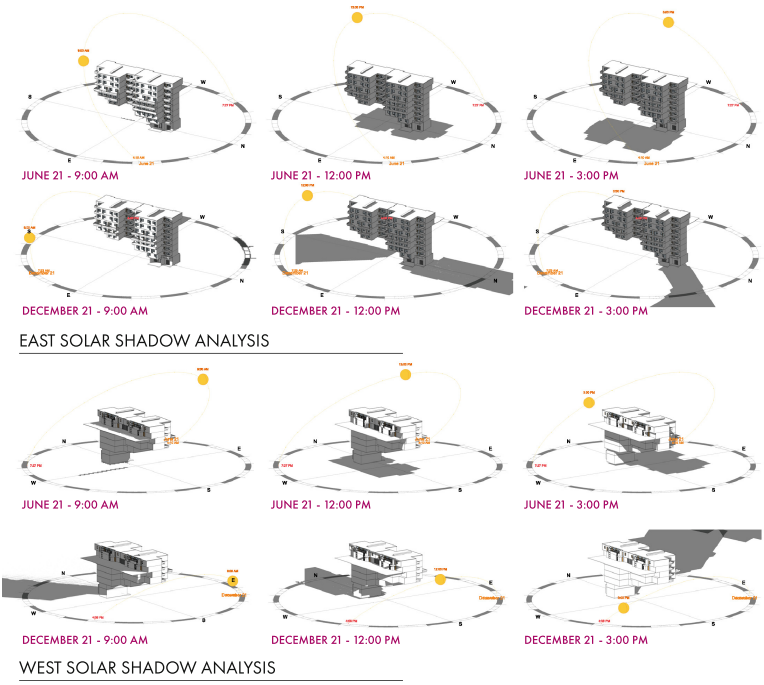

Fig. 8. Solar shadow analysis of typical residential, modular units of *Building B3* at the *Ciglan*e residential complex using Revit software simulation.

buildings which focused on the raw expression of structural materials and often disregarded passive thermal and moisture performance facade systems. An additional contrast to typical Brutalist expression was that the exterior finish layers of brick were executed in natural colors of off-white, amber, and terra-cotta to playfully break down the material monotony and the monolithic cascading volumes. Meanwhile, the exposed concrete layers were painted white or left exposed and sealed with an epoxy finish [3].

Figure 9 illustrates typical building enclosure systems, based on limited, available construction drawings and project manual descriptions. Access to archival wall sections was not found.

As outlined in Fig. 9, the sequence and materiality of solid facade layers were such to enable thermal insulation and moisture diffusion from the buildings. This type of assembly is still predominant in conventional practice, and although it is not considered high-performing, it represents the latest technology for its time. Based on available information and applying the standard, United States measurements such as the typical thickness of brick veneer (4 in/10 cm) and typical thickness of CMU back-up wall (8 in/20 cm), a manually tabulated thermal resistance of the typical solid facade system resulted in an R-value of 2.05/11.64 (m^2-°K/W/h-ft^2-°F/Btu). This value barely exceeds the minimal thermal performance requirement of a solid facade for the harsher of two climate zone classifications, that of 5A, which is an R-value of 2.01/11.40 (m^2-°K/W/h-ft^2-°F/Btu) [7]. Compared to the milder climate zone classification, that of 4A, which

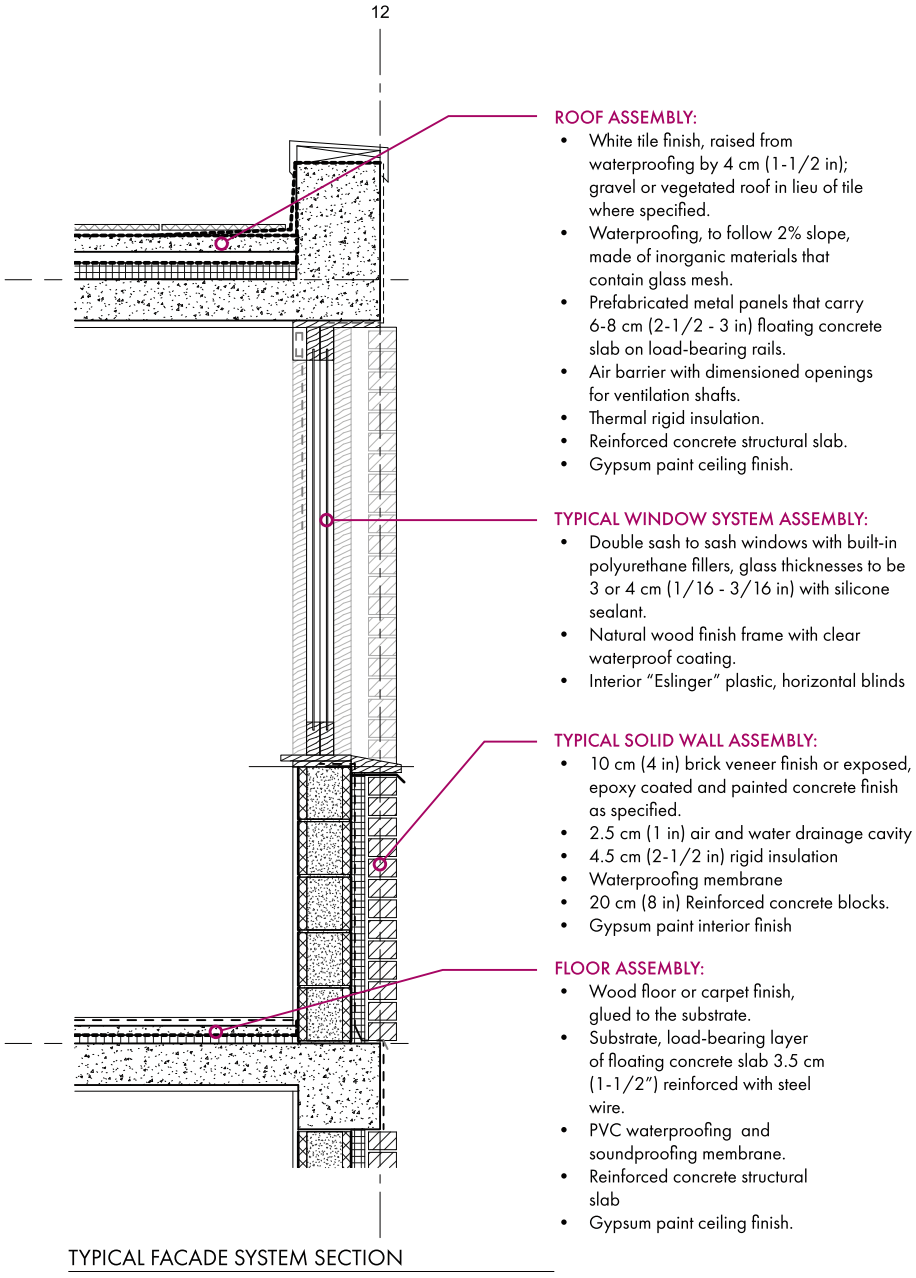

Fig. 9. Typical enclosure system section of *Building B3* at the *Ciglan*e residential complex.

requires a lower, minimum R-value of 1.67/9.5 (m^2-°K/W/h-ft^2-°F/Btu) [7], then the typical solid facade of *Ciglane* would well exceed this recommendation, by 18%. These

preliminary results show that the *Ciglane* residential buildings were designed according to the latest technology of their time, not accounting for their age and degradation over time. Implementation of these construction methods was important for this climate type, where moisture and coldness are predominant for the majority of the year. While the brick veneer, concrete frame facade with integrated water-proofing, rigid insulation, and an air cavity is a generally well-performing enclosure system [7], thermal bridging concerns exist in areas of the facade that integrate extended upturn or downturn slabs, and intentionally expose the concrete structure.

Similar to the solid facade assembly, the glazed facade system was also technologically advanced for its time when single glass windows with non-thermally broken aluminum frames were common. All windows on the residential units, including terrace doors, were designed as double, sash-to-sash, natural wood frame windows with built-in fillers made of polyurethane [3]. The wood finish was sealed with a clear, waterproof, chemical preservative to maintain the natural color and grain texture, and to juxtapose these warm facade elements against the Brutalist concrete [3]. Windows and terrace doors were to be equipped with external sun protection, with the "*Eslinger*", plastic rolling blinds. However, as seen with the solar analysis these may only benefit the east and west-facing bedroom volumes.

5 Conclusion and Future Research

As this paper only presents the preliminary archival, empirical, and initial simulation analysis of building performance for one of the residential buildings in the *Ciglane* neighborhood, continued efforts will include WUFI and THERM software simulation analysis to quantify building enclosure performance, and IES-VE software simulation analysis to quantify a full energy model according to design intent. These results will be used to propose delicate retrofit strategies which can improve building performance and re-simulations will be conducted to quantify and compare those performance values against the original design intent values.

However, even at this stage of research, results demonstrate not only the historical and theoretical significance of this urban and architectural complex, but also show that some of the most advanced construction techniques and technologies of this time were applied. Moreover, despite this having been an enormous, urban scale undertaking to urgently provide thousands of housing units, supporting programs, and infrastructure, careful attention was paid to implementing environmentally conscious design features and principles to center the human experience for an optimal quality of urban life that could be achieved on a challenging site.

References

1. Sirco, J., Jasarevic, I.: Ciglane Prije Ciglana (Translation: Ciglane before Ciglane). AABH (Asocijacija Arhitekata u Bosni i Hercegovini - Association of Architects in Bosnia and Herzegovina) (2019). https://aabh.ba/ciglane-prije-ciglana/
2. Niebyl, D.: The Architectural Legacy of Sarajevo's '84 Winter Olympics. Spomenik Database (2020). https://www.spomenikdatabase.org/post/the-architectural-legacy-of-sarajevo-s-84-winter-olympics

3. DOM Sarajevo: Idejno rjesenje regulacionog plana stanbenog naselja “Djuro Djakovic” u Sarajevu (in translation: Design Intent Regulation Plan for Residential Community “Djuro Djakovic” in Sarajevo), Zavod za studije i projektovanje “DOM” Sarajevo (in translation: Department of Architectural Studies and Design “DOM” Sarajevo) (1979)
4. Days of Architecture Sarajevo: Bauhaus 100 - Architectural Urban Competition for Conceptual Idea of a Square with Viewpoint Ciglane, Sarajevo. Center Municipality Sarajevo (2019). http://www.daniarhitekture.ba/media/2155/da2019_bauhaus100-eng.pdf
5. ASHRAE: Standard 90.1 User’s Manual: ANSI/ASHRAE/IES Standard 90.1-2019: Energy Standard for Buildings except Low-Rise Residential Buildings: I-P and SI. ASHRAE (2019)
6. Wilkinson, T.: Toward a concrete Utopia: MoMA’s powerful exhibition on Yugoslavia’s architecture is testament to the successful heterogeneity of a failed socialist state. Archit. Rev. **1458**, 58–63 (2019)
7. Aksamija, A.: Sustainable Facades: Design Methods for High-Performance Building Envelopes. Wiley, Hoboken (2013)

Evaluating Integration of Informal Settlements in Sarajevo Through Space Syntax Analysis

Tijana Tufek-Memisevic(✉)

Candarc, LLC, Chicago, USA
tijana@candarc.com

Abstract. Urban processes over the last century, conditioned by factors like rapid industrialization, rural to urban migration and post-war internal displacement influenced the large-scale emergence of informal settlements on the slopes of Sarajevo, BiH creating pressure on economy, infrastructure, environment, and the necessity to mitigate geomorphological hazards. In the absence of consistent urban planning strategy, with an instated legislation that is based on legalization of illegal construction, it is highly important to conduct evidence-based urban analyses of all affected areas to steer the course of development towards a sustainable urban trajectory. This research relies on Space Syntax analyses as a tool in elucidating the layout characteristics and spatial relations within selected study area of three settlements on the slopes of Sarajevo. A comparison is conducted between the Space Syntax analysis of existing conditions with the same analysis of planned conditions drafted in the official regulatory plans, to determine the level of change in terms of connectivity and urban integration. Central node areas within the layouts are identified with a 15-min distance walkability potential. The conducted spatial evaluation of selected area in this research provides basis for analyses of other settlements of the same character in and around Sarajevo. Furthermore, the level of urban intervention in the settlements can be determined and tailored to improve long-term sustainable urban development.

Keywords: Space syntax · Informal settlements · Sustainable development

1 Introduction

1.1 Space Syntax Method for Urban Sustainability

One of the major challenges in improving sustainability of an urban environment, is to base spatial interventions on the analysis of their socio-economic impacts through evidence-based knowledge and skill sets. Over the last few decades, Space Syntax method has become a widely used approach in analyzing spatial and social relations in the built environment, rooted in mathematical precision with high explanatory capacity. In its essence Space Syntax consists of a set of theories and techniques based on calculations of spatial configurations and correlation with the human spatial behavior. It is a unique evidence-based approach developed over decades of empirical research. The

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 253–263, 2023.
https://doi.org/10.1007/978-3-031-17767-5_18

method is applicable on a variety of scale levels, from organization of building interiors to cities and large urban agglomerations.

Space Syntax can also be viewed as a set of techniques that combine tangible factors (movement and land use) with intangible factors (cognition and behavior) [1, 2]. Advancements in computer and software development since the 1970s, when the method was initially conceived by Bill Hillier from the University College of London, allow for new and more refined analysis in terms of socio-spatial relations and its application on systems of various complexity. In addition to urban planning and architecture, more disciplines ranging from sociology, transport engineering, real estate development, psychology etc. are showing interest in the concept and analytical techniques of Space Syntax.

"In the Space syntax method, the term "space" appears as an active matrix of settlement processes in which the physical layout of the city is closely connected to its social and cultural relations" [1].

The fundamentals of Space Syntax are based on the natural movement theory. The theory describes ways in which spatial configuration influences movement patterns, economic activity, land use and building density. In the analysis fundamentals, the way the built environment influences human behavior is that people navigate through space by moving along linear routes, interacting in convex spaces, and changing visual fields as they move. Therefore, spatial networks can be graphically represented either through axial or segment maps. In an axial analysis the shortest route from point A to point B is the one with fewest axial steps. In a segment analysis the shortest route from an origin to a destination is the route with least angular changes.

It is a general understanding that areas with a high level of integration attract higher flows of movement, mixed land-use and density, hence are considered more "urbanized" [3].

Using Space Syntax method as an approach for the purpose of upgrading informal settlements around the world is especially beneficial in terms of elucidating key areas where targeted interventions are needed. A focused approach like this is particularly significant for the urban developments on the slopes around Sarajevo where urban processes throughout the last century, encouraged greater construction of residential areas in an unsustainable way. Dominant single-family residential construction on the slopes of the city grew without consistent urban planning policy as a response to housing shortage, rapid industrialization, and internal displacements in the aftermath of war. The settlements include areas vulnerable to landslides, create pressure on the city's infrastructure and significantly intensify air pollution by the dominant use of environmentally damaging heating sources. Since 1996 several regularization actions have been launched by the Sarajevo Canton authorities in attempt to standardize infrastructure for the informally constructed settlements. As the legislation enabled legalization of illegally constructed housing, the term "informal" became disputable. However, the character, origin, and development of the settlements certainly categorize them as such.

In terms of limitation, it is important to point out that in literature there is certain concern about reductionism in the Space Syntax approach, particularly in axial analysis. Justifiable arguments are raised about reducing real life spatial activity and presence

to movement only, reducing urban space to its syntactic properties and possibly prioritizing visibility over accessibility [3]. Additionally, it is understandable to question the difference of pedestrian movement on an even plane and an uneven terrain. Research points out that an incline in the terrain can be correlated with walking attractiveness and increase of the walking time depending on the slope of the terrain [5, 10, 11] (Fig. 1).

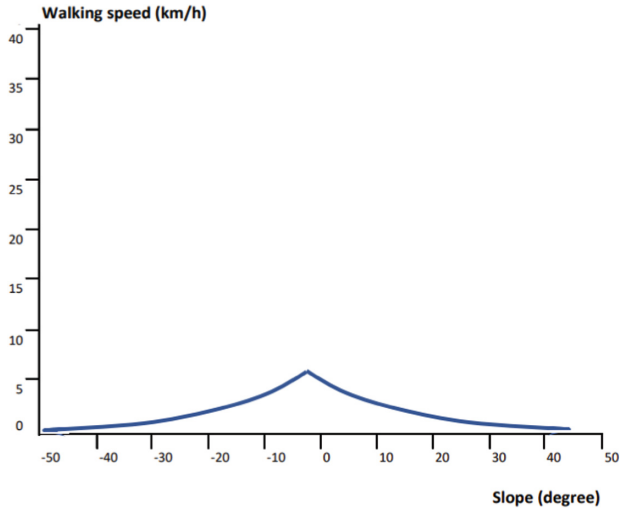

Fig. 1. Depiction of average walking speed in relation to slope. (Source: Tobler's Hiking Function KPH [5])

Considering both the advantages together with the limitations of the approach, this research aims to point out the potential to elucidate the existing layout character of an analyzed location. Through this approach, the different levels of urban intervention in informal settlements of Sarajevo can be acknowledged, evaluated, and tailored to improve long-term sustainability based on detailed insight on the current conditions. By using a trial-and-error approach in changing the existing matrix, new urban interventions can be proposed to influence movement and spatial layout for increased integration, walkability, connections, and urban activities.

1.2 Informal Settlements in Sarajevo

Sarajevo is a linear city [6]. It's elongated form of development has been primarily conditioned by the dominant topographic features consisting of a valley along river Miljacka, with surrounding hills and mountains. Over centuries, the city expanded westwards from the valley's narrow origin below Mount Trebevic, towards a wider flatland area. Sarajevo's development throughout history was disrupted by numerous shifts in political systems, regimes, wars, and destruction, creating a significant level of planning inconsistency with an incomplete and fragmented urban fabric. The most apparent distinction is illustrated in the difference between developments on the slopes and the developments along the valley (Fig. 2).

Fig. 2. The figure illustrates distinction between informal settlements on the slopes and planned development within the valley (Source: author)

During the Ottoman period urbanization occurred in the narrow Eastern city center by following a logic of functional distribution between private and public. Central activities of public life were arranged in the valley. Whereas development on the slopes was arranged in a coherent manner with single family housing distributed in an amphitheatrical urban form. The layout followed a traditional planning strategy of assuring the right to vistas and spaces between neighboring houses. The Old town hillside developments are the only areas where such rules have been followed. Further growth and development expansion on continuing slopes occurred without much or any planning strategy, creating mostly informal settlements as result of different urban processes. On the opposite, multi-family housing together with public functions became predominant in the valley and expanded gradually in a planned manner throughout different time periods.

Intense urbanization was triggered by large rural to urban migration during the period of former Socialist Federal Republic of Yugoslavia caused by rapid industrialization. Private housing construction intensified, dominated the slopes, and accounted for almost the equal amount as state provisioned public housing [7].

A new wave of migration to Sarajevo from different parts of the country, occurred as a consequence of forced displacement and largest refugee crisis in Europe at the time due to the 1992–1995 war. As part of the Dayton Peace agreement, a repossession of housing prior to the war was declared. However, destruction, distinct ethno-territorial division in the country, avoidance of uncertainty as well as higher employment, education and urban living opportunities in Sarajevo prevented many new residents from returning to their previous homes in other parts of BiH.

Urbanization on the slopes occurred in a disintegrated fashion, with low level connection to the city fabric and low internal integration within the settlements. In some

instances, for example, street network disconnection conditions students at a local school to walk along the busy city longitude, Drinska street, instead of having a safe internal access to the premise and facility.

Upon the expiration of the Urban master plan of Sarajevo 1986–2015 it was officially declared that the existing one shall be kept in effect until a new Master Plan is developed, which has yet not been conducted. Meanwhile there are urban regulatory plans[1] pertaining to individual city areas and new ones are being drafted. Considering the historically uncoordinated expansion of the selected area and other surrounding settlements alike despite the presence of geomorphological hazards, evidence-based planning and development trajectory analyses in ensuring urban sustainability in necessary. The aforementioned reasons give plausible justification for conducting this research analysis and open the possibility of further investigation in other city areas with similar characteristics.

2 Methodology

The research methodology is based on applying Space Syntax analysis on three selected northern hillside settlements within the city of Sarajevo - Boljakov Potok, Buca Potok and Pofalici (Fig. 3). Contrary to the latter two, a regulatory plan has not yet been drafted for Boljakov Potok settlement. The Space Syntax theory and method, rooted in mathematical measures and calculation, allows for observation of layout characteristics in terms of spatial configuration of street patterns and spatial relationships within the chosen settlements. Using DepthmapX software for segment analysis by determining integration, connectivity, node count and total depth, this study aims to:

- evaluate/elucidate the existing layout character of the informal settlements
- discover potential patterns in spatial relations
- identify existing and potential centralities
- point to areas that lack connections
- underline potential for increased walkability and urban activities
- compare existing condition to planned in terms of integration

Based on the provided outputs, new informed urban planning and urban design decisions can be implemented in the still evolving planning documentation of Canton Sarajevo.

The study area was selected due to its geographic layout and spatial disposition along the northern city longitude. Being on a higher elevation level and accompanied by the main railway route, the longitudinal transit - Drinska street, creates a spatial boundary (North-South) between the selected informal settlements and Sarajevo's dominant urban development along the valley. It creates a distinct cut in the urban fabric connecting the hillside and valley developments at three key points - two underpasses and one freeway connection.

[1] Many countries in SE Europe (especially from former Yugoslavia) adopt urban regulatory plans as planning tools for smaller areas. The plans are generally produced by local government, but often adjusted to proposals of developers.

Due to this barrier-like feature, it is deemed unnecessary to include the southern city fabric within the Space Syntax analysis as the results will simply underline the lack of connections. Horizontal limits of the study area are demarcated by Drinska street's starting point in the east and its A1 freeway connection in the west.

For this research a segment map analysis has been conducted measuring global and local Integration levels, Choice, Node count and Connectivity to determine the layout character, evaluate existing connections and central areas. Local integration and node count measures were implemented on existing layout of Buca Potok and compared with planned interventions in the urban regulatory plan to provide insight into the effects of their implementation.

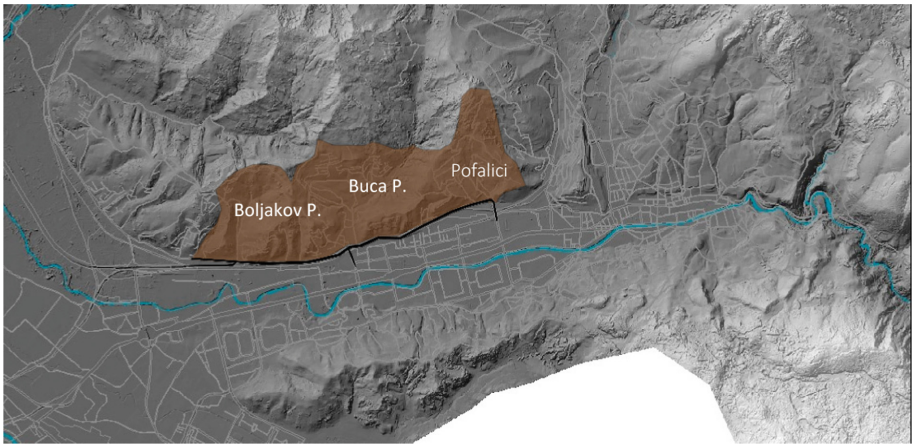

Fig. 3. Figure illustrates selected study area on the slopes - Boljakov Potok, Buca Potok and Pofalici settlements

As a general rule of visual representation in within the graphic analyses of Space Syntax a color range from red to blue depicts the range of more intensity to less in respective measurements. Integration measure, also referred to as to-movement, can be measured on a global scale, meaning - city wide, and a local scale - within a selected city area. Global integration is essentially a measure that describes the relation of each street to all others in a predefined spatial system [2]. The analysis highlights the city's main centers, while local sub-centers are less prominently depicted. Local integration is key in assessing the value of mean depth of streets within a defined radius. Total depth determines whether a space is placed deep or shallow within a system. The shallower a space, the easier it is to reach.

3 Space Syntax Analysis on Selected Informal Settlements

Space Syntax global integration measurement shows strongest integration of urban fabric along the main city longitudinal axis. It is a predictable result considering that the city development was conditioned along this line. However, global integration on a radius

of 1200m or ¾ of a mile (Fig. 4), which in urban planning is also considered as a 15-min pedestrian walking distance, illustrates most intensity within the Old Town and Grbavica city area. Grbavica connects to one of the selected hillside settlements - Pofalici via underpass on Drinska street.

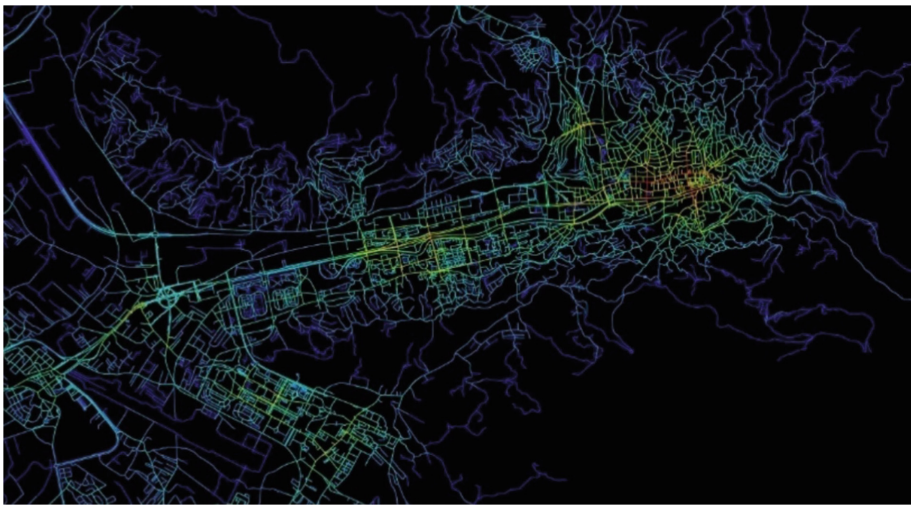

Fig. 4. Global Integration R1200. Illustration depicts most integrated city areas for 15-min pedestrian movement

Local integration analysis (Fig. 5) of the selected study area depicts strongest integration along lower parts of the slopes, most prominently in Buca Potok area connecting to Drinska and Adema Buce streets. This area differs also due to the presence of commerce and multi-family housing.

Integration level is slightly less present, but still prominent along Pofalici settlement's Humska and Pofalicka street. On the other hand, the settlement of Boljakov Potok shows low integration value. In all three settlements most disintegration and isolation is noticeable in the areas of higher elevation, but also within some central parts of the urban fabric.

Further segment map analysis was performed on a list of measures, that include Choice, also referred to as in-betweenness measure, Connectivity, Depth and Node Count on different radii - 200, 400, 600, 800 and 1200 m. The decline in average walking speed in relation to slope has been taken into account when analyzing the 15-min walkability and possible centralities within the study area. In general, the average walking speed of pedestrians in relation to slope declines as the slope degree increases [5, 10, 11]. Existing routes within the selected area cover different degrees of slope. Not all routes are safe, pedestrian-friendly and they vary in number of obstacles that pedestrians encounter. With that in mind, for the purpose of this research and considering the large scale of the selected area, a distance of 800 m was analyzed instead of the standard approx. 1200 m distance for an average 15-min walk.

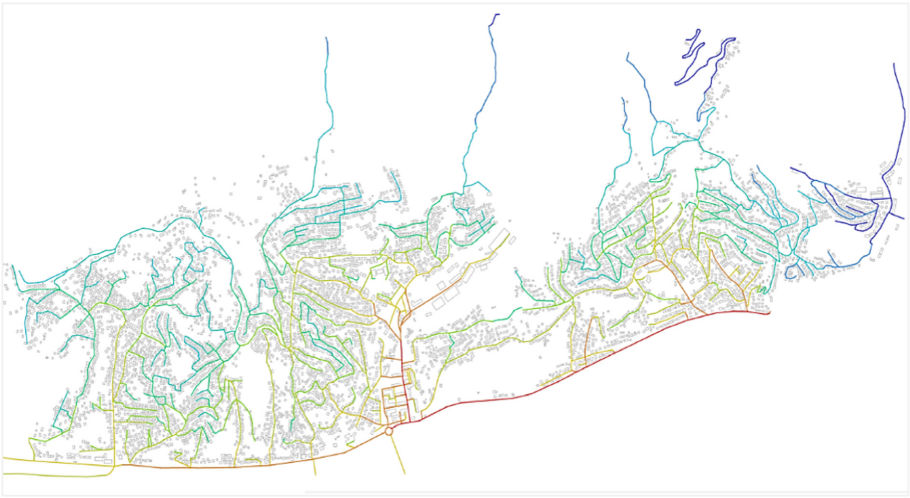

Fig. 5. Local T1024 integration analysis on segment map. Illustration depicts most integration range within the selected study area

Fig. 6. T1024 Node Count R800. Figure illustrates potential centralities within the study area for additional function

The node count on radius 800 m (Fig. 6) illustrates potential for creating central areas within the settlements. As the illustrated nodes are placed further inside the urban tissue of the settlements this could allow better integration of the more isolated higher parts of the settlements by providing amenities and urban activities around the specified nodes. However, it is imperative that the addition of new functions in this area is coordinated with the existing layout of geomorphological hazards. The settlement of Boljakov Potok does not show potential for such central nodes. Therefore, the existing matrix can be

explored through trial-and-error method in establishing new connections and determining potential for central areas of the settlement with new urban function. Moreover, since there is no applicable urban regulatory draft currently available for Boljakov Potok.

The area of Buca Potok settlement was chosen for the purpose of demonstrating the existing state in comparison to the adjusted conditions created by the official urban regulatory plans (Figs. 7 and 8).

The integration measure analysis illustrates that more integration value is added within the already most integrated part of the settlement, while the interventions in the rest of Buca Potok do not create a significant change in integration. For example, the proposed connection between Esada Midzica street and Dolacka depicts a blue line, meaning low level of overall integration. This conclusion, however, is not diminishing the importance of creating that connection.

Node Count R 800 analysis of existing and new condition does not show new potential for centrality within the settlement. Intensity around Nusreta Prohica is slightly increased in the new proposition.

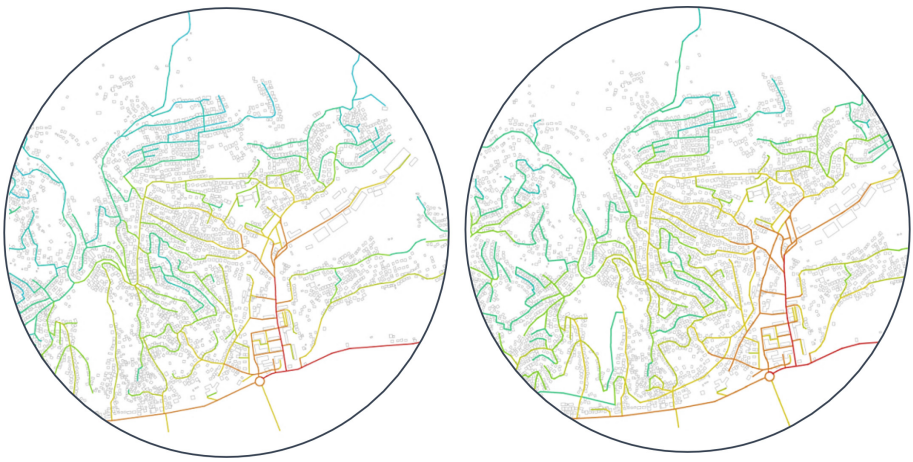

Fig. 7. Comparison of local integration measure in existing (left) and planned (right) conditions

4 Conclusion

Intense urbanization on the slopes of Sarajevo created numerous challenges in the long-term sustainable development of the city. Legislative attempts in mitigating these challenges fall short at attempting to standardize infrastructure requirements through legalization of illegal construction, mitigation of existing landslides and the absence of consistent urban planning strategy. Based on the incomplete planning documentation and the characteristics of existing layout elucidated by this research, in order to steer the course of urban development towards a sustainable trajectory, an evidence-based urban analysis of the affected area is necessary. Space Syntax is a valuable tool that can provide

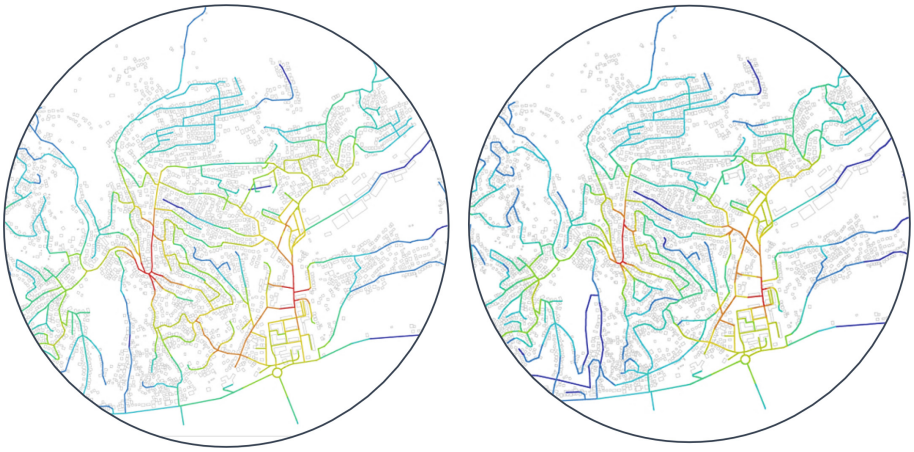

Fig. 8. Comparison of node count R800 measure in existing (left) and planned (right) conditions

a unique insight into the level of integration, connectivity, and potential key areas for urban intervention.

The number of connections needs to be increased in areas that are shown to be disintegrated and fragmented, particularly in the higher levels of the settlement, as well as Boljakov Potok settlement altogether. Official plans analyzed in comparison with existing condition show little amount of change in terms of overall integration and potential centralities within the studied settlement, Buca Potok. The analysis shows potential for creating centralities within the existing urban tissue, based on a 15-min walkable distance. Adjusting plans to accommodate basic services within these areas provides potential to increase pedestrian instead of vehicle traffic circulation. Any type of intervention, however, requires alignment with the layout of existing landslide maps of the area.

This study serves a basis for further detailed analysis of the selected area, as well as a reference for analyzing other informal settlements within and around the city. Future planning decisions depend on precision and accuracy, particularly due to the existence of geomorphological hazards. Implementing the right interventions in key areas elucidated by this research, can stimulate more walkability, more safety and decrease traffic pressure on the existing infrastructure.

References

1. Yamu, C., van Nes, A., Garau, C.: Bill Hillier's legacy: space syntax—a synopsis of basic concepts, measures, and empirical application. Sustainability **13**(6), 3394 (2021)
2. Akkelies van Nes, A., Yamu, C.: Introduction to space syntax in urban studies. Springer, Cham (2021). https://doi.org/10.1007/978-3-030-59140-3
3. Pafka, E., Dovey, K., Aschwanden, G.D.P.A.: Limits of space syntax for urban design: axiality, scale and sinuosity. Environ. Plan. B Urban Anal. City Sci. **47**(3), 508–522 (2020)
4. Pingel, T.J.: Modeling slope as a contributor to route selection in mountainous areas. Cartogr. Geogr. Inf. Sci. **37**(2), 137–148 (2010)

5. Tobler, W.: Non-isotropic geographic modeling (Technical Report No. 93-1). National Center for Geographic Information and Analysis, Santa Barbara (1993)
6. Tufek-Memisevic, T., Stachura, E.: A linear city development under contemporary determinants. J. Środowisko Mieszka-niowe **14**, 190–195 (2015)
7. Urbanistički plan Grada Sarajeva (1999). Urbanistički plan Grada Sarajeva za urbano područje Sarajevo (Stari Grad, Centar, Novo Sarajevo, Novi Grad, Ilidža i Vogošća) za period od 1986. do 2015. godine (prečišćeni tekst). Službene novine Kantona Sarajevo (01-05-12/99)
8. Tsenkova, S.: Urban planning and informal cities in southeast Europe. J. Archit. Plan. Res. **29**(4), 292–305 (2012)
9. Martín-Díaz, J., Palma, P., Golijanin, J., Nofre, J., Oliva, M., Čengić, N.: The urbanisation on the slopes of Sarajevo and the rise of geomorphological hazards during the post-war period. Cities **72**, 60–69 (2018)
10. Sarmady, S., Haron, F., Talib, A.Z.: Simulation of pedestrian movements on slope using fine grid cellular. arXiv:2010.03387 (2020)
11. Meeder, M., Aebi, T., Weidmann, U.: The influence of slope on walking activity and the pedestrian modal share. Transp. Res. Procedia **27**, 141–147 (2017)

Green Infrastructure: Spatial Potentials of the Greening the City of Brčko

Slobodan Bulatović(✉)

University of Architecture, Department of Urbanism, University of Belgrade, Belgrade, Serbia
bulatovic-s@hotmail.com

Abstract. Urban development and the need for new facilities significantly reduce green spaces in cities worldwide. However, green infrastructure is crucial for the city and its inhabitants because it cleans the air, absorbs atmospheric water and attracts citizens. Moreover, these surfaces encourage socialising and positively affect the health of citizens. That is why it is necessary to find city spaces to develop new green areas. In this paper, a structural analysis of the urban area, i.e. the green spaces of Brčko, will be performed to find new potential green spaces in the city. Apart from planning documents, the research will be based on maps that will show the relationship between built and green space. Based on them, this paper will define the green potential of the space. Brčko is a developing city, and this paper aims to show the attitude of such cities toward larger green areas and their potential. The conclusions will further define the importance of green spaces for cities. It will also provide guidelines and recommendations for developing green open public spaces.

Keywords: Green infrastructure · Mapping potential of space · Open public spaces · Quality of life · City of Brčko

1 Introduction

The development of cities and their surroundings has expanded rapidly in recent decades. This is primarily influenced by the growing number of people who want to live in them. As a result, large-scale environmental pollution occurs in urban areas. Social injustice also increases due to significant differences in wealth and the distance of homeplace from the city or open public spaces [1]. All this affects the changes in the urban tissue because it leads to an increase in the built-up area. This increase harms other spaces in the city because it directly affects their coverage. As a result, the quality of life in the city is declining sharply. There is also a growing disparity between the city and its surroundings [2]. In recent years, open public spaces have become increasingly important in cities because they affect the different perceptions of an urban area. They are also of great importance to the population.

Open public spaces, as mentioned, play an essential role in urban areas. These spaces represent the urban fabric because they connect independent built spaces and entire settlements into one large whole called the city. On the other hand, their impact on citizens

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 264–275, 2023.
https://doi.org/10.1007/978-3-031-17767-5_19

and the quality of life in the city is significant. There is a belief among planners, architects, and other participants in the city's development and citizens that open public spaces make cities more livable because they positively affect health and social equality [3]. These spaces have the mentioned positive influences because they enable the gathering and socialising of the population of a certain settlement or city and encourage the creation of various connections between them [4]. In his book Urban Design: Street and Square [5], Cliff Moughtin explains that spatial configuration and urban forms that directly depend on open public spaces and the buildings surrounding them have a powerful impact on citizens' relationships and the quality of their stay in the city. This can be considered valid if we know that citizens use these spaces to perform their daily routines, including physical and mental rest [6]. When it comes to open public spaces, they encourage interactions between a broader range of society [7]. We should not ignore the fact that these areas are used daily by all demographic categories of the population, regardless of age, gender, or other affiliation [8].

However, just as there are differences between other urban elements, open public spaces differ. First of all, these spaces could be conditionally divided into grey and green open spaces [9]. Grey open spaces could be considered all those whose surfaces are built or paved instead of natural ones. These are certain squares, streets, paved playgrounds, etc. Green open spaces are natural spaces characterised by grassy areas and other natural greenery and trees. These areas include parks, natural inner block yards, tree-lined avenues along the street, city forests, areas along rivers and shores, etc. Green open public spaces in the city, and above all, parks and city forests are created to provide citizens with the possibility of various forms of living and recreation [10]. These areas can be fully considered places where the population, in addition to the benefits of socialising and recreation, also has the opportunity to improve their mental and physical health [11]. Parks and other green areas in the city have positive impacts on citizens and their health because they provide them with a connection to nature and, at the same time, escape from the city crowds, noise, and limited and walled spaces. Also, these areas are essential for CO_2 reduction and mitigation of other harmful effects in the city [12]. Due to their advantages and benefits, these spaces must be part of the urban structure, and their existence in cities could not be questioned. Children's access to green areas is also vital. Public spaces, which may contain some aspects of children's play, contribute to the sustainable development of the youngest urban residents [13]. Moreover, the rich green space affects the more minor traffic activities in the immediate vicinity and, at the same time, provides space for free play and entertainment [14].

However, there has been an increasing trend of destroying accessible green areas where new residential and business premises have been developed in recent years. Changes in urban structure significantly impact spatial and physical characteristics, but they also have an enormous impact on changes in the urban landscape [15]. Such changes are most noticeable in large cities developing rapidly but can also be seen in smaller cities, even in low development. One of these smaller cities with slow growth is the city of Brčko in Bosnia and Herzegovina, where a significant imbalance between built-up areas and open green areas is also noticeable. Therefore, the current structure of the space in the city centre in Brčko will be investigated in this paper, emphasising the participation of green areas in that structure. After that, this paper will analyse the potential of the

space for the development of new open green areas. For the results to be adequate, maps of spaces with existing and potential green locations will be made. Indeed, the current planning documentation of the city of Brčko will be used in the paper. This paper aims to determine whether cities or the specific city of Brčko have opportunities and potential for developing new green areas or will become a grey concrete dormitory in the future. The paper's conclusions will seek to raise awareness of the importance of green spaces in the city and recommendations for finding and forming new park spaces in cities.

2 Background Research

As mentioned in the introduction, green areas in cities significantly impact the quality of space and, thus, residents' quality of life. The most represented, and probably, the essential public green areas in cities are parks. According to Mark Francis [16], there are two types of parks: the city and neighbourhood parks. City parks are mainly located not far from the city centre and primarily represent green spaces nurtured and maintained by city utilities. Neighbourhood parks are smaller green areas that are often combined with other open spaces or buildings such as playgrounds, sports facilities, etc. Francis also states that open public spaces in cities should all together represent one natural system, and this, of course, requires the presence of green areas, trees or flowers. With the help of such spaces, it is possible to influence better air quality in the city, adequate waste and atmospheric water management, and it is certainly possible to improve the environment's health [17]. Over the last few decades, projects have been launched in major cities to enhance the air quality in urban areas. Such an example can be found in Stuttgart, Germany, where an urban forest was planned, which was supposed to affect cleaner air, and at the same time, provide wood supplies for energy production [18]. Such thinking is still present today because it is believed that green spaces in cities can play a crucial role in global warming and growing urban climate problems. After all, they are recognised as elements that can help acclimatise space [19].

The advantage of green spaces in the city is that they are one of the main elements in creating a smart city. Smart cities are the main direction of developing many city policies in the 21st century. In such cities, efforts are being made to program green and grey infrastructure. If these two infrastructures are developed smartly and sustainably, they can benefit significantly from each other. This is precisely what the Pamenti Forest City plan, made for Cancun, seeks to achieve [20]. This "forest" would improve the city's energy efficiency and undoubtedly eliminate wastewater and atmospheric water problems. Many other cities are also trying to raise citizens' awareness of the importance of green spaces. Thus, for example, the Natural History Museum in Berlin, with the help of an application, seeks to reveal to the population the green areas in the environment and flora and fauna found in them [21]. The mentioned projects in cities worldwide are of great importance in raising the awareness of users and all actors in space planning on the significance of green spaces for the city. In addition to all the benefits for urban areas and their inhabitants, these spaces have a crucial role in preserving biodiversity with diversity and permanent or occasional inhabitants.

Parks in cities and other green areas are certainly part of the social infrastructure. From the aspect of man as a user of space, these spaces have tremendous significance because they enrich the social infrastructure and give it a new component in the area. As Jack Layton and Alan Latham [22] point out in their research on Finsbury Park in London, these spaces are among the most critical elements that link society and public space, i.e. social infrastructure and the environment. That is why their maintenance and development are essential. Urban policy developments should be based mainly on new green spaces. Problems with the development of new grey spaces to the detriment of green spaces are visible worldwide. One example is the city of Malmö, where modernist housing estates are being renovated to reduce the green fund while increasing the percentage of grey infrastructure and population density [23]. On the other hand, if all the benefits of green spaces are considered, it is clear that they can affect the quality, resulting in increasing the value of space around these areas. The model of the city of Belfast in Northern Ireland concluded that greening policies affect land value, tourism, flood mitigation, employment, quality of place, climate change and, indeed, the health of citizens [24].

The city of Brčko, which was selected for the case study in this study, faces insufficient public green spaces in the inner city area. As in other developing cities, accelerated urban development increases the construction fund while at the same time taking into account the capacity of urban infrastructure and certainly not taking into account the participation of green spaces in the urban structure. Therefore, this research seeks to raise awareness of all actors in the area about the importance of green spaces and the obligation to include these areas in planning policies to prevent their complete disappearance. The paper will analyse spatial potentials based on space structure and record them on maps. In that way, the existing green space will be adequately illustrated as the possibility of the city of Brčko the development of new green spaces. It is indisputable that all cities, regardless of development, have specific locations that can become new urban green areas and even the initiators of new spatial development in the near or distant future.

3 Methodology

Analysing the potential of space can be performed in several ways. Indeed, to begin with, it is crucial to determine whether open or closed space, public or private, is being analysed. Many researchers have studied the criteria for the quality of open public spaces. When it comes to the qualities of green open public spaces, they can be analysed through user enjoyment, i.e. based explicitly on the role in creating the urban landscape or the impact on the area's microclimate [25]. Based on the evaluated qualities, it can be determined whether a specific space has potential, i.e., it is suitable to become a new development factor of an urban area. Also, space can be analysed based on structural analysis. Structural analysis of space can show the complexity of urban spaces [26]. This analysis can define the elements of which a specific space is composed. Based on structural analysis, green open public areas within the urban space can be clearly defined in this particular case. These individual elements can be singled out, i.e. green spaces such as parks, urban forests, etc. Their deficit, surplus, or potential in spatial coverage can be defined [27].

Of course, the potential for developing new green spaces in the city cannot be defined only based on structural analysis of open space, i.e. the separation of individual urban elements from the urban structure. It is necessary to consider other space parameters, such as population density, development of other infrastructure systems, construction of space, etc. Therefore, it is crucial to analyse the spatial planning documents of a particular city or settlement. The role of planning documents is primarily to become instruments for implementing planned, spatially defined and controlled urban development [28]. Therefore, spatial and urban plans and the proposed future directions of development and spatial solutions must also contain data on the current state of space, which adequately reflect the urban structure [29]. Precisely because of their comprehensiveness and the content of data on the current situation, these plans can help discover the real potential of the space.

For these spatial potentials for the development of new green open public spaces in cities, specifically in the city of Brčko, to be presented and thus become the subject of future discussions, it is necessary to map them, i.e. show them on a map. Spatial maps have multiple benefits for all citizens and participants in planning processes in a particular area. The maps make it possible to define better planning policies, including environmental management processes [30]. Also, the maps help to create an image of the space for all interested parties in the discussion. Indeed, in addition to an accurate presentation, the maps also affect the relevance of the results [31].

In this paper, as mentioned, the potential of space in the city of Brčko in terms of creating new green public spaces will be examined. Therefore, a structural analysis of space will be done, including the study of the primary planning documents, such as the Spatial Plan and the Urban Plan in Brčko. All the results will be shown on maps to see the real possibilities for developing new green infrastructure. Also, one of the maps will represent the current situation, i.e. the position and representation of green open public spaces in the inner city of Brčko. Indeed, the goal is to adapt the colours on the maps to the shades of the grey and green infrastructure, emphasising large green areas such as city parks, settlements, and urban forests.

4 Case Study – City of Brčko

Analysing the spatial potential for developing new green open public spaces requires an adequate case study. Given that large cities overgrowing are increasingly striving to introduce green infrastructure in any form, this paper emphasises cities that are not developing at all or slowly. Large cities with rapid development are constantly introducing innovations that, in addition to planning and developing green areas, also include greening buildings. Such an example can be seen in Milan, where a building called “Bosco Verticale” or “Upright Forest” was built [32]. However, on the other hand, small and medium-sized cities whose development is slow due to various economic, social, historical or geographical factors do not have the opportunity to fully dedicate themselves to the development of green infrastructure that affects the structure of residential or commercial buildings. Therefore, it is necessary to develop green open public spaces such as urban forest parks in these cities to mitigate the adverse effects of future development.

One of the cities that is slowly developing due to historical and socio-economic factors is the city of Brčko. This city belongs to a group of medium-sized cities. This city is located in the northeast of Bosnia and Herzegovina along the Sava River. As mentioned, certain historical factors greatly influence the current development trend. For example, the city of Brčko, like the rest of Bosnia and Herzegovina, was affected by the civil war during the 1990s [33]. After that period, the city's development was in expansion for a certain period, but after that, there was stagnation, while today, the development of grey infrastructure is accelerating again. Due to such growth, green areas in Brčko are primarily endangered, which, as mentioned in the paper, have tremendous positive effects on urban areas and the population. According to the 2013 census, there are about 40,000 inhabitants in the city of Brčko [34].

According to the Urban Plan, the most crucial element of the greenery system in Brčko is the central city park, whose importance is reflected in its function of satisfying ecological parameters in the urban environment. In addition, it is undoubtedly essential as a place of everyday rest. However, the plan states that the park's reconstruction is necessary because it is too devastating. Also vital is the Ficibayer Park, or the urban forest that covers an area of 41 hectares. Its advantage is a large area and position along the Sava River, giving it remarkable potential in quality and impacting residents' mental and physical health. In addition to these areas, other smaller parks are vital for the urban structure and the creation of the urban landscape of the city of Brčko. Of course, they are also significant in the further development and modernisation of the city.

Fig. 1. View of larger green public open spaces in the city of Brčko. Source: author

As can be seen in Fig. 1. in the inner city area of Brčko, there is a certain number of green public spaces (shown in green on the map). Of course, these spaces have their qualities and potential. Still, let's take into account the fact that the construction of residential buildings intended for multi-family housing is intensifying in the city of

Brčko. Therefore, these spaces are not enough. Of course, the map does not show small neighbourhood parks and green areas along the roads, but they are certainly not places for recreation and daily rest.

5 Results

The urban space of the city of Brčko is made up of various residential buildings and public spaces. In the narrower urban area, individual housing facilities are represented to a greater extent, with many multi-family housing facilities, i.e. residential buildings. However, in recent years, space development has been more focused on constructing new residential buildings to the detriment of individual housing and open public spaces. According to the document Amendments to the Urban Plan of the City of Brčko (II) for 2007–2017. Year, the average population density in Brčko in areas intended for housing is 48 inhabitants per hectare. This population density certainly creates an obligation for the development of green areas. Specific research in European cities has shown that green areas in cities should not be more than 500m from the place of residence or a 10 to 15 min walk from the residential building [35]. Many countries in Europe, including those from the Scandinavian Peninsula, have devoted themselves to planning policies aimed at developing new park spaces due to the loss of green areas and greater distances between places of residence and places of recreation [36].

Fig. 2. Locations that can become a new green open public space in the city of Brčko. Source: author

As can be seen in Fig. 2. In the area of the city of Brčko, specific spaces have the potential to become new green open public spaces. The map shows in green colour the locations that currently belong to green areas but are not public or do not have all the

qualities necessary to become significant green spaces. Places that can become new green open public spaces are marked in yellow, and they are currently part of the city's grey infrastructure or represent wild parking spaces. Also, the yellow area marks the areas previously used for industrial or other purposes but can certainly potentially become part of the green infrastructure in the future.

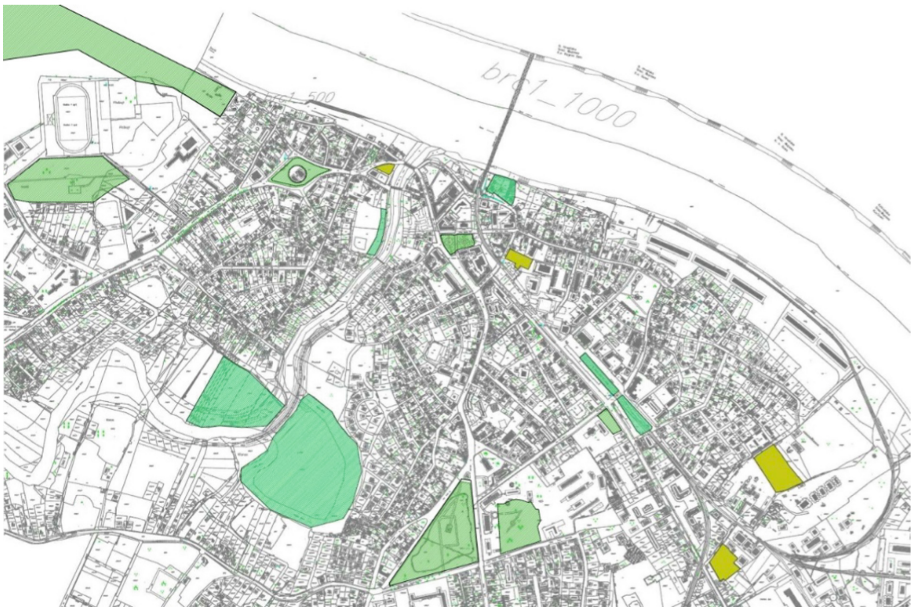

Fig. 3. Map of existing and potential green public spaces. Source: author

In Fig. 3, all existing and potential green open public spaces are united. Based on the map (Fig. 3), it is evident that the city of Brčko can become much richer in terms of green spaces. It can also be noticed that the share of green spaces in the total area of the inner city would increase significantly. This would allow the population much better accessibility to these areas and a smaller distance of the place of residence from the parks.

As can be seen in Fig. 4. Existing and new proposed green open public spaces can have a perfect and simple connection. All the proposed spaces are located in very accessible locations in the inner city. This makes them easily accessible via existing paths located along roads or on the banks of city rivers. Undoubtedly, it can be concluded that potential green spaces can have an excellent connection with all existing parks.

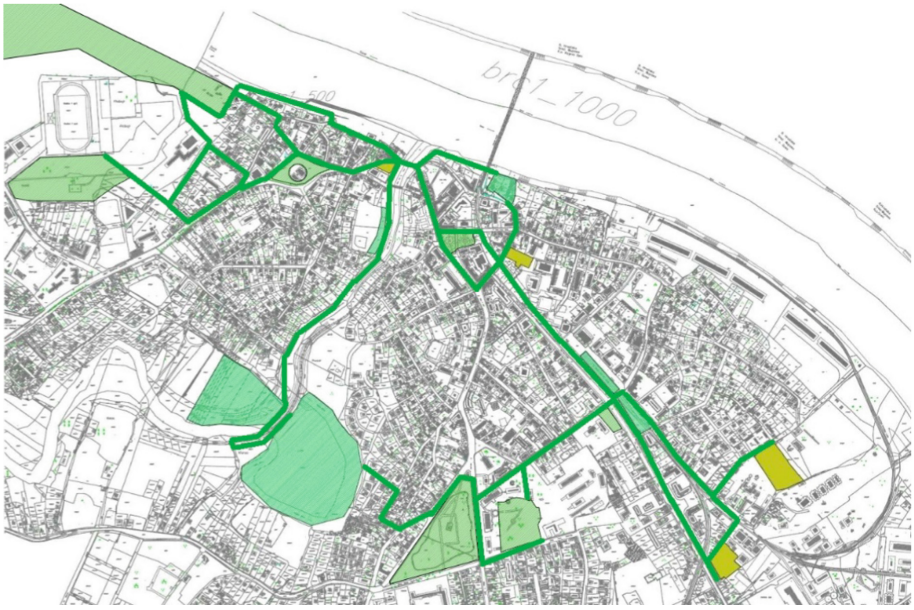

Fig. 4. Connectivity of new proposed and existing green open public spaces. Source: author

6 Conclusions

As mentioned several times in the paper, green spaces in cities play a crucial role in spatial development. Since these spaces are the main elements of maintaining a quality environment, their existence and maintenance are unquestionable. At the same time, green spaces help citizens maintain physical and mental health at the necessary level for everyday needs, obligations and stressful situations. Also, as mentioned in the introduction, green spaces are essential for children.

As can be seen in the example of the city of Brčko, prominent individual green locations are primarily represented in urban areas. Almost all cities have one central city park with several smaller parks next to certain public buildings or water bodies. In addition, urban forests can often be found in the cities on the outskirts of the narrower urban area, as is the case with the city of Brčko. However, due to the accelerated construction and the desire of more and more people to live in cities, the maintenance and development of new green spaces have been neglected in the 21st century. On the other hand, in almost all cities, some spaces can become new green areas and thus affect the quality of the environment and, therefore, the quality of the urban landscape. In the city of Brčko, locations that can become new open green public spaces in the inner city are areas that are used as wild parking spaces. Also, locations with potential are located along rivers or lakes. Such locations in developing cities are not adequately regulated or do not have elements of green infrastructure. Also, spaces that have great potential to become green spaces are the yards of former industries or spaces that in the past had a specific purpose that is now completely eradicated. An example is an area where the railway in the city

of Brčko is located, which has been used minimally in recent years and could easily be relocated, thus freeing up space for a new line park in the city.

From the example of the city of Brčko, it can be concluded that medium-sized cities that are poorly developed or in development have the potential for the growth of new green public spaces. Indeed, the assumption is that larger cities have the same or similar, or even much greater potential for the development of green infrastructure. However, the planning policies of large cities primarily contain guidelines and rules for the development of green public spaces. Specific recommendations that could help in determining the spatial potential, and certainly in the development of green areas are:

– It is crucial to perform a structural analysis of space, find abandoned and devastated areas near or within residential and business complexes, and convert them into a new green public space.
– To promote the importance of greenery in the city, i.e. to present its benefits for the environment and the population's health.
– Make a study that would give preliminary results about the importance of green areas in terms of quality and value of space to encourage investors to develop these areas and residential buildings.

Green infrastructure is an indispensable element of urban space and must be given full attention in planning processes. The benefits of this infrastructure are manifold and are certainly a guide to developing a smart city.

Finally, it should be emphasised that by increasing the total share of green space in the urban structure, the city of Brčko would benefit greatly. These areas would provide the population with new places for leisure and recreation. Green spaces would undoubtedly become the new "lungs" of the city, and they would also reduce the possibility of flooding the area around them. The development of new green open public spaces would completely change the urban image of the city of Brcko in a positive sense.

References

1. Fainstein, S.S.: The Just City. Cornell University Press, Ithaca, NY (2010)
2. Kühn, M.: Immigration strategies of cities: local growth policies and urban planning in Germany. Eur. Plan. Stud. **26**, 1747–1762 (2018). https://doi.org/10.1080/09654313.2018.1484428
3. Grabalov, P., Nordh, H.: The future of urban cemeteries as public spaces: insights from Oslo and Copenhagen. Plann. Theor. Pract. **23**(1), 1–18 (2021). https://doi.org/10.1080/14649357.2021.1993973
4. Oldenburg, R.: The Great Good Place. Da Capo Press, Cambridge (1999)
5. Moughtin, C.: Urban Design: Street and Square. Architectural Press, Oxford (2003)
6. Djukic, A., Vlastos, T., Joklova, V.: Liveable open public space - from flaneur to cyborg. In: Smaniotto Costa, C., et al. (eds.) CyberParks – The Interface Between People, Places and Technology. LNCS, vol. 11380, pp. 38–49. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-13417-4_4
7. Dietrich, U., Kengyel, N.: What makes a public open space liveable?. In: 11th International Conference on Urban Regeneration and Sustainability, pp. 685–696. Alicante, Spain (2016). https://doi.org/10.2495/SC160571

8. Carmona, M., De Magalhaes, C., Hammond, L.: Public Space: The Management Dimension. Routledge, UK, London (2008)
9. Wandl, A., Rooij, R., Rocco, R.: Towards sustainable territories-in-between: a multidimensional typology of open spaces in Europe. Plan. Pract. Res. **32**, 55–84 (2016). https://doi.org/10.1080/02697459.2016.1187978
10. Pereković, P., Kamenečki, M.: Park elements as indicators of recreational potential. Prostor **25**, 342–357 (2017). https://doi.org/10.31522/p.25.2(54).12
11. Marić, J., Đukić, A., Antonić, B., Furundžić, D.: The effects of open space on reducing workplace stress: case study of business park in the post-socialist urban setting. Sustainability **13**(1), 336 (2021). https://doi.org/10.3390/su13010336
12. Stupar, A., Milaković, M., Graovac, A.: The reactivation of the natural potential of Belgrade: Biophilia and biomimicry as new competitive advantages? Arhitektura i urbanizam **37**, 35–42 (2013). https://doi.org/10.5937/a-u37-3762
13. Shin, E., Kim, H.: Analysing green roof effects in an urban environment: a case of Bangbae-dong, Seoul. J. Asian Architect. Build. Eng. **14**, 315–322 (2015). https://doi.org/10.3130/jaabe.14.315
14. Jansson, M., Sundevall, E., Wales, M.: The role of green spaces and their management in a child-friendly urban village. Urban For. Urban Greening **18**, 228–236 (2016). https://doi.org/10.1016/j.ufug.2016.06.014
15. Marić, I., Niković, A., Manić, B.: Transformation of the New Belgrade urban tissue: filling the space instead of interpolation. Spatium **22**, 47–56 (2010). https://doi.org/10.2298/SPAT1022047M
16. Francis, M.: Urban open spaces. Adv. Environ. Behav. Design **1**, 71–106 (1987). https://doi.org/10.1007/978-1-4899-5345-2_4
17. Hough, M.: City Form and Natural Process. Van Nostrand Reinhold, New York (1984)
18. Spirn, A.W.: The Granite Garden: Urban Nature and Human Design. Basic Books, New York (1984)
19. Klemm, W., Lenzholzer, S., Van den Brink, A.: Developing green infrastructure design guidelines for urban climate adaptation. J. Landscape Archit. **12**, 60–71 (2018). https://doi.org/10.1080/18626033.2017.1425320
20. Gabrys, J.: Programming nature as infrastructure in the smart forest city. J. Urban Technol. **29**(1), 1–8 (2022). https://doi.org/10.1080/10630732.2021.2004067
21. Moss, T., Voigt, F., Becker, S.: Digital urban nature: probing a void in the smart city discourse. City **25**, 255–276 (2021). https://doi.org/10.1080/13604813.2021.1935513
22. Layton, J., Latham, A.: Social infrastructure and public life – notes on Finsbury Park London. Urban Geogr. **43**(5), 1–22 (2021). https://doi.org/10.1080/02723638.2021.1934631
23. Zalar, A., Pries, J.: Unmapping green space: discursive dispossession of the right to green space by a compact city planning epistemology. City **26**(1), 1–23 (2022). https://doi.org/10.1080/13604813.2021.2018860
24. Hunter, R.F., Dallat, M.A.T., Tully, M.A., Heron, L., O'Neill, C., Kee, F.: Social return on investment analysis of an urban greenway. Cities Health, 1–18 (2020). https://doi.org/10.1080/23748834.2020.1766783
25. Gehl, J.: Life Between Buildings. Van Nostrand-Reinhold, New York (1987)
26. Pereković, P.: Perception of the role of complexity in landscape design. Agronomski fakultet, Zagreb (2011)
27. Booth, N.K.: Basic Elements of Landscape Architectural Design. Waveland press INC., Prospect Heights (1979)
28. Mrak-Taritaš, A.: Urban development plan: zagreb as an example of its role and significance. Prostor **16**, 232–245 (2008). https://hrcak.srce.hr/30701
29. Pegan, S.: An approach to urban planning. Prostor **4**, 95–108 (1996). https://hrcak.srce.hr/24103

30. Hohtenthal, J., Minoia, P., Pellikka, P.: Mapping meaning: critical cartographies for participatory water management in taita hills. Kenya Prof. Geogr. **69**, 383–395 (2017). https://doi.org/10.1080/00330124.2016.1237294
31. Turunen, J.: Mapping the idea of Europe – cultural production of border imaginaries through heritage. J. Borderlands Stud. 1–20 (2021). https://doi.org/10.1080/08865655.2021.1918569
32. Crnčević, T., Manić, B., Marić, I.: Green walls of urban spaces in the context of climate change - an overview of the actual planning frameworks and experiences. Arhitektura i urbanizam **41**, 40–48 (2015). https://doi.org/10.5937/a-u0-9459
33. Clarke-Habibi, S.: Cultural and educational exchange in post-war Bosnia and Herzegovina. In: Chou, C.P., Spangler, J. (eds.) Cultural and Educational Exchanges between Rival Societies. EIS, pp. 55–78. Springer, Singapore (2018). https://doi.org/10.1007/978-981-13-1547-3_4
34. Agency for statistic of Bosnia and Herzegovina: Census 2013. 20 Jan 2022. http://www.statistika.ba/?show=12&id=30163
35. Grunewald, K., Richter, B., Meinel, G., Hendrik, H., Syrbe, R.U.: Proposal of indicators regarding the provision and accessibility of green spaces for assessing the ecosystem service "recreation in the city" in Germany. Int. J. Biodivers. Sci. Ecosystem Serv. Manag. **13**, 26–39 (2017). https://doi.org/10.1080/21513732.2017.1283361
36. Nordh, H., Olafsson, A.S.: Plans for urban green infrastructure in Scandinavia. J. Environ. Plan. Manag. **64**, 883–904 (2021). https://doi.org/10.1080/09640568.2020.1787960

Civil Engineering

Construction of Green Buildings – A Conceptual Framework for Sustainability Implementation

Nerma Smajlović Orman(✉), Irhad Mrkonja, and Hajrudin Džafo

International Burch University, 71000 Sarajevo, Bosnia and Herzegovina
nerma.smajlovic.orman@ibu.edu.ba

Abstract. The construction industry is facing increasing pressure when it comes to the impact of construction technology, the use of natural resources in the construction and maintenance of buildings after construction, as well as the sustainability of buildings. Measures introduced by leading countries and experts in the fight against the impact of harmful gas emissions on the environment also concern the construction industry, which is ordered to improve its impact on the natural environment in the future, i.e., to begin the era of the so-called green buildings, which will help slow down the global warming process on the planet. This paper will explore the existing conceptual framework for sustainability implementation in the fields of architecture and construction. The research was conducted by reviewing the relevant literature published by experts around the world who have published scientific and research papers on this topic. The objectives of this paper are to provide principles that most authors in different countries and cultures agree on when it comes to green building construction.

Keywords: Green building · Construction industry · Design principles · Sustainability

1 Introduction

A green building is a term that is used for the building which reduces or eliminates negative impacts on our environment and climate conditions, i.e., has a positive impact because improving quality of life and preserving natural resources of our environment. In a practice any building can be a green building; schools, hospitals, houses, etc., if their design follow sustainable building features [1].

One of the definitions of green building that can be found in literature describes this type of buildings as philosophical and technical foundations in construction ecology [2]. In the same book, the term "sustainable construction" is described as the most comprehensive term for all activities that are being involved in the integration of the built with the natural environment. Also, the authors compare this type of construction with the creation of a healthy built environment respecting ecologically sound principles.

The concept of sustainable development can be described as improving the quality of life that is directly connected with present and future generations, in a sense that architects according to the improvement of quality of life enable generations to live in a healthy

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 279–291, 2023.
https://doi.org/10.1007/978-3-031-17767-5_20

environment and improved social, economic, and environmental conditions [3]. Energy-efficient buildings (new constructions or renovated existing buildings) can be defined as buildings that are designed to provide a significant reduction of the energy needed for heating and cooling, independently of the energy and of the equipment that will be chosen to heat or cool the building. The Energy Performance of Buildings Directive (EPBD) requires all new buildings from 2021 on (public buildings from 2019 on) to be nearly zero-energy buildings (NZEB), which means a building that has a very high energy performance. The primary energy requirements of nearly zero-energy buildings (NZEB) vary between 0 and 160 kWh/m^2 a for residential buildings.

It is important to mark at the beginning of this paper that buildings are one of the largest consumers of energy. If energy efficiency is increased, in addition to reducing emissions, energy poverty would be solved, economic recovery would be improved, and people's vulnerability to energy prices in the market would be reduced [4].

According to NASA and the National Oceanic and Atmospheric Administration, it is announced that 2016 was the hottest year recorded ever, and how human activities have warmed the Earth in the past 50 years [5]. According to this article and the opinion of the author, a green building can contribute positively to climate change because its design considers energy, water, indoor environment quality, material selection, and location. Building operations together with building materials and construction generate nearly 40% of annual global CO_2 emissions [6].

Due to the above, the construction of the green building is more than ever the focus of interest of various authors. This paper will explore the existing conceptual framework for sustainability implementation in the fields of architecture and construction. The research was conducted by reviewing the relevant literature published by experts around the world who have published scientific and research papers on this topic. The objectives of this study are to provide environmental, economic, and social principles that most authors in different countries and cultures agree on when it comes to green building construction. Besides the mention, this paper also brings a conclusion of literature review related to the principles of right material decisions for implementing the best results in designing a green building.

2 Architectural Design and Sustainability Principles

There is a worldwide need for sustainable development, which strongly encourages the importance of hiring architects to create a good contemporary design, who will bring original design solutions to ensure exceptional architecture that respects the context in which is built while respecting the principles of sustainable development and expressing visual needs of the next generations. This type of design has to meet different design objectives, such as comfortable indoor climate, healthy environment, life-cycle costs, resource use, environmental loading, functionality, and architectural expression which must be adopted from the very early stages of the design process and must ensure close cooperation among the design team where are beside architect also other engineers included [7]. Green buildings are designed and have in aim to be constructed following the sustainability framework such as a balance between environmental, economic, and social principles [8]. Mentioned authors proposing framework based on the following:

resource conservation, cost efficiency, and design for human adaptation. The authors of this paper will adopt these three principles and make a literature review of the same.

2.1 Environmental Principles: Resource Conservation

Environment principles include a building that preserves nature and uses renewable resources for building. This means that materials that can be found locally always bring environmental benefits in a manner to helps lessen the environmental burdens, and shortens transport distances, thus reducing air pollution produced by vehicles. The most important for further conservation is the fact that local materials fit in the climatic condition of the area where they are excavated or found. Besides a positive impact on the environment, these purchases support area economies [8]. The sustainable design needs to support efforts in the relationship between soil, water, plant communities, and associations that deal with this issue by showing more respect for the landscape, but also to point out the importance of the impact of human use of these resources [9]. Environmental performance could be improved by selecting sustainable materials and by supporting products substantially [10]. Improving the environment through sustainable design and the green building must include strategies for efficient use of water, material, land, and energy [9, 10]. They are proposing methods for energy conservation such as smart choice of materials and construction methods.

Literature Review Findings. Summarizing the literature, the authors of this paper are listed in Table 1. Strategies and methods to achieve resource conservation.

Table 1. Strategies and methods to archive resource conservation – literature review findings.

Efficient use of	Methods
Materials	*Smart Waste Management* *Selection of Green Materials: durable, non-toxic, and local materials with the potential to be reused or recycled or already used or recycled materials* *Design for Pollution Prevention*
Land	*Adaptation of existing buildings to new uses: Building in an existing built environment or building in non-arable land Incorporation into nature*
Energy	*Developing an energy-efficient technological process* *Passive Energy Design: Natural heating and cooling with minimal losses and the use of alternative energy sources; Green material selection to reduce energy in production, conservation, and demolition*

Ambient and Orientation. The first written reference for building orientation and passive solar principles was by socrates about 2300 years ago [11]. Socrates wrote: "Now in houses with a south aspect, the sun's rays penetrate the porticos in winter, but in the summer the path of the sun is right over our heads and above the roof so that there is shade. If then, this is the best arrangement, we should build the south side loftier to get the winter sun and the north side lower to keep out the winter winds."

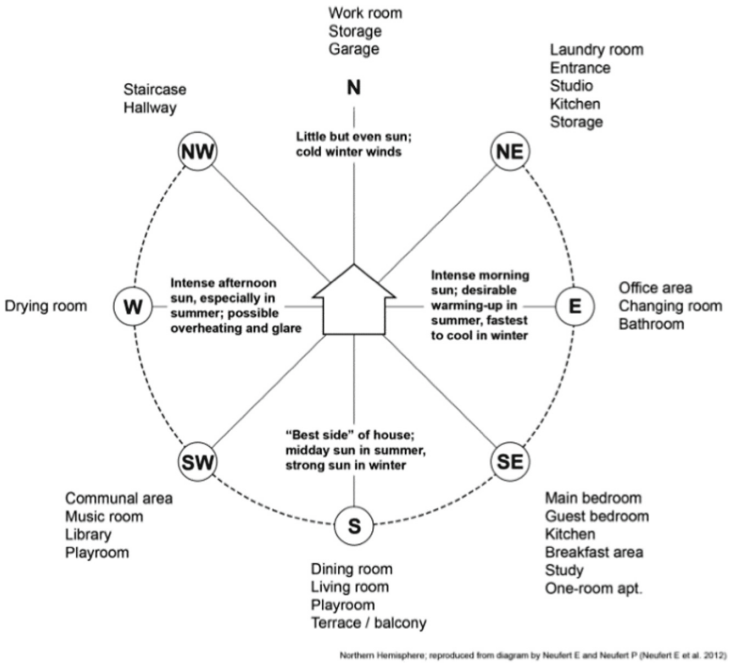

Fig. 1. Room orientation related to the movement of the sun throughout the day (Northern Hemisphere) [12].

Following the trajectory of the sun described in Fig. 1, which is important when planning the orientation of buildings and spaces within them, there are general rules that require that the south-facing rooms will have good daylight and will benefit from solar radiation throughout the year. On this side of the building, it is necessary to plant deciduous trees, which will shade and protect from the sun's rays in summer, and in winter will allow the penetration of sunlight, which will naturally heat the space. The areas in the south are very well sunny in the morning, but for energy efficiency, vertical shading must be planned to protect against overheating. When it comes to the western orientation, the same rules apply as on the eastern side of the building, except that it is about strong sun rays in the afternoon. In the northern orientation of the building, care must be taken to plant trees in front of the building, for protection from cold winds [13].

The overall energy efficiency of a building depends also on the solar orientation because it is supposed that a properly oriented building can save money by reducing 85% heating and cooling costs. Also, there is a suggestion to orientate the building on the way that the main long axis of the building, with the most glass surfaces, is East-West or rotate mentioned sides for a maximum of 20 degrees. It is important to include in the design a position of the landscape features such as trees and walls that must be in the way to make a shadow in the summer and allow the sunlight in the winter [14]. However, when it comes to the tropics, a north-south orientation is recommended as this ensures that the building takes advantage of winds that will naturally help with cooling and thus prevent excessive sunlight from the east and west causing overheating [15]. "Green"

envelopes of buildings are one of the ways to create energy-efficient buildings, i.e. to save energy and contribute to mitigating energy losses. The shade effect given by plants is the most important parameter in this case [16]. Applying green facades could make an effect on the building behavior, especially if the green façade is positioned in the right orientation. A case study based on a building block in Barcelona, Spain, has proven that the north and west green façade show lower performance than other orientations [17]. According to this study, southeast and southwest-oriented green facades reduced their energy consumption by 28%., i.e. energy cost per year could be decreased with a green façade in the southeast orientation while this decrease is 18% for the southwest orientation. Also, this study concludes that choosing the proper orientation of a green façade as a final layer on the building exterior could significantly affect the quantity of ventilation in the building which is also an important effect on the quantity of energy consumed.

Literature Review Findings. Nature has its laws whose correct interpretation helps to build buildings that are energy efficient. Each building needs to adapt to the actual conditions on the ground, neighboring facilities, and the direction of the prevailing winds. Recognizing the orientation of buildings, the ambient in which they are built, as well as the features of green facades are crucial when creating green building projects.

Reusing and Recycling Materials. The construction industry, although contributing to the overall socio-economic development of each country, is a major exploiter of non-renewable natural resources and pollutants contributing to environmental degradation through resource depletion, energy consumption, air pollution, and waste generation [18]. Yearly, around 120 million tons of waste are produced by the construction, demolition, and excavation, while only half of it is recycled or reclaimed [18].

Two principles prevail in waste reduction: first, to reduce the quality of waste generated, and second, to adopt an effective management system for unavoidable generated waste. The effective management system includes three referral options, namely ‘reuse’, ‘recycle’ or ’disposal’. The balance between the three will depend on the nature of the materials that are wasted. The cost, in turn, will depend on the availability of reusability and recyclability and the possibility of reuse on a particular project [19]. The observation of construction sites of conventional buildings showed that more attention to reuse or disposal is paid to materials that impact the budget, such as steel from metal formwork which had a recovery level of about 100%, while timber formwork had only 50% [18]. Green building design includes at the beginning plan for reducing waste, such as using less raw materials if possible. If the construction firm is responsible for the waste and if there is a possibility of making their supply chain closed, then we can expect that they will reuse those materials and remanufacture products on their own site. There is an alternative solution such as selling those secondary materials [20].

Unlike the traditional demolition, the reuse of building materials in a manner of functional components such as bricks, tiles, or windows, presents an alternative to reducing construction and demolition waste in the renovation and demolition of buildings, performing deconstruction of the building [21]. A designer must consider whether any material or component of a building can be used when it comes to deconstruction [8].

Literature Review Findings. Reusing or recycling materials must be a prerequisite when it comes to preserving the environment; the suggestion is to reuse materials or components to reduce waste and save energy for the production of materials, transportation, and the like.

Materialization: Selection of Green Materials. Materials used for green building must reduce final production costs but also reduce environmental impacts. That is the main reason for the review of materialization under environmental principles in this paper [9]. Authors in the mentioned study used sustainable assessment criteria (SAC) identified based on the sustainability triple bottom (TBL) approach but also literature review in the field of material selection in combination with the requirement of project stakeholders. They conclude, after extensive research, that there are 6 most important components in the selection of green materials, i.e materials for the construction of green buildings: environmental impact, resource efficiency, waste minimization, life cycle cost, performance capability, and social benefits.

Classification of the components important for the selection of materials for the construction of green buildings is divided into three categories, economic, environmental, and social principles, i.e points of view. Waste management, water consumption, and potential for recycling and reuse are priorities under environmental criteria, while the life expectancy of materials, meeting stakeholders' needs, and operation and maintenance costs are the most important in the economic sense. The social point of view ranked health and safety as a top priority, but local material use and labor availability followed, according to the opinion of eight experts involved in developing these conclusions [22].

When it comes to resource conservation, in addition to all the above, it is believed that improving the efficiency and effectiveness of material flow can bring economic benefits [18].

Literature Review Findings. Literature review about the selection of green materials shows that materials must be sustainable – materials with a potential to be reused or recycled as an answer to positive environmental impact, in order to reduce waste but also save energy and other resources, which directly leads to the field of cost efficiency – the economic principle of green buildings.

Technology Performance: Green Structures. There are more and more architectural examples every day of how green construction is performed, as more and more professional literature is available that describes the techniques of construction of such facilities and gives guidelines on how to maintain them. Below is a review of the literature on parts of green building and how to perform them.

Green Roofs. The forerunner of green roofs, known as man's habitat in the earliest history of architecture, were dugouts and caves covered with vegetation [23]. Green roofs of modern architecture are performed in layers where the final layer is a substrate that allows plants to grow and maintain [24]. According to the literature review [25, 26, 24], there are several types of green roofs with specific layering materials. Common to all of them are the same elements: roof slab-foundation, which can be made of concrete or steel, waterproofing and waterproofing membrane, indispensable protection from plant roots, drainage and/or aquifer, substrate, and vegetation.

Depending on the thickness of the substrate and the type of plants on the roof, green roofs can be characterized as intense or extensive. Intensive green roofs are mostly performed on flat roof surfaces and require a minimum of 20 cm of the substrate layer so that the plants have the same conditions as those on the ground. These plants can grow up to two meters in height, and smaller plants and lawns require regular watering. On the other hand, extensive green roofs do not require much care, because they are not exposed to active use, and belong to the lighter types of green roofs where the thickness of the substrate ranges from 7 to 12 cm. Therefore, old classic roofs can be adapted to this type of green roof [24].

Although it is a popular opinion that green roofs have an aesthetic role, they also have much more important functional roles, such as reducing the temperature, which is most important in cities, reducing the energy consumption of the building, and enabling recreation. In addition, green roofs retain up to 90% of rainwater and thus facilitate the sewage system [26]. Green roofs are also air purifiers, and further explain that one square meter of a green roof can purify 0.2 kg of smog dispersed in the air (exhaust gases, smoke, dust…), and in 1 year can absorb up to 5 kg CO_2. Green roofs can provide additional sound insulation and reduce noise by up to 10 dB. It is desirable to build them in areas of high noise, such as areas near airports, heavy industry, etc. Furthermore, they conclude that green roofs with a layer of vegetation, substrate, and non-combustible roof construction-concrete, reduce the possibility of spreading fire [27].

Green roofs can extend the life of a classic roof by almost double, looking at prices that are almost the same [23].

Green Walls and Green Facades. Besides the environmental impact, the green wall provides thermal insulation and establishes a consistent building temperature [28]. They can be completely covered with vegetation or just partially, as they can be outdoor and indoor [24].

For the successful realization of the green wall, it is necessary to consider the adequate position of the wall during the design, and the construction of the load-bearing structure, carefully observe the climatic conditions, and choose the appropriate plant material. [29]. When it comes to layers of green walls, they are very specific but also similar to the layers of all other green structures. They consist of plant material, substrates in the form of synthetic fibers or inorganics such as plastic, waterproofing system, various moisture protection membranes, irrigation systems, and load-bearing structures (to transfer green wall load to facade construction), and lighting that allows photosynthesis [25].

Traditional green facades are made with climbing plants that climb the walls. They are also known as one of the oldest methods of green walls. These species grow from the ground or from pre-designed pots, where the walls of the building serve as supports. What is specific about these facades is that the plants need a lot of time to cover the entire wall [24].

Living Walls – Modular Panels. As an architectural element, there is also a system of vertical gardens that are organized in pre-prepared and planted panels, known as modules with plant growth medium [24].

2.2 Economic Principles: Cost Efficiency

It is generally considered that green buildings are much more expensive than conventional buildings and that they are not worth the extra cost [30]. Several dozen building representatives and architects were contacted to compare the cost of 33 green buildings from across the United States with the cost of conventional designs for those same buildings when they realize that the average premium for these green buildings is 2% which is considerably lower than is usually perceived. The cost of a green building is mainly related to the increased time of architectural and engineering design, and modeling costs but also the time required to integrate sustainable construction practices into projects. A green building provides economic benefits that conventional buildings do not have, such as energy and water savings, reduced waste, improved indoor environmental quality, greater comfort/productivity, and lower operations and maintenance costs. Also, a green building consumes on average 30% less energy than conventional buildings, which he explained in the specific example: if the average annual energy price of buildings in Massachusetts is approximately \$2.00/ft^2 (approximately \$25.53/m^2) then the reduction for a 100,000 ft^2 (approximately 9290 m^2) state office building is \$60,000 per year. With a 20-year present value of expected energy savings at a real discount rate of 5% worth about three-quarters of a million dollars [30].

Very often new projects consider both green building and standard construction techniques, when the final decision is made based on budget, schedules but also long-term effects [31]. The benefits of green building design and construction on a manufacturing facility in Pennsylvania, comparing old and new manufacturing facilities. A new facility built on green building principles offers more advantages in daylight, air quality, and thermal comfort. Also, employees generally agreed with these conclusions, and they are more satisfied with their work area but also building itself. After measuring the impacts of the green building on the productivity, health and safety, absenteeism, and energy savings of mentioned facility and its employees, the decision to build a green building was correct and it is justified not only from the environmental point of view but also economic [31].

A comparative case study is made using two green-certified industrial manufacturing buildings and a similar-natured conventional building to establish the economic sustainability of green buildings in a sense of the life cycle cost. This study shows that the cost of building a green industrial production building is 37% higher than the cost of a conventional building of a similar nature, but when considering the costs of operation, maintenance, and end life of green buildings, savings of 28, 22 and 11% are seen. According to these calculations, in Sri Lanka where the study is done, the overall cost saving in green buildings is 21% [32].

Literature Review Findings. According to a literature review of 3 different studies, we can conclude that green building provides economic benefits in comparison with conventional buildings in the conservation of building or later maintenance costs such as energy and water savings, reduced waste, improved indoor environmental quality, greater comfort/productivity, and lower operations costs.

2.3 Social Principles: Design for Human Adaptation

After all the problems the world is facing caused by significant pollution and high levels of greenhouse gas emissions, an important pillar for the implementation of green building projects is the protection of human health and physical resources. The social pillar of green building includes improving the quality of life, ensuring social self-determination and cultural diversity as well as protecting and promoting human health through a healthy and safe working environment [9].

Observing the habits of modern society, more than 70% of modern man's time is spent inside. The role of architecture is to become a tool in improving the safety, health, physiological comfort, physiological satisfaction, and productivity of those who use the built space. Quality and comfort are often lost due to preoccupation with style and form. A sustainable product must work well, i.e., it must not allow negative effects on users and their productivity, while the importance of energy savings is unquestionable in the case of a sustainable project [10].

A sustainable industry must balance human needs with the available natural and cultural environment. This further leads to the construction of a healthy building, which does not contain hazardous materials and directly promotes health and comfort in the space where the entire life cycle is spent. The designer must plan healthy facilities that will meet the needs of social life but also increase human productivity. A few features that belong in green buildings to humans are thermal comfort, the acoustical environment, daylighting, natural ventilation, building functionality, and building aesthetics. But also, designers must eliminate any hazard in advance by making a plan for fire protection or crime prevention [9].

Thermal comfort is achieved through the synergy of parameters such as indoor air temperature, indoor surface temperature, indoor humidity, and airflow in the room. Today, there are regulations and legislation that state the exact numerical values calculated for preserving human health, and which refer to the mentioned parameters. To achieve visual comfort, it is necessary to balance the influence of lighting and adjust the values of the reflection index determined for rooms with different functions, and in addition, the importance of reflection coefficients of any surface cannot be ruled out because they are a secondary light source [33].

The undeniable facts that benefit public health are the inclusion of greenery, natural light, and visual and physical access to open spaces, not only in residential buildings but also in other buildings, because landscaping not only supports the environment and habitat of other species on the planet [34].

Literature Review Findings. Designing for a human means not only satisfying his physical and obvious needs but also the needs of his health and mental condition, which are nourished by many parameters from the environment of which the individual is generally unaware. This includes stimuli from the environment that affect thermal and acoustic comfort of space, visual and aesthetic satisfaction when using the space, as well as eliminating feelings of fear and physical insecurity caused by predictable or unpredictable hazards. The authors of this paper are listed in Table 2. Features of Design for Human.

Table 2. Features of design for human – literature review findings.

Design for human	Features
Physical needs *(Includes building functionality)*	*Shelter for living* *Space for working (office or similar)* *Space for relaxation and entertainment (malls, arenas, etc.)* *Space for religious needs*
Health and mental condition	*Thermal comfort* *Acoustic comfort* *Visual and aesthetic satisfaction* *Natural light and ventilation* *Inclusion greenery*
Safety needs	*Safe environment from different hazards:* *-Fire protection* *-Theft protection* *-Weather protection (rain, floods, storms…)* *-Static stability in case of an earthquake*

3 Discussion

Although in this paper the discussion of materials of green building is conducted within the framework of environmental principles, the essence is that materials can equally belong to economic principles as well, if their conservation is observed. Materials with the potential to be reused or recycled as an answer to positive environmental impact, will reduce waste but also save energy and other resources, which directly leads to the field of cost efficiency - the economic principle of green buildings. When it comes to the materials in a construction process, it is assumed that if the construction firm is responsible for the waste and if there is a possibility of making their supply chain closed, then we can expect that they will reuse those materials and remanufacture products in their own site. Also, selling secondary materials should become a practice for all investors and contractors.

Effective material management in the designing process must include terms such as ‘reuse’, ‘recycle’, or ‘disposal’, in order to improve the environmental impact of buildings.

Much attention among researchers has been paid to the theoretical treatment of the term green buildings, as presented in this paper. It is noticeable that less developed countries in the world consciously avoid green building because of the high costs of construction, and future researchers should expand their interest and show practical examples of economic benefits in the later use of green buildings and real opportunities and interest in green buildings in countries in development.

4 Conclusion

The need for the construction of green facilities is growing, which is shown by the devastating statistics that the construction industry makes up 40% of the total greenhouse

gases [6]. The construction of the facility itself, i.e., the construction technology, requires more and more attention everywhere. We must reduce this number, to preserve our living environment and natural resources, which are decreasing every day.

Researching literature and opinions of experts became clear that the construction of green buildings requires great attention from several different aspects, and this paper presented three comprehensive principles of green: environmental, economic, and social principles. Of course, the nature of these principles is complex and by going deeper into the issue, it became clear that it is impossible to separate any of these principles from the other, i.e., that green building can be implemented only if the synergy of these principles is complete.

Nature has its own laws whose correct interpretation helps to build buildings that are energy efficient. Green building provides economic benefits in comparison with conventional buildings in the conservation of building or later maintenance costs such as energy and water savings, reduced waste, improved indoor environmental quality, greater comfort/productivity, and lower operations costs.

This paper started a discussion about the technological performances of green structures where green facades, walls, and panels are mentioned. The recommendation for the other researchers is to continue a discussion of the impact of the green building on the habitat of plants such as moss and algae on the facades considering their position, orientation, and color of the façade.

References

1. World Green Building Council, About Green Building: What is green building?, https://www.worldgbc.org/what-green-building. Accessed 10 Jan 2022
2. Kibert, C.J., Sendzimir, J., Guy, G.B.: Construction Ecology: Nature as a Basis for Green Buildings. Spon Press, London (2002)
3. Ortiz, O., Castells, F., Sonnemann, G.: Sustainability in the construction industry: a review of recent developments based on LCA. Constr. Build. Mater. **23**, 28–39 (2009)
4. European Commision, Press corner: Revision of the Energy Performance of Buildings Directive. https://ec.europa.eu/commission/presscorner/detail/en/QANDA_21_6686. Accessed 10 Jan 2022
5. Huynh C.: Industry: how green buildings can help fight climate change, U.S. Green Building Council. https://www.usgbc.org/articles/how-green-buildings-can-help-fight-climate-change, Accessed 16 Jan 2022
6. Architecture 2030, Thought Leadership: Why the building sector?, https://architecture2030.org/why-the-building-sector/. Accessed 16 Jan 2022
7. El Demery, I.M.: Sustainable architectural design: reviving traditional design and adapting modern solutions. ArchNet-IJAR **4**(1), 99–110 (2010)
8. Akadiri, P.O., Chinyio, E.A., Olomolaiye, P.O.: Design of a sustainable building: a conceptual framework for implementing sustainability in the building sector. Buildings **2**(2), 126–152 (2012)
9. Akadiri, P.O., Olomolaiye, P.O.: Development of sustainable assessment criteria for building materials selection. Eng. Constr. Archit. Manag. **19**(6), 666–687 (2012)
10. Sev, A.: How can the construction industry contribute to sustainable development? a conceptual framework. Sustain. Develop. **17**(3), 161–173 (2009)
11. Kahn, C.H.: Philosophy before socrates. Anc. Philos. **17**(1), 159–163 (1997)

12. A New Framework for Residential Daylight Performance Evaluation - Scientific Figure on ResearchGate. https://www.researchgate.net/figure/Room-orientation-related-to-the-movement-of-the-sun-throughout-the-day-Northern_fig1_319097274. Accessed 13 Feb 2022
13. Brstina, S.: Izvođenje: Kako najbolje orijentisati prostorije u kući, Gradnja, https://www.gradnja.rs/kako-najbolje-orijentisati-prostorije-u-kuci/. Accessed 31 Jan 2022
14. EcoWho, Articles & Info: The importance of building orientation, The Original Eco Friendly & Sustainable Living Portal (EcoWho). https://www.ecowho.com/articles/6/The_importance_of_building_orientation.html. Accessed 31 Jan 2022
15. Anumah, J.J., Anumah, L.: Building orientation; enhancing nature with nature. J. Appl. Sci. Environ. Sustain. **3**(7), 29–35 (2017)
16. Pérez, G., Coma, J., Sol, S., Cabeza, L.F.: Green facade for energy savings in buildings: the influence of leaf area index and facade orientation on the shadow effect. Appl. Energy **187**, 424–437 (2017)
17. Bagheri Moghaddam, F., Fort Mir, J.M., Besné Yanguas, A., Navarro Delgado, I., Redondo Dominguez, E.: Building orientation in green facade performance and its positive effects on urban landscape case study: an urban block in barcelona. Sustainability **12**(21), 9273 (2020)
18. Kareem, W., Asa, O.A., Lawal, M.O.: Resources conservation and waste management practices in construction industry. Oman Chapter Arab. J. Bus. Manag. Rev **7**, 20–31 (2015)
19. Chun, L.P., Grosskopf, K.R., Kibert, C.J.: Sustainable construction. In: Construction Waste Management and Recycling Strategies in the United States, pp. 689–696. Center for Construction and Environment, Gainesville (1994)
20. Akdağ, H.C., Beldek, T.: Waste management in green building operations using GSCM. Int. J Sup. Chain. Mgt **6**(3), 174 (2017)
21. da Rocha, C., Sattler, M.: A discussion on the reuse of building components in Brazil: an analysis of major social, economical and legal factors. Resour. Conserv. Recycle. **54**, 104–112 (2009)
22. Al-Atesh, E.A., Rahmawati, Y., Zawawi, N.A.W.A., Utomo, C.: A decision-making model for supporting selection of green building materials. Int. J. Constr. Manag. 1–12 (2021)
23. Hopkins, G., Goodwin, C.: Living Architecture: Green Roofs and Walls. Csiro Publishing, Collingwood (2011)
24. Korasić, M.: Zelena gradnja u krajobraznoj arhitekturi (2019). https://urn.nsk.hr/urn:nbn:hr:204:643278. Accessed 09 Jan 2022
25. Baković, I.: Zeleni krovovi i vertikalni vrtovi – okosnice ekološkog dizajna i budućnost urbanog razvoja. Glasnik Zaštite Bilja **35**(4), 18–20 (2012)
26. Bass, B., Baskaran, B.: Evaluating rooftop and vertical gardens as an adaptation strategy for urban areas. National Research Council Canada (2003)
27. Wong, N.H., Tan, A.Y.K., Tan, P.Y., Chiang, K., Wong, N.C.: Acoustics evaluation of vertical greenery systems for building walls. Build. Environ. **45**(2), 411–420 (2010)
28. Pérez, G., Rincón, L., Vila, A., González, J.M., Cabeza, L.F.: Behaviour of green facades in mediterranean continental climate. Energy Convers. Manag. **52**(4), 1861–1867 (2011)
29. Jain, R., Janakiram, T.: Vertical gardening: a new concept of modern Era. In: Commercial Horticulture, pp. 527–536. New India Publishing Agency, New Delhi (2016)
30. Kats, G.H.: Green Building Costs and Financial Benefits. Massachusetts Technology Collaborative, Massachusetts (2003)
31. Ries, R., Bilec, M.M., Gokhan, N.M., Needy, K.L.: The economic benefits of green buildings: a comprehensive case study. Eng. Econ. **51**(4), 259–295 (2006)
32. Weerasinghe, A.S., Ramachandra, T.: Economic sustainability of green buildings: a comparative analysis of green vs non-green. Built Environ. Proj. Asset Manag. **8**, 528–543 (2018)
33. Oral, G., Yener, A., Bayazit, N.: Building envelope design with the objective to ensure thermal, visual and acoustic comfort conditions. Build. Environ. **39**(3), 281–287 (2004)

34. Chatterjee, A.K.: Sustainable construction and green buildings on the foundation of building ecology. Indian Concrete J. **83**(5), 27–30 (2009)
35. Akadiri, P.O., Olomolaiye, P.O., Chinyio, E.A.: Multi-criteria evaluation model for the selection of sustainable materials for building projects. Autom. Constr. **30**, 113–125 (2013)
36. Jackson, L.: The relationship of urban design to human health and condition. Landsc. Urban Plan. **64**(4), 191–200 (2003)
37. Building Green: A guide to using plants on roofs, walls and pavements, Brighton & Hove Building Green. https://brightonandhovebuildinggreen.files.wordpress.com/2017/07/johnstone-and-newton-building-green.pdf. Accessed 10 Jan 2022

Railway Corridors within Croatian Cities: Obstacles or Opportunities?

Željka Jurković, Marijana Hadzima-Nyarko(✉), and Danijela Lovoković

Faculty of Civil Engineering and Architecture Osijek, Josip Juraj Strossmayer University of Osijek, Ulica Vladimira Preloga 3, 31000 Osijek, Croatia
mhadzima@gfos.hr

Abstract. At the time of construction, the railways were located on the outskirts of the Croatian cities or away from the city limits. Cities grew, in their expansion "skipped" the railway, and the railway became a spatial and physical barrier to the connection of the city, railway corridors became intra-city traffic corridors. Consequently, the railway has generated and is generating multiple problems in the functioning of the city and the quality of life of its citizens. The basic problems in railway corridors in Croatia are spatial, traffic, environmental, technological, proprietary, financial, management, safety, and maintenance issues. The article typifies conflict spaces within railway corridors into points (individual locations), linear (along the railway line), or territorial spaces (surfaces for different purposes). The article identifies the basic problems in the railway corridors and gives a comparative analysis of the possibility of turning problems related to railway corridors into opportunities for urban development.

Keywords: Railway corridors · Croatia · Opportunities · Urban development

1 Introduction

The era of railway prosperity in Europe began in the middle of the 19th century, when the railway, as land transport, became the initiator of industrialization and transport connections. Apart from the development of transport and the economy, the railway has significantly influenced the urban development of cities. At the time of its construction, the railway corridors were away from the city limits. Cities grew, and in their expansion, they "skipped" railway lines as spatial and physical barriers and city boundaries, that is, railway corridors became intra-city traffic corridors.

The development of cities in the 21st century is primarily based on the reconstruction and conversion of existing built parts, the construction of unbuilt parts, and increasing the density. At the level of the European Union, sustainable transport planning is set out in the Urban Mobility Action Plan, adopted in 2009 [1]. Transport systems in the 21st century can no longer be planned only sectorally (technically) but multidisciplinary, integrally with the surrounding purposes in the city and with special care for environmental protection [2, 3]. In these processes, is the railway only a barrier to connecting parts of the city or the potential for the formation of the city's urban development corridor?

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 292–302, 2023.
https://doi.org/10.1007/978-3-031-17767-5_21

The structure of this paper is as follows. The first part defines railway corridors, discusses the main problems of railway corridors, and explains the need for an integrated approach to traffic planning in the city. In the second part, spatial and traffic problems within the railway corridors are systematized. The central part of the article discusses the problems and possibilities of railway corridors and provides conclusions and guidelines for further research. In a separate chapter, examples from the city of Osijek are presented, which show how problematic situations in railway corridors can be annulled and turned into locations of urban development.

2 Identification of Basic Problems in Railway Corridors in Croatian Cities

Corridors are spaces in which transport, economic and demographic processes are linearly articulated [4] and integrate infrastructure, urbanization, and economic development [5–7]. Previous research by various authors, including the authors of this article, included research on spatial and transport issues of railways in Croatian cities - railway hubs (Zagreb, Rijeka, Osijek, Vinkovci, Slavonski Brod), and how it affected the spatial development of cities [8–15]. The conclusion is that the same processes took place in Croatian cities: the railway was initially built away from the borders of the cities, cities grew, skipped railways, and the railway remained a spatial barrier to connecting parts of the city. Based on previous research, the basic problems in the railway corridors in Croatia are presented in Table 1.

Table 1. Basic problems in railway corridors in Croatia.

Basic problems	Detailed description of the Basic problems	Jurisdiction
Spatial	Barrier to connecting parts of the city The spaces of the railway corridors are not completely built or the space needs to be repurposed	State, City
Traffic	Conflict with other transport systems (road, tram)	State, City
Environmental	Noise pollution Risk of accident The perception of the space along the railway as dirty and untidy	State, County, City
Technological	Outdated technology	State
Proprietary	State property	State
Financial	Expensive management and maintenance (state aid)	State
Management	Inadequate management Generating financial losses	State
Safety	Traffic conflict points (crossings in one level)	State, County, City
Maintenance	Expensive and insufficient maintenance	State

The subject of the research is the space of railway corridors in cities that make up the railway (transport infrastructure) and the immediate environment (space of different purposes and different levels of completion) [15].

Of the listed problems in Table 1, the most comprehensive are spatial problems [15]. They are the most comprehensive because they often include several types of problems (traffic, environmental, inadequate use of space). Schematically, they can be divided into three types depending on the size and impact on the surrounding space: individual location - conflict point, linear spatial problem – linear conflict, and territorial problem.

Individual location - conflict points (Fig. 1) include traffic conflict points and conversion or renovation of individual buildings (eg. Reconstruction of existing railway buildings) for other purposes. Conflict points include intersections (hubs) with other transport systems, where the traffic flow is interrupted and traffic takes place at a reduced speed and is regulated by light and sound signals, traffic jams, or the like (Fig. 2). Intersected areas include intersections on one level where several types of traffic take place at the same. Resolving individual conflicting traffic points involves building uneven intersections, underpasses, or overpasses.

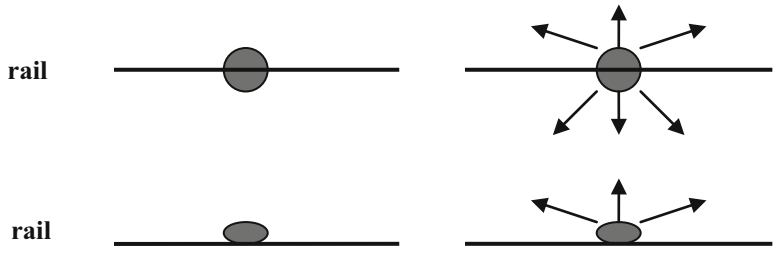

Fig. 1. Scheme of individual location - conflict point and its impact on the surrounding space.

Fig. 2. Conflict point (Osijek): interrupted traffic flow.

In linear conflict spaces (Fig. 3) belong strokes where the railway is a spatial and functional barrier to connecting parts of the city [15]. Linear spatial conflicts are the

biggest spatial, traffic, and functional obstacles to the connection of parts of the city separated by a railway (Fig. 4). Resolving linear conflict spaces implies conversion and arrangement of a part of space, change of purpose of a part of space, construction of a missing or replacement building, etc. (Fig. 5).

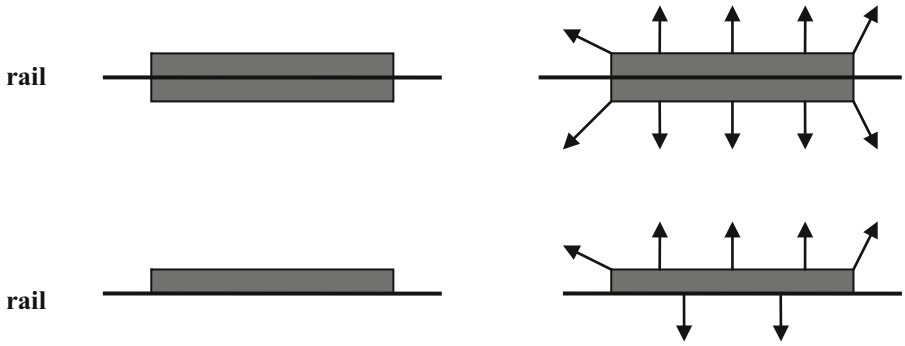

Fig. 3. Scheme of a linear spatial problem (linear conflict) and its impact on the surrounding space.

Fig. 4. Linear conflict (Osijek): parts of the city separated by a railway line.

Territorial conflict areas refer mainly to the existence of abandoned areas (zones) of former railway or industrial facilities (Fig. 6).

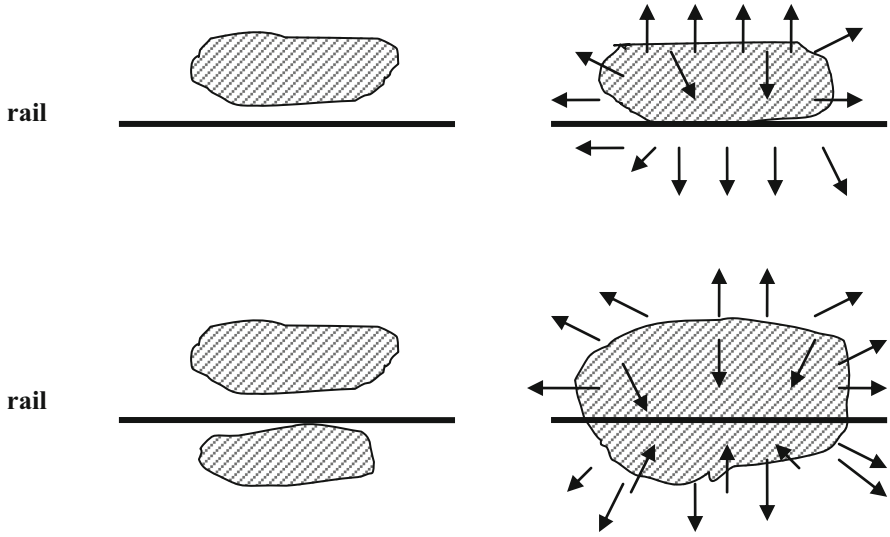

Fig. 5. Scheme of a territorial spatial problem (spatial conflict) and its impact on the surrounding space.

Fig. 6. Territorial conflict (Osijek): spatial problem.

3 Correlation of the Relationship of Problems in the Areas of Railway Corridors and Opportunities for Improvement

Corridors, whether natural (river, canal) or artificial (road, railway), throughout history spontaneously, and later planned, become the backbone of the economic and urban

development of many cities. In the 21st century, the planning of the transport system within cities is inextricably linked to spatial planning, where the precondition for sustainable development of the public transport system (railway) is the development of public intra-urban and inter-urban transport.

Arguments in favor of the corridor as a planning concept emphasize the traffic, spatial, institutional, economic, and ecological (environmental) aspects of the corridor [7, 15, 16]. Thus planned corridors can re-form the spatial structure of the city and shape the city [15, 18].

The transformation possibilities of railways and railway corridors are:

- encouraging the mobility of the population by establishing public inner-city railway and suburban railway transport (inter-city railway) and public intercity transport, which contributes to the reduction of road (motor) traffic and CO^2 emissions
- variety of possible sizes, shapes, and scales of interventions
- diversity of urban and traffic interventions within the railway corridors
- railway stations can become new points of centrality and urbanity, and form the identity and development of certain parts of the city
- along with the space of the corridor, it is possible to form a new urban landscape (cityscape), change the image of the city, or create a new identity of the city [8, 15, 18].

The transformation opportunities arise from the spatial specifics and characteristics of the space of railway corridors in the city, as presented in Table 2:

- linear or radial provision of railway corridors in the city structure, including locating in the central areas of the city
- connecting different parts of the city and the outskirts with the center
- improvements in the technological conditions of the railway, which consequently frees up these spaces for a new purpose
- the areas along the railway, from its construction until today, have never been completely urban or architecturally completed [15, 18].

Based on our previous research, in previous chapters, we presented the most important problems in the railway corridors in Croatia (Table 1.) In previous chapters, we also identified three types of major problems in the railway corridors. In Table 2. we present the correlation between the basic problems in the railway corridors and identify the opportunities that are provided to solve this problem, i.e. we suggested how to transform the problems within the railway corridors into opportunities for urban development.

Table 2. Correlation of basic problems and basic opportunities.

Basic problems →	Basic opportunities
Spatial	The railway is an infrastructure network that has spatial geometry within the city structure which can be used for multipurpose use, including its location in central urban areas The specificity of the transformation of railway corridors in relation to other types of urban transformations is in their linear or radial provision in the city structure, from the center to the edges, connecting different parts of the city, connecting the city periphery with the center The transformation of the space of railway corridors can take place in stages and polycentrically Railway stations can become new points of centrality and urbanity, and form the identity and development of certain parts of the city
Traffic	The radial or linear location of the railway within the city is the possibility to quickly connect parts of the city (by inner-city railway) Fast, safe, economically and environmentally friendly transport system High capacity rail transport system Weather-independent transport system
Environmental	The inner-city railway is an environmentally friendly means of transport for sustainable urban mobility (electromobility)
Technological	The use of EU funds is an opportunity for technological improvements (increasing the speed and safety of traffic and the purchase of new trains)
Proprietary	Involvement of private investors, granting concessions, public-private partnership
Financial	The use of EU funds and private investors Opportunity to complete the construction of undeveloped spaces within the railway corridors and investment
Management	Involvement of private investors and management
Safety	Increasing the quality of life in the city
Maintenance	The use of EU funds and private investors Involvement of private investors and management

4 Railway Corridors in Osijek: Examples of Opportunities

The traffic solution of the Osijek railway junction is determined in the valid spatial plans: The Spatial Development Plan of the City of Osijek and the General Urban Plan of Osijek. In these plans, individual interventions are planned to resolve conflict traffic points, but larger territorial interventions are also planned to relocate the freight line outside the city and build a new freight station. In the past two decades, only two interventions were built: two new pedestrian bridges (overpasses), which resolved two conflicting traffic points. The construction of two overpasses, one in the Upper Town (Fig. 7) and the other in the Lower Town (Fig. 8) can be considered a solution to the individual conflict traffic problem (railway traffic and pedestrian traffic).

Fig. 7. Pedestrian bridge at the railway station, Osijek, Croatia, architects: Branimir Kljajić and Goran Jagić, 2009.

Fig. 8. Pedestrian bridge over a railway corridor at the Sugar factory, Osijek, Croatia, architect: Assoc. Prof. Željko Koški, PhD, other authors: Prof. Zvonimir Marić, PhD, Prof. Damir Markulak, PhD, and Prof. Damir Varevac, PhD, 2005.

An example of a possible territorial change in Osijek is the dismantling of the railway towards the eastern industrial zone (Fig. 4, Fig. 9) since a new railway is planned instead, south of the city. In this way, significant areas that can be used for public purposes would be freed up (Fig. 10), as the authors of this article proposed.

Fig. 9. Railway towards the Osijek eastern industrial zone – current situation.

Fig. 10. Territorial situation after dismantling the railway towards the Osijek eastern industrial zone – one of the possible usage scenarios for public purposes.

5 Discussion and Findings

The railway is institutionally connected to the state, and to this day the solution to the railway issue is superior to the spatial or development interests of cities. In recent times, the Croatian state transport policy [19, 20] must also satisfy the interests of the EU.

The specific objectives of the transformation of railway corridors relate to ensuring the permeability of railway corridors, whereby the transport corridor space becomes the development corridor of the city and the space of mobility for city residents. Of particular importance is the new role of railway stations, which should become central places of urban planning.

The research identified the types of the most important problems in the railway corridors in Croatian cities – railway hubs and suggested how to transform the problems within the railway corridors into opportunities for urban development. A correlation between each problem has been established and given the opportunity to achieve a solution to the problem. It is in this radial and linear extension (network) through the central parts of the city that the greatest potential for the transformation of railway corridors lies and solving the spatial and traffic problems. By merging the separated parts of the city, sustainable transport and spatial development would be achieved and the quality of life in the city would be increased. In the example of the city of Osijek, examples of individual, linear and territorial problems are shown and opportunities for their transformation that would contribute to urban development are presented.

6 Conclusion

In Croatian cities, there is a possibility of quality application of corridor planning since it includes an integrated approach: simultaneous planning of the railway transport system and the surrounding area. Urban transformation of railway corridors is needed in those cities where the railway restricts the expansion or integration of parts of the city, in cities where railway traffic is relocated, and in cities where the railway is or will become a public urban transport system. Consequently, by compressing or relocating the railway, spaces for new conversion are freed up within cities. Such territorial changes are the greatest opportunity for urban development of the Croatian cities which are also railway hubs.

Railway transport as an environmentally and economically acceptable means of transport is becoming stronger, and at the inner-city level, this will impose the need to transform railway corridors by individual, linear or territorial transformations and solve basic problems within the corridors. The specificity of the transformation of railway corridors in relation to other types of urban transformations is their linear or radial provision in the city structure, from the center to the edges, connecting different parts of the city, connecting the city periphery with the center, improving railway technological conditions. The new role of railway stations in the revitalization of railway transport in the 21st century is not sufficiently emphasized and researched in the domestic professional and scientific literature dealing with issues of sustainable transport and spatial development of cities.

Further research on the concept of corridor planning as an approach to the spatial planning of 21st-century cities and research on the relationship between the railway and the shape of the city are proposed.

References

1. Sustainable Urban Mobility Plans. https://www.ubc-staiable.net/sites/www.ubcenvironment.net/files/publications/guidelines_for_developing_and_implementing_a_sump.pdf. Accessed 20 Feb 2022
2. Krasić, D., Ščukanec, A.: Transport corridor planning, Basics of traffic planning and modeling, Authorized lectures, Postgraduate specialist study Transport logistics and management, University of Zagreb, Faculty of Transport and Traffic Sciences (2007)
3. Wright, P.H., Ashford, N.J.: Transportation Engineering Planning and Design. John Wiley and Sons, New York (1989)
4. Hesse, M., Rodrigue, J.-P.: The transport geography of logistics and freight distribution. J. Transp. Geogr. **12**, 171–184 (2004)
5. Priemus, H., Zonneveld, W.: What are corridors and what are the issues? Introduction to special issue: the governance of corridors. J. Transp. Geogr. **11**, 167–177 (2003)
6. Bruinsma, F.R., Rienstra, S.A., Rietveld, P.: Economic impacts of the construction of a transport corridor; a multi-level and multi-approach case study for the construction of the A1 highway in the Netherlands. Reg. Stud. **31**, 391–402 (1997)
7. Chapman, D., Pratt, D., Larkham, P., Dickins, I.: Concept and definitions of corridors: evidence from England's Midlands. J. Transp. Geogr. **11**(3), 179–191 (2003)
8. Andrijević, S.: Analysis of the perception of space along railway tracks in zagreb, research on space. In: Proceedings of the Scientific Colloquium of the Doctoral 2005/2006, Zagreb (2006)
9. Andrijević, S., Bašić, S., Tutek, I.: Railway in the spatial plans of the city of Zagreb. Space **2**(30), 175–186 (2005)
10. Lovra, É., Obad-Šćitaroci, M., Bojanić Obad-Šćitaroci, B.: Transformations of urban structure, the role of railways in shaping urban fabric in the cities of the Austro-Hungarian Monarchy (1867–1918). Space **2**(52), 188–201 (2016)
11. Sić, M.: Paneuropski prometni koridori i razvoj Osječke regije. Croatian Geogr. Bull. **74**(2), 53–67 (2012)
12. Gorničić-Brdovački, J.: Development of railways in Croatia until 1918. In: Proceedings of the Historical Institute of the Yugoslav Academy of Sciences and Arts, Zagreb (1952)
13. Lajnert, S.: Structure of railways in Croatia from Austro-Hungary to the present day. HŽ-Croatian Railways, Zagreb (2003)
14. Kranjčević, J.: Contribution to the knowledge of urban and architectural development of Slavonski Brod 1945–1955, Contributions to the history of Brod and its surroundings, book 3. In: Živaković-Kerže, Z.: Croatian Institute of History - Branch for the History of Slavonia, Slavonski Brod, Srijem and Baranja, pp. 231–252 (2017)
15. Jurković, Ž.: Evaluation model of the transformation potential of railway corridors within cities. Ph.D. thesis, University of Zagreb, Zagreb, Croatia (2019)
16. Karlson, M., Karlsson, C.S.J., Mörtberg, U., Olofsson, B., Balfors, B.: Design and evaluation of railway corridors based on spatial ecological and geological criteria, Transportation Research Part D, 207–228. https://linkinghub.elsevier.com/retrieve/pii/S1361920915301000 (2016)
17. Witte, P.A.: The Corridor Chronicles - Integrated Perspectives on European Transport Corridor Development, Disertation. Utrecht University, Utrecht (2014)
18. Jurković, Ž, Hadzima-Nyarko, M., Lovoković, D.: Railway corridors in croatian cities as factors of sustainable spatial and cultural development. Sustainability **13**, 6928 (2021). https://doi.org/10.3390/su13126928
19. Spatial Development Strategy of the Republic of Croatia, Official Gazette 106/17 (2017)
20. Transport Development Strategy of the Republic of Croatia (2017–2030), Zagreb (2017)

Application of Compromise Programming in Evaluation of Localities for Construction of Municipal Landfill

Miljan Kovačević(✉)

Faculty of Technical Sciences, University of Pristina, Knjaza Milosa 7, 38220 Kosovska Mitrovica, Serbia
miljan.kovacevic@pr.ac.rs

Abstract. In order to consider the problem of optimization of complex systems in construction from all points of view, various considerations are needed, such as engineering, environmental, economic, spatial, climatic, and social. A larger number of participants participate in the selection of the location for the landfill, i.e. it is a matter of group decision-making. The choice of location for municipal waste disposal should be a balance between different conflict criteria. Criteria for the evaluation of municipal solid waste landfills based on the recommendations of the European Union and Directive 1999/31/EC were used. By applying compromise programming, we come to a solution that simultaneously satisfies most of the criteria, and at the same time minimizes the maximum deviation from an individual criterion, while this is not the case with simplified multi-criteria ranking.

Keywords: Multicriteria optimization · Compromise programming · Compromise solution · Municipal waste management

1 Introduction

The quantities of municipal waste produced as well as the manner in which it is disposed of can adversely affect the environment, polluting water, air, soil, and vegetation cover and pose a potential danger to public health. The choice of the location for the municipal waste landfill must be made multidisciplinary, respecting numerous criteria: economic, sociological, spatial, political, climatic, and ecological. The problem of finding the optimal location is characterized by the existence of heterogeneous and conflicting criteria. The proposed "best" solution has a great chance to be accepted as a good compromise between the various conflicting interests of many participants in decision-making if it is acceptable by the majority in the decision-making process and there are no such bad criteria for "opponents". This can be achieved by compromise programming. The paper describes in detail the procedure for implementing the Vikor method of compromise programming in the process of determining the optimal location of the municipal landfill.

The choice of location for municipal waste disposal should be a balance between different conflict criteria. On the one hand, the landfill should be located as close as

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 303–325, 2023.
https://doi.org/10.1007/978-3-031-17767-5_22

possible to the center of gravity of the space from which the waste is collected, so that transport costs are as low as possible, and on the other hand, in order to reduce possible adverse effects on the population, the landfill should be as far as possible.

European Union Directive 1999/31/EC on landfills defines minimum standards that must be respected in the planning, design, construction, operation, and monitoring of landfills [1]. In the USA, the EPA has prescribed the Criteria for Municipal Solid Waste Landfills (Municipal Solid Waste Landfill Criteria) [2, 3]. In Germany, there are so-called GDA recommendations (GDA Emphfehlung: Geotechnik der Deponien und Altlasten) [4].

In developed countries, the total amount of municipal waste is constantly increasing. In the USA, the specific amount of waste increased from 1.22 kg/inhabitant per day in 1960 to and in 2001 this value was 1.99 kg/inhabitant per day [1, 5]. This stagnation is alleviated by reaching the appropriate standard of living, but also by the rational use of goods, as well as recycling.

Based on the Directive of the European Union 1999/31/EC, the Criteria were defined, which were evaluated with a score of C = 1 to 5, and at the same time, depending on the importance of evaluating the quality of sites, they were classified into 4 weight categories with the following weight factors [1]:

$$K_1 = 5.2;\ K_2 = 3.5;\ K_3 = 2.3;\ K_4 = 1.6;$$

where the ratio $K_{i+1} = K_i / 1,5$ is valid between weight categories. The weighted sum of all criteria is equal to 100 [1].

Criteria for the evaluation of municipal waste sites are classified in order according to the specifics related to the characteristics of the site in the following way [1]:

1. Dimensional and natural characteristics of the site (Criteria listed under numbers 1–12 in Sect. 3).
2. Position or distance of the site in relation to the facilities of certain categories, visibility of the site of the municipal landfill, and ambient fit of the site of the municipal landfill (Criteria listed under numbers 13–25 in Sect. 3).
3. Traffic connections with the municipal landfill, transport distances of the site, and infrastructural equipment of the site (Criteria listed under numbers 26–32 in Sect. 3).
4. Provision of materials to be installed in the landfill (Criteria 33–35 in Sect. 3).
5. Current use of space and ownership of land (Criteria listed under numbers 36–37 in Sect. 3).

The process of site selection for a municipal landfill is dominated by methods of multicriteria analysis, primarily AHP, Prometheus, and Electra, as well as their fuzzy variants.

Norese [6] used an ELECTRE method to compare sites and rank them to select the best sites. A team made up of analysts from different organisations supported this work from a technical point of view. A group of 45 decision-makers (local authorities and representatives from the different communities that were involved) worked together with a facilitator group to identify the criteria judged relevant to analyse the consequences of the location of a plant.

Melo et al. [7] present a methodology used to assess and select areas for landfills implantation in the city of Cachoeiro de Itapemirim - ES (Espírito Santo State, Brazil), using "GIS incorporated Fuzzy AHP". The results showed that GIS was a useful and agile tool in integrating spatial information for decision-making in the assessment and selection process of areas suitable for landfill implantation.

Sener et al. defined ten different criteria (lithology, surface water, aquifer, groundwater depth, land use, elevation, slope, and distance to roads) in relation to landfill site selection. Each criterion was identified and weighted using AHP. Then, each criterion is mapped using the GIS technique, and a suitability map is prepared by overlay analyses [8].

Yildirim uses and describes a raster GIS-based landfill site selection (LSS) method. The paper discusses a method that utilizes a raster-based spatial database in which the factors affect the landfill site selection. The final product of this method is the cost surface map showing pixel-based values of the appropriate areas [9].

Balasooriya in his research used GIS analysis and semi-quantitative risk assessment and eight map layers such as surface water bodies, distance from transportation routes and urban areas, land use/land cover, soil, rainfall, population density, and elevation. ArcGIS 9.3 software and its extensions have been used as the GIS tool since it is can perform Semi-quantitative risk assessment using Multi-Criteria Evaluation (MCE) analysis [10].

Abdulaziz et al. identified 87 performance indicators (PIs) through an exhaustive review of the literature and expert knowledge. Interview surveys were conducted with decision-makers from two municipalities and academia in the Qassim Region of KSA to evaluate the indicators against three decision criteria, i.e., relevance, measurability, and understandability. The criteria weights were established through the fuzzy analytic hierarchy process (FAHP) while the linguistic scores (defined as fuzzy numbers) were aggregated using the Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE II) [11].

Sk Ajim and Ateeque use a GIS-based multi-criteria decision support approach based on a fuzzy analytic hierarchy process and geospatial technique to assess the suitability analysis for landfill site selection in Kolkata Municipal Corporation, India [12].

Mallick applies the GIS-based fuzzy-AHP method of multicriteria analysis as a method in the process of finding a suitable landfill site for Abha-Khamis-Mushyet located in the Aseer region, Saudi Arabia. Following the extensive literature review and expert opinion, 10 themes were selected for this study such as drainage density, land use/land cover (LULC), slope, elevation, lineament density, normalized difference vegetation index (NDVI), rainfall, distance from the airport, distance from the road, and geology. These themes have been developed through RS (remote sensing) and conventional data [13].

Alkaradaghi and associates propose multi-criteria decision-making (MCDM) analytical hierarchy process (AHP) methods in a model for landfill site decisions. The model assumes the input of two groups of factors that need to satisfy the optimal values of weight coefficients. These groups of constants are natural factors and artificial factors, and they included thirteen selected criteria: slope, geology, land use, urban area, villages, rivers, groundwater, slope, elevation, soil, geology, road, oil and gas, land use, archeology, and power lines. The criteria were used in the geographic information

system (GIS), which has a high capacity to process and analyze various data. In addition, multi-criteria decision-making (MCDM) methods followed by the weighted linear combination (WLC) method were used to derive criteria weightings using a matrix of pair-wise comparison [14].

2 Compromise Programming Method

Optimization problems in engineering practice are common and can relate to single-criteria and multi-criteria optimization problems. Examples of single-criteria optimization can be related to the optimization of model parameters where the aim is to create a model with, for example, the least mean square error in relation to experimental tests [15–19]. In addition, there are methods of multicriteria optimization for problems with a continuous model (methods of multicriteria mathematical programming) or it is a matter of choosing the best solution from a given finite set of alternatives (combinatorial optimization methods) [20, 21].

To determine a narrower set of solutions to the problem of multicriteria optimization in some papers, it is proposed to use the ideal point as a reference point in the space of criterion functions [22–25]. Suppose that there is an optimal solution x_i^*, i.e. f_i^*, according to the i-th criterion:

$$f_i^* = \max_{x \in X} f_i(x), \; i = 1, 2, \ldots, n. \tag{1}$$

Then the ideal solution to the problem of multicriteria decision-making can be called the vector $F^* = (f_1^*, \ldots, f_n^*)$, where n is the number of criterion functions $f_i(\mathrm{x})$, $\mathrm{i} = 1, \ldots, \mathrm{n}$.

F(x) denotes the vector criterion function $F(x) = (f_1(x), f_2(x), \ldots, f_n(x))$.

If there is a solution $x \in X$ for which $F(x^*) = F^*$, then all criterion functions have maximum values for the same solution x^*, so x^* can be adopted as the optimal solution to the multicriteria optimization problem. However, such a solution rarely belongs to the set X, so an admissible solution is sought that is "closest" to the ideal in the space of criterion functions. The solution that is closest to the ideal, based on the adopted distance measure, is called a compromise solution.

The following metrics are most often used as a measure of the distance from an ideal point [22, 23].

$$L_p\left(F^*, F\right) = \left\{ \sum\nolimits_{i=1}^{n} \left[f_i^* - f_i(x) \right]^p \right\}^{1/p}, \; 1 \le p \le \infty \tag{2}$$

This metric represents the distance between the ideal point F* and point F(x) in the space of criterion functions. In order to emphasize the dependence on the parameter p, the metric $L_P(F^*, F)$ will be denoted by $R(F(x), p)$.

The solution $x + (p) \in X$ which achieves the minimum of the function $R(F(x), p)$ is called the compromise solution of the multicriteria optimization problem with the parameter p [22, 23].

The function $R(F(x), p)$ for $p = \infty$ has the following form:

$$R(F(x), \infty) = \max_i \left[f_i^* - f_i(x) \right] \tag{3}$$

This last equation shows that compromise programming for p = ∞ reduces to a minimax problem [16, 17].

2.1 Compromise Ranking

The ranking is needed when you want to determine the order of various planned alternative solutions based on given goodness measures or criteria $f_1, f_{2,\ldots,} f_n$. This chapter discusses the multi-criteria ranking of alternatives from a given set $\{a_1, a_{2,\ldots,} a_J\}$. The method for multi-criteria ranking of alternative solutions was developed based on elements from compromise programming.

We start from the "boundary" forms of the L_p metric [22–24], which is used in compromise programming [7], for the alternative a_j.

$$S_j = \sum_{i=1}^{n} [w_i(f_i^* - f_{i,j})/(f_i^* - f_i^-)], \ (for\ p = 1), \tag{4}$$

$$R_j = \max_i [w_i(f_i^* - f_{i,j})/(f_i^* - f_i^-)], \ (for\ p = \infty). \tag{5}$$

f_{ij} – represents the value of the i-th criterion function for the alternative a_j; $f_i^* = \max_j f_{ij}$; $f_i^- = \min_j f_{ij}$; i = 1, 2, . . . , n.

Ranking with measures S_j and R_j determines the places with $s(a_j)$ and $r(a_j)$ on the ranking lists for alternatives a_j, $j = 1, \ldots,$ J. The ranking lists obtained in this way are quite different, so further procedure for determining one ranking list.

With the obtained values for the measures S_j and R_j, j = 1, . . . , J a new ranking task can be formulated in order to obtain a unified ranking list. Now the compromise ranking is done based on the new criterion functions S_j and R_j.

In the new two-criteria problem, the ideal alternative has the following values of goodness measures [22, 23]:

$$S^* = \max_j S_j \text{ and } R^* = \max_j R_j, \tag{6}$$

$$S^- = \max_j S_j \text{ and } R^- = \max_j R_j \tag{7}$$

A new ranking measure has been introduced according to [22, 23]:

$$Q_j = v_1(S_j - S^*)/(S^- - S^*) + v_2(R_j - R^*)/(R^- - R^*). \tag{8}$$

The compromise ranking method has the ability to specify the weights of decision-making strategies v_1 and v_2 ($v_2 = 1 - v_1$). In the case when it is desired to give preference to satisfy most of the criteria, without taking into account the individual criterion, $v_1 > v_2$ is given. If complete non-satisfaction of any criterion is not desired, higher values should be given for v_2.

Compromise ranking gives a ranking list according to the measure Q_j. This ranking represents a compromise between strategies: maximum group benefits (better alternatives are good according to most criteria) and minimum-maximum deviation from individual ideal values (better alternatives must not be extremely bad according to any of the criteria f_i).

2.2 VIKOR Multicriteria Compromise Ranking Method

The task of multi-criteria decision-making can be formulated as follows [22–25]:

$$\underset{a\in A}{vko} f_1(a), f(a), \ldots, f_n(a) \tag{9}$$

where is:
A – set of permissible (potential) alternatives.
a $= (x_1, x_2, \ldots)$ is an alternative obtained for certain values of system variables (x).
f_i – *i*- the criterion function.
vko – operator for multicriteria optimal solution.

The VIKOR method, presented here, was developed to determine a multicriteria optimal solution [22–25]. The proposed solution (alternative) has a great chance to be accepted as a good compromise between the different conflicting interests of the participants in the decision-making if it is:

1. acceptable by the majority in the decision-making process
2. there are no such bad criteria indicators for which the opponents would have clear reasons not to accept it.

These two conditions are covered by measures S and R in the compromise ranking because measure S determines the "best" alternative that satisfies the "majority" (sum) of criteria, while measure "R" determines the alternative that that is not "extremely bad" according to some criteria (the maximum "dissatisfaction" of the criteria is minimized).

The VIKOR method proposes as a multicriteria the best alternative (for given weights w_i) the one that is in the first position on the compromise ranking list for $\upsilon = 0.5$ according to [22–25] only if it also has:

- "sufficient advantage" over the alternative from the next position (condition U_1).
- "sufficiently firm" first position with a weight change of υ (condition U_2).

To evaluate the "advantage", the difference between the measures Q_j for $\upsilon = 0.5$. Alternative a' has a sufficient advantage over the following a'' from the ranking list if:

$$Q(a'') - Q(a') \geq DQ, \tag{10}$$

where DQ is the "priority threshold" DQ $=$ min $(0.25; 1/(J-1))$.

The first alternative on the compromise ranking list has a "strong enough" position if it meets at least one of the following conditions [22–25]:

- has the first position on the ranking list according to Q for $\upsilon = 0.25$ and $\upsilon = 0.75$,
- has the first position on the ranking list according to QS,
- has the first position on the ranking list according to QR.

3 Choice of Landfill Location by Compromise Programming – Numerical Example

Evaluation of potential sites is done through established criteria. In the following example, four hypothetical locations for municipal waste storage were evaluated in detail, and the collected data for each of these four alternatives were analyzed. The analysis refers to the criteria and data after 2009.

Hypothetical location Kosovska Mitrovica - defined location represents an alternative a_1, with the values of the criterion functions $f_{i.1}$. Hypothetical location Zvečan - defined location represents an alternative a_2, with values of criterion functions $f_{i.2}$. Hypothetical location Leposavić - defined location represents an alternative a_3, with values of criterion functions $f_{i.3}$. Hypothetical location - Zubin Potok defined location represents an alternative a_4, with values of criterion functions $f_{i.4}$. Criteria for evaluation of municipal solid waste landfill sites based on the recommendation 1999/31/EC [1]:

1. Space - available volume for waste disposal, available surface area for accommodation of landfill space and ancillary facilities, expressed by the period of meeting needs. Weight category:$\mathbf{K_2}$.

- assessment **1**. up to 5 years;
- assessment **2**. up to 10 years;
- assessment **3**. up to 15 years;
- assessment **4**. up to 20 years;
- assessment **5**. $\geq$ 25 years.

$$f_{1.1} = 2, f_{1.2} = 3, f_{1.3} = 5, f_{1.4} = 2.$$

2. Terrain relief - suitability of the terrain for landfill accommodation. Weight category: $\mathbf{K_1}$.

- assessment **1**. broken relief, very uneven terrain, especially pronounced in karst areas, non-compact (divided) spatial whole;
- assessment **2**. broken relief, uneven terrain, compact spatial whole;
- assessment **3**. non-compact (divided) spatial whole, which includes several valleys, calm terrain naturally shaped and suitable for landfill accommodation;
- assessment **4**. compact spatial unit naturally designed to accommodate a landfill on steep terrain or in a natural depression;
- assessment **5**. slightly sloping or flat terrain, naturally shaped to accommodate the landfill, possible formation of the landfill in the excavation or embankment.

$$f_{2.1} = 4, f_{2.2} = 1, f_{2.3} = 3, f_{2.4} = 2.$$

3. Geological-tectonic characteristics. Weight category: $\mathbf{K_2}$.

- assessment **1**. pronounced fault zone;
- assessment **2**. very faulty carbonate rock masses with numerous surface and underground karst forms or flat terrain;

- assessment **3**. flysch sediments, clays, marls, sandstones, etc.;
- assessment **4**. glacial sediments;
- assessment **5**. igneous rocks.

$$f_{3.1} = 4, f_{3.2} = 1, f_{3.3} = 2, f_{3.4} = 3.$$

4. Engineering-geological characteristics. Weight category: $\mathbf{K_4}$.

- assessment **1**. unbound rock masses, unstable slopes, landslides, active landslides;
- assessment **2**. complex of unbound and semi-bound rock masses, the possible occurrence of landslides when undermining the slope foot;
- assessment **3**. semi-bonded rocks, possible landslides during heavy rainfall;
- assessment **4**. bonded poorly petrified wall masses, stable slopes;
- assessment **5**. solid rocks, slopes stable and at higher angles of inclination.

$$f_{4.1} = 3, f_{4.2} = 2, f_{4.3} = 1, f_{4.4} = 2.$$

5. Hydrogeological characteristics: soil structure, layer thicknesses, water permeability. Weight category:$\mathbf{K_1}$.

- assessment **1**. rock masses of cracked cavernous porosity and high water permeability;
- assessment **2**. rocks of intergranular porosity, larger granulations (coarse-grained gravel);
- assessment **3**. rocks of lower permeability (glacial and deluvial sediments);
- assessment **4**. materials low water permeability - mostly impermeable complexes $10^{-6} > \text{k} > 10^{-9}$m/s, or high water impermeability, but small layer thickness, less than 1.0 m;
- assessment **5**. waterproof materials (clay, flysch) $\text{k} < 10^{-9}$ m/s, layer thickness $>$ 1.0 m.

$$f_{5.1} = 5, f_{5.2} = 2, f_{5.3} = 4, f_{5.4} = 3.$$

6. Landscaping. Weight category:$\mathbf{K_2}$.

- assessment **1**. very complex works on leveling the terrain, in a large percentage with blasting: the largest part of the landfill area is covered;
- assessment **2**. complex works on leveling the terrain, in some parts blasting are necessary;
- assessment **3**. leveling works on the larger part of the landfill with the use of mechanization;
- assessment **4**. leveling of the terrain is performed on a smaller part of the landfill with the use of mechanization;
- assessment **5**. simple works on leveling the terrain, covering a smaller part of the landfill area.

$$f_{6.1} = 3, f_{6.2} = 2, f_{6.3} = 4, f_{6.4} = 2.$$

7. Seismicity of MCS, with a return period of 100 years. Weight category: $\mathbf{K_3}$.

- assessment **1**. 9–8 MCS;
- assessment **2**. 7 MCS;
- assessment **3**. 6 MCS;
- assessment **4**. 5 MCS;
- assessment **5**. < 5MCS.

$$f_{7.1} = 4, f_{7.2} = 1, f_{7.3} = 3, f_{7.4} = 2.$$

8. Climatic characteristics: annual precipitation in mm. Weight category: $\mathbf{K_3}$.

- assessment **1**. >1500 mm;
- assessment **2**. 1000–1500 mm;
- assessment **3**. 600–1000 mm;
- assessment **4**. 300–600 mm;
- assessment **5**. <300 mm.

$$f_{8.1} = 4, f_{8.2} = 3, f_{8.3} = 1, f_{8.4} = 3.$$

9. Climatic characteristics: air temperature in °C (average annual). Weight category: $\mathbf{K_3}$.

- assessment **1**. <6 °C;
- assessment **2**. 6–9 °C;
- assessment **3**. 9–12 °C;
- assessment **4**. 12–15 °C;
- assessment **5**. >15 °C.

$$f_{9.1} = 3, f_{9.2} = 1, f_{9.3} = 3, f_{9.4} = 2.$$

10. Climatic characteristics: **winds**. Weight category:$\mathbf{K_2}$. .

- assessment **1**. winds of strong intensity and high frequency, prevailing direction towards settlements, roads, beaches, and other localities of residence and work of the population;
- assessment **2**. winds of lower intensity and lower frequency of the prevailing direction towards the relevant facilities;
- assessment **3**. prevailing winds of variable direction, partly directed towards relevant objects;
- assessment **4**. dominant winds in the opposite direction from settlements and other places of residence of people, winds of weak intensities in the direction of settlements;
- assessment **5**. most winds in the opposite direction from settlements and other places of human habitation.

$$f_{10.1} = 3, f_{10.2} = 2, f_{10.3} = 1, f_{10.4} = 2.$$

11. Surface waters: distance from surface streams, natural and artificial lakes, and the sea; surface waters from the immediate gravitational basin; risk of flooding, protection from adverse effects. Weight category: $\mathbf{K_2}$.

- assessment **1**. constant river flow or standing water at a distance of 500 to 1000 m, there is a risk of flooding in high water, the necessary measures to protect against these waters;
- assessment **2**. minor watercourses, permanent or intermittent (streams, torrents), there is a danger of flooding, it is necessary to relocate or channel them;
- assessment **3**. large inflow of water from precipitation from the immediate catchment area, defense against these waters requires more complex facilities; occasional flows or streams with small flows downstream from the landfill, flooding excluded;
- assessment **4**. constant currents at a distance of more than 1 km, no danger of flooding; or: inflow of water from precipitation from the immediate catchment area, defense against these waters possible with standard solutions;
- assessment **5**. great distance from watercourses, flooding excluded, a very small surface inflow of water from precipitation, possible simple protection from these waters.

$$f_{11.1} = 1, f_{11.2} = 4, f_{11.3} = 5, f_{11.4} = 2.$$

12. Groundwater: position of aquifers, depth of aquifers, the possibility of flooding of localities. Weight category: $\mathbf{K_2}$.

- assessment **1**. the aquifer is issued for a short time, at high levels of higher frequency, above the bottom of the landfill on one part of the bottom surface, and at other levels below the bottom; flooding of one part of the landfill is occasional. Periodic seasonal filling of the landfill with water from the crack environment with the possibility of capturing and evacuating that water;
- assessment **2**. the aquifer is released at high levels, which are low frequency, very rarely rises to the bottom of the landfill; wetting of the bottom of the landfill is possible;
- assessment **3**. the aquifer is located at high levels 1 to 3 m below the landfill;
- assessment **4**. the aquifer is located at high levels >3 m below the bottom of the whole landfill;
- assessment **5**. the aquifer issued does not exist.

$$f_{12.1} = 3, f_{12.2} = 2, f_{12.3} = 1, f_{12.4} = 2.$$

13. Distances to the nearest settlements of concentrated construction or residential zones of urban settlements, beaches, sports and recreation areas; the existence of natural or artificial barriers in the interspace (geomorphological formations, dense and high vegetation cover, etc.) is taken into account, as protection from winds from the direction of the landfill, or as an obstacle to the view. Weight category: $\mathbf{K_2}$.

- assessment **1**. distance 1.52 km, or 0.751 km in the presence of barriers;
- assessment **2**. 2–3 km, or 11.5 km with a barrier;

- assessment **3**. 3–4 km, or 1.52.0 with a barrier;
- assessment **4**. 4–5 km, or 2.02.5 with a barrier;
- assessment **5**. More than 5 km, or more than 2.5 km with a barrier.

$$f_{13.1} = 3, f_{13.2} = 2, f_{13.3} = 1, f_{13.4} = 2.$$

14. Distance to sacral buildings, cultural monuments, or protected natural assets. Weight category: $\mathbf{K_3}$.

- assessment **1**. Distance 1.0–1.25 km, or 0.5–0.75 km in the presence of a barrier;
- assessment **2**. 1.25–1.50 km, or 0.75–1.0 km with a barrier;
- assessment **3**.1.5–2.0 km, or 1.0–1.25 with barrier;
- assessment **4**. 2–2.5 km, or 1.25–1.5 with a barrier;
- assessment **5**. More than 2.5 km, or more than 1.5 km with a barrier.

$$f_{14.1} = 2, f_{14.2} = 4, f_{14.3} = 3, f_{14.4} = 1.$$

15. Distance from health facilities for inpatient treatment, health resorts, and facilities for food, pharmaceutical industry, and drinking water treatment plants; the existence of natural barriers in the interspace (relief, vegetation) is taken into account. Weight category: $\mathbf{K_3}$.

assessment **1**. Distance 1.0–1.25 km, or 0.5–0.75 km in the presence of a barrier;
assessment **2**. 1.25–1.50 km, or 0.75–1.0 km with a barrier;
assessment **3**. 1.5–2.0 km, or 1.0–1.25 with barrier;
assessment **4**. 2–2.5 km, or 1.25–1.5 with a barrier;
assessment **5**. more than 2.5 km, or more than 1.5 km with a barrier.

$$f_{15.1} = 3, f_{15.2} = 2, f_{15.3} = 1, f_{15.4} = 4.$$

16. Distance to individual residential, commercial, agricultural, sports, and similar facilities, which are not part of the settlement. Weight category: $\mathbf{K_3}$.

- assessment **1**. <250 m;
- assessment **2**. 500 m;
- assessment **3**. 1000 m;
- assessment **4**. 1 500 m;
- assessment **5**. >1500 m.

$$f_{16.1} = 4, f_{16.2} = 1, f_{16.3} = 5, f_{16.4} = 2.$$

17. Distance to land parcels used in agriculture and livestock, excluding land that would be covered by the landfill. Weight category: $\mathbf{K_4}$.

assessment **1**. <100 m;
assessment **2**. 100–300 m;
assessment **3**. 300–500 m;

assessment **4**. 500–1000 m;
assessment **5**. >1000 m.

$$f_{17.1} = 3, f_{17.2} = 1, f_{17.3} = 1, f_{17.4} = 2.$$

18. Line distance from 1st order roads (L1), other roads, and railways (L2), depending on whether there are natural shelters in the interspace. Weight category:$\mathbf{K_3}$.

	L1 without/with shelter		L_2 without/with shelter	
• assessment **1**.	500 m,	300 m	300 m	200 m
• assessment **2**.	600 m	400 m	400 m	250 m
• assessment **3**.	800 m	500 m	500 m	300 m
• assessment **4**.	1000 m	600 m	600 m	400 m
• assessment **5**.	> 1000 m	> 600 m	> 600 m	> 400 m

$$f_{18.1} = 3, f_{18.2} = 2, f_{18.3} = 4, f_{18.4} = 2.$$

19. Visibility of the site. Weight category. $\mathbf{K}_3$

- assessment **1**.S een from all distances and all angles;
- assessment **2**. the site is slightly sheltered;
- assessment **3**. the site is largely sheltered;
- assessment **4**. a locality can be seen from a very great distance;
- assessment **5**. it is not visible at all, except when the site itself is reached.

$$f_{19.1} = 3, f_{19.2} = 2, f_{19.3} = 1, f_{19.4} = 2.$$

20. Distance from the airport zone. Weight category: $\mathbf{K_4}$.

- assessment **1**. to 1.5 km;
- assessment **2**. 1.5 to 2 km;
- assessment **3**. 2 to 3 km;
- assessment **4**. 3 to 5 km;
- assessment **5**. Outside the airport landing zone.

$$f_{20.1} = 5, f_{20.2} = 5, f_{20.3} = 5, f_{20.4} = 5.$$

21. Distance from the main transmission line, gas pipeline, oil pipeline, pipeline for transport of drinking water (relevant position of the pipeline, if it is located downstream from the landfill). Weight category: $\mathbf{K_3}$.

- assessment **1**. <100 m;
- assessment **2**. 100–200 m;
- assessment **3**. 200– 300 m;
- assessment **4**. 300–500 m;

- assessment **5**. >500 m.

$$f_{21.1} = 4, f_{21.2} = 2, f_{21.3} = 2, f_{21.4} = 2.$$

22. Downstream distance to the boundaries of the sanitary protection zones of drinking water sources, which serve for public water supply or are potential for that purpose. Weight category: $\mathbf{K_3}$.

	(a) to the protection zone:	(b) to the wider protection zone:
• assessment **1**.	0 – 0.2 km	the landfill is on the border of the protection zone
• assessment **2**.	0,2 - 0,5 km	< 1,0 km
• assessment **3**.	0,5 - 1,0 km	1 - 2 km
• assessment **4**.	1,0 -1,5 km	2 - 3 km
• assessment **5**.	>1.5 km	> 3 km

The assessment according to the zone with a less favorable distance is authoritative.

$$f_{22.1} = 4, f_{22.2} = 2, f_{22.3} = 1, f_{22.4} = 1.$$

23. Distance from catchment facilities for individual water supply (wells, springs,). Weight category: $\mathbf{K_4}$.

- assessment **1**. 100–200 m downstream from the landfill or 100–150 m from other sides of the landfill;
- assessment **2**. up to 500 m downstream from the landfill or 150–200 m from other sides;
- assessment **3**. 500 to 1000 m downstream or 200–250 m on other sides;
- assessment **4**. 1.0–1.5 km downstream or 250–300 m from other sides;
- assessment **5**. More than 1.5 km downstream or more than 300 m on other sides.

$$f_{23.1} = 3, f_{23.2} = 1, f_{23.3} = 1, f_{23.4} = 2.$$

24. Distance from the facilities used for public water supply of the settlement (reservoirs, pumping stations, etc.). Weight category: $\mathbf{K_4}$.

Eliminator: less than 200 m.

- assessment **1**. 200–400 m;
- assessment **2**. 400–750 m;
- assessment **3**. 750–1000 m;
- assessment **4**. 1000–1500 m;
- assessment **5**. >1500 m.

$$f_{24.1} = 3, f_{24.2} = 2, f_{24.3} = 1, f_{24.4} = 1.$$

25. Ambient fitting, during operation and after the closure of the landfill. Weight category: $\mathbf{K_3}$.

- assessment **1**. grossly disturbed and completely changed natural environment during exploitation and after the closure of the landfill;
- assessment **2**. Grossly disturbed natural environment during exploitation, and partially after the closure of the landfill;
- assessment **3**. the natural environment is disturbed during exploitation, and to a lesser extent after landfill closure;
- assessment **4**. The natural environment is slightly disturbed during exploitation, and undisturbed after the closure of the landfill;
- assessment **5**. The environment was not disturbed during or after the closure of the landfill.

$$f_{25.1} = 3, f_{25.2} = 3, f_{25.3} = 1, f_{25.4} = 2.$$

26. Transport distance and height difference from the center of the space from which the waste is collected, determined according to the center of gravity of the mass of produced waste to the landfill. Weight category: $\mathbf{K_1}$.

- assessment **1**. >16 km;
- assessment **2**. 12–16 km;
- assessment **3**. 8–12 km;
- assessment **4**. 4–8 km;
- assessment **5**. <4 km.

$$f_{26.1} = 3, f_{26.2} = 1, f_{26.3} = 1, f_{26.4} = 2.$$

27. Characteristics of the road on which waste is transported, outside the area from which the waste is collected: road rank, road width, horizontal and vertical characteristics of the route (falls, curves), surface treatment and road condition, climatic conditions (snow, ice, cleaning and maintenance in winter conditions). Weight category: $\mathbf{K}_2$.

- assessment **1**. local road; width up to 4 m, with larger slopes and numerous curves, snow, and ice in winter, difficult cleaning;
- assessment **2**. local road, with smaller slopes and fewer curves, snow and ice in winter, difficult cleaning; local road as mentioned under (1), but without snow;
- assessment **3**. main road and road with higher slopes, snow and ice in winter, the road is cleaned in winter;
- assessment **4**. main road, with small slopes, snow, and ice in winter, the road is cleaned in winter;
- assessment **5**. main road, with small slopes, without snow and ice.

$$f_{27.1} = 3, f_{27.2} = 2, f_{27.3} = 5, f_{27.4} = 2.$$

28. Access road - reconstruction or construction of a new road. Weight category: $\mathbf{K_4}$.

	New road	Reconstruction of the road
• assessment **1.**	> 1000 m,	> 1500 m
• assessment **2.**	500 – 1000 m	800 – 1500 m
• assessment **3.**	200 – 500 m	300 – 800 m
• assessment **4.**	< 200 m	< 300m
• assessment **5.**	there is a road of satisfactory characteristics	

$$f_{28.1} = 2, f_{28.2} = 2, f_{28.3} = 1, f_{28.4} = 2.$$

29. Construction of special buildings on the access road (bridges, tunnels). Weight category: $\mathbf{K}_3$.

- assessment **1**. buildings of very great length in difficult conditions;
- assessment **2**. buildings of great length (approx. 15–20 m) in normal conditions;
- assessment **3**. buildings of medium length (approx. 10–15 m);
- assessment **4**. buildings of short length (up to 5–10 m);
- assessment **5**. there are no special buildings.

$$f_{29.1} = 3, f_{29.2} = 2, f_{29.3} = 1, f_{29.4} = 3.$$

30. Distance to the connection to the public electricity network. Weight category: $\mathbf{K_4}$.

- assessment **1**. >2 km;
- assessment **2**. 1–2 km;
- assessment **3**. 0.5–1 km;
- assessment **4**. 0.3–0.5 km;
- assessment **5**. <0.3 km.

$$f_{30.1} = 3, f_{30.2} = 2, f_{30.3} = 1, f_{30.4} = 2.$$

31. Water supply. Weight category: $\mathbf{K_4}$.

- assessment **1**. from a public water supply system with a connection longer than 4 km or through its own water supply system, with a supply longer than 3 km and with water intake from a natural aquifer or shorter length, if the water is provided by collecting rainwater in bistrneys;
- assessment **2**. from a public water supply system with a connection 2–4 km long or from your own water supply system with a supply up to 3 km long;
- assessment **3**. from a public water supply system with a connection 1–2 km long or from your own water supply system with a supply up to 7 km long;
- assessment **4**. from a public water supply system with a 0.5–1 km long connection or from the authorities. Plumbing with supply length up to 500 m;
- assessment **5**. from public water supply with a connection up to 500 m long.

$$f_{31.1} = 3, f_{31.2} = 1, f_{31.3} = 2, f_{31.4} = 2.$$

32. Distance to the city sewage network and the possibility of introducing a landfill filtrate into the network. Weight category: $\mathbf{K_3}$.

- assessment **1**. >2 km;
- assessment **2**. 1–2 km;
- assessment **3**. 0.5–1 km;
- assessment **4**. 0.25–0.5 km;
- assessment **5**. <0.25 km.

$$f_{32.1} = 3, f_{32.2} = 1, f_{32.3} = 1, f_{32.4} = 1.$$

33. Material for current layer and final cover layer - borrowing distance. Weight category: $\mathbf{K_2}$.

- assessment **1**. >5 km;
- assessment **2**. 2–5 km;
- assessment **3**. 1–2 km;
- assessment **4**. < 1 km;
- assessment **5**. on the spot.

$$f_{33.1} = 3, f_{33.2} = 2, f_{33.3} = 3, f_{33.4} = 2.$$

34. Mineral material for impermeable base and/or final covering layer (clay, etc.) - possibility of supply, distance. Weight category: $\mathbf{K}_1$.

- assessment **1**. >5 km;
- assessment **2**. 2–5 km;
- assessment **3**. 1–2 km;
- assessment **4**. <1 km;
- assessment **5**. on the spot.

$$f_{34.1} = 3, f_{34.2} = 2, f_{34.3} = 1, f_{34.4} = 2.$$

35. Mineral material for drainage layer (gravel, sand, gravel), distance. Weight category: $\mathbf{K_3}$.

- assessment **1**. >10 km;
- assessment **2**. 5–10 km;
- assessment **3**. 2–5 km;
- assessment **4**. 1–2 km;
- assessment **5**. <1 km.

$$f_{35.1} = 3, f_{35.2} = 1, f_{35.3} = 3, f_{35.4} = 1.$$

36. Ownership parceling of land. Weight category: $\mathbf{K}_2$.

- assessment **1**. 100% private ownership, a large number of individual plots of the small area;

- assessment **2**. 100% private ownership, larger plots;
- assessment **3**. private ownership about 75%, state ownership about 25% of the land;
- assessment **4**. Private and state ownership of about 50% of the land;
- assessment **5**. 100% state ownership.

$$f_{36.1} = 4, f_{36.2} = 2, f_{36.3} = 1, f_{36.4} = 2.$$

37. Current land use: gardens, arable land, orchards, meadows, pastures, forests, thickets, uncultivated land, individual buildings (residential, agricultural, and other purposes), etc. Weight category: $\mathbf{K}_4$.

- assessment **1**. cultivated agricultural land (gardens, arable land, orchards), individual residential and other buildings within the property, sports fields, etc.;
- assessment **2**. quality high forests;
- assessment **3**. meadows;
- assessment **4**. pastures, low forests;
- assessment **5**. uncultivated land, thickets, bare land.

$$f_{37.1} = 3, f_{37.2} = 5, f_{37.3} = 2, f_{37.4} = 5.$$

4 Results and Discussion

The search for the optimal alternative in the multicriteria sense in the planning of complex systems comes down to determining a set of good alternatives that are presented to the decision-maker. The proposed solution should be sustainable and represent a compromise between the use and degradation of resources, both in the present and in the future, and must be accepted by decision-makers whose structure is often complex. In this part of the paper, a mathematical approach is proposed for defining a compromise set of alternatives at the technical level that enables the adoption of a sustainable solution by the decision-maker.

Defining and evaluating criteria for the problem of multicriteria optimization, i.e. multicriteria ranking is most often done using the so-called Delphi method [20]. This method requires the formation of a team of relevant experts at the local or national level that will define the optimization criteria and their weighting coefficients. The procedure is most often performed by surveying in several iterations.

In this paper, the criteria and the corresponding weights are adopted based on a recommendation defined on a similar basis, but by a significantly larger group of experts at the international level, which was adopted and given as a recommendation by several European countries. The evaluation of individual criteria in this paper is treated as a classification problem, where each alternative is classified into one of the five defined classes and received a rating of one to five. The analyzed criteria can be classified into two groups: quantitative and qualitative criteria. The assessment of quantitative criteria is obtained by technical or statistical analyzes and measurements (precipitation, mean temperature, plot ownership, etc.). The assessment of qualitative criteria is done subjectively by experts (Visibility of the site, Ambient fitting, during operation and after the closure of the landfill, etc.). The paper focuses on the methodological principle of the

application of compromise programming, which, according to the author of the paper, has not been applied to the problem of determining the location of the landfill so far.

In this case, the values of the criterion functions are not expressed in the same units of measure, there are different criterion functions (heterogeneous criterion space). In order to use the metric of compromise ranking in these cases as well, a certain transformation is introduced, which is achieved by dividing by the length of the range (the length of the value interval) the criterion function. The length of the range of the i-th criterion function is $D_i = f_i^* - f_i^-$, where for each i-th criterion f_i^* corresponds to the best alternative system (or decision), and f_i^- the worst. To transform criterion functions into dimensionless functions with a range in the interval [0, 1], the following transformation (Table 1) is used here:

$$d_{ij} = T\left(f_i^* - f_{ij}\right) = \left(f_i^* - f_{ij}\right)/D_i$$

where do we get the following metric values:

$$S_j = \Sigma_{i=1}^{i=37} w_i d_{ij};$$

$$S_1 = \sum_{i=1}^{i=37} w_i d_{i1} = 0.161750;\ S_2 = \sum_{i=1}^{i=37} w_i d_{i2} = 0.717250;$$

$$S_3 = \sum_{i=1}^{i=37} w_i d_{i3} = 0.614333;\ S_4 = \sum_{i=1}^{i=37} w_i d_{i4} = 0.636833;$$

$$R_j = \max_i\left[w_i d_{ij}\right];\ R_1 = \max_i\left[w_i d_{ij}\right] = 0.035;\ R_2 = \max_i\left[w_i d_{ij}\right] = 0.052;$$

$$R_3 = \max_i\left[w_i d_{ij}\right] = 0.052;\ R_4 = \max_i\left[w_i d_{ij}\right] = 0.035;$$

The VIKOR method introduces a modified measure R_j by adding to the value obtained in the previous expression a value of the quantity r_j, which is determined based on the following relation:

$$r_j = \frac{S_j - R_j^-}{100};\ R_j^- = \max_j R_j = 0.052;$$

$$r_1 = \frac{0.161750 - 0.052}{100} = 0.001098;\ r_2 = \frac{0.717250 - 0.052}{100} = 0.006653;$$

$$r_3 = \frac{0.614333 - 0.052}{100} = 0.005623;\ r_4 = \frac{0.636833 - 0.052}{100} = 0.005848;$$

$$R_1' = 0.035 + 0.001098 = 0.036098; R_2' = 0.052000 + 0.006653 = 0.058653;$$

$$R_3' = 0.052 + 0.005623 = 0.057623; R_4' = 0.035 + 0.005848 = 0.040848;$$

To determine the compromise ranking list, the value of weight υ should be set, which should also depend on the number of criteria (n): $\upsilon = 0.5$ for $n \leq 4$, for

$5 \leq n \leq 10$, $\upsilon = 0.7$ for $n \geq 11$. However, the value of υ depends primarily on the final decision-making process: $\upsilon = 0.9$ or $\upsilon = 1.0$ can be adopted for a "majority vote".

If in the decision-making system each criterion is represented by one or more decision-makers and if each has the right to "veto", then "minimax decision-making strategies" should have more weight, and the value of υ should be $\upsilon < 0.5$, and in the case of independent decision-makers without the compensation system is proposed $\upsilon = 0$. The value of υ is set in the VIKOR software package itself ($\upsilon = 0.5$) [22–25].

In the applied analysis, the coordinates of the optimal point in relation to which we evaluate individual alternatives are determined from the best values of individual criterion functions. Some alternatives will be better than other alternatives if their distance from the optimal point is smaller. In this case, the alternatives were evaluated in terms of their optimality in terms of all criteria, but also in terms of their optimality in relation to individual criteria. The attitude towards certain criteria is important because these individual criteria can be important for one of the parties involved in decision-making, and we want to find an optimal solution that will satisfy this potential minority in decision-making. The measurement of the global optimality of an individual alternative is assessed using the QS metric, while the optimality according to individual criteria is measured by the QR metric. The optimal solution is obtained by superimposing these two metrics in the metric Q. The weights that will be assigned to each of these metrics in assessing the optimality of alternatives depend on the complexity and structure of the decision-maker. In this case, both strategies were given the same weight.

In this case, it can be seen that in terms of optimality alternative a_1 is significantly better in relation to the alternative a_4 (Table 1) in terms of individual multiplied normalized values of criteria f_2, f_5, f_{33}, where the difference compared to the first next ranked alternative a_4 by these criteria is from 0.034667 to 0.035, in terms of criteria $f_{22}, f_{26}, f_{32}, f_{34}, f_{35}.f_{36}$ is from 0.023 to 0.026, while the other criteria values of these two alternatives do not differ so much. In terms of the relationship between alternatives a_4 and a_3, it can be seen from the Fig. 1 that the alternative a_4 in terms of the QR metric is the better alternative, while in terms of the QS metric this is not the case. As the definitive metric Q for alternative a_4 is obtained by superimposing these two metrics, alternative a_4 represents a better-ranked alternative than alternative a_3, for the value $\upsilon = 0.5$. However, if the value υ is changed, the relationship between the order of alternatives would be different, and for values υ from 0 to 0.9476, alternative a_4 would be optimal, and for υ from 0.9476 to value 1, alternative a_3 would be optimal. Alternative a_2 is the worst-ranked by both criteria QR and QS.

$$S^* = 0.161750; S^- = 0.717250; R^* = 0.036098; R^- = 0.058653;$$

By analyzing the final result (Table 2), we can see that based on the QS metric, the following order of alternatives is: $a_1 \rightarrow a_3 \rightarrow a_4 \rightarrow a_2$. Based on the QR metric, the order of alternatives is as follows: $a_1 \rightarrow a_4 \rightarrow a_3 \rightarrow a_2$. The final order of alternatives based on the metric Q has the following order $a_1 \rightarrow a_4 \rightarrow a_3 \rightarrow a_2$. Based on the obtained order, we can see that by considering only group benefits, we do not get the same order as in compromise programming, which takes into account the sum of criteria,

Table 1. Values of criterion functions for individual alternatives

i	f_i	f_i^*	f_i^-	w_i	$w_i \times d_{i1}$	$w_i \times d_{i2}$	$w_i \times d_{i3}$	$w_i \times d_{i4}$
1.	f_1	5	2	0.035	0.035000	0.023333	0.000000	0.035000
2.	f_2	4	1	0.052	0.000000	0.052000	0.017333	0.034667
3.	f_3	4	1	0.035	0.000000	0.035000	0.023333	0.011667
4.	f_4	3	1	0.016	0.000000	0.008000	0.016000	0.008000
5.	f_5	5	2	0.052	0.000000	0.052000	0.017333	0.034667
6.	f_6	4	2	0.035	0.017500	0.035000	0.000000	0.035000
7	f_7	4	1	0.023	0.000000	0.023000	0.007667	0.015333
8	f_8	4	1	0.023	0.000000	0.007667	0.023000	0.007667
9	f_9	3	1	0.023	0.000000	0.023000	0.000000	0.011500
10	f_{10}	3	1	0.035	0.000000	0.017500	0.035000	0.017500
11	f_{11}	5	1	0.035	0.035000	0.008750	0.000000	0.026250
12	f_{12}	3	1	0.035	0.000000	0.017500	0.035000	0.017500
13	f_{13}	3	1	0.035	0.000000	0.017500	0.035000	0.017500
14	f_{14}	4	1	0.023	0.015333	0.000000	0.007667	0.023000
15	f_{15}	4	1	0.023	0.007667	0.015333	0.023000	0.000000
16	f_{16}	5	1	0.023	0.005750	0.023000	0.000000	0.017250
17	f_{17}	3	1	0.016	0.000000	0.016000	0.016000	0.008000
18	f_{18}	4	2	0.023	0.011500	0.023000	0.000000	0.023000
19	f_{19}	3	1	0.023	0.000000	0.011500	0.023000	0.011500
20	f_{20}	5	5	0.016	/	/	/	/
21	f_{21}	4	2	0.016	0.000000	0.016000	0.016000	0.016000
22	f_{22}	4	1	0.023	0.000000	0.015333	0.023000	0.023000
23	f_{23}	3	1	0.016	0.000000	0.016000	0.016000	0.008000
24	f_{24}	3	1	0.016	0.000000	0.008000	0.016000	0.016000
25	f_{25}	3	1	0.023	0.000000	0.000000	0.023000	0.011500
26	f_{26}	3	1	0.052	0.000000	0.052000	0.052000	0.026000
27	f_{27}	5	2	0.035	0.023333	0.035000	0.000000	0.035000
28	f_{28}	2	1	0.016	0.000000	0.000000	0.016000	0.000000
29	f_{29}	3	1	0.023	0.000000	0.011500	0.023000	0.000000
30	f_{30}	3	1	0.016	0.000000	0.008000	0.016000	0.008000
31	f_{31}	3	1	0.016	0.000000	0.016000	0.008000	0.008000
32	f_{32}	3	1	0.023	0.000000	0.023000	0.023000	0.023000
33	f_{33}	3	2	0.035	0.000000	0.035000	0.000000	0.035000
34	f_{34}	3	1	0.052	0.000000	0.026000	0.052000	0.026000
35	f_{35}	3	1	0.023	0.000000	0.023000	0.000000	0.023000
36	f_{36}	4	1	0.035	0.000000	0.023333	0.035000	0.023333
37	f_{37}	5	2	0.035	0.010667	0.000000	0.016000	0.000000

but also each individual criterion. A compromise solution is alternative number three or a_1 (Location Kosovska Mitrovica) which has the smallest measure Q. It is also the only compromise solution because it has a sufficient advantage over the next placed

Table 2. Ranking of individual alternatives using metrics of the VIKOR method

i	S_i	R_i	QS_i	QR_i	Q_i
1	0.161750	0.036098	0	0	0
2	0.717250	0.058653	1	1	1
3	0.614333	0.057623	0.814731	0.954371	0.884551
4	0.636833	0.040848	0.855236	0.210633	0.532934

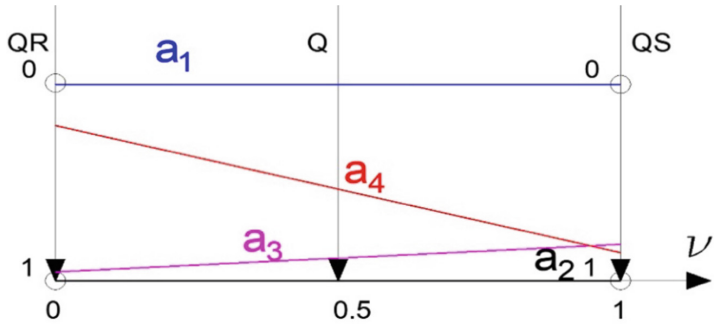

Fig. 1. Dependence of alternative position on weight υ

alternative to the condition U_1, and has a stable first position with a change weight according to condition U_2.

5 Conclusion

The choice of the location for the municipal waste landfill must be made by taking into account numerous criteria - economic, sociological, spatial, political, climatic, and ecological. The problem of finding the optimal location is characterized by the existence of heterogeneous and conflicting criteria, as well as a larger number of participants in decision-making who represent these interests. By applying compromise programming, we come up with a solution that simultaneously satisfies most of the criteria, and at the same time does not have such bad criteria indicators according to an individual criterion.

In the preliminary stages of decision-making at the technical level, the structure of the decision-maker is often unknown, and therefore the decision-making strategy in terms of defining the relationship between "majority voting" and "individual vote" is unknown. The exact relationship between these two strategies needs to be determined by a team of experts, who define the value of the weight υ.

The proposed methodology of multicriteria decision-making enables a complete and systematic solution to the problem of choosing the optimal location of the municipal waste landfill and represents support to the final decision-makers in the decision-making process. With this methodology, the potential location of the communal landfill is evaluated through several criterion functions (economic, sociological, spatial, political, climatic, ecological). Therefore, the proposed "best" solution has a great chance to be

accepted as a good compromise between the different conflicting interests of decision-makers, because it is acceptable to most participants in the decision-making process and has no such bad value in relation to individual criteria and opponents would have no reason to they reject him.

References

1. Ćorović, A.: Upravljanje komunalnim čvrstim otpadom. Biblioteka Tehničke i primijenjene nauke, Edicija Građevinarstvo, Podgorica (2008)
2. EPA 530/SW/89/072: Decision Makers guide to Solid Waste Management (1989)
3. EPA 625/6–91/031: Material Recovery Facilities for Municipal Solid Waste. Handbook (1991)
4. Stief, K.: Fachworterverzeichnis Deponietechnik, English-Deutch Deutch-English. Erich Schmidt Verlag, Berlin (2006)
5. OECD Environmental Data Compendium. Paris (2004)
6. Norese, M.F.: ELECTRE III as a support for participatory decision-making on the localisation of waste-treatment plants. Land Use Policy **23**(1), 76–85 (2006). https://doi.org/10.1016/j.landusepol.2004.08.009
7. Melo, A.L.O., Calijuri, M.L., Duarte, I.C.D., Azevedo, R.F., Lorentz, J.F.: Strategic decision analysis for selection of landfill sites. J. Surv. Eng. **132**, 83–92 (2006)
8. Sener, S., Sener, E., Karagüzel, R.: Solidwaste disposal site selection with GIS and AHP methodology: a case study in Senirkent-Uluborlu (Isparta) Basin. Turkey. Environ. Monit. Assess. **173**, 533–554 (2010). https://doi.org/10.1007/s10661-010-1403-x
9. Yildirim, V.: Application of raster-based GIS techniques in the siting of landfills in Trabzon Province, Turkey: a case study. Waste Manag. Res. **30**, 949–960 (2012)
10. Balasooriya, B.M.R.S., Vithanage, M., Nawarathna, N.J., Kawamoto, K., Zhang, M., Herath, G.B.B.: Solid waste disposal site selection for Kandy District, Sri Lanka: integrating GIS and Risk assessment. Int. J. Sci. Res. **4**, 1–6 (2014)
11. AlHumid, H.A., Haider, H., Alsaleem, S.S., Shafiquzamman, M., Sadiq, R.: Performance indicators for municipal solid waste management systems in Saudi Arabia: selection and ranking using fuzzy AHP and PROMETHEE II. Arab. J. Geosci. **12**, 1–23 (2019). https://doi.org/10.1007/s12517-019-4645-0
12. Ali, S.A., Ahmad, A.: Suitability analysis for municipal landfill site selection using fuzzy analytic hierarchy process and geospatial technique. Environ. Earth Sci. **79**(10), 1–27 (2020). https://doi.org/10.1007/s12665-020-08970-z
13. Mallick, J.: Municipal solid waste landfill site selection based on fuzzy-AHP and geoinformation techniques in Asir Region Saudi Arabia. Sustainability **13**, 15–38 (2021)
14. Alkaradaghi, K., Ali, S.S., Al-Ansari, N., Laue, J., Chabuk, A.: Landfill site selection using MCDM methods and GIS in the Sulaimaniyah Governorate. Iraq. Sustain. **11**, 4530 (2019). https://doi.org/10.3390/su11174530
15. Kovačević, M., Ivanišević, N., Dašić, T., Marković, L.: Application of artificial neural networks for hydrological modelling in Karst. Građevinar **70**, 1–10 (2018). https://doi.org/10.14256/JCE.1594.2016
16. Kovačević, M., Ivanišević, N., Petronijević, P., Despotović, V.: Construction cost estimation of reinforced and prestressed concrete bridges using machine learning. Građevinar **73**, 1–13 (2021). https://doi.org/10.14256/JCE.2738.2019
17. Kovačević, M., Lozančić, S., Nyarko, E.K., Hadzima-Nyarko, M.: Modeling of compressive strength of self-compacting rubberized concrete using machine learning. Materials **14**, 4346 (2021). https://doi.org/10.3390/ma14154346

18. Kovačević, M.: Model for forecasting and assessment of construction cost of reinforced-concrete bridges. Doctoral Dissertation, University of Belgrade, Faculty of Civil Engineering, Belgrade, Serbia (2018). https://doi.org/10.13140/RG.2.2.24025.65129
19. Kovačević, M., Bulajić, B.: Material consumption estimation in the construction of concrete road bridges using machine learning. In: Glavaš, H., Hadzima-Nyarko, M., Karakašić, M., Ademović, N., Avdaković, S. (eds.) OTO 2021. LNNS, vol. 369, pp. 324–343. Springer, Cham (2022). https://doi.org/10.1007/978-3-030-92851-3_24
20. Dutina, V., Marković, L., Knežević, M., Kovačević, M.: Izbor varijante trase puta višekriterijumskom optimizacijom. Rudarski radovi Bor **4**, 169–190 (2011)
21. Marković, L., Marković, L.M., Kovačević, M., Jovanović, J.: Višekriterijumske metode za vrednovanje i rangiranje varijantnih rešenja investicionih projekata. In: Mladenović, N., Urošević, D., Stanimirović, Z., (eds.) Proceedings of SYM-OP-IS 2015, 42nd International Symposium on Operations Research. Matematički Institut SANU (2015)
22. Opricović, S.: Optimizacija sistema. Građevinski fakultet, Beograd (1992)
23. Opricović, S.: Višekriterijumska Optimizacija Sistema u Građevinarstvu. Građevinski fakultet, Beograd (1998)
24. Opricović, S., Tzeng, G.H.: Extended VIKOR method in comparison with outranking methods. Eur. J. Oper. Res. **178**(2), 514–529 (2007)
25. Zeleny, M.: Compromise Programming Multiple Criteria Decision Making. University of South Carolina Press, Columbia (1973)

Watercourse Recovery Process - The Role and Importance of Water Monitoring

Emina Hadžić[1](✉), Ognjen Bonacci[2], Hata Milišić[1], Denis Zvizdić[3], and Nerma Lazović[1]

[1] Faculty of Civil Engineering, University of Sarajevo, Patriotske lige 30, SarajevoSarajevo, Bosnia and Herzegovina
emina_hadzic@gf.unsa.ba

[2] Faculty of Civil Engineering, Architecture and Geodesy, University of Split, Matice hrvatske 15, Split, Croatia

[3] Faculty of Architecture, University of Sarajevo, Patriotske lige 30, SarajevoSarajevo, Bosnia and Herzegovina

Abstract. Social, economic, and political development, both in the past and today, is largely linked to the availability and distribution of freshwater contained in rivers. However, very often, and especially in recent decades, rivers are brought into the context of danger to humans, either in the event of high waters or because of their increasing pollution. Human development, population growth, urbanization, and climate change, are just some of the causes that have led to a significant decline in river health globally. The importance of preserving the quality of watercourses, and preserving the amount of water, is gaining weight, especially after the realization of the lack of it for many human needs. Unfortunately, water pollution is increasing day by day. Industries and households discharge their wastewater into rivers, household waste is usually dumped directly into it, and various chemical fertilizers and pesticides, which are mostly used unplanned in agriculture, are filtered into groundwater and surface water.

Hydrotechnical facilities in the riverbed significantly change the natural water regime and the sediment transport regime, which in turn has an irreversible negative impact on aquatic ecosystems. Raising public awareness of ways, measures, and opportunities for conservation of water resources in general, with all technical and technological measures implemented in society, must inevitably be raised to a higher level. be simple.

The paper will analyze the contemporary attitude of man towards watercourses, considering the historical heritage that influenced this relationship. Special attention will be paid to passive and active measures of watercourse recovery, and recovery monitoring.

Keywords: Ecological revitalization · Monitoring · Watercourse recovery · Measures

1 Introduction

People have always inhabited river valleys and river banks. The first civilizations arose on fertile land near the Tigris and Euphrates in Mesopotamia, the Nile in Egypt, and the

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 326–341, 2023.
https://doi.org/10.1007/978-3-031-17767-5_23

Yellow River in China. Possibility of using watercourses as a waterway, more favorable climatic conditions in river valleys, favorable conditions for agricultural production, use of water potential for electricity production, in industry, use of river water for cooling thermal power plants, fishing, recreation, and water sports are just some from the reasons that attracted people to the river valleys. Rivers have always been the most important source of fresh water for man. And not only that, often rivers in their natural state, through natural retentions and backwaters were the best defense against floods, and coastal vegetation had a significant impact on the purification of water that infiltrates from watercourses underground.

Watercourses are non-stationary watercourses, with very frequent changes in water quantity and sediments over time, but they can also be with significant changes in water quality over time and space. Pollution that reaches rivers can spread very quickly and spread spatially along watercourses. Preventing river pollution and pollution is crucial, but it is neither easy nor simple to put into practice. It can be reduced, first of all, through measures of industrial and domestic wastewater treatment, through measures to replace the use of chemicals and pesticides in agriculture and the transition to organic production, or by applying good agricultural practices. The application of integrated water resources management within the catchment area, guided by the principles of sustainable development, could ensure the health of watercourses and associated ecosystems in the long run, [1].

Through practice, it has been shown that watercourses, as an integral part of nature, cannot be controlled by force, but only by understanding its natural processes. As a result of the continuous flow of energy and matter through the changing space in which they move, watercourses are extremely dynamic, open, and living systems. That is why they have played a key and hitherto insufficiently understood and studied role in the history of the planet, and especially in the development of civilization. The fact is that their indisputable great significance has not been sufficiently recognized for a long time, not only by the general public but also by experts who study watercourses and all (natural and social) phenomena related to them. The state of awareness of this interdisciplinary issue has changed significantly in recent times, and many aspects related to watercourses have begun to be studied intensively and interdisciplinary, and much more care has been taken of watercourses. Such, one might say, necessary and positive trends have occurred as a result of the fact of numerous and major catastrophes caused primarily by human interventions.

When analyzing the processes related to watercourses, one should be aware of the fact that all these aspects, but also many others, are strongly interconnected. Another problem is the fact that science has not yet sufficiently understood and explained these connections, which makes it difficult and impossible to take sustainable measures to protect watercourses and their functions, [1].

2 Ecological Revitalization of Watercourses and Its Relevance within a Theory of Sustainable Development

Ecological revitalization of watercourses refers to a variety of measures aimed at establishing the natural state and functioning of the river and the river environment. Through

the establishment of natural conditions and processes, the revitalization of watercourses is planned to create a framework for sustainable, multipurpose river use (ECRR). Technical structures such as hydropower overflows and dams, reinforced embankments to prevent erosion, construction of canals to protect against floods, pollution of water bodies with wastewater or chemicals, and extracting sediment from rivers to increase navigability are just some of the examples of human activities and their impact on rivers.

In European countries, there is hardly a single river that avoided this kind of human influence, resulting in a more or less disturbed river system. In addition to visible disturbances, there are a number of hidden effects of human activity (changes in water regime that lead to changes in characteristic natural processes in river systems, such as processes of erosion and deposition of sand and clay, annual or seasonal flooding rhythm with a high risk of damage; summer droughts, etc.).

All of this has often not been considered important in recent history or problematic but has now been identified as an important factor in reducing the natural values of water-dependent habitats and ecosystems across Europe. Along with water quality problems and possible effects of climate change, many river systems in Europe today are far from their so-called. Intact. As a result, in many cases, characteristic riverine habitats have declined rapidly in recent decades, and some have even disappeared from certain river systems. The same is true for many plant and animal species in these habitats and ecosystems. At the EU and national level, EU Member States have made some progress in recent decades on endangered river systems. Meanwhile, many states have taken steps to ensure that water quality in streams and rivers does not deteriorate further.

Improving water quality is a continuous process, which began in the 1970s with the adoption of general legislation on water quality and which resulted in an integrated approach to water quality in 2000 (entry into force Water Framework Directives). In a number of cases, the state of water quality has even improved markedly. Chemical pollution and wastewater discharge are strictly regulated and kept to a minimum. The chemical load is reduced and the oxygen levels in the water are increased. Many fish and other animal species are re-inhabiting rivers.

This is already a good result, but the current overall reduction in biodiversity suggests that much remains to be done. EU countries have agreed to implement the Water Framework Directive in order to guide the development of watercourse revitalization plans to ensure that signs of improvement continue in the coming decades. EU countries need to implement River Basin Management Plans as instruments to take action to be aimed at further improving freshwater systems in Europe. These measures will not only focus on water quality but specifically on improving the hydro morphological status of watercourses and lakes. The overall goal is to “rebuild” the system as best we can, using reference conditions for water bodies in their natural, undisturbed state.

2.1 Chronological Overview of Water Use Phases

Today there are very few watercourses in the world or only their individual sections where the natural regime has not been changed. Natural watercourses undisturbed by human interventions, in addition to being indicators of the health of the entire environment, represent places of the highest aesthetic values. In the middle of the nineteenth

century, the man began mass activities to "tame" rivers and control their natural processes. These works were especially intensified in the middle of the twentieth century when the development of technology enabled the rapid execution of the most complex construction projects. At first, everything looked ideal. Man achieved his goals by controlling nature according to his needs. It seemed as if the man was creating "paradise on earth." The short-term and selfish needs of people were primarily taken into account, without considering the needs of nature and the environment. It was only when cracks appeared in the ideally conceived process of controlling the nature of open watercourses, and this began to happen particularly intensely in the twentieth century, that man realized that much had gone in the wrong direction. Man has neglected the key role of watercourses in ecological terms [1, 2]. That role had been hinted at before, but people didn't pay enough attention to it. It was thought that possible omissions could be corrected relatively easily by additional interventions.

The human attitude towards watercourses changed over time and depended primarily on the level of technical and technological development at which man was. Rivers have been significant to man since the time of the first human communities, which used fertile floodplains around rivers for agricultural production. With the increase in water demand in arid areas, facilities for controlling and diverting river flow were built. It is believed that King Menes 3100 p.K., blocked the Nile near Memphis to protect the city from river overflow. Biswas [3] chronologically presented the engineering works of the Sumerians, Egyptians, and Harapans, who in 2500 BC, developed very strong civilizations in the Indus River Basin. This includes the establishment of the first water laws of the "codex", such as the Hammurabi Code of 1750 BC. in ancient Babylon, and about 200 BC, in China, when Emperor Yu began to control rivers in the interest of soil improvement and land reclamation.

Ways of using river waters can be observed in phases throughout history, noting that not all phases can be applied to every geographical region. Each phase of river use was associated with special requirements which, at the time of the so-called hydrotechnical civilizations, were associated with the use of large amounts of water, in a larger area. The achievements of these first so-called hydro-technical civilizations, as Wittfogel called them [4], were quite astonishing, given the lack of any theoretical knowledge and hydraulic calculations. In the period before the Industrial Revolution, watercourses were used with very few morphological changes, but with very intensive use of the surrounding land (most often deforestation), which in any case had a great impact on watercourses.

With the industrial revolution, the imperative was to use new technologies. Many industries have been located along rivers to facilitate the use of available water for a variety of purposes. During this period, river transport developed, as well as coal and other industrial materials, even before the beginning of the development of railway transport. As a consequence of the industrial revolution, the first water supply systems were established, as well as direct abstractions of river water for the needs of industry or the population. The late 1990s and the first half of the 20th century again led to more extensive use of rivers, based on the use of available technologies.

This phase can best be described by the sentence "technology can fix it", [5]. With the development of large cities come the beginnings of integrated watercourse management

at the catchment level, however, on the other hand, there is an intensive regulation of rivers, construction of dams, and other facilities to regulate the water regime, which can be considered the fifth phase. The realization of the effects of human activities on aquatic ecosystems and the environment leads to the development of the idea of sustainability in the late twentieth and early 21st century. The aim is to prevent further degradation of the river environment by applying mitigation, improvement, and restoration techniques, i.e., restoring rivers to their original state.

2.2 Human-Watercourse Relationship

The processes that take place in watercourses and their catchments are subject to constant and sudden changes due to natural and increasingly anthropogenic influences whose short-term and even more long-term consequences are difficult and often impossible to control. When human activities on rivers carry out massive interventions that significantly change the natural hydrological and/or morphological regime, there is a disturbance or even complete loss of dynamic balance. The consequences of this can be devastating. We are just witnessing many of them. The following occur: (1) More frequent and stronger floods; (2) Water quality degradation; (3) Habitat losses for fish and other animals and plants related to the river and its natural hydrological variations; (4) Complete and often irreparable devastation of the entire ecosystem of watercourses and basins, and as a consequence destabilization of economic, social and political structures and processes in these areas.

In addition to the above, the loss of aesthetic and other values of natural watercourses that can negatively affect the development of tourism, recreation, sports activities, etc. should not be neglected.

3 Basic Principles of Watercourse Recovery

The repair process gained momentum in the 1970s and 1980s. It first started in developed countries such as the US, EU countries, and Australia. However, significant progress in the application of various measures to the recovery of watercourses can also be found in developing countries. The goals of recovery should be defined by an interdisciplinary approach by decision-makers, with the consensus of interdisciplinary technical teams and other participants in social and political life. They should be the integration of two important groups of factors: (i) relating to future conditions to be achieved (ecological reference status), (ii) and arising from knowledge of social, political, and economic values in the basin or part of the basin under consideration.

The ecological state of watercourses, which is to be achieved by applying watercourse recovery measures, is often based on a commonly accepted idea of how natural watercourses once looked and functioned. Consequently, it represents an ideal state for recovery, regardless of whether this reference state can be achieved or not. This ideal situation is given by the term “potential” and can be described as the highest ecological status that an area can achieve, without political, social, or economic constraints [6]. However, the fact is that through the recovery process, the set goals usually have to be

corrected and replaced with more realistic and specific recovery goals, i.e., those that can be reached.

Namely, defining the goals of recovery must also include important political, social, and economic characteristics, and other issues, which differ from watercourses, watersheds, regions, states, and the like, and are in fact nowhere the same. When these considerations are processed into an analysis, realistic goals of a recovery project can be identified, based on the ability of watercourses to achieve a targeted ecological status. Identification of realistic goals is key to the success of watercourse recovery because it sets the framework for adaptive management within the realistic framework of expected results. Unrealistic recovery goals create unrealistic expectations. In defining realistic recovery goals, it may be useful to divide them into two separate but interrelated categories - **primary and secondary**.

The primary goals should be to identify and analyze problems/opportunities, and include a vision of the desired future situation, considering possible constraints on the success of the recovery process, and issues such as the spatial scale of recovery, specific requirements for a specific target or endangered species. Space users and the like. The primary goals are usually those that drive the whole project, such as stabilization of watercourse river slopes, sediment control, water quality protection, flood control, improvement of the condition of aquatic and terrestrial ecosystems in the considered area, and improvement of environmental characteristics. **Secondary goals** should be developed to directly or indirectly support primary recovery goals.

According to the set goals and realistic possibilities for their implementation, the recovery of watercourses is planned. In doing so, several possibilities for watercourse recovery should be distinguished: restoration, rehabilitation, and remediation (Fig. 1).

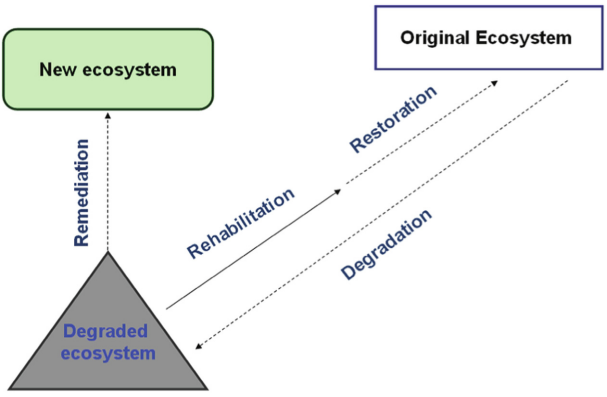

Fig. 1. Graphic representation of the difference between restoration, rehabilitation, and remediation, [7].

The first and most demanding activity, restoration, involves returning the river to its original ecological state, according to all relevant ecological parameters (flow regime, bottom substrate, indigenous aquatic and coastal ecosystems, environmental conditions), [8] According to Wade et al. [9], the restoration is aimed at the reconstruction and return of the intact physical, chemical and biological state of the watercourse. In its purest sense, it means a complete structural and functional return to the state before the disorder.

Since in a number of cases this task is not realistic, rehabilitation is resorted to. Rehabilitation is usually a realistic and achievable activity and includes works and measures that significantly improve the ecological conditions in the river and bring it closer to the former balanced ecological conditions. It is a very complex, long-lasting, and expensive activity, but it is increasingly treated as inevitable, in order to avoid negative environmental, social, and even political consequences. However, already performed rehabilitation works in a number of metropolises around the world show that such works have economic and developmental significance, while sociological and political significance is undoubted, [8]. Rehabilitation indicates a process that can be defined as a partial functional and/or structural return to a former or pre-degradation state, especially in terms of environmental conditions. In conclusion, rehabilitation measures relate only to changes in some elements within the degraded water system but still aim to return the ecosystem closer to its original state.

If the level of degradation of the river ecosystem is so great that the rehabilitation of the system is not feasible, remediation should be approached. Remediation implies such an improvement of ecological conditions, that the river system is translated into a new ecosystem, in another space of ecological conditions, but with a much better status than the anthropogenically degraded river system. The remediation process often has to be done on rivers that are in urban conditions, when a radically canalized and ecologically destroyed and dead river need to be made attractive to people again, which beautifies the city and enriches it, but with some other ecological conditions compared to the original, [8].

3.1 Watercourse Recovery Measures

New approaches and solutions seek to accelerate positive natural processes and the use of artificial interventions in a way that functions as natural. In this sense, two significantly different approaches and the corresponding methods of recovery of open watercourses have been crystallized, called: (1) Passive measures; (2) Active measures.

Passive measures include recovery approaches and methods that seek to stimulate processes in the watercourse that will themselves help its recovery. These are interventions that make small changes in the watercourse and which are therefore slower. These include environmental engineering.

Active measures include approaches and methods of restoration that are mostly classical engineering but that carefully take into account the environmental effects. The simplest example of the difference between passive and active watercourse recovery measures can be given by showing the different protections of the banks of open watercourses. Passive measures include any kind of encouragement of the growth of natural vegetation, while active measures include the installation of stone embankments, the construction of coastal fortifications, the installation of geotextiles, or other types of artificial protection. In practice, passive and active measures are often combined and such approaches often give the best results.

Passive Watercourse Recovery Measures.
Passive measures are divided into the following two groups: (1) Restoration of natural flora and fauna; (2) Removal of unnatural species. Gordon et al. [10], believe that the biggest disadvantage of passive measures lies in the fact that in this way the open watercourse is slowly restored, and the processes last between 10 and 100 years, which is often unacceptable for practical reasons. They advocate the application of the principle of eliminating sources that create problems, control of the spread of harmful plant and animal species, and the application of preventive measures. As a very educational example, Erskine and Webb [11], report on the negative consequences of open water management measures in southeastern Australia, which were applied in the period from 1886 to 1995. It was a mass felling of coastal vegetation and cleaning of leafy and wood waste from riverbeds and shores. These measures were implemented in accordance with applicable laws and were funded by the state.

The consequences they have caused are many times negative. Increased water flow velocities have caused a strong deepening of the riverbed, destabilizing the shores, widening the open watercourses, and massive loss of fish habitats. These negative consequences have indicated the need to implement different measures that will take joint care of land and water resources management, in order to protect the environment, and in particular to support biodiversity. Erskine and Webb [11], therefore propose that the introduction of massive leafy and wood waste into riverbeds and shores be introduced as a measure to rebuild open watercourses in South East Australia. The basic problem for the efficient execution of this task is the lack of sources of the mentioned waste. If this work were left to nature itself, i.e., if only passive measures were strictly applied, they estimate that the restoration process would take more than 100 years.

Coastal vegetation has a multiple role in the ecosystem of open watercourses. It helps stabilize shores, regulate nutrients, filter sediment, create shade, represents areas where birds nest, and also serves as a hiding place for larger animals. The vegetation cover has a mitigating effect on the water temperature in open watercourses. It prevents it from warming up in summer and reduces cooling in winter, [10]. Measurements have shown that coastal ice is formed on sections of watercourses that are not covered by vegetation and that watercourses that do not have coastal vegetation dry out longer and more often than watercourses along whose shores dense vegetation grows. Coastal vegetation seems to influence the open watercourse to act as an accumulation, i.e., to retain runoff and slowly release it downstream.

The biggest advantage of vegetation over artificial engineering materials such as steel and concrete is the possession of self-regenerating properties. Thanks to this property, coastal vegetation recovers very quickly, within a few years, after decay caused by natural or anthropogenic factors. It is a process that costs nothing and can be supported and accelerated by human-led measures.

The new trend of open watercourse management is aimed at supporting a stable and self-sustaining natural vegetation cover. It is recommended to use domestic species, wherever possible. Of particular importance is the role of vegetation as a habitat and shelter for wildlife, birds, fish, invertebrates, etc. Vegetation must be carefully selected, considering the speed and properties of its growth, its shape and aesthetic values, its endangerment, etc. planning the process of vegetation restoration along watercourses, special attention must be paid to different sections of watercourses, but also to different cross-sectional zones related to hydrological and hydraulic properties of water flow. Cultivation of exotic plant species is not recommended. When artificially growing coastal vegetation, care should be taken not to use measures and procedures that could harm other parts of the ecosystem. This primarily refers to the application of herbicides and fertilizers that can harm other plant and animal species.

As a frequent passive measure, artificial reed cultivation is carried out, which aims to increase the value of habitats by increasing nutrient production, creating protection for fish and shadows on the water face. If the reed is grown in slow-flowing zones on the inner sides of the curves, in parts of the riverbed that are sinusoidal, the reed will act as a deflector, i.e., it will divert water. It will affect the narrowing of the riverbed in low waters, locally increase flow rates creating natural meanders and other diverse forms of bottom suitable as habitats for fish development in different parts of their life cycle. Reeds will help stop fine sediments at the edges of the riverbed, thus reducing the need to clean them. Reeds cannot survive in water deeper than 50 cm for a long period of time. Its development requires water speeds of less than 0.2 m/s because higher speeds can erode its root system. In the case when the watercourse has steep banks, and it is desired to grow reeds on them, it is necessary to reshape them, i.e., to soften them.

A special problem with the cultivation of coastal vegetation occurs because it can increase the risk of floods, which should be taken into account, not only for technical but also for some other reasons. Also, care should be taken that dense vegetation, even in the coastal area during dry periods, can be endangered by forest fires. In order to reduce the risk of fire, it is necessary to take the same measures of cultivation and cleaning of coastal vegetation as in the continental forests. The health of the coastal ecosystem depends not only on a plant but also on animal species that live in that area. There are ways to speed up the process of restoring animal species in the coastal area. To perform this task, it is necessary to know the usual or optimal density of individuals of a particular animal species in an area.

Re-colonization of invertebrates is the fastest, provided that there is a favorable substrate in the space with enough nutrients. For some species whose migration abilities are limited, larval sowing procedures have been developed. There are numerous and rich experiences with the restocking of watercourses, which have pointed out the importance of rivalry between species and the important role of predatory fish in the ecosystem of open watercourses. Gordon et al. [10], believe that a number of realistic options should be assessed in the planning phase of water management projects. Criteria for choosing the best must be found considering the price, efficiency, and environmental impact. The use of passive measures reduces the need for later work on system rehabilitation. Planning must be linked to different space valuations.

Some less, valuable ones, such as car parks and gardens, can be used as retentions during floods, while others need to be protected by expensive and safe measures. In watercourses where large-scale regulatory works are inevitably carried out in order to protect against floods and ensure the navigation, measures should be taken to mitigate the negative effects on the environment as much as possible. In this sense, passive measures have proven to be more effective, long-lasting, and cheaper than active ones. The main disadvantage in relation to active measures is their slowness. Therefore, engineers, but also politicians are more inclined to take active measures because they give the impression that something significant and safe has been done and that the problem is definitely solved.

Compared to passive measures, active measures to rehabilitate open watercourses are more direct, but also often more expensive. The purpose of changing the shape of the open watercourses and the construction of buildings in the riverbed is to restore the number and diversity of physical habitats, which were degraded by previous works. Meanders, lakes, furrows, islands, false riverbeds, coastal vegetation, fish shelters, diverters, etc. contribute to biodiversity by creating numerous and diverse physical habitats in open watercourses, increasing water turbulence in places and reducing their speed in places, creating sections of eroding riverbeds and parts where sediment and nutrients are deposited, shading shaded and sunny areas of watercourses, etc.

4 Recovery Monitoring

Successful recovery of watercourses is almost impossible without well-planned and performed monitoring. The process of collecting qualitative or quantitative data, using predetermined indicators of process progress, is monitoring recovery. It is important to note that monitoring should be planned at the time of preparation of the recovery project when it should actually begin with it. As the effects of the implemented measures, on the selected section of the watercourse or catchment, are measurable even in the years after the performed activities, the recovery process is not considered completed after the recovery project has been performed.

Monitoring during the implementation phase of the recovery process provides all necessary information on the course of the recovery process and is performed primarily to ensure proper implementation of recovery plans, while actual monitoring of the successful recovery plan is performed later, after the implementation of the planned recovery activities. In this sense, the monitoring carried out after the activities carried out on the recovery of watercourses is extremely important, in order to assess the effectiveness of the implemented measures. Hadžić & Bonacci [1], believe that monitoring can provide invaluable knowledge that will lead to improved recovery practices, including identifying approaches that have not been successful and why.

The key activities that continuously monitor the monitoring process, and which need to be undertaken to ensure the successful recovery of watercourses, *in addition to monitoring, are the process of evaluation and adaptive management*. These activities are carried out at different levels, depending on the size and scope of the recovery project. Each recovery project is specific due to the diversity of the watercourse itself, due to different recovery objectives, and therefore there is no single template that would indicate which approach to developing a monitoring plan or which approach to the evaluation should be applied. They must be developed together with the watercourse recovery project, considering the physical, environmental, and socio-economic specifics.

The evaluation describes a process in which, based on the analysis of monitoring data, recovery progress is assessed and adaptive management options are considered. Adaptive management also reflects the need for flexibility in meeting/failing to meet set goals or their continuous adjustment, and in relation to the results achieved, through monitoring and evaluation. It is formally described in the literature as a structured, iterative decision-making process, with the aim of reducing the uncertainty of recovery success, certainly with the help of continuous monitoring, [6].

Although monitoring and evaluation of watercourse recovery and adaptive management are common in science, practice, and business, they are most often not adequately planned through watercourse recovery and are ultimately implemented inadequately. Thus, for example, there are very few documented examples of good adaptive management in recovery projects. The costs associated with the poorly designed recovery and monitoring programs are significant, both in terms of potentially negative impacts on the ecosystem and society, and in terms of the once unnecessary loss of financial resources.

4.1 The Role of Monitoring in the Recovery Process

As already pointed out, as part of the process of recovery of watercourses, monitoring is performed before and after the implementation of recovery measures, and certainly during their implementation. Each of the mentioned types of monitoring is equally important for achieving success in the recovery process, and for gaining new knowledge in order to improve existing approaches, but also the results of recovery. Monitoring should provide all the necessary information on the course of the recovery process. Evaluation of the recovery process as well as adaptive management are directly related to monitoring. Using the information obtained from the evaluation of the monitoring process, it is possible to assess the effectiveness of the steps taken in the recovery process, i.e., implemented measures and activities, in order to achieve the goals and objectives of recovery and to avoid future mistakes.

Even with the best recovery projects and their implementation, monitoring will often result in the identification of some unforeseen problems and require corrections either during or immediately after the implementation of certain measures, [7]. Thus, most of the measures and activities carried out in the process of recovery of watercourses, require some supervision of the implementation of activities through monitoring, while adaptive management. Namely, very often, due to different outcomes in relation to the planned outcomes of the recovery process, it is necessary to make management decisions regarding the continuation of the recovery process, but in the light of new knowledge. Due to the complexity and variability of watercourses, recovery measures can generally be viewed as experiments, most often with an uncertain outcome. Since each watercourse is specific, so is each recovery project or program, and therefore the monitoring plan is completely specific.

A good monitoring plan should strive to be accessible, adaptable, transparent, interdisciplinary, scientifically reliable, responsible, and realistic. Among other things, they should (yes) answer a number of questions, including the choice of parameters to be monitored, how this monitoring is carried out, who is responsible for undertaking monitoring, how often measurements need to be carried out, and in what period, as well as a number of others. Issues which will be discussed in more detail below. Developing an effective monitoring plan requires consideration of many issues, including those related to scientific, logistical, and financial aspects, as well as the specific objectives of watercourse recovery. Also, a good monitoring plan will enable continuous monitoring in achieving the recovery goals and will enable the improvement of planned measures and activities if the results of monitoring and evaluation show it.

According to the FISRWG [12], the monitoring plan should provide answers to important and specific questions related to the recovery of watercourses:

1. What was the condition of the watercourse at the beginning of the recovery process (so-called baseline monitoring)?
2. Has the recovery been done entirely according to the project (so-called monitoring of activities or implementation of recovery activities)?
3. Are the recovery costs well planned or are the planned amounts exceeded (so-called financial monitoring or monitoring costs)?
4. Were they performed river repair activities successful in terms of meeting realistic project objectives (e.g., restoration of ecosystem functions and services and consequent environmental or socio-economic outcomes, in relation to the stated project objectives) (so-called monitoring of achievement of objectives)?
5. What else is happening in the watercourse that was not known at the beginning of the recovery process planning (so-called supervisory monitoring)?

In Table 1. The development of a monitoring plan as part of the watercourse recovery process is presented.

Table 1. Development of a monitoring plan, according to The Federal Interagency Stream Restoration Working Group-FISRWG, [12].

A. Planning		B. Implementation and management	C. Responsibility for monitoring results
Step 1	**Defining goals and tasks of watercourse recovery**	▪ Existence of a vision for the duration of the monitoring plan ▪ Roles and responsibilities must be clearly defined ▪ Quality assessment procedures must be adopted ▪ Clear interpretation of results	▪ No action
Step 2	**Development of a conceptual model**		▪ Maintenance
Step 3	**Selection of criteria for performance evaluation:**		▪ Add, abandon, or modify plan elements
	▪ Relationship between performance and goals		▪ Modification of project objectives
	▪ Criteria development		▪ Adaptive control
	▪ Determining reference locations	▪ Data management ▪ Providing contacts	▪ Documentation and reporting ▪ Dissemination of results
Step 4	**Selection of parameters and monitoring methods:**		
	▪ Selection of efficient parameters and monitoring methods ▪ Overview of activities within the catchment area		
	▪ Selection of methods and techniques required for testing and sampling		
	▪ Conducting sociological research		
	▪ Reliance on "instream" organisms to evaluate the success of projects		
	▪ Minimize unnecessary measurements ▪ Insert subsequent parameters		
Step 5	**Cost estimate:**		
	▪ Costs of the monitoring plan itself		
	▪ Quality assurance ▪ Data management		
	▪ Field research ▪ Laboratory research		
	▪ Data analysis and interpretation report preparation		
	▪ Presentation of results		
Step 6	**Categorization of data types**		
Step 7	**Determining the level and duration of monitoring:**		
	▪ Involvement of landscape ecology ▪ Determination of sampling time, frequency, and duration ▪ Development of a statistical framework for data analysis ▪ Sampling level selection		

5 Concluding Remarks

Experiences gained through implemented watercourse recovery projects have shown that insufficient attention has been paid to monitoring and evaluation of ecological and ecosystem indicators of watercourse recovery. Although progress in the implementation of monitoring has generally been observed in the last decade, it can be concluded that there has been no progress in monitoring and evaluating the socio-economic performance indicators of the already implemented recovery measures.

Obstacles to effective monitoring and evaluation are, according to Speed et al. [7], most often occur as a consequence of:

(i) Insufficiently defined, unclear and immeasurable goals to be achieved by recovery, and thus inadequate recovery projects.

(ii) Ignorance of the river system as a whole, its complexity, and inability to accurately predict the consequences, which makes it difficult to distinguish the results of applied recovery measures from changes in river systems. Morandi et al. [13], argue that for many projects, monitoring and evaluation have been more affected by the nature and severity of the recovery institution than by actual changes due to the application of recovery measures.

(iii) Lack of technical and scientific pragmatism in defining appropriate indicators and measurements, and collecting insufficiently clear, comprehensive, and valid data. Namely, Ayres et al. [15], believe that very often recovery monitoring provides a wealth of useful but also unusable information on ecosystem services.

Even when considering the impact of recovery on the ecological status of watercourses, monitoring generally focuses on physical changes in biotopes or biocenoses, not considering the impact on the wider area and even the entire basin, as well as the impact on watercourse health. Monitoring results are thus limited to individual projects or case studies, which do not necessarily reflect a wider basin or region. Moreover, monitoring different physical, biological, and socioeconomic variables can provide conflicting results, which call into question the success of the recovery process.

(iv) The need to monitor recovery outcomes at various time intervals, including monitoring before and after recovery activities. Feld et al. 15], believe that, in order to understand the function of aquatic ecosystems, monitoring should begin, not one year as was the practice, but several years before the start of watercourse recovery activities. According to Morandi et al. [13], post-recovery monitoring is rarely extended by more than 10 years, which can often be insufficient. It is also worth mentioning that monitoring the results of the recovery process should be monitored in the long term, as most monitoring ends after a few years, which according to Feld et al. [14], considers insufficient.

(v) Lack of money for monitoring and evaluation. Namely, it is certain that insufficient attention is paid to the planning of financial resources for monitoring and evaluation during the recovery process of watercourses, especially when it comes to smaller projects.

The lack of monitoring makes it difficult, not only to assess progress in achieving the goals of the recovery project but also to make appropriate management decisions to maximize progress. Moore and Michael [16], believe that even when monitoring is sufficient, a lack of expert analysis and evaluation of the data collected can also reduce the effectiveness of adaptive management. Although adaptive management has a very long history of application, and although it has proven to be an extremely important tool in achieving goals, its application is rather limited. When planning a recovery, most often only the theoretical possibility is left, which allows adaptive management to change the priorities and tasks in the recovery process. Consequently, recovery projects rarely allow for practical modification of management, based on monitoring of the information obtained.

Adaptive management should not be considered only as "adaptation management", but as a way of testing hypotheses identified at the beginning of planning through the recovery process, which can be considered as an experiment to test initial hypotheses. We can say that the key challenge in using an adaptive approach to management is to find the right balance between knowledge gained in the past, achieving the best results based on current knowledge, and acquiring new knowledge during the recovery process to improve future management.

Adaptive management involves adjusting the direction of management as new information becomes available during the recovery process that was often not planned at the very beginning of the process (Fig. 2). It is certain that such an approach requires a willingness to experiment, with uncertain results, and acceptance of occasional failures, which should be a lesson for future processes.

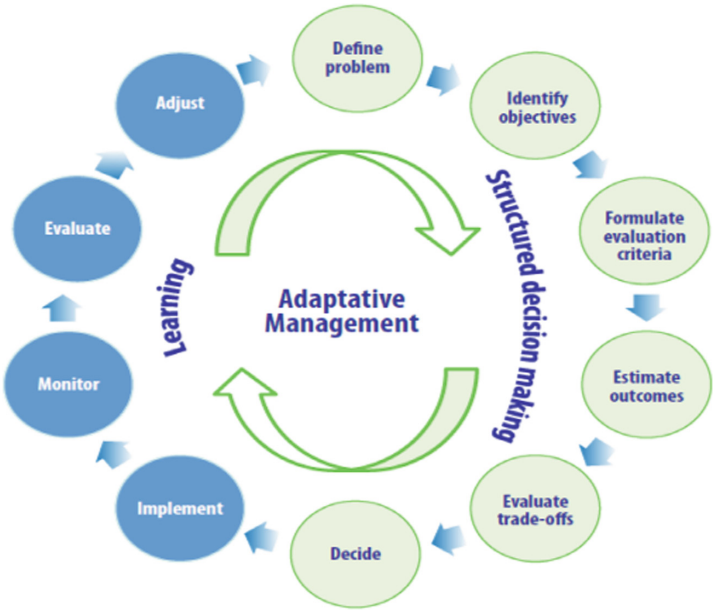

Fig. 2. Adaptive taking t, characterized as "learning by doing", [7].

The most common reasons why adaptive management is not implemented effectively can be sublimated as: excessive reliability in recovery results; unwillingness to stop unproductive activities because they are reluctant to give up efforts in which a lot of time and energy has been invested; lack of effective monitoring, scientific and substantial evaluation of the process. Projects often continue tasks and working elements, even when monitoring results indicate that recovery goals cannot be achieved.

References

1. Hadžić, E., Bonacci, O.: Okolišno prihvatljivo upravljanje vodotocima. Univerzitet u Sarajevu-Građevinski fakultet, Sarajevo (2019)
2. Boon, P.J., Davies, B.R., Petts, G.E: Global Perspectives on River Conservation: Science, Policy and Practice. Wiley, Chichester (2000)
3. Biswas, A.K.: Dams: cornucopia or disaster? Int. J. Water Resour. Dev. **20**(1), 3–14 (2004)
4. Wittfogel, K.: Hydraulic civilizations. In: Thomas, W.L. (ed.) Man's Role in Changing the Face of the Earth. Chicago. University of Chicago Press, Chicago (1956)
5. Leopold, A.: A Sand County Almanac and Sketches from Here and There. Oxford University Press, New York (1977)
6. Bonacci, O.: Ekohidrologija vodnih resursa i otvorenih vodotoka, Građevinski fakultet u Splitu (2003). ISBN 953-6116-27-8
7. Speed, R., et al.: River Restoration: A Strategic Approach to Planning and Management. UNESCO, Paris (2016)
8. Popovska, C., Đorđević, B.: Rehabilitacija reka - Nužan odgovor na pogoršanje ekoloških i klimatskih uslova. Vodoprivreda 0350-0519,**45**, 261–263 (2013)
9. Wade, P.M.: Management of macrophytic vegetation. In: Calow, P., Petts, G.E. (eds.) The Rivers Handbook, vol. 1, pp. 363–385. Blackwel Science, Oxford (1994)
10. Gordon, N.D., McMahon, T.A., Finlayson, B.L., Gippel, C.J., Nathan, R.J.: Stream Hydrology - An Introduction for Ecologists, 2nd edn. Wiley, Chichester (2004)
11. Erskine, W.D., Webb, A.A.: Desnagging to resnagging: new directions in river rehabilitation in southeastern Australia. River Res. Appl. **19**(3), 233–249 (2003)
12. FISRWG. Federal Stream Corridor Restoration Handbook (NEH-653). USDA (1998)
13. Morandi, B., Piégay, H., Lamouroux, N., Vaudor, L.: How is success or failure in river restoration projects evaluated? Feedback from French restoration projects. J. Environ. Manag. **137**, 178–188 (2014)
14. Feld, C.K., et al.: From natural to degraded rivers and back again: a test of restoration ecology theory and practice (2011)
15. Ayres, A., et al.: REstoring rivers FOR effective catchment Management, Inventory of river restoration measures: effects, costs and benefits (2014)
16. Moore, A.L., Michael, A.: On valuing information in adaptive-management models. Conserv. Biol. **24**(4), 984–993 (2009)

Reform of the Water Services Sector in Bosnia and Herzegovina – An Important Step Towards Sustainable Development

Suvada Šuvalija[1](✉), Alma Imamović[2], Sandi Zulić[3], and Vesna Muslić[4]

[1] Faculty of Civil Engineering, Department of Water Resources and Environmental Engineering, University of Sarajevo, Patriotske lige 30, 71000 Sarajevo, Bosnia and Herzegovina
suvada.suvalija@gf.unsa.ba

[2] Ministry of Agriculture, Water Management and Forestry of the Federation of BiH, Water Management Sector, Hamdije Čemerlića 2, 71000 Sarajevo, Bosnia and Herzegovina

[3] UNA Consulting d.o.o., Bosanskih banova 23, 77000 Bihać, Bosnia and Herzegovina

[4] Association "Aquasan Network in BiH" d.o.o., Bosanskih banova 23, 77000 Bihać, Bosnia and Herzegovina

Abstract. In order to achieve improvement in the field of water services of the Bosnia and Herzegovina (BiH), and gradually achieve sustainability of service provision and harmonization of their quality with European Union (EU) standards, it is necessary to adopt a Program for Improvement of Water Services of BiH (Program). The paper presents a summary of the current state of the BiH water services sector and identifies shortcomings as the reasons for the poor state of this sector. To implement the reform, and in cooperation with international development partners, the Federal Ministry of Agriculture, Water Management and Forestry (FMAWMF) coordinated the process of the Program drafting. The starting point for the development of the Program is the vision of the reform of the water services sector as a functional system, which ensures sustainable and quality water supply and other water management services in accordance with EU standards. Achieving this vision requires a harmonized regulatory framework; efficient institutions defined by legal regulations and defined, functional, and controlled financial flows that ensure operational efficiency and full cost recovery. The paper presents the activities required for the implementation of the Program to achieve greater sustainable development of water service providers/suppliers (public water utility companies). At the end of the paper, key recommendations for the improvement of the BiH water services sector and concluding remarks were given.

Keywords: Water services · Sustainable development · Reform program · Water utility companies · Price of water services

1 Introduction

Water services mean all services that for users (households, public institutions, or any economic activity), ensure the capture, accumulation, and storage of surface or groundwater, water treatment to the level of potable water quality and distribution to end-users,

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 342–351, 2023.
https://doi.org/10.1007/978-3-031-17767-5_24

and wastewater collection through public sewerage systems and their treatment and discharge into water resources (mainly surface water), including the delivery of abstracted or potable/drinking water to another local government units (LGUs) or its public water utility company (PWUC) (i.e. another operator) [1].

Water services are covered in two areas - the area of water use and protection and the area of utilities. Water services, i.e., communal activities of water supply, drainage, and wastewater treatment, are of general social interest, as they meet the basic needs of the population and other users of these services [2]. Quality water services today are the basis for the life and development of modern society. Highly developed countries have an extremely functional and high-quality level of all these water services [3].

Municipal water facilities or a set of municipal water facilities, together with the associated devices, form a technical or technological unit and serve or may serve the delivery of water services [4]. Commonly, the communal water supply and sewerage infrastructure facilities in the BiH are owned by the local self-government units (municipality, city or canton, or legal or natural persons who built these facilities, and they take care of the management of these facilities). The existing regulations determine the competence of local self-government units to ensure the provision of water supply and wastewater services on their territory through PWUCs. Local units (LGUs) and their PWUCs, as providers of water services, face a number of challenges in the process of delivering these services. For example, the current challenges are increasingly stringent legislation, poor efficiency and productivity in the water services sector, increasing diversity and pollution, climate change (increased runoff and flooding) and high-water losses, as well as dilapidation, poor maintenance and poor management of communal infrastructure (facilities and equipment) [5, 6]. There is no vision of what needs to be achieved in the water sector in the BiH in the medium and long term, nor a policy that would define general goals and priorities for the provision and development of water services. Previous water supply and sewerage and wastewater treatment programs have focused mainly on expanding the water supply and sewerage network without paying due attention to sustainability i.e., proper management of water services and infrastructure for water services, and protection of water resources [7]. Unfortunately, the long-term stagnation of the water services sector in the BiH has created numerous challenges in this area, which is why a strong impetus is needed to start the process of change and ensure its sustainability. The main response to these and other similar challenges is the reform of the water services sector and thus achieving long-term sustainability and efficiency in the provision of water services [2, 8].

Although the Water Framework Directive (WFD) has been significantly transposed into BiH legislation, public service regulations have not sufficiently elaborated the principles of water sector management and have not established an adequate regulatory framework for setting utility prices [9]. This is particularly pronounced in the development of Water Management Plans in accordance with the WFD, which are prepared by the competent Water Agencies. The implementation of these plans is still low due to the lack of the necessary construction of communal infrastructure, especially wastewater treatment plants (WWTP), as the most complex and most expensive communal water facilities. The application of clearly defined criteria and steps in the process of calculating and adopting prices for water services helps PWUCs and LGUs to conduct regular

planning and periodic analysis of key financial and operational performance indicators. The Association for Water and Environmental Protection "Aquasan Network in BiH" has for many years advocated reform processes in the water services sector and a transparent approach to calculating prices for water services, based on economic principles, having respect for social standards, and affordability [12]. However, only recently, with the support of international development partners, have the preconditions been established for launching reform activities in the BiH water services sector. Thus, in order to implement these reform activities, the FMAWMF, in cooperation with international development partners, coordinated the process of drafting the BiH Water Services Improvement Program. The program has been prepared, the draft program has passed a public debate (June 2021), and its adoption by the BiH Government is expected soon.

2 State of Water Services in Bosnia and Herzegovina

2.1 Availability and Quality of Water Services

The World Health Organization (WHO) has classified water supply and health safety of potable water as one of the twelve basic indicators of the health status of a country's population [10]. Coverage of the population/users with this communal infrastructure, and thus water services, represents the percentage of the population that has access to and benefits from water supply and sewerage services, and the share of wastewater that is treated before discharge into watercourses [11]. In the world, the prosperity and standard of a country are measured by how many people are connected to the public water supply system, but also to systems that mean protection of water from pollution, and these are primarily sewage systems and wastewater treatment plants (WWTP). In developed European countries (e.g., Sweden, Denmark, the Netherlands, etc.) this percentage is 100%, which means that virtually high-quality water services are available to all users (households, businesses, industry, etc.) [3]. Table 1 provides an overview of some key data related to public health interaction and water service coverage, in the highly developed Netherlands (Western Europe), underdeveloped Mali (Africa), and BiH (developing country) [1, 10].

In Bosnia and Herzegovina, the situation regarding the provision of water services is significantly worse compared to the countries of Western Europe. Access to public water services in BiH is low by regional and global standards, while water losses are very high and wastewater is mostly not treated, but discharged directly into surface waters and the environment [9, 12]. Namely, until recently, only 3% of the population was connected to the WWTP. However, in the past few years, several WWTPs have been built or reconstructed (Sarajevo, Bijeljina, Bihać, Mostar, Bileća, Konjic), which has significantly increased the percentage of wastewater treatment (currently about 15%). Also, there are significant differences in the coverage/availability of water services when it comes to rural or urban populations. On average, the rural population has about 20% less access to safe water than the urban. Differences in sanitary conditions (collection and treatment of wastewater) between urban and rural populations are even more pronounced than in the case of access to drinking water (safe water).

It is estimated that the quality of water services in the BiH is recording a negative trend, mostly due to the decrease in the quality of drinking water caused by pollution.

Table 1. Some key indicators of the water services impact on public health.

Countries: Indicators of human health:	Mali	The Netherlands	BiH
Life expectancy (male)	45 years	77 years	72 years
Life expectancy (female)	47 years	81 years	77 years
Infant deaths due to diarrhea	18,3%	0%	0%
Availability of sewers (rural)	42%	100%	
Availability of sewers (urban)	71%	100%	46%
Availability of good drinking water (rural)	21%	100%	58%
Availability of good drinking water (urban)	3%	100%	75%

Although PWUCs fence and regulate the first sanitary protection zone, they almost never apply any measures for the second or third protection zone. In rural areas, chlorination of drinking water is mostly done manually (which is risky from the point of view of concentrations that can be dangerous to health), and in some cases very irregular, while in urban water supply systems disinfection is mostly done through automatic gas chlorinators.

2.2 Deficiencies in the Bosnia and Herzegovina Water Services Sector

The general situation in the water services sector and the overall operational and financial operations of most PWUCs in the BiH can be assessed as unsatisfactory. According to the World Bank analysis conducted in 2017 and presented in the document "Institutional Review of the Water Services Sector in BiH" [1], and taking into account other analyzes conducted after that period, the identified shortcomings of the current PWUCs situation show the following:

- prices do not ensure the reimbursement of all costs, which are still insufficiently known, because they are not separated by function;
- inefficient asset management leads to deterioration of existing infrastructure;
- the inventory of assets is incomplete and therefore does not allow the calculation of real depreciation and fundraising for regular maintenance;
- low values of calculated depreciation included in the price of water services do not ensure the renewal of infrastructure, because water (communal) infrastructure is not fully recorded in the books of fixed assets;
- too many employees with inadequate qualifications and knowledge burden the business and work productivity, and
- new investments are usually made through credit borrowings without proper verification of the affordability of the investment for the local community, which creates high operating costs.

In the past, international development partners have invested significant financial resources in the water services sector. Unfortunately, many investments made proved to be unsuccessful investments in infrastructure because it is not used after construction

and is not self-sustainable. Despite direct investments of over EUR 500 million (from international financial institutions and bilateral donors) in the water services sector in BiH in the last 10 years, this sector is far from the standards required by the European Union's (EU) water acquis [12].

The Position Document of the Aquasan Network in BiH (AQUASAN) lists the reasons i.e., shortcomings that affect the overall operational and financial operations of the majority of PWUCs in BiH, and they are:

- political influences when making decisions on financing and development of water services at the local level;
- the public service contract between the local communities and the PWUCs has not been signed or is not consistently applied;
- there is no clearly defined methodology for calculating water service prices;
- the number of employees is generally higher than the optimally required number of employees;
- lack of qualified employees in local communities and PWUCs;
- the non-existence or inconsistent application of internal procedures;
- cost accounting and cost centers are not established or are only partially established;
- high physical and administrative losses of water, and due to inadequate investment maintenance of infrastructure and consequently high value of non-revenue water (average 59%, and reaches more than 70%);
- high costs of electricity for the operation of pumping plants;
- fixed assets - communal water infrastructure (water supply and sewerage network, with facilities and devices on the network) is not fully recorded in the business books;
- depreciation is not calculated on all fixed assets used by PWUCs when providing water services;
- business plans of local communities and PWUCs are not mutually harmonized;
- significant reduction of water consumption due to the depopulation of the citizens;
- insufficiently developed system of monitoring the performance of PWUCs through benchmarking and improvement measures based on business indicators;
- there is cross-subsidization between different categories of service users, where the prices of services for legal entities are 1.5 - 3 times higher than the prices of services for individuals, thus the PWUCs currently provides cost recovery.

Some of the consequences of these shortcomings are already present in water supply systems. Namely, there is an increasing reduction in the regular supply of service users and thus the dissatisfaction of citizens (with the risk to health after supply interruptions) [1, 9]. The generated revenues of PWUCs, which are usually characterized by poor collection and high receivables, and high staff costs as the first priority of payment, leave insufficient funds for infrastructure maintenance. The lack of affordability testing for new investments leads to an unsustainable system and the inability to cover operating costs, as well as difficult loan repayment.

3 Reform of the Bosnia and Herzegovina Water Services Sector

3.1 Sustainability as a Goal of the Reform Program

The ultimate goal of the reform program for the improvement of the water services sector is to achieve [8, 9]:

- Social sustainability: all service users have access to appropriate and affordable water services that meet their health and living needs;
- Environmental sustainability: the provision and development of water services do not endanger biodiversity, habitat functioning, and hydrological processes;
- Legislative and legal sustainability: means the establishment and implementation of a regulatory and supervisory framework that will enable the sustainable provision and development of water services;
- Economic sustainability: the provision of water services is affordable and cost-effective.
- Financial sustainability: by introducing a well-coordinated incentive structure, PWUCs financing is directly linked to better business and accountability;
- Institutional sustainability: means that state, entity, cantonal and local authorities (ministries, water agencies, LGUs) carry out combined and coordinated activities to establish and implement a strong system of improvement of sectoral institutions and PWUCs, and institutions in charge of managing and providing water services have sufficient resources to carry out these activities in the long run.

So, the benefits of the reform program will have: service users, providers of water services (PWUCs); local self-government units (LGUs), entity and cantonal ministries as well as competent water agencies and environmental funds, Ministry of Foreign Trade and Economic Relations of BiH and the private sector, i.e. consultants, suppliers, and contractors (because they will have a growing market to provide its services thus contributing to the economic development of the country).

A reform Program implies the implementation of a series of activities necessary for building and improving institutions, and infrastructure and creating conditions for improved provision of sustainable water services in local communities (LGUs). The competent institutions in BiH are facing a reform process that requires [1, 12]:

– the harmonized regulatory framework,
– functional institutional framework and
– Controlled financial flows.

3.2 Regulatory Framework

The development of the BiH Water Services Improvement Program was initiated after the international development partners set the establishment of the regulatory framework for sustainable water services in BiH as a precondition for continuing to provide support to this sector. Regulatory reforms in the water services sector include assessing deficiencies in the existing regulatory framework that have led to these challenges,

proposing improvements to existing regulations, and/or enacting additional regulations (e.g. adopting a new Law on Water Services, or improving the existing Law on Communal Activities, at the appropriate administrative level), as well as the most efficient procedure for overcoming the lack of capacity of the necessary bodies/institutions to carry out all necessary activities. These reforms should anticipate and support the creation of missing procedures and bodies/institutions, and define individual responsibilities, as well as the consequences of non-compliance with these responsibilities (with a benchmarking system). In summary, reforms related to the legal framework include amendments to existing regulations by introducing the following instruments:

- obligations to regularly monitor PWUCs performance indicators and reporting;
- obligations to sign contracts for the provision of public water services between LGUs and PWUCs;
- obligations to adopt a methodology for pricing water services;
- obligations to develop and adopt strategic and operational business plans according to the given content;
- the obligation to keep a register of all assets managed and maintained by the PWUCs;
- establishment of a regulatory body for water service prices (at the appropriate level of administration).

3.3 Institutional Framework

To carry out adequate reforms in the water services sector, it is necessary to assess the shortcomings in the existence or capacity of existing and necessary bodies or institutions to carry out all necessary activities and responsibilities and propose the most efficient procedure for overcoming such shortcomings [11]. Institutional reforms must take into account that there is already a high level of employment in the public sector, ie that the restructuring of existing institutions and strengthening of existing capacities have a very high priority in relation to any new employment. In this regard, the key recommendations for improving the operational sustainability of PWUCs include the following activities:

- Initiate urgent measures to optimize the number of employees in PWUCs by improving the organizational structure and streamlining the number of employees, the application of new technologies in order to reduce the extremely high cost of hiring employees;
- Initiate urgent measures to improve the work of PWUCs and maintain the systems they manage through measures:
  - environmental efficiencies (reduction of water abstracted for water supply needs), which includes reduction of non-revenue water (through reduction of physical leaks and apparent losses),
  - energy efficiency (reduction of electricity costs at their plants).
- Establish an appropriate dedicated revolving fund (BiH administration, possibly with the assistance of international financial institutions) for PWUCs to finance and encourage projects that contribute to increasing the efficiency of PWUCs and their operational and financial sustainability.

3.4 Controlled Financial Flows

The framework for controlling financial flows in the water services sector requires a detailed analysis of deficiencies in existing financing of the operation and maintenance of water supply systems and an assessment of required investments (by local communities through local budgets, loans, or grants provided by international financial institutions, cantonal or entity funds, etc.) [12]. It is also necessary to establish new procedures to check the affordability of future operational costs of new investments, check whether local community budgets have been adopted taking into account the needs of sectoral local investments and whether tariffs are adjusted to new investment costs, etc. The financial sustainability of PWUCs includes the following:

- Initiate and encourage measures to improve the collection of receivables;
- Establish cost accounting;
- Adopt a methodology for pricing water services, based on the principles of cost recovery, operational efficiency, and affordability;
- Register all assets managed by PWUCs, and set aside and use the calculated depreciation for the maintenance of the said assets;
- Introduce risk management, and ensure internal control and monitoring and measurement of service quality.

3.5 Key Recommendations and Reform Activities

For the sustainability of the water services sector in the BiH, it is necessary to have in force legislation that ensures sectoral processes, bodies, and financial flows that guarantee high-quality water services and their long-term operational and financial sustainability [9, 11]. These legal regulations should define institutions that effectively implement all their responsibilities and are capable of responding quickly to new challenges. And finally, functional financial flows should be defined, and continuously monitored in relation to the achieved operational efficiency, full cost recovery, and affordability. These frameworks and the necessary activities within them are the subject of reform i.e., the Program for the Improvement of the Water Management Sector.

Given that the reform processes in the water services sector require activities at all levels of government, it is necessary to ensure the commitment of all participants in the processes. Higher levels of government in BiH, and above all the entities (and cantons in FBiH) are responsible for the preparation and adoption of strategic planning documents, as well as the drafting of regulations. They should draft, adopt and consistently implement the Entity Laws on Water Services, which will include provisions relating, inter alia, to the determination of the lowest price of water services. The Law on Water Services should also define the establishment of a regulatory body, which would determine the minimum prices of water services, which in the case of FBiH may be at the cantonal level, although priority should be given to establishing such a body at both entities. The establishment of a regulatory body would certainly be of great importance because it ensures more transparent work and equal treatment in all local communities.

Significant recommendations for the improvement of the water services sector relate to the operators themselves i.e., PWUCs. Some of them are related to achieving

operational sustainability, among which is certainly the need for the following urgent launch:

- Improving the work of PWUCs and maintaining the systems they manage through environmental and energy efficiency measures (listed in Chapter 3.2);
- Analyzes of optimization and rationalization of the number of employees through the introduction of technological innovations in their operational processes and
- Financial measures (listed in Chapter 3.3), among which are key activities to improve the process of debt collection, the establishment of cost accounting, directing the calculation of depreciation for the sustainability of assets, and the formation of prices for water services according to the recommended methodology.

4 Conclusions

According to regional and world standards, the current state of the BiH water services sector is unsatisfactory. The reasons for this situation are numerous institutional, legal, operational, and financial shortcomings in the water services sector, which lead to the unsustainability of this sector. The provision of public water services through utility companies (PWUCs) is threatened in many local communities due to these shortcomings. Namely, PWUCs do not generate enough income to be self-sustaining, and average levels of income from water services do not cover operating and maintenance costs.

Considering the current state of the water services sector and the stated shortcomings, it is clear that without urgent intervention and reform changes in the water services sector, the population in BiH will face consequences that can have serious impacts on good living conditions and health and water protection and the environment. This imposes the necessity of adopting the Program of Measures for the Improvement of the Water Services Sector, with the ultimate goal of its reform. The vision of the reform is a functional water services sector, which ensures sustainable and quality water supply and other water management services in line with EU standards. This will avoid new unsuccessful investments in water infrastructure, which is not adequately used after construction. Reform of the water services sector implies both reforms of the regulatory and institutional framework and control of financial flows. The reform implies good management of the sector for the benefit of all users, not only the development of policies, laws, and regulations but also their full implementation as well as an improvement based on monitoring their performance.

The ultimate goal of the reform is to achieve the sustainability of the water services sector in BiH and thus resilience to the expected shock caused by climate change and pollution of water resources in urban areas.

References

1. Water Supply and Sanitation Institutional Water Sector Review in BiH (final draft). Una Consulting, d.o.o. in cooperation with World Bank (2017). https://www.unaconsulting.ba/en/reference/water-supply-and-sanitation-wss-institutional-water-sector-review-in-b-h/31. Accessed 11 Jan 2022

2. Jusić, S., Imamović, A., Lozančić, Ž.: New approach of stormwater management. In: Association of Consulting Engineers of Bosnia and Herzegovina (UKI BiH). The second B&H Water Congress, pp. 261–269 (2019). https://www.academia.edu/41164311/Z_B_O_R_N_I_K_R_A_D_O_V_A_P_R_O_C_E_E_D_I_N_G_S_2_Water_Congres_BiH. Accessed 19 Dec 2021
3. Jusić, S.: Sweden's public water supply system. J. Sava River Basin District Agency Sarajevo, VODA I MI, **82**, 53–59 (2013). https://www.voda.ba/udoc/casopis/Vodaimi82.pdf. Accessed 02 Feb 2022
4. Imamović, A.: Challenges of implementation of water protection projects in the federation of BiH. In: World Water Day, Sava River Basin District Agency, Zenica 2223 March (2017). https://www.voda.ba/uimages/Alma%20Imamovic%20ZR.pdf. Accessed 01 Feb 2022
5. Hadžić, E., Ademović, N., Milišić, H., Jusić, S.: Natural disasters risk management in Bosnia and Herzegovina. In: Gocić, M., Aronica, G., Stavroulakis, G., Trajković, S. (eds.) Natural Risk Management and Engineering. Springer Tracts in Civil Engineering. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-39391-5_3. Accessed 09 Feb 2022
6. Hadžić, E., Imamović, A.: 8. Water resources in Bosnia and Herzegovina. In: Water Resources Management in Balkan Countries, 1st ed. Springer International Publishing (2020). https://www.springerprofessional.de/en/water-resources-in-bosnia-and-herzegovina/17327578. Accessed 19 Sep 2021
7. Šuvalija, S., Hadžić, E., Milišić, H.: Urban stormwater management – new challenges. In: Karabegović, I. (ed.) NT 2021. LNNS, vol. 233, pp. 1046–1054. Springer, Cham (2021). https://doi.org/10.1007/978-3-030-75275-0_115
8. Lawson, E., Farmani, R., Woodley, E., Butler, D.: A resilient and sustainable water sector: barriers to the operationalisation of resilience. Sustainability **12**, 1797 (2020). https://doi.org/10.3390/su12051797
9. Policy Document Comprehensive Improvement of the Water Services Sector in BiH (2019). https://www.upkp.com.ba/page/dokumenti/FINALNI%20DOKUMENT%20O%20POLITIKAMA_%202019_BHS.pdf. Accessed 11 Jan 2022
10. WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation (JMP) - 2015 Update UN-Water (unwater.org) World Health Organization (2015). https://www.unwater.org/publications/whounicef-joint-monitoring-program-water-supply-sanitation-jmp-2015-update/
11. Wareg | 1st European Forum on Regulation of Water Services (EFRWS) (2019). https://www.aquapublica.eu/event/wareg-1st-european-forum-regulation-water-services-efrws. Accessed 23 Jan 2022
12. Draft program for improvement of water services in the federation of Bosnia and Herzegovina and the use of the announced financial and technical support (2021). https://fmpvs.gov.ba/wp-content/uploads/2021/05/07_nacrt-programa-za-unapredjenje-vodnih-usluga.pdf. Accessed 13 Jan 2022

Author Index

T. Tufek-Memišević et al. (Eds.): ICSD 2022, LNNS 529, pp. 353–354, 2023.
https://doi.org/10.1007/978-3-031-17767-5