

Smart research and regional cooperation: strategic gaps and opportunities in the Western Balkan region

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Abstract

Objectives: This study aims to identify strategic gaps and opportunities for strengthening smart research and innovation in the Western Balkan region. Through highlighting underused mechanisms of region coordination, this research seeks to evaluate the alignment of national legal policy frameworks with European Union (EU) smart research frameworks through diagnosing the current institutional and infrastructural gaps and proposing pathways for future regional collaboration, policy transfer, and policy coherence. **Prior work:** Smart transformation in research in Higher Education Institutions (HEIs) is a necessity in the WB region, where digitalization of research workflows and innovation education and scientific research technologies are needed. Previous research has shown that national research systems are fragmented, especially in terms of smart science and digitalization. Innovation systems, technology transfer mechanisms, and smart specialization remain under development, and the potential of regional cooperation for international competitiveness remains unexplored. **Approach:** This study employs a comparative policy analysis approach through systematically comparing national legislations, national policies, and frameworks. It assesses alignment with EU policies and frameworks and alignment between the countries of the WB region, identifying the main gaps and the potential for smart research regional cooperation. **Results:** Findings of this study show that there remain significant disparities in terms of the level of capacity building, regional cooperation, funding, stakeholder engagement, digital infrastructure, innovation, and technology transfer. International cooperation and, more specifically, coordinated regional cooperation for smart specialization of the WB region. **Implications:** Addressing the identified gaps requires a harmonization of policy instruments at the regional level and strengthening regional collaboration platforms not only between HEIs but also with other stakeholders such as the public sector and industry. **Value:** This study provides insights for policy makers, HEIs, innovation and research providers, public entities, industry, and other concerned civil society, which are the main stakeholders in the development of the Quadruple Helix Models. With adequate regional coordination and cooperation effort, the WB region can be a dynamic actor in the European Research Area (ERA)

Keywords: Smart research, regional cooperation, smart transformation, digitalization.

1. Introduction

Teaching, research and the third mission of universities have become strategic priorities in the development of higher education and research in the Western Balkans (WB) region. WB countries, Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia, are making efforts to enhance research excellence through international and regional research collaboration that are closely aligned with European Union (EU) policies, European Higher Education Area(EHEA), European Research Area(ERA), and the Bologna Process and the Digital Education Action Plan (2021–2027). Moreover. EU accession aspiration and the accomplishment of the EU accession chapters make education reform one of the main of transformation and development. Countries are in different stages of EU accession, where Montenegro and Albania target EU membership respectively in 2028 and 2030.

Regional cooperation is essential for increasing the global competitiveness of the region in terms of science and education. The Western Balkans Agenda on Innovation, Research, Education, Culture, Youth, and Sport (the Innovation Agenda)(2021) is a comprehensive framework developed by the EU that aims to boost innovation capabilities of the region, strengthen education systems and research infrastructure, promote brain circulation, bridge the digital divide, and foster digital transformation. Universities are recognized as key actors in innovation ecosystems, smart education, and smart research. Regional cooperation has been supported by EU-funded initiatives such as Horizon Europe, Erasmus+ + and the Western Balkans Investment Framework (WBIF).

At the national level, in spite of rule of law challenges and political instability, lack of infrastructure, and low implementation of structural reforms, the majority of the countries of the region have developed national legal frameworks and policy frameworks on higher education, science, and innovation. Despite the undeniable potential of the regional cooperation, little attention was paid in terms of regional collaboration in scientific research in the era of digital transformation where universities are embracing the transformation to smart universities and research, as a core activity of the smart university would need to adapt to the smart paradigm. Therefore, it is necessary to analyses and compare what kind of advancements WB countries have made in their national legal frameworks and national policy frameworks in terms of regional scientific research collaboration to understand their contribution in the establishment of smart education and smart research at the regional level, with the ultimate goal of EU alignment and global competitiveness. In the second section of this paper literature review will be presented, in the third section methodology will be explained concluding with results and conclusions respectively in the fourth and fifth question.

2. Literature review

2.1 From traditional to smart universities: the role of smart research

A smart university is defined as a university that uses ICT (information communication technology), AI (artificial intelligence) and innovation in learning, research and third mission to achieve organizational objectives and requiring significant organizational transformation and leadership and managerial commitment and willingness [1]. Smart universities seek to improve the quality of life of students and academic and administrative

staff in a sustainable way [174] contributing to Sustainable Development Goals (SDGs). Proposed solutions contribute to the achievement of all SDGs [3].

The development of smart university was often associated with smart educational activities within the university context; therefore, the integration of digital tools and AI (artificial intelligence) tools in learning and teaching activities of the smart university would help to achieve educational goals [4]. As developed by smart education framework [5] includes new or improved learning and teaching approaches, essential transforming technologies, enriching technologies and supporting technologies, smart universities should promote a friendly educational environment from smart pedagogies and smart learners. Furthermore [6] developed a national smart education framework using the Delphi technique that includes forward-thinking governance and policy initiative, digital learning environments that are oriented towards smart education, transformative teaching enabled through smart technology and overacting considerations [7]. Moreover, smart education has an essential role in developing high quality regional higher education systems through smart learning environment [8], which include the application social, technological and AI tools into learning environments. The development of smart learning environments in smart universities requires also a combination of resources (financial, human and technological) and skills (leadership, collaboration, interpersonal and emotional intelligence) [9] shaping individual self-perception and learning experiences. As highlighted by a study in Moldova by [10] in order to maximise the results of digitalisation in the universities context it is necessary address skills of competences of academic staff and students and pay attention to the working methods. To implicit smart education it is not only sufficient to have the appropriate digital infrastructure or capacity building of staff and students, it is required also to establish appropriate governance mechanisms for digitalisation [11].

[184] Propose a smart campus framework based on smart economy, smart technology and data, smart governance and smart environment. The smart economy domain of smart campus includes business services, improved efficiency, innovation ecosystem, utility, and cost-savings. The smart society domain of the smart campus is composed by community engagement, quality of campus life, social responsibility and versatile learning whereas in the environmental domain, there are elements such as environmentally-friendly services, renewable energy, sustainable development and zero waste. The smart governance domain contains elements such as cybersecurity, data governance, decision-making and service management, competed by the smart technology and data domain that includes big data and storage technologies, detection support technologies, dissemination technologies and sensing technologies. The concept of smart campus founded in the concept of smart city allows universities to implemented social responsibility and third mission related activities [13]. Smart campuses should address not only the needs of students and academic and administrate staff of the university but also they should provide real solutions for needs of the community in terms of digitalization, sustainability and health and wellbeing [14]. Have developed indicators in assessing the technology dimension and the sustainability dimension of the smart campus based a human-centered perspective.

If teaching and the third mission are addressed in the existent literature on smart universities, smart research development within smart universities remains underexplored. There does not exist a specific term in the literature that refers explicitly to smart research, there exist several studies that refer indirectly to research activities in smart universities. As argued by [15] smart universities go beyond the concept of activities of smart learning or smart third mission activities, research activities and the processes and outcomes of research activities are as well transformed by the paradigm shift caused by the digital, AI and sustainable transformation. In the smart specialization era, the concept of smart university should strengthen research opportunities evolving towards a new concept of academic and corporate knowledge management. In terms of scientific research, a smart university should promote open academic communities that are incentivized to participate in research projects, start up and business development programs with industry, application to scientific grants and research mobility programs. Some universities such as the University of Malaga in Spain have adopted the concept of smart city into the smart university and smart campus supporting as well research activities [16] engaging researchers and students of the university from different fields in the design and development of the smart campus activities. Established innovation framework facilitate the collaboration between research and the industry. In WB region, there is a gap in the research in terms of smart university, smart education and smart research, there are no studies addressing these concepts and focusing explicitly in the region or in separate countries of the region.

As in the existing literature there is not yet a clear definition of smart research but the adjective smart is only connected to teaching and third mission activities, research activities remain embedded only in the development of the concepts of smart university, smart campus and smart specialization, but for the research activities within the smart university and the smart campus the dimension of collaboration remains essential.

2.2 Smart research and universities' regional cooperation

Cooperation between universities and research centers is often related to the concept of knowledge transfer including dimensions of selection of partners, working culture and funding [17]. Matching the concepts of regional cooperation and higher education means that the regional lenses are applied to the multi-dimensional and multi-directional cooperation in the higher education context, [18] suggest several areas of regional cooperation such as human resource development, academic development, social and cultural development and contributions to democratic citizenship [19]. Proposes a framework for universities' regional cooperation composed by three approaches the functional approach (academic activities, research activities, aligned strategies and policies), organizational approach (organizations, institutions and networks) and regional-level approach (regional level agreements). Moreover, two models of universities' cooperation are proposed the international joint university model (commonly single campus institutions) and regional universities (multiple campus or virtual campus universities). The main benefits of universities' regional cooperation are diversified access to education and research and facilitation of bilateral and regional cooperation in terms of teaching, research and innovation.

Collaborative inter-university research enhances the research potential of universities through common research projects. [20] distinguish two types of university cooperation networks that affects research performance of universities, intra-organisational networks focused on collaboration within universities on inter-organisational networks focused on collaboration across universities. These networks jointly create a synergy that influences positively the research performance of universities and influences research capacities and research capabilities of universities. Research performance of universities is further enhanced in regional research ecosystems rather than in stand-alone organizations because can generate regional spillovers through an accelerated knowledge production process [21]. International collaboration is a key factor of research performance of universities [22], internal and external collaboration between universities improves scientific production indicators such as citation indicators. In the WB countries, higher scientific research production is one of the main requirements for academic promotion, consequently scientific research productivity is improved [23] but it is not linked to number of scientific researchers that universities have.

Research mobility is one of the most important dimensions of universities' internationalization increasing the opportunities for career development, scientific production quality, [24] empathies that increasing funding on research mobility's reduces the cost of exploring new international collaboration opportunities with international collaborators and improves scientific production quality, consequently research impact of scientific research produced during research mobility's is higher. In the context of WB countries the mobility of researchers through structured mobility schemes such as Erasmus+, MSCA or COST was one of the most important tools used to integrate WB researchers in the ERA [25] and to stimulate brain circulation in a one the regions of Europe with highest brain drain rate, but outgoing mobility of researchers from the region remains significantly higher. Some of the main motivations for the mobility of researchers in WB region are future career development, participation in research project, exploration of new research themes, open the horizons to a new culture, reputation, working conditions, access to research facilities, higher salaries, commercialization of research and family ties. Although several initiatives of research mobility have been developed in the region such the regional grant scheme to support mobility funded by the Western Balkans Funds and the EU or the project *"Enhancing Mobility-Driven Research and Innovation in the Western Balkans for Sustained Economic Growth and Convergence with the European Union"* funded by Open Society Foundation and implemented by Centre Science and Innovation for Development (Side), Albania from 01.05.2024 – 30.04.2025. There are no explicit studies on the importance and impact of mobility of researchers and the regional cooperation.

To achieve the full potential on international and regional collaboration in scientific research, a promotion of equitable partnerships at the regional and global level is required together with the establishment of research protocols and supportive communication channels because international collaboration requires often teamwork, intercultural competence and an ethical research working culture [26]. Collaboration activities enhance research skills and capabilities of academics [27] crucial for their academic knowledge and personal development. Therefore, research capacity building needs should be assessed

especially in developing countries [28] and developed through tailored training programs, mentoring and support activities. Despite of the high number of capacity building projects implemented in the WB region under Erasmus+, there is no empirical evidence on projects focused on developing research skills of academic staff in WB universities and on the role of global or regional cooperation in developing these skills. Building research capability requires as well a systemic thinking and a continuous collaboration with different stakeholders such as policy-makers, the industry or civil society [29].

Research portfolios of universities can be diversified through commitment to interdisciplinary research [30] and benefit from further research collaboration opportunities. Research focus of universities requires a strategic approach to research activities and research cooperation in order to gain a global competitive advantage [31]. Developing large scale research infrastructures in universities influences as well the development of the entrepreneurial university based on innovative research activities, collaboration, utilization and impact [32]. Entrepreneurial universities through engaging in innovation, knowledge, and technology transfer activities accelerate the development of regional entrepreneurial ecosystems, regional innovation, regional economic development and smart specialization strategies [33]. There are three different approaches that universities can have in knowledge and technology transfer activities: local development strategy (generalist and low prestige universities), specialist (high prestige universities focused in income generation) and autonomy (technology transfer offices, faculty strategy) [34]. Collaboration between universities and between universities and the industry can lead to open innovation ecosystems. In the WB region, knowledge and technology transfer between even it is important for universities and industry remains fragmented and lack of strategic planning and it needed create synergies in order to develop common products and services from the applied research results [35].

Even in the over mentioned paragraphs, there were highlighted critical elements of smart research intertwined with regional cooperation, digital transformation is one the main conditions to assure the development of the smart research concept within smart universities but also to strengthen regional cooperation. Digital tools do not only improve research collaboration but also research process is transformed. Nevertheless, when comparing universities to other organizations in terms of levels of digital transformation maturity, university still fall apart [35], this can be related to change management issues and lack of leadership commitment to digital transformation [36]. Have identified the critical factors of success of digital transformation in universities that are divided in two groups: internal factors (culture and leadership, strategy and planning, human capital and partnership/collaborations) and external factors (management/ processes, technology/infrastructure, sustainability and user experience). The establishment of partnerships/collaborations with other university and other organizations from the business sector or the civil society as critical factor and driver of digitalization can be fostered through collaboration in research and joint projects and through sharing resources and best practices on digitalization. Although, digital transformation in smart universities faces some challenges such as structural elements, management and strategy, implementation and digital skills. There are no studies focusing in digital transformation and region cooperation in universities of the WB region.

As it was highlighted on the these two sections of literature review not only the development of the concept of smart research remains still ill-defined in the literature but also in WB region there very limited theoretical and empirical contributions concerning smart research and regional cooperation between universities in WB region. Therefore, it is necessary to investigate the strategic gaps and opportunities on smart research and regional cooperation starting from the national legal and policy frameworks of the WB countries.

3. Methodology

The research methods used in this study are qualitative as the study is based on an exploratory approach. Comparative policy analysis was used to map different national legal and policy mechanisms in the six WB countries in order to address the strategic challenges and opportunities in terms of smart research and regional cooperation. 18 laws of higher education, scientific research and innovation of Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] were analyzed together with 15 national strategies on higher education, scientific and smart specialization [55] [56] [57] [58] [59] [60] [61] [62] [63] [64] [65] [66] [67] [68] [69]. Comparative policy analysis allows having a deeper understanding on the different critical factors and mechanisms that shaped research and regional cooperation in the universities of the WB region, to identify convergences and divergences among different countries and to provide solutions to different challenges identified in the current legal and policy landscape. The comparison used in this study is cross-national because it focuses on country comparison in terms of research and regional cooperation.

4. Results

4.1 Key dimensions of the smart research in the national legal frameworks

Bosnia and Herzegovina is the only country in the region that does not have a dedicated law on scientific research activity. Kosovo, Montenegro, North Macedonia, and Serbia have adopted specific laws on innovation activities, whereas Albania and Bosnia and Herzegovina still rely on indirect mechanisms. These key dimensions of smart research were identified on the national legal frameworks of the WB countries:

International collaboration

The international collaboration dimension in smart is strongly aligned with the EHEA and ERA especially in Albania, Kosovo, Montenegro and Serbia. Whereas Albania and Serbia perceive diaspora's integration in international collaboration, Montenegro focuses explicitly in regional cooperation as key driver of international cooperation. Due to the particular context of the country, Bosnia and Herzegovina's legal framework dates of 2007 and there is not specific focus on internationalization. In North Macedonia, national and international cooperation are prioritized.

Mobility of researchers

The mobility of researchers is legally regulated in Albania and Kosovo where universities set their own regulations and criteria compatible with the national legal frameworks. Serbia is the only country of the region that refers to EU-charter mobility. Montenegro

prioritizes mobility for top researchers whereas in the national legal framework of North Macedonia specific mobility cooperation goals. In Bosnia and Herzegovina, only the legal framework of Republican Serosa refers to researchers' mobility's.

Capacity building of researchers

Capacity building of researchers is explicitly regulated by law on all WB countries; Albania prioritizes career development, Kosovo skills, Montenegro regional cooperation and top researcher development, North Macedonia training activities and Serbia digitalization. Bosnia and Herzegovina is the only country of the region to have included explicit aspect of capacity building of researchers in the legal framework even if this concept is included in the legal framework.

Research related innovation and technology transfer

Kosovo, Montenegro and Serbia have specific policies on innovation driven and innovation led universities. Innovation and technology transfer related activities are embedded in national legal framework of Albania and North Macedonia via as well respectively science and technology parks and technology transfer centers. Whereas in Bosnia and Herzegovina the role of universities in research related to technology and transfer activities is only emphasized in the national legal framework.

The role of universities in research activities

In the countries of the WB region, the role of universities in research activities is regulated by law where the three main activities of the universities are research teaching and the third mission activities, only in Bosnia and Herzegovina this role of universities is mentioned by not deeply elaborated. There is no reference to the concept of smart research in national legal frameworks of the WB countries.

4.2 Collaboration in smart research related to national strategies

The main strategic documents that are analyzed are national strategies on scientific research, higher education, and smart specialization. All WB countries have dedicated strategies except Bosnia and Herzegovina and Kosovo due to their particular national contexts.

The key strategic dimensions on the importance of collaboration in the WB countries are summarized in the following table.

Table 1. Key dimensions of the strategic priorities in the WB region

Country	International collaboration	Capacity building	Digitalization	Research and innovation focus in universities
Albania	EU alignment and diaspora	Research capacity in terms of infrastructure and development of research capabilities and skills	Central focus	Innovation and excellence through business and academia collaboration
Bosnia and Herzegovina	Fragmented	Lack of concrete focus	Peripheral focus	Fragmented
Kosovo	EU networks and diaspora	Building capacities at the institutional level	Strategic focus	Applied research internationalization.
Montenegro	Regional, EU and diaspora	Support for young researchers and top researchers	Strategic focus	Internationalization and excellence in research
North Macedonia	EU alignment	Cross-sectoral support	Strategic focus	Specialization and applied research across different sectors
Serbia	Deep EU alignment	Entrepreneurship and innovation focus	Priority	Excellence and third mission oriented

Source: The Authors

International collaboration is integrated in all national strategies, especially in Albania, Serbia, and Montenegro, and in a more moderate way in Kosovo and North Macedonia, while it remains very fragmented in Bosnia and Herzegovina. The most important pattern of international collaboration is EU alignment and collaboration through joint projects. Albania, Montenegro, Kosovo, and Serbia consider diaspora inclusion an important mechanism of internationalization. Regional cooperation is a priority of internationalization only in Montenegro. All the countries commit to research capacity building even for doctoral students. Montenegro and Serbia even focus specifically on young researchers; in Kosovo, concrete measures on capacity building are absent. Digital readiness for scientific research is the main priority in Serbia, while other countries include it only in transversally in their national strategies.

Universities are important catalysts for research and innovation in Montenegro, North Macedonia, and Serbia through academia and industry collaboration and the development of the Quadruple Helix Model. In Albania and Kosovo, universities are involved indirectly in innovation processes. Albania, Montenegro, and Serbia have drafted documents that show a strategic depth in terms of objectives elaboration and concrete indicators, while in Kosovo and Macedonia, these documents are being drafted or proposed with a mid-term approach having more the form of mid-term action plans rather than long-term development strategies. Bosnia and Herzegovina has profound gaps and lack of strategic articulation the key dimensions of the importance of the strategic collaboration for smart research and regional cooperation.

4.3 A SWOT analysis for smart research in the WB countries

After the analysis of the national legal and policy framework on smart research and regional cooperation the following SWOT analysis is proposed:

Table 1. SWOT Analysis of the WB region

Strengths	Weaknesses
● Alignment with EU frameworks (ERA, EHEA, Horizon etc.) ● HEIs central actors in research and innovation ● Robust policy framework (Albania, Serbia, Montenegro) ● Legal framework supporting the involvement of HEIs in scientific research ● Active participation in mobility programs ● Active participation in international projects ● Capacity building initiatives ● Commitment for open science ● Involvement of diaspora	● Fragmented governance structures(Bosnia and Herzegovina) ● Incomplete of draft level strategies (Kosovo and North Macedonia) ● Problems the implementation of strategies and rule of law ● Limited funding for research and development ● Fragmented regional innovation ecosystem ● Low visibility of competitiveness of national research ● Bureaucratic obstacles in project implementation ● Limited research infrastructure and digital readiness ● Weak development with partnerships with industry and of the Quadruple Helix Model ● Research skills shortage

Opportunities

Region synergies and collaboration for international projects and mobility's (Albania and Montenegro have already set strategic priorities)

- Access to EU and international funding
- Harmonization of regional policies on research and Innovation
- Growth of public and private partnerships
- Youth engagement policies
- Strategic use of diaspora networks for international cooperation
- Participation in global and regional networks
- Development of smart education and smart research through digitalization

Threats

- Brain drain
- Migration and ageing of population
- Political instability and regional tensions that affect collaboration
- Short-term of medium term planning in terms of research and innovation
- Lack of international competitiveness and attractiveness of the region in terms of research and innovation
- Competition of EU funds
- Current geopolitical risks
- Institutional resistance and adaptively to reform some sectors

Source: The Authors

5. Conclusions

The WB countries have made considerable progress in embedding smart scientific research collaboration into their national legal frameworks national development agendas. By aligning with European Union frameworks such as the ERA and EHEA, with a strong foundation in researchers' mobility, capacity building, international collaboration, innovation and technology transfer and research focus. However, structural and strategic challenges persist especially in countries such as Bosnia and Herzegovina, Kosovo and North Macedonia.

To unlock the full potential of smart research, WB countries must deepen concrete national commitment that has to show transparent and accountable implementation of higher education, scientific research and innovation reform requiring an improvement of governance and autonomy mechanisms of universities and an adaptation of new models of internationalization that integrate regional cooperation and partnerships with other stakeholders streamline governance, and foster stronger partnerships between academia, industry, and civil society in the region and beyond.

The adoption of smart education and smart research strategies is an excellent opportunity for universities in the WB countries. Smart education leverages digital technologies, data analytics, and personalized learning to enhance educational outcomes, research and accessibility [70]. It empowers institutions to deliver flexible, student-centered learning experiences and research experiences. Smart education and smart research require capacity of staff students in digital skills, AI skills and greens, which should be included in national development strategies of WB countries.

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