

CHALLENGES OF THE UNIVERSITY OF MARIBOR IN THE AREAS OF EUROPEAN INTEGRATION, MICRO-CREDENTIALS, DIGITALISATION AND THE GREEN TRANSITION

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The third decade of the Bologna Process will be largely focused on the institutionalisation of the Common European Higher Education Area (EHEA). With the adopted University of Maribor Strategy 2021–2030, the university follows the most important guidelines of the Bologna Process. As a partner of the European Alliance ATHENA, it actively participates in the shaping of the EHEA. At the university, as part of the implementation of the Recovery and Resilience Plan (RRP) pilots, we are developing numerous pilot short courses. In the field of green transition, the university is successfully implementing 23 RRP pilot projects to ensure sustainable operations. The university is ahead of a building infrastructure investment cycle, which will involve twelve faculties over the next five years. The university is aware of the challenges posed by the development of artificial intelligence tools. Through its research work, it acts as a developer of artificial intelligence tools, while at the same time developing a culture of responsible use of artificial intelligence. By developing and implementing the INNOVUM platform, the university aims in the field of knowledge transfer to make a significant contribution to building the foundations for the development and innovation breakthrough of the Eastern Slovenia Cohesion Region.

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1 Universities as the Foundation of Society's Development Efforts at National and Global Levels

1.1 The Common European Higher Education and Research Area as the Key to Long-Term Successful Development of Europe's Economic and Social Space

With the accelerated process of globalization over the past 30 years and the rapid development achieved during this period, particularly by Asian countries, conditions in an increasingly globalized world have changed, along with the competitiveness of individual regions. The European Union, with its 27 member states and 448 million inhabitants, faces significant challenges in maintaining global economic competitiveness and its leading role in the world due to fragmentation, untapped potential, and the resulting lack of synergistic effects. In recent years, Europe's lag has become increasingly evident in several key technology areas, such as semiconductor technologies, quantum computing, artificial intelligence, photovoltaics, digital infrastructure, and cybersecurity, as well as in innovation and commercialization of innovations. Many of these technologies require adequate financial, infrastructural, material, and human resources for their development – resources that, due to fragmentation and often partial interests, individual member states have not been able to provide in the past, despite certain joint efforts, and consequently have not prevented falling behind in these areas. European policy has long recognized the challenges of maintaining global competitiveness and the need to pool development potential, especially in research and higher education. It seeks to achieve this by developing the European Research Area (ERA) and the European Higher Education Area (EHEA).

1.2 The Bologna Process as the Fundamental Building Block of the Common European Higher Education Area

The accelerated development of the common European Higher Education Area began with the signing of the Bologna Declaration in 1999 by ministers responsible for higher education from 29 European countries (European Higher Education Area [EHEA], 1999). The main goal of the Bologna Process was to establish a common European Higher Education Area. This area was officially launched in March 2010 during the ministerial conference in Budapest and Vienna, marking the 10th

anniversary of the Bologna Process. The key objectives of the Bologna Process at the time of signing the Bologna Declaration were related to harmonizing higher education systems in the signatory countries, introducing a three-cycle study structure, developing the European Credit Transfer and Accumulation System (ECTS), promoting mobility, ensuring quality and standards, and promoting the European dimension in higher education.

The first decade of the Bologna Process was a decade of transforming the European Higher Education Area in line with the guidelines for establishing the three-cycle study system. In the second decade, through activities such as student and staff exchanges under the Erasmus programme, the process of building trust among European higher education institutions began, primarily through mutual recognition of students' academic achievements completed at individual institutions during exchanges, the inclusion of visiting professors in the pedagogical process, and the implementation of joint study programmes. Through these activities, European higher education institutions acknowledged the equivalence and comparability of quality within the European Higher Education Area, paving the way for further development of the common area. Through periodic ministerial conferences (every two or three years) ministers responsible for higher education of the signatory countries of the Bologna Declaration have shaped government commitments to enable further steps in developing the common European Higher Education Area.

The third decade of the Bologna Process, as the decade of institutionalizing the common European Higher Education Area at the European level, is largely framed by the decisions of ministerial conferences in Paris (2018) (EHEA, 2018), Rome (2020) (EHEA, 2020a), and Tirana (2024) (EHEA, 2024). Ministerial communiqués and annexes adopted at these conferences provide further guidelines for the development of the common European Higher Education Area until 2030. Special emphasis is placed on strengthening the fundamental values of the common European Higher Education Area, such as academic freedom, integrity, and democratic governance of higher education institutions.

According to the established guidelines, by 2030 the European Higher Education Area will represent a space where students, staff, and graduates can move freely to study, teach, and conduct research. It will fully respect the fundamental values of higher education, democracy, and the rule of law, promote creativity, critical

thinking, free flow of knowledge, and expand opportunities offered by technological development for research-based and student-centred learning and teaching. It will be an inclusive, innovative, and interconnected European Higher Education Area.

The adopted communiqués recognize the potential of higher education institutions to foster significant social change (through improving knowledge, skills, and competences of students and society) and to contribute to sustainability, environmental protection, and other key goals. They also reaffirm the commitment of higher education institutions to motivate and guide students toward becoming active, critical, and responsible citizens, offering opportunities for lifelong learning and supporting them sustainably in their social roles.

European higher education is called upon to strengthen its role as a key actor in achieving the United Nations Sustainable Development Goals (SDGs) by 2030 (Spremenimo svet..., n.d.). Through its educational, research, and innovation capacities, it must significantly influence fundamental global objectives and contribute to achieving sustainable development goals.

At the last three ministerial conferences, ministers reaffirmed the importance of three key commitments of the Bologna Declaration, which are prerequisites for successful development and innovation in the European Higher Education Area. These are: the introduction of a three-cycle system of study programmes and degrees based on learning outcomes and the European Credit Transfer and Accumulation System (ECTS), compatible with the overarching qualifications framework of the European Higher Education Area (QF-EHEA), supporting the recognition of qualifications throughout the European Higher Education Area by implementing the Lisbon Recognition Convention and its principles, promoting a culture of quality in higher education through appropriate quality assurance procedures in line with the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG), adopted in 2005 by ministers responsible for higher education, based on a proposal prepared by the European Association for Quality Assurance in Higher Education (ENQA) in cooperation with the European Students' Union (ESU), the European Association of Institutions in Higher Education (EURASHE), and the European University Association (EUA). In 2015, a revised document of the Standards and Guidelines was approved (Evropsko združenje za zagotavljanje kakovosti, 2015).

The communiqués also include commitments to support, promote, and safeguard the values of academic integrity, institutional autonomy, student and staff participation in higher education governance, and public responsibility for higher education. These values are to be reflected in national legislation and implemented in practice.

Ministers also confirmed the importance of establishing an inclusive European Higher Education Area by 2030, capable of supporting a cohesive, sustainable, and peaceful Europe, where students at all stages of their learning journey are fully supported by policies ensuring access to and completion of higher education, regardless of their background or circumstances. They expressed support for higher education institutions in strengthening their contribution to society and local communities and committed to responding to sustainability goals (SDGs) and supporting a combination of face-to-face and online learning and teaching. A commitment was also made to ensure synergy with the European Education Area (EEA) and the European Research Area (ERA).

Based on the principles and guidelines for strengthening the social dimension of higher education in the European Higher Education Area (EHEA, 2020b), outlined in the Rome Communiqué of 2020, the conference in Tirana approved the document Indicators and Descriptors for the Principles of the Social Dimension of Higher Education in the European Higher Education Area (Bologna Follow-up Group, 2024) as the first comprehensive and consolidated framework for the social dimension in the European Higher Education Area. An important decision was also adopted to promote the improvement of data collection quality through participation in related initiatives such as Eurostudent. Directions were confirmed to support activities in the areas of the green and digital transition and lifelong learning, within which micro-credentials were identified as a new form of educational provision.

The impact of Artificial Intelligence (AI) on our society and economy, as well as on learning, teaching, assessment, and research, was recognized. The use of AI technology will require adaptation of existing practices and the development of new practices and policies at both institutional and systemic levels, while appropriately considering opportunities, risks, and challenges. Particular emphasis was placed on the ethical dimension in the development and implementation of AI and on

supporting ethical, trustworthy, responsible, and rights-based use of AI in learning, teaching, and research practice, with the aim of ensuring transparency, fairness, collaboration, and the well-being of students and staff.

In the field of student mobility, the promotion of physical mobility was identified as an important activity, with the goal of achieving at least 20% mobile students. To achieve this goal, it is essential to ensure secure data exchange in strengthening the recognition of acquired knowledge and skills, quality assurance, and mobility, as well as establishing interoperability standards that will facilitate easier student access to mobility opportunities and support services, such as the European Student Card initiative and the digital solution “Erasmus Without Paper”.

For further strengthening of the European Higher Education Area, it is necessary to achieve deeper integration and institutionalization of transnational cooperation, supported by the Erasmus+ programme, reinforced by Bologna tools and commitments, and by ensuring their implementation. It was recognized that initiatives at various levels, including European University Alliances, create new opportunities for academic communities and must involve student and staff participation in all decision-making processes. In this process, the European Commission’s communication on the plan for a European degree (European Commission, 2024) is also significant.

1.3 Strategy of the European University Association (EUA) “Universities without Walls: A Vision for 2030”

The strategy of the European University Association is an important document that largely sets the framework for the future development of universities in the European area and for strengthening their role in modern society.

The European University Association (EUA) published the document “Universities without Walls: A Vision for 2030” in 2021 (EUA, European University Association, 2021). This provides a comprehensive framework for the future development of universities in Europe. It emphasizes openness, sustainability, inclusiveness, and the need for strong, autonomous, and responsible institutions that will effectively serve society in the coming decade.

The vision defines the direction of university development up to 2030, enabling universities to address challenges in a rapidly changing world, such as the climate crisis, technological progress, geopolitical tensions, and growing inequality. It identifies key aspects of further development of universities, including openness, transformative capacity, and transnationality – universities must be open and connected to society, acting as physical and virtual spaces for collaboration and knowledge exchange. They should promote innovation in education, research, and engagement with the wider community. They must strengthen transnational cooperation that transcends borders, thereby enhancing learning, research, and the fulfilment of universities' missions. Universities should ensure sustainability, diversity, and engagement. Sustainability must be a fundamental principle influencing campus life, education, research, innovation, external activities, and internationalization. They should embrace diversity in all its forms and guarantee inclusion for all students, academic staff, and researchers, actively engage with their communities, and address societal challenges. Universities must be strong, autonomous, and responsible, with strong leadership and sufficient autonomy to effectively fulfil their mission. They should be accountable to society and uphold academic freedom and ethical standards in their operations.

The strategy “Universities without Walls” is not a blueprint for European policies but serves as a basis for dialogue and action within the European higher education area, primarily at national levels. This includes, among other things, reforming academic careers to recognize a broader spectrum of contributions and promote interdisciplinarity, strengthening civic engagement and the role of universities in addressing societal challenges, and fostering interoperability of learning opportunities among European higher education institutions.

The European Strategy for Universities, published by the European Commission in January 2022 (European Commission, n.d.), aligns with the EUA vision. The aim of the published strategy is to strengthen links between education, research, and innovation while building on the European Higher Education and Research Area. The published European strategy also highlights the importance of the principles described in the “Universities without Walls” strategy.

1.4 European University Alliances

The third decade of the Bologna Process will, in line with the guidelines of the ministerial conferences in Rome and Tirana and the European Universities Initiative (European Commission, Directorate-General for Education, Youth, Sport and Culture, n.d.), be largely focused on institutionalizing the European Higher Education Area at the European level through the operation of European university alliances. The goal is to establish federations of European universities in the first phase and the institution of a “European University” by 2030. Elements of this process also include the European degree, the European Student Card, and the implementation of the “Paperless Erasmus” project.

The European Universities Initiative, launched in 2019 as part of the broader Erasmus+ framework, formalized efforts to create sustainable transnational alliances (European Commission, Directorate-General for Education, Youth, Sport and Culture, n.d.). The initiative supports efforts to achieve key objectives, such as: establishing transnational university alliances that can collaborate on common educational goals and strengthen institutional cooperation, promoting European integration in higher education (strengthening the identity of European higher education and fostering a more connected European Education Area), cultural exchange (encouraging cultural understanding and exchange among students and staff from different European countries), strengthening European identity (fostering a sense of European identity and citizenship through educational experiences and shared values), improving quality and competitiveness (enhancing the quality and attractiveness of European higher education institutions globally and ensuring their competitiveness), promoting student mobility (increasing mobility of students and staff among participating institutions and attracting talent from outside the European Higher Education Area), developing joint study programmes (encouraging the development and recognition of joint programmes, enabling students to gain experience and qualifications at multiple universities during their studies), fostering research collaboration (pooling research capacities of partner universities to address societal challenges and contribute to knowledge and innovation), developing and implementing lifelong learning (raising awareness of lifelong learning and skills development to make education more adaptable to labour market needs), inclusion and accessibility (developing inclusive higher education within the European area) as well as digital transformation (promoting the use of

digital technologies and innovative teaching methods to improve learning experiences).

The European Commission allocates significant funding to support this initiative through programmes such as Erasmus+ and Horizon Europe and is preparing mechanisms for long-term stable financing in the coming years, aiming to establish a competitive, innovative, and digitally supported European Higher Education Area.

As of 2025, there are 65 European university alliances operating in Europe that have received funding from the Erasmus+ programme, one alliance with previous funding and an awarded Seal of Excellence, and seven alliances that have received the Seal of Excellence. In total, more than 640 higher education institutions from all parts of Europe are transforming higher education and significantly strengthening the process of building a common European Higher Education Area.

1.5 National Legislative Framework in Higher Education

The operation of higher education institutions at the national level is governed by two overarching laws – the Higher Education Act and the Scientific Research and Innovation Activities Act – taking into account long-term development strategies in the field of higher education (National Higher Education Programme 2030) and research activities (Research and Innovation Strategy of Slovenia 2021–2030). The first was adopted by the National Assembly in 2025, and the second in 2021.

1.5.1 National Higher Education Programme 2030

The National Higher Education Programme until 2030 (“Resolucija o nacionalnem programu visokega šolstva do 2030 (ReNPVŠ30)”, 2022) represents a strategic framework for the development of Slovenian higher education in the coming decade, aiming to create an accessible, high-quality, responsive, and internationally comparable higher education system that will contribute to a knowledge-based society.

The key strategic objectives of the programme are: improving quality, increasing responsiveness, flexibility, and attractiveness, strengthening international integration, increasing research and innovation intensity, enabling lifelong learning opportunities, and improving knowledge transfer to the environment.

The programme stipulates that achieving these strategic objectives will be possible through planned activities in the following areas: ensuring quality and excellence (raising the level and quality of higher education in Slovenia, promoting excellence in teaching and research, developing and updating study programmes according to societal and labour market needs, and ensuring quality education and student support), increasing responsiveness and flexibility (adapting the higher education system to the needs of the economy, non-economic sectors, and society as a whole, promoting interdisciplinarity and cooperation with other sectors, developing flexible forms of study and lifelong learning, considering and co-shaping digital transformation in education, research, and innovation), strengthening international integration (increasing the openness of higher education institutions to the international community, promoting mobility of students, teachers, and researchers, integrating into the European Higher Education Area and European university alliances, developing joint study programmes and cooperation with international institutions, adapting legislation to attract foreign experts and students), improving accessibility and inclusiveness (ensuring broad access to higher education for all, promoting social and regional inclusion in the academic process, developing support mechanisms for students from diverse backgrounds, enabling free study in all three cycles), increasing research and innovation intensity and knowledge transfer (promoting scientific research and artistic activities, strengthening links between research institutions and the economy, improving knowledge and innovation transfer to society), ensuring appropriate conditions for the operation of higher education institutions (amending legislation for a flexible and responsive higher education system, ensuring sufficient public funding, strengthening autonomy and accountability of higher education institutions, promoting high standards of academic culture and ethics).

1.5.2 Research and Innovation Strategy of Slovenia 2021–2030

The key focus of the Resolution on the Scientific Research and Innovation Strategy of Slovenia 2030 (“Raziskovalna in inovacijska strategija Slovenije 2021–2030 (ReZrIS30)”, 2022) is the transformation of Slovenia into an innovative, sustainable, and competitive knowledge-based society. The strategy provides a strategic framework that will guide public policies and investments in research, development, and innovation in Slovenia over the next decade, aiming to achieve ambitious development objectives and strengthen Slovenia’s position as an innovative country.

The strategy addresses key aspects of science and innovation development and focuses on setting objectives and implementing appropriate measures in the following key areas: advocating for excellent science as a prerequisite and guarantee for ecological, democratic, and socially just societal and economic development, ensuring an attractive research environment with an appropriate awarding system, establishing a system for identifying and developing potential in niche areas that can contribute to the development of society as a whole, shortening the path from scientific findings to societal implementation, guaranteeing freedom of scientific research through the autonomy of research organizations, organizing research work effectively and transparently, nurturing the next generation of top scientists, ensuring access to world-class international research infrastructure as well as technological, entrepreneurial-innovation infrastructure and e-infrastructure, and their continuous modernization, strengthening interdisciplinarity in research, ensuring transparent periodic international evaluation of research organizations, proactively introducing principles of open science and open innovation, and promoting polycentric and diversified development of research organizations.

1.5.3 Scientific Research and Innovation Activities Act

The Scientific Research and Innovation Activities Act (ZZrID), adopted in 2021, regulates the provision of public services in the field of research activities, including for higher education institutions (“Zakon o znanstvenoraziskovalni in inovacijski dejavnosti (ZZrID)”, 2021). The Act establishes important foundations for the more successful implementation of the mission of higher education institutions in scientific research, as it largely introduces a new framework for financing, organizing, and conducting scientific research and innovation activities. Its aim is to promote high-quality research and innovation, ensure conditions for achieving excellence, enhance the competitiveness of the economy, contribute to the development of knowledge and scientific potential in the Republic of Slovenia, strengthen international cooperation, and encourage open science and innovation.

The provisions of the Act grant higher education and research institutions greater operational and administrative freedom in planning and implementing research activities, while also setting clear mechanisms for accountability and transparency. In the area of research funding, the Act ensures an increase in public investment in research, development, and innovation, with the goal of achieving a competitive

ratio relative to GDP. It also defines co-financing mechanisms using EU funds and other sources to increase long-term stability and predictability of funding.

The Act pays significant attention to fostering collaboration between research and higher education institutions and the economy, aiming to improve the effectiveness of knowledge transfer into practice and to promote an innovation culture at various levels of society.

Since the Act grants autonomy in research to research institutions, it also defines measures to ensure a quality loop as a basic mechanism for improving the functioning of the research system. This includes systems for regular monitoring, self-evaluation and evaluation, and reporting on the effectiveness of research activities.

The Act emphasizes the importance of education and training of researchers and creating an attractive environment for work in research, as well as the importance of open access to scientific publications and data. Through specific provisions, it encourages the participation of Slovenian research organizations and researchers in international projects and networks.

1.5.4 Higher Education Act

In 2025, the National Assembly of the Republic of Slovenia adopted a new Higher Education Act. The text of the Act clearly recognizes the important role of higher education as one of the key drivers of social development, with the fundamental mission of strengthening and empowering citizens for personal growth, professional careers, and active citizenship, as well as for the spiritual, social, artistic, cultural, and economic development of the community (“Zakon o visokem šolstvu”, 2025). Therefore, higher education plays a central role in creating conditions for the sustainable development of a knowledge-based society and bears responsibility to fulfil its societal mandate, based on the trust expressed through constitutionally guaranteed autonomy, by performing its three core missions: research, education, and social engagement, and by achieving excellence in all three areas to contribute to scientific, economic, social, cultural, and democratic development.

The Higher Education Act (“Zakon o visokem šolstvu”, 2025) and the Scientific Research and Innovation Activities Act (“ZZrID”, 2021) together form the fundamental framework for the provision of public services in higher education. The Higher Education Act introduces key systemic solutions for ensuring long-term stable financing of higher education and defines comprehensive mechanisms for its implementation in the form of lump-sum financing. It sets the dynamics for increasing financial resources to the level of the projected GDP share, redefines the relationship between the basic and development pillars of funding, and introduces a new infrastructure pillar aimed at long-term provision of funds for the development and renewal of infrastructure capacities of higher education institutions. In line with the definition of public service in higher education, the Act redefines the workload of academic staff and specifies the implementation of sabbatical leave. It also broadens the possibilities for the use of foreign languages in higher education; however, due to the restrictions imposed, these possibilities will not allow Slovenian institutions to achieve the same level of internationalization as their counterparts in developed Western European countries. These limitations will hinder the full exploitation of potential for successful integration of Slovenian higher education institutions into European integration processes and their ability to operate even more effectively at the global level – primarily due to restricted opportunities for employing foreign experts, which are essential for internationalization of the Slovenian higher education, with the aim of ensuring brain circulation and talent attraction beyond Europe. The Act also provides a detailed framework for the operation of the National Agency for Quality in Higher Education and the procedure for granting concessions. It legally defines micro-credentials as short educational and training programmes aimed at acquiring specific knowledge, skills, and competences that meet social, personal, cultural, or labour market needs. Furthermore, it introduces provisions for organizing and implementing regular physical activity programmes for students during their studies, with emphasis on the first year of first-cycle study programmes. It also includes detailed provisions on gender equality, as well as prohibitions of sexual and other harassment and bullying.

The new legislative framework established by both Acts largely follows the guidelines of commitments adopted in ministerial conference communiqués and annexes, as well as strategic documents in the field of higher education issued by the European Commission. It represents an important step toward more successful integration of Slovenian higher education institutions into European integration

processes, enabling more equitable participation in European university alliances. However, due to the restrictions on the use of foreign languages in higher education and the resulting limitations on employing a larger number of foreign experts in the educational process, thus preventing a significant increase in research potential, the Act will not allow full exploitation of the internationalization potential of Slovenian higher education. This is crucial for achieving a sufficient number of highly educated professionals in Slovenia in the long term, which, given future demographic trends, is essential for ensuring global competitiveness of Slovenian society in the future as well.

It is also important that both Acts, together with the long-term development strategies (National Higher Education Programme until 2030 and Slovenian Scientific Research and Innovation Strategy 2030), are aligned with the Slovenian Development Strategy 2030 (Šooš et al., 2017) and complement other national strategic documents, such as: Slovenian Industrial Strategy 2021–2030 (Vlada Republike Slovenije, 2021), Slovenian Smart Specialization Strategy (*Slovenska strategija trajnostne pametne specializacije*, 2023), National Energy and Climate Plan (Vlada Republike Slovenije, 2024), National Environmental Protection Programme 2030 (“Resolucija o Nacionalnem programu varstva okolja za obdobje 2020–2030 (ReNPVO20–30)”, 2020), Digital Slovenia 2030 (Vlada Republike Slovenije, 2023), and National Programme to Promote the Development and Use of Artificial Intelligence in the Republic of Slovenia until 2025 (Vlada Republike Slovenije, 2021).

2 University of Maribor Strategy and Operational Challenges in the Next Decade

In 2021, the University of Maribor adopted the University of Maribor Strategy 2021–2030, outlining its development path for the new decade. The goals set are ambitious yet realistic and follow the vision of the university becoming a globally recognized innovation ecosystem where employees and students create with joy. The vision is aligned with the adopted strategic documents for the development of the common European Higher Education Area, as defined by commitments of governments expressed in communiqués adopted at ministerial conferences supporting the implementation of the Bologna Process. It is also consistent with the strategy of the European University Association “Universities without Walls”, the principles of the Magna Charta Universitatum 2020 (Magna Charta, 2020), and follows the guidelines

of the Research and Innovation Strategy of Slovenia 2021–2030 (“Raziskovalna in inovacijska strategija Slovenije 2021–2030 (ReZrIS30)”, 2022) and the National Higher Education Programme 2030 (“ReNPVŠ30”, 2022). The strategy is based on a commitment to creating an inclusive, innovative, and interconnected higher education space that will educate active, critical, and responsible citizens, ensure the quality of education and research, uphold academic integrity, and promote sustainable societal development (Univerza v Mariboru, 2021).

In the field of education, activities focus on creating an inclusive, research-based learning environment, fostering the use of innovative teaching methods and modern learning settings, establishing conditions for a student-centred learning process, and promoting lifelong learning. In the field of scientific and artistic activities, the university commits to research excellence and international comparability within the broader research space. This will be achieved primarily by strengthening creative interdisciplinary research cores in key research areas, ensuring sustainable, socially responsible, and high-quality development of scientific disciplines and research fields and sub-fields, in line with the principles of smart specialization, with an emphasis on addressing societal challenges. Internationalization goals are linked to strengthening the university’s international visibility, developing various forms of education in foreign languages, promoting international mobility of staff and students, and actively co-shaping the European Higher Education Area – particularly through initiatives and activities aimed at establishing a European university and through participation in the ATHENA European University Alliance.

2.1 ATHENA European University Alliance

The University of Maribor is a member of the ATHENA European University Alliance (Athena, 2024), which it also chairs in 2025. ATHENA is an alliance focused on advancing technology through higher education and innovative approaches. The ATHENA alliance consists of 9 universities from EU member states and one university from Ukraine. The EU member universities are: University of Maribor, Slovenia, Hellenic Mediterranean University, Greece, Maria Curie-Skłodowska University, Poland, Polytechnic Institute of Porto, Portugal, University of Orléans, France, University of Salento, Italy, University of Siegen, Germany, University of Vigo, Spain and Vilnius Gediminas Technical University, Lithuania. The Ukrainian member is Igor Sikorsky Kyiv Polytechnic Institute, Kyiv. The

ATHENA alliance brings together 96 faculties, with over 15,000 staff, more than 96,000 students, and 51 associated partners from industry, government, NGOs, and other public institutions.

The key objective of the alliance is to reduce fragmentation in Europe – closing the European gap related to regional socio-economic and technology-driven development – while promoting a transition to smart, sustainable, and inclusive growth, achieving global recognition, and ensuring conditions for successful brain circulation.

A distinctive feature of ATHENA is its integration of arts, social sciences, and humanities with natural and engineering sciences, fostering technological progress that holistically addresses social and environmental challenges. By leveraging interdisciplinarity, ATHENA combines fundamental and applied research and ensures deep engagement with regional communities. Interdisciplinarity and integration of all four missions – education, research, innovation, and social awareness – are mandatory in all activities, cooperation structures, and operational models.

Through the transfer of global knowledge and connections to local environments, the alliance aims to contribute to regional development. Using the complementary expertise of its members, ATHENA addresses three critical challenges: the technological gap between Europe and its global competitors, inequalities among European regions, and the need for a socially responsible, human-centred approach to technological development. ATHENA's thematic priorities are fully aligned with the RIS3 – Research and Innovation Strategies for Smart Specialization.

Medium-term goals of the alliance include developing ATHENA University study programmes, jointly delivered by member institutions, and establishing ATHENA University research cores in specific fields to pool top research capacities and achieve global competitiveness of ATHENA University in scientific research.

The alliance's activities are rooted in a commitment to European values – linguistic and geographic diversity supports its mission to foster shared understanding of European values and culture by embracing diverse identities. Increased mobility and transnational cooperation in all activities will help connect regions that differ

geographically, socially, and culturally, with a strong emphasis on social inclusion, diversity, and equality.

3 Micro-Credentials Will Transform the Approach to Acquiring New Knowledge and Skills

Technological development, the green transition, and economic and demographic changes are reshaping the global labour market, creating a need for lifelong learning and the acquisition of competences required for the future workforce. Higher education is also facing major changes, as traditional education for specific professions no longer provides the necessary resilience of the population to increasingly rapid changes. Competences are coming to the forefront, and higher education is being significantly complemented by lifelong learning. At the heart of these changes are micro-credentials – short educational programmes and training courses that enable the acquisition of specific knowledge, skills, and competences tailored to social, personal and cultural needs as well as labour market demands.

According to the World Economic Forum, 44% of the global workforce will require additional training or reskilling in the next five years, as two-fifths of their existing competences will be transformed or become obsolete between 2025 and 2030 (World Economic Forum, 2025). Data from the OECD (Organisation for Economic Co-operation and Development, 2023) show that currently only 40% of adults in Europe engage in lifelong learning. To address these challenges, the European Union (EU) adopted the Council Recommendation of 16 June 2022 on a European approach to micro-credentials for lifelong learning and employability (“Priporočilo Sveta z dne 16. junija 2022 o evropskem pristopu k mikrodokazilom za vseživljenjsko učenje in zaposljivost”, 2022), which provides the basis for developing flexible learning pathways in Member States, including integration into national qualification systems.

Following the Council Recommendation and within the framework of the Recovery and Resilience Plan, activities to promote lifelong learning and establish a unified micro-credential system in Slovenian higher education began in the second half of 2022. The University of Maribor approved the first version of its Guidelines for the Development of Micro-Credentials in June 2023 (Univerza v Mariboru, n.d.-b), taking a leading role and actively contributing to the preparation of the Guide for

Developing a Micro-Credential System in Slovenian Higher Education (Gergorić, 2024), published by the Ministry of Higher Education, Science and Innovation (MVZI) in cooperation with the National Agency for Quality in Higher Education (NAKVIS).

So far, the members of the University of Maribor have developed numerous pilot short courses under the Recovery and Resilience Plan (RRP), in collaboration with the labour market, to test different approaches to cooperation with the environment. There is strong interest from employers, both in co-designing the content of such educational courses and in training their employees.

Within UM's lifelong learning framework, various short programmes are being prepared, divided into non-accredited short courses without assessment of learning outcomes, non-accredited short courses with assessment of learning outcomes, and accredited short courses with assessment of learning outcomes and issuance of a micro-credential. Certificates for non-accredited short courses are issued by UM members in line with existing lifelong learning practices. For accredited short educational programmes and training courses for obtaining micro-credentials, a detailed process is defined for accreditation, modifications, implementation, issuance of micro-credentials, and evaluation procedures, based on established quality assurance standards in higher education and UM's internal quality management processes.

In developing short educational programmes and training courses for obtaining micro-credentials, we will adhere to the same standards as those applied in designing a course unit within a higher education study programme. Courses will be delivered by qualified higher education teachers with appropriate references in education. Once the legal framework is adopted, short educational programmes and training courses for obtaining micro-credentials co-designed with employers and aligned with labour market needs will be eligible for accreditation. After approval by the faculty senate, proposals will be reviewed by the UM Committee for Education and Study (KIS UM), which includes vice-deans for education, student representatives, and professional staff. The final decision will be made by the UM Senate. All accredited short educational programmes and training courses for obtaining micro-credentials will be published in UM's Lifelong Learning Catalogue. Participants will be registered in the Academic Information Subsystem (AIPS), which will store

records of accredited short educational programmes and training courses, participants, and issued micro-credentials. Participants will receive a UM digital identity, granting access to necessary university infrastructure. UM micro-credentials will be issued exclusively for accredited short educational programmes with verified learning outcomes, based on an approved syllabus. Gathering feedback from all stakeholders will be essential. Evaluation processes will involve learners, higher education teachers and staff, industry experts, and other relevant stakeholders. Quality assurance mechanisms for micro-credentials are crucial for their recognition by both learners and employers.

The University of Maribor sees micro-credentials as an enhancement of its lifelong learning offer and an opportunity to establish an innovative mechanism for long-term cooperation with industry and non-economic sectors. In this process, we strive to involve representatives from the working environment already at the stage of preparing the conceptual design of short educational programmes and training courses for obtaining micro-credentials. Direct involvement of external stakeholders is key to closing gaps regarding competences, fostering innovation, opening new career paths, and increasing the international competitiveness of the economy. Economic development depends on identifying key competences for future labour market needs. This challenging task can only be addressed through collaboration between researchers and employers, enabling faster transfer of research results into practice and creating new high-added-value jobs.

For the development of short educational programmes and training courses for obtaining micro-credentials, the University of Maribor emphasizes the need for a digital platform to connect information on competences acquired through study programmes and short courses with identified labour market and societal needs. As part of the university's Recovery and Resilience pilot project Agile Development of Education and Micro-Credentials, we have therefore undertaken the development of systemic support, the advancement of all forms of education supported by a competence framework, and the creation of a UM classification of competences. The process of accreditation, monitoring development, and ensuring the quality of study programmes and short courses will also be digitally supported. The platform will include a catalogue of courses to promote and facilitate enrolment in short courses. UM is also developing support for managing micro-credentials in the form of verifiable digital credentials.

The success of micro-credentials will depend on effective collaboration with external stakeholders and the establishment of a system ensuring quality, transparency, cross-border comparability, recognition, and transferability. Only then can micro-credentials reach their full potential. With an appropriate lifelong learning offer, participants will become more resilient to labour market changes, and the University of Maribor will responsibly contribute to the development of society as a whole which is its core mission.

4 Green Transition and Digitalization Processes

4.1 Green Transition

The University of Maribor is successfully implementing 23 pilot projects in the field of green transition aimed at ensuring sustainable operations (Univerza v Mariboru, 2022). These projects are funded by the Ministry of Higher Education, Science and Innovation. The university has made significant progress in adopting and introducing sustainability measures in communication and administration, including extensive use of electronic signatures, conducting parts of administrative procedures online, and eliminating the need for printing documents. Currently, 45% of laboratories/departments/centres at the university are actively engaged in green transition initiatives. All university members have included measures or guidelines for the green transition in their work plans or action plans (Murko, 2024). The experience of remote work during the pandemic has increased acceptance of virtual presence and videoconferencing, reducing the need for mobility which is particularly important for University of Maribor members located in other Slovenian regions, where travel requirements have been significantly reduced thanks to these options.

Over the past five years, the University of Maribor has significantly improved the energy efficiency of its buildings through investments in renovation and energy upgrades, especially in student dormitories. It is now entering a new investment cycle in building infrastructure: over the next five years, 12 university members will be included in projects involving sustainable and energy-efficient new constructions and renovations between 2025 and 2030, marking important steps toward achieving the set green transition goals.

Within the 23 pilot projects under the Recovery and Resilience Plan (RRP projects), university members are developing study content that integrates green transition topics to strengthen participants' green and digital competences. The activities are guided by the goal of piloting the transfer of essential and current expert knowledge from inside and outside the education system into formats that will enable diverse and flexible pathways for obtaining micro-credentials. The objectives also include updating study programmes with content that will enable graduates to acquire competences aligned with the modern needs of employers for the transition to a sustainable, circular, and digitalized economy – competences that will allow rapid and flexible employment across various fields and encourage graduates to engage in lifelong learning and actively participate in development activities for the green transition.

Key activities also include introducing paperless operations across all UM members, creating synergies for students, external stakeholders, and staff. By implementing paperless processes, the university supports systemic changes in higher education infrastructure through increased use of ICT and low-carbon ethical digitalization.

An important aspect of the green transition is raising awareness and empowering the academic community. Therefore, activities focus on systematic education of the academic community on green and digital topics. As part of these activities, sets of course units on environmental and digital empowerment will be implemented, providing heterogeneous learning content that will address the two fundamental areas – digital and green transition – from multiple perspectives. As part of the pilot project activities, a greater share of project-based, problem-oriented, and teamwork will be integrated into various study programmes, thereby fully or partially replacing traditional forms of pedagogical and independent student work with project-based, problem-oriented, and/or team work. Another major goal of pilot projects is establishing a single virtual entry point of the University of Maribor for employers and to develop innovative forms of cooperation between students and employers for an effective detection, adaptation and responsiveness of the University to the changing needs of the labour market in selected fields of educational and other activities, taking into account the principles of a green and digital transition to Society 5.0.

Through these RRP projects, UM is taking significant steps toward achieving the set green transition objectives. The university recognizes that achieving sustainable living goals requires collaboration across the entire academic and local community. UM will continue developing comprehensive strategies and action plans that encompass all aspects of sustainable living. Through the implementation of pilot projects under the Recovery and Resilience Plan, we will integrate sustainability practices into study programmes to a significant extent, thereby empowering students to address environmental challenges associated with green transition activities.

4.2 Ensuring Information Security

The pace of technological change is increasing. Organizations continue to invest in technologies to manage their operations and to execute their business processes more successfully and efficiently. At the same time, new systems are accumulating, such as those supporting remote work and those aimed at improving user experience. Simultaneously, there is a growing number of factors that threaten the confidentiality, integrity, and availability of information. The emergence of ever-new internet threats has become a constant challenge in ensuring stable, uninterrupted business operations and in managing pressures in today's environment. Such challenges also present an opportunity to develop a more proactive and comprehensive approach that would ensure a higher level of resilience.

Disruptive and often successful cyberattacks are more frequent, sophisticated, and effective than ever before, targeting organizations of all industries and sizes. Cybercrime is expected to reach the size of the world's third-largest economy – after the USA and China – by 2025 and, globally, will become a more profitable form of crime than all types of illegal drug trade (Morgan, 2024). Every day we read and hear about new cyberattacks, with increasingly advanced attack vectors emerging. Risk factors that must be managed in the field of information security to maintain the three fundamental pillars of security have long surpassed purely technological risks. Cybersecurity involves the application and implementation of a set of standards, frameworks, rules, recommendations, and practices that organizations use to protect their applications, data, programmes, networks, and systems from cyberattacks and unauthorized access.

First, it is necessary to understand the risks and plan measures for their management in a timely manner. The basic standard that defines risk management guidelines is ISO 31000, which also includes an annex with a practical guide for implementing this standard. ISO 31010 provides more detailed guidance on selecting and applying various techniques for risk assessment. The strength of these documents lies in their unified and systematic overview of principles and methods for risk management.

In the field of internationally recognized standards for ensuring information security, the leading family of standards is ISO 27000 (International Organization for Standardization, n.d.), with the first standard adopted as early as 2000. This is a collection of approximately one hundred standards covering areas such as: information security management, security risk management (complementing ISO 31010 and ISO 27005, which focuses solely on risk management within the 27001 framework), information security audits, definition of security controls (in networks, software), incident handling, and privacy assurance. These standards are regularly updated by the issuing body and are generally process-oriented. ISO standards themselves are not inexpensive, and to achieve compliance, expressed through a time-limited certificate, an organization must successfully undergo formal reviews or audits.

Another important group of standards in the field of information security comes from the U.S. National Institute of Standards and Technology (NIST). The SP 800.53 framework (National Institute of Standards and Technology, 2020) is based on five steps: Identify, Protect, Detect, Respond, and Recover. These standards offer numerous security controls, such as access controls, configuration management, information security awareness training, and incident response. More practically oriented is the NIST Cybersecurity Framework (CSF) (National Institute of Standards and Technology, 2024), which, based on the same five steps, provides a set of guidelines and best practices that organizations can use to identify, assess, and manage cybersecurity risks. Compared to the mentioned ISO standards, NIST recommendations are more specific and updated more frequently.

In addition to these groups of standards for ensuring information security, organizations often use recommendations from the Centre for Internet Security (CIS Controls), which aim to mitigate the most common cyberattacks on modern systems and networks. There are numerous mappings of these controls to the already

mentioned NIST CSF and other standards. The advantage of CIS recommendations lies in their practical application, as there are tools available that allow required configurations to be implemented relatively easily across different systems (CIS Benchmarks). Due to numerous technical limitations caused by such configurations, they are quite unpopular among system administrators.

Similarly, the MITRE ATT&CK® knowledge base can be used to ensure information security. It is a globally accessible database of attacker tactics and techniques. Its uniqueness lies in the fact that it is based on real-world observations. The knowledge base is used as a foundation for developing specific threat models and methodologies in the private sector, government institutions, various developer communities, and cybersecurity service providers.

In the area of controls, the most widely adopted tool is COBIT (first version published already in 1996), a framework for managing and governing information technology. It is a collection of best practices and procedures for achieving an organization's strategic objectives through effective use of available resources and minimizing IT risks. COBIT is a process-oriented tool that divides IT operations into four domains and more than 30 processes. It is harmonized with other standards and best practices, including the ISO family, as well as CISO, ITIL, CMMI, TOGAF, and PMBOK. Importantly, the latest versions are also aligned with the IT Assurance Framework (ITAF), which significantly increases transparency.

For data protection and cybersecurity risk management, the EU prescribes several directives and regulations, such as GDPR, DORA, and NIS-2, which generally impose relatively strict requirements. However, compliance with specific regulations depends on the industry or other criteria (e.g., company size). For example, NIS-2 requirements focus on critical and essential service providers. Additionally, Europe has tightened oversight of Internet of Things (IoT) devices through the Cyber Resilience Act. NIS-2 requires member states to strengthen their cybersecurity capabilities while introducing measures for risk management and reporting obligations for entities across multiple sectors. It also sets rules for cooperation, information sharing, supervision, and enforcement of cybersecurity measures. Obligated entities must adopt proportionate technical, operational, and organizational measures to ensure cybersecurity, including securing the entire lifecycle of all products involved in IT solutions. Key measures include managing

and preventing exploitation of technical vulnerabilities, ensuring and maintaining logging, implementing and managing data backups, and identity and access management. Most of these regulations also focus on the consequences of cybersecurity incidents, including how incidents are reported and how organizations provide assurance of their recovery capabilities. It is particularly important to emphasize that the NIS-2 directive explicitly introduces top management accountability for non-compliance with cybersecurity risk management measures.

Today's information security programmes encompass creating an appropriate security culture and awareness, mature information security management, risk management, meeting security requirements for compliance, reducing supplier and third-party risks, implementing zero trust, vulnerability and threat management, secure cloud services, modernizing identity and access management, preparing for ransomware attacks and other security incidents, achieving required levels of personal data protection, and generally improving security posture and data exposure (Info-Tech research group, n.d.).

Initiatives at both organizational and local levels aimed at strengthening secure behaviour and culture, managing third-party risks related to generative artificial intelligence, and improving companies' perception of cybersecurity represent an exceptional opportunity for organizational leaders. Collaboration between IT managers and business executives in addressing these areas can deliver a dual benefit: it promotes secure business transformation and builds resilience within the organization. When preparing security plans, we must do more than blindly follow best-practice frameworks or standards. Only a proactive information security strategy that is comprehensive, risk-aware, and aligned with business needs can help us manage emerging and future changes. Recently, artificial intelligence has transformed the "security landscape," and organizations will also need to protect themselves against increasingly sophisticated threat actors. New attack vectors and methods, such as deepfakes and quantum computing, require more than reactive behaviour. One of the greatest challenges in the ICT industry is ensuring adequate, competent personnel, especially in the field of cybersecurity. It is particularly concerning that Slovenia faces the most significant difficulties among all EU countries in attracting ICT professionals (Varga, 2024).

4.2.1 Ensuring Information Security at the University of Maribor

In 2013, following a public consultation, the Senate of the University of Maribor adopted the Information Security Policy (ISP) with a clearly defined goal "to ensure uninterrupted and secure operations of UM and to reduce damage by preventing and mitigating the consequences of undesirable information security events." The ISP is aligned with the recommendations of the ISO 27001 family of standards and applies to all users of the university's information system. Controls were defined by areas, and compliance was verified at least once a year. User identity and access management has been fully automated for over a decade. Annual external information security checks (penetration tests) are carried out, as well as user training on information security awareness, although participation is not formally required.

A significant milestone in raising awareness of information security occurred after a security incident in October 2024, which disabled the operation of the university's computer system. All user-facing systems and services were fully restored, and data was recovered without loss or leakage. The incident enabled something previously unattainable – the immediate implementation of two-factor authentication for system logins, which did not cause resistance among users accustomed to working in a much less regulated environment.

Undoubtedly, the University of Maribor will need to significantly strengthen its efforts to establish an effective information security system, including building a competent internal team. Although the university is not currently subject to European information security directives (e.g., NIS-2), it is advisable to adhere to these principles.

While the existing ISP remains fully relevant and without major shortcomings, it will be updated this year. It will be necessary to establish information security management systems and a business continuity management system, based on a prior risk analysis. Recovery and restoration plans must undergo regular testing and validation. Regular external security audits and ongoing training will continue. A key requirement will be maintaining the definition of system owners (already specified in the current ISP), their role in risk identification and analysis, and the execution of system ownership tasks. Roles of internal departments (such as the legal office or

public relations office) must be defined in the incident response plan, with clear RACI assignments (Responsible, Accountable, Consulted, and Informed).

Approved policies and prepared plans are not enough – enhanced resilience requires continuous monitoring of risks and the effectiveness of necessary measures, as well as regular reviews. This cannot be achieved without a deliberate strengthening of capabilities (a critical shortage of internal IT staff has been identified) and long-term provision of conditions for systematic implementation of required activities and technical measures.

4.3 Artificial Intelligence in University Operations

With its ability to communicate with humans, recognize and classify patterns, recreate artistic content, learn, and rapidly evaluate decision-making strategies, artificial intelligence has long fascinated the broader public. This raises the question of how current and future advancements in AI can be applied in research and pedagogical processes, as well as in the overall functioning of the university. In this context, artificial intelligence is understood as autonomous computer systems capable of learning, reasoning, problem-solving, pattern recognition, and adapting to new situations or planning and providing suggestions that assist humans in decision-making. The implementation of such systems is mostly based on domain-specific learning, which enables pattern recognition in the present and future predictions based on past examples. The usefulness of AI extends to virtually all areas of human activity. However, caution is necessary, as so far we have only developed systems of so-called weak AI, which can learn to perform specific tasks from past patterns but cannot transfer learned knowledge across domains, reason on that basis, or form their own opinions. The effectiveness of AI is therefore directly dependent on the quality and scope of the data used for its learning. A lack of similar patterns in the past results in guesswork, while errors in learning data lead to errors in processing current patterns. It is no surprise that AI applications have achieved the greatest success in areas with abundant learning data. Among these are also educational processes.

Explainable AI describes approaches and tools that allow humans to understand the principles behind AI decision-making. Such systems can be evaluated and, to some extent, corrected. They can incorporate mechanisms to ensure security, privacy, and

adherence to ethical and moral principles. At the same time, these approaches enable the discovery of hidden patterns within learning examples and potentially uncover new knowledge. Explainable AI thus has a significant impact on research processes and science in general. It allows simplified analysis of vast amounts of experimental data and helps distinguish complex interactions among various influencing factors that define observed processes and natural or social phenomena. The European Commission recognizes this, defining AI as a catalyst for scientific breakthroughs and a key instrument in the scientific process.

Recently, the European AI strategy was introduced (European Commission, 2018), aiming to position the EU as a leader in AI development and ensure that AI is trustworthy and human-centred. This strategy includes substantial investments in the development of computational capacity, software, and solutions across different levels of technological maturity. Computational and software infrastructure is thus becoming essential research equipment – future research will be unimaginable without it. The race is on, and our competitors recognize the importance of AI and are rapidly developing internal capacities for its use. Software infrastructure is evolving into an enabling technology and a horizontal component, no longer limited to technological and natural sciences but increasingly supporting social sciences and humanities.

Until now, intellectual work was understood as requiring specific knowledge for planning, problem-solving, calculation, creation, management, control and other activities involving complex thinking. In doing so, we have largely treated as an intellectual work any activity involving the above activities, regardless of which of these it required and to what extent. AI systems introduce the need for a new perspective on intellectual work. The core of today's AI systems consists of statistical classifiers, meaning they do not truly understand the data they process. Thus, current AI systems can only perform routine intellectual tasks that do not require contextual understanding – essentially, intelligence without reason. Using AI systems in performing various tasks today reveals the extent to which these tasks, which we have often understood as intellectual work, can be performed simply by taking into account narrower or broader contexts and recognizing patterns within them, without the need to understand the content of the work. It is worth pointing out, that some of these tasks can still be highly complex.

In the future, it will be useful to distinguish between parts of intellectual work that can be classified as intellectual routine (not requiring contextual understanding) and parts that involve innovation and creativity, requiring complex reasoning and contextual understanding.

This distinction is important because AI systems are expected to take over most tasks that can be performed through intellectual routines. Future AI development and its practical application will likely reveal the extent of intellectual routine in many tasks previously considered intellectual work. While AI will relieve humans of much routine work – including intellectual tasks – the degree of routine and the necessity of human involvement in producing final results will raise the bar for human competitiveness, requiring greater innovation, creativity, and the ability to understand complex problems. At today's level of AI development, the added value of human work will primarily lie in understanding AI-generated results and in innovative and creative thinking.

4.3.1 AI Systems and the Labour Market

The rapid development of AI systems and the exponential growth of their applications in recent years will soon have a major impact on the disappearance of certain professions, at least in the form we know them today, while also enabling the emergence of new ones.

According to calculations by the World Economic Forum (WEF) in its April 2023 report (World Economic Forum, 2023), 14 million jobs worldwide will disappear by 2030, and a quarter of all jobs will undergo significant changes. By 2027, 69 million new jobs are expected to be created. However, the report also states that by the same year, 83 million jobs will disappear. This means a net decrease of 14 million jobs, or about 2% of all currently employed workers. According to the report's projections, the greatest changes can be expected in the entertainment and media industry, while the smallest changes will occur in hospitality and tourism.

Given the highly dynamic development of the labour market in the coming years and the anticipated major changes, it is crucial to understand the new threshold of workforce competitiveness introduced by emerging AI systems for various professions. In light of the World Economic Forum's (2023) predictions about the

future labour market, an important question arises: what skills were required for the 83 million jobs expected to disappear in the coming years and what skills and competences will be needed for the 69 million newly created jobs. Equally important is the question of how many of the 83 million workers losing their jobs will possess the necessary skills to fill any of the newly created 69 million positions. More than ever before, we must also ask how many of those displaced by AI systems will even be able to acquire the skills required for these new jobs. Considering the tasks that AI systems will take over, it is expected that the new jobs will primarily require skills that go beyond intellectual routine – namely, creative work, understanding complex problems, and innovative thinking. This undoubtedly poses significant new challenges for all generations and employee profiles.

4.3.2 AI Systems and Education

The widespread availability of large generative language models has had a significant impact on education as well. When these models first appeared, concerns were raised primarily about their negative effects and potential misuse, which could harm the quality of education. The current level of AI development cannot be ignored, nor can its continued evolution and application across various fields be prevented. Therefore, banning AI tools in education is not a sensible approach; instead, it is essential to understand their added value and integrate them into teaching in a way that enables the achievement of desired knowledge, competences, and skills.

Recent analyses show that over 85% of students have already used AI tools during their studies, while more than 50% use them regularly, at least once a week (Rong & Chun, 2024). Generative AI leads the way, helping students create summaries of study material, practice quizzes for exam preparation, and detailed explanations of content through dialogue. Although it is now clear that, due to the aforementioned limitations, weak artificial intelligence cannot replace humans in the learning process, it can nevertheless help us find the information we are looking for much more quickly and efficiently. We can reasonably expect that continued development will improve the reliability of these systems and, consequently, the accuracy of the information they provide. At all stages of the learning process, the focus can shift from dry presentation of facts and properties of learning entities to explaining their broader context, the reasons behind these properties, and their application in addressing today's challenges, thus greatly improving learning efficiency. In this

context, a noticeable trend toward personalized learning has already emerged, enabling learning at an individualized pace and in a way that best suits each learner. Intelligent mentoring systems, virtual assistants, and automated grading save time for educators and provide more accurate and consistent feedback. However, we must not overlook the ethical questions present in both teaching and research processes. Today, significant effort is invested in developing principles for ethical use and building trust in AI through explainable AI concepts.

In May 2023, the University of Maribor prepared guidelines for using generative AI tools in the pedagogical process (Univerza v Mariboru, Oddelek za izobraževanje in študij, 2023). These guidelines emphasize the need to strengthen awareness of responsible AI tools use in the pedagogical process and to remind all participants that the goal of education is the journey, not just the destination that we reach at the end. It is along this journey that we acquire the knowledge, skills, and competences necessary to achieve the desired outcome. Today, more than ever, we must recognize that using tools like ChatGPT can often deprive us of the path we should – or must – take ourselves. This also means losing the essential knowledge, skills, and competences that form the core of education. The key challenge ahead is how to use these tools while still walking the necessary path toward the goal. We must understand that there are no shortcuts to knowledge.

Moreover, as AI tools evolve, education will not become simpler, it will become more demanding. To remain competitive in the future labour market, students will need to acquire knowledge, skills, and abilities that go beyond intellectual routine. Given the current and anticipated capabilities of AI systems, a logical question arises whether understanding complex problems, innovative thinking, and creative work is possible without mastering intellectual routines.

4.3.3 Future Societal Development and the Inevitable Synergistic Operation of Various Technologies

The development of artificial intelligence tools will significantly influence the future evolution of society. Due to the rise and widespread use of large generative language models, which have deeply penetrated public awareness, society increasingly realizes that, to ensure successful sustainable development, it must act immediately to prevent or at least limit the misuse of these technologies and avoid, as much as

possible, the developmental pitfalls they bring. The demonstrated capabilities of AI systems, especially large generative language models, and the resulting predictions about their potential applications have caused considerable surprise in the society, mainly because these systems “threaten” a range of professions requiring a high level of education. Previous expectations regarding automation and robotics mostly suggested that modern technological development, like in the past, would primarily endanger jobs requiring lower levels of education.

Nevertheless, it is essential to recognize that the future will not be shaped by AI systems alone; rather, they will often be used in combination with other emerging technologies. Among these are wireless communication technologies such as 5G, 6G, and 7G. The 5G technology (already well established today) offers significantly higher data transfer capacities and lower latency (below 5 ms) with greater energy efficiency. This will enable much broader use of these technologies in industrial process automation and the development of the Internet of Things (IoT). The realization of the Industry 4.0 concept (full automation of production through so-called “dark factories,” where manufacturing processes occur without human workers), the development of autonomous devices and vehicles, and humanoid robots – all heavily incorporating AI systems – will also greatly impact professions requiring lower education levels and primarily involving physical and/or intellectual routines. The Industry 5.0 concept (similar to Japan’s Society 5.0) largely stems from the fact that AI systems, next-generation communication technologies, and automation and robotics processes in manufacturing and society will to a large extent take over tasks requiring routine intellectual or physical work. Human roles in such a society will primarily focus on purely creative and innovative work and on understanding and managing complex problems.

Therefore, continuous evaluation of the human role in modern society, its ability to coexist with rapidly evolving technology, and proactive resolution of key Society 5.0 issues will be crucial to avoid societal unpreparedness for new technological challenges, especially their negative effects, which we experienced on a much smaller scale with the rise of social media, and the harmful consequences feared with the advent of AI systems. The responsibility of universities – as autonomous educational and research institutions – toward society in fulfilling their mission will thus become even greater. They will need to educate professionals capable of surpassing the threshold of intellectual routine and empowered to use AI tools effectively, while

also developing responsible science to provide solutions that minimize misuse and technological pitfalls.

Artificial intelligence will undoubtedly have a profound and lasting impact on the development of universities and fundamentally transform some key operational processes. Adaptations to this reality are inevitable. It is up to us to implement them timely, strategically, and effectively, and to use them to become better. Greater flexibility, simplification of administrative procedures, and data-driven decision-making in management processes are guiding principles that must also be pursued in the operations and functioning of the university as an institution.

5 Collaboration with the Environment and Effective Transfer of Knowledge and Technologies in the Future

Collaboration with the economy and the social environment, as well as the effective transfer of knowledge and technologies, have been and remain key commitments of the University of Maribor in fulfilling its third mission.

Successful cooperation and support for the activities of researchers and students of the University of Maribor in the field of knowledge and technology transfer (Univerza v Mariboru, n.d.-a) is provided by the Knowledge and Technology Transfer Office in cooperation with other university services. The Office successfully manages knowledge transfer activities also within the largest business support network, the Enterprise Europe Network, of which the University of Maribor is a part and which has established contact points in more than 60 countries worldwide.

The University of Maribor is the coordinator of the DIGI-SI consortium, the purpose of which is to actively accelerate the digital transformation of the economy and the public sector. Within the project, the university offers a wide range of services that help companies and the public sector in their digitalization efforts.

5.1 Technological Innovation Centre of the University of Maribor – INNOVUM Platform

To achieve even more successful collaboration and transfer of knowledge and technologies to the environment, the University of Maribor has developed the concept of the INNOVUM platform as a systemic solution (INNOVUM, 2025). The platform consists of three pillars: human resources and RDI projects (operating in accordance with the principles of open science), research infrastructure (providing open access to public high-tech research infrastructure), and a supportive environment (Technological Innovation Centre – support for open innovation).

By establishing the Technological Innovation Centre, the University of Maribor will provide effective central infrastructural support for scientific research and innovation processes, as well as for the transfer of knowledge and technologies to the environment. The Technological Innovation Centre will primarily focus on supporting breakthrough high-tech entrepreneurial projects driven by innovation and research, carried out by new and established companies that represent 3–4 percent of the business population. By providing spatial infrastructure, research and development human resources, top-tier research equipment, and various services in the fields of innovation, intellectual property protection, and the development of a supportive environment programme, the key conditions will be created for achieving effective knowledge and technology transfer in the segment of breakthrough innovations and beyond.

The development of the INNOVUM platform represents an important contribution of the University of Maribor to building the foundations for development and innovation breakthroughs in the cohesion region of Eastern Slovenia through the lens of economic development.

References

- Athena. (2024). *Athena University*. <https://athenauni.eu/athena-2024/>
- Bologna Follow-up Group. (2024). *Indicators and descriptors for the principles of the social dimension in the European Higher Education Area*. https://ehea.info/Immagini/BFUG_WG_on_SD_Indicators_and_Descriptors_4.3_2024_-_FINAL_.pdf

- EHEA, European Higher Education Area. (1999). *The Bologna Declaration of 19 June 1999*. https://ehca.info/media.ehea.info/file/Ministerial_conferences/02/8/1999_Bologna_Declaration_English_553028.pdf
- EHEA, European Higher Education Area. (2018). *Paris Communiqué: Paris, May 25th 2018*. https://ehca.info/media.ehea.info/file/2018_Paris/77/1/EHEAParis2018_Communique_final_952771.pdf
- EHEA, European Higher Education Area. (2020a). *Rome Ministerial Communiqué: EHEA Rome 2020*. https://ehca.info/Upload/Rome_Ministerial_Communique.pdf
- EHEA, European Higher Education Area. (2020b). *Rome Ministerial Communiqué: ANNEX II: EHEA Rome 2020: Principles and Guidelines to Strengthen the Social Dimension of Higher Education in the EHEA*. https://ehca.info/Upload/Rome_Ministerial_Communique_Annex_II.pdf
- EHEA, European Higher Education Area. (2024). *Tirana Communiqué: Tirana Ehea Ministerial Conference 29–30 May 2024*. <https://ehca.info/Download/Tirana-Communique.pdf>
- EU initiative. (2019). *European Universities Initiative*. <https://education.ec.europa.eu/education-levels/higher-education/european-universities-initiative>
- EUA, European University Association. (February 4, 2021). *Universities without walls – A vision for 2030*. <https://www.eua.eu/publications/positions/universities-without-walls-eua-s-vision-for-europe-s-universities-in-2030.html>
- European Commission. (n. d.). *Communication from the Commission on a European strategy for universities*. <https://education.ec.europa.eu/sites/default/files/2022-01/communication-european-strategy-for-universities-graphic-version.pdf>
- European Commission. (2024). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A blueprint for a European degree*. https://education.ec.europa.eu/sites/default/files/2024-03/European_Degree_Communication_Graphic_Version_EN.pdf
- European Commission, Directorate-General for Education, Youth, Sport and Culture. (n. d.). *European Universities initiative*. <https://education.ec.europa.eu/education-levels/higher-education/european-universities-initiative>
- European Commission. (2018). *Umetna inteligenca za Evropo [Artificial Intelligence for Europe]*. <https://eur-lex.europa.eu/legal-content/SL/TXT/PDF/?uri=CELEX:52018DC0237>
- European Association for Quality Assurance in Higher Education. (2015). *Standardi in smernice za zagotavljanje kakovosti v evropskem visokošolskem prostoru (ESG) [Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG)]*. https://www.enqa.eu/wp-content/uploads/filebase/esg/ESG%20in%20Slovenian_by%20SQAA-NAKVIS.pdf
- Gergorič, I. (2024). *Vodnik za razvoj sistema mikrodokazil v slovenskem visokem šolstvu*. Ministry of Higher Education, Science and Innovation; Slovenian Quality Assurance Agency for Higher Education. https://moja.um.si/vsezivljenjsko-ucenje/Documents/2024.12-Vodnik_za_razvoj_sistema_mikrodokazil_v_Slovenskem_visokem_solstvu.pdf
- Rong, H., & Chun, C. (2024). *A report on Digital Education Council AI Student Survey 2024*, Digital Education Council, 2024. <https://26556596.fs1.hubspotusercontent-eu1.net/hubfs/26556596/Digital%20Education%20Council%20Global%20AI%20Student%20Survey%202024.pdf>
- Info-Tech research group. (n. d.). *Security & Research Center: A holistic approach to building an agile, robust security program*. <https://www.infotech.com/research-centers/9>
- INNOVUM. (2025). INNOVUM Platform. <https://www.um.si/prenos-znanja/tehnoloski-inovacijski-center-univerze-v-mariboru-innovum/>
- International Organization for Standardization. (n. d.). *ISO/IEC 27000 family – Information security management*. <https://www.iso.org/standard/iso-iec-27000-family>
- Magna Charta. (2020). *Magna Charta Universitatum 2020*. <https://www.magna-charta.org/magna-charta-universitatum/mcu2020>
- Morgan, S. (2024). Top 10 cybersecurity predictions and statistics for 2024. *Cybercrime Magazine*. <https://cybersecurityventures.com/top-5-cybersecurity-facts-figures-predictions-and-statistics-for-2021-to-2025/>

- Murko, A. (2024). *Zelena Univerza v Mariboru: Master's Thesis*. Univerza v Mariboru, Filozofska fakulteta. <https://dk.um.si/IzpisGradiva.php?lang=slv&id=90898>
- National Institute of Standards and Technology. (2020). *Security and privacy controls for information systems and organizations*. <https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-53r5.pdf>
- National Institute of Standards and Technology. (2024). *The NIST Cybersecurity Framework (CSF) 2.0*. <https://doi.org/10.6028/NIST.CSWP.29>
- OECD – Organisation for Economic Co-operation and Development. (2023). *OECD Skills Outlook 2023: Skills for a Resilient Green and Digital Transition*. OECD Publishing. <https://doi.org/10.1787/27452f29-en>
- Priporočilo Sveta z dne 16. junija 2022 o evropskem pristopu k mikrodokazilom za vseživljenjsko učenje in zaposljivost. (2022). *Uradni list Evropske unije*, (C 243/02), [https://eur-lex.europa.eu/legal-content/SL/TXT/PDF/?uri=CELEX:32022H0627\(02\)](https://eur-lex.europa.eu/legal-content/SL/TXT/PDF/?uri=CELEX:32022H0627(02))
- Republika Slovenija. (2021). *Nacionalni program spodbujanja razvoja in uporabe umetne inteligence v Republiki Sloveniji do leta 2025 (NpUI) [National Programme to Promote the Development and Use of Artificial Intelligence in the Republic of Slovenia until 2025 (NpUI)]*. <https://www.gzs.si/Portals/Panoga-ZIT/Vsebine/novice-priponke/NpUI-SI-2025.pdf>
- Resolucija o nacionalnem programu visokega šolstva do 2030 (ReNPVŠ30) [Resolution on the National Higher Education Programme until 2030 (ReNPVŠ30)]. (2022). *Uradni list RS*, (49/22).
- Resolucija o znanstvenoraziskovalni in inovacijski strategiji Slovenije 2030 (ReZrIS30) [Resolution on the Scientific Research and Innovation Strategy for Slovenia 2030 (ReZrIS30)]. (2022). *Uradni list RS*, (49/22).
- Resolucija o Nacionalnem programu varstva okolja za obdobje 2020–2030 (ReNPVO20–30) [Resolution on the National Environmental Protection Programme for the period 2020–2030 (ReNPVO20-30)]. (2020, 2022). *Uradni list RS*, (31/22). <https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/2011-01-1974>
- Slovenska strategija trajnostne pametne specializacije [Slovenian Smart Specialization Strategy]*. (2023). https://evropskasredstva.si/app/uploads/2024/02/Strategija-S5_verzija_1_1.pdf
- Spremenimo svet: Agenda za trajnostni razvoj do leta 2030 [Transforming our world: the 2030 Agenda for Sustainable Development]*. (n.d.). https://www.gov.si/assets/ministrstva/MZZ/Dokumenti/multilateral/razvojno-sodelovanje/publikacije/Agenda_za_trajnostni_razvoj_2030.pdf
- Šooš, T., Lautar, K., Urbančič, H., Kobe Logonder, N., Kmet Zupančič, R., & Fajjić, L. (Eds.). (2017). *Strategija razvoja Slovenije 2030 [Slovenian Development Strategy 2030]*. Služba Vlade Republike Slovenije za razvoj in evropsko kohezijsko politiko. https://www.gov.si/assets/ministrstva/MKRR/Strategija-razvoja-Slovenije-2030/Strategija_razvoja_Slovenije_2030.pdf
- Univerza v Mariboru. (n.d.-a). *O raziskovanju [About research]*. <https://www.um.si/raziskovanje/oraziskovanju/>
- Univerza v Mariboru. (n. d.-b). *Smernice za razvoj mikrodokazil na Univerzi v Mariboru: različica 2.0. [Guidelines for the Development of Micro-Credentials: version 2.0]*. https://moja.um.si/vsezivljenjsko-ucenje/Documents/2024.01.18-Smernice_za_razvoj_mikrodokazil_na_UM_2.0.pdf
- Univerza v Mariboru. (2021). *Strategija Univerze v Mariboru 2021–2030*. University of Maribor Press. <https://doi.org/10.18690/978-961-286-443-9>
- Univerza v Mariboru. (September 5, 2022). *Pilotni projekti Univerze v Mariboru za zelen in odporen prehod v Družbo 5.0*. <https://www.um.si/objava/pilotni-projekti-univerze-v-mariboru-za-zelen-in-odporen-prehod-v/>
- Univerza v Mariboru, Oddelek za izobraževanje in študij. (2023). *Uporaba generativnih orodij umetne inteligence v pedagoškem procesu [Using Generative AI Tools in the Pedagogical Process]*. https://moja.um.si/en/study/Documents/Smernice_za_uporabo_UI_v_pedagoskem_procesu_16.5.2023_final.pdf

- Varga, M. (October 20, 2024). Delovna sila postaja vedno večji izziv. *Glas gospodarstva*.
<https://glasgospodarstva.gzs.si/delovna-sila-postaja-vedno-vecji-izziv/>
- Vlada Republike Slovenije. (2021). *Slovenska industrijska strategija 2021–2030* [Slovenian Industrial Strategy 2021 – 2030]. Ministrstvo za gospodarski razvoj in tehnologijo.
<https://www.gzs.si/Portals/206/Slovenska%20industrijska%20strategija.pdf>
- Vlada Republike Slovenije. (2023). *Digitalna Slovenija 2030: Krovna strategija digitalne preobrazbe Slovenije do leta 2030* [Digital Slovenia 2030: Overarching Strategy for the Digital Transformation of Slovenia by 2030]. https://www.gov.si/assets/ministrstva/MDP/Dokumenti/DSI2030-potrjena-na-Vladi-RS_marec-2023.pdf
- Vlada Republike Slovenije. (December 18, 2024). *Posodobljeni celoviti nacionalni energetske in podnebni načrt Republike Slovenije* [Updated Comprehensive National Energy and Climate Plan of the Republic of Slovenia]. https://www.energetika-portal.si/fileadmin/dokumenti/publikacije/nepn/dokumenti/nepn2024_final_dec2024.pdf
- World Economic Forum. (2023). *The Future of Jobs Report 2023*. <https://www.weforum.org/publications/the-future-of-jobs-report-2023/in-full/executive-summary/>
- World Economic Forum. (2025). *Future of Jobs Report 2025: Insight report: January 2025*.
https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf
- Zakon o znanstvenoraziskovalni in inovacijski dejavnosti (ZZrID) [Scientific Research and Innovation Activities Act (ZZrID)]. (2021, 2023, 2024). *Uradni list RS*, (186/21, 40/23, 102/24).
- Zakon o visokem šolstvu (ZViS) [Higher Education Act (ZViS)]. (2025). *Uradni list RS*, (67/25).

