

An Overview of Indicators Related to Innovation and Competitiveness

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Abstract - In the 21st century, innovation is becoming one of the most important tools for sustainable economic development, providing a competitive advantage for economic organisations and contributing to the solution of social and environmental challenges. Innovation and competitiveness are closely linked. However, in this study, we did not attempt to provide a complete presentation of the two concepts, as a significant part of the literature analysis has already been done so. Our study focuses on understanding the two concepts and making them "tangible" through literature and indicators. We have attempted to review the international innovation and competitiveness indicators created by various organisations. In our changing world, we need indicators that reveal the national and regional aspects of the innovation and competitiveness performance of nations and regions. We have presented this in a short study.

Keywords — *innovation, competitiveness, rankings, review, performance.*

INTRODUCTION

The topic of competitiveness is constantly present in public conversation, and the average person is coming across it more, whether through political events or economic news. The question may be raised why we come across this concept so often. The phenomenon of competitiveness has already been a topic of interest to researchers for quite some time, namely how economic organisations, national economies or supranational entities can gain a competitive advantage and become more competitive. In the 21st century, innovation is becoming one of the most important tools for sustainable economic development, contributing to increased competitiveness and the resolution of social and environmental challenges through the creation of new value. In Drucker's words, innovation means activities that focus purposefully on achieving change in the economic and social opportunities of a business [1]. Change, when it results in the creation of new value, leads to innovation, which is the main basis for competitiveness. Porter says that companies secure their competitive advantage through innovation, which they need to maintain through continuous development [2]. Varga highlighted the close relationship between innovation and competitiveness, conducting a research study on national economies (in EU member states) based on innovation and competitiveness assessments and analysis by the European Commission and leading competitiveness research centres. He found that the most competitive countries also lead the way in innovation performance [3]. Csath defines competitiveness as follows:

"A national economy is competitive when the nation's capabilities are well utilized and continuously strengthened in the long term, companies create jobs that require as much knowledge and creativity as possible and generate high added value, and as a result, people's standard of living and quality of life continuously improve." [4]. In this definition, the author clearly presents the human aspect, in which, with the proper and supportive functioning of social subsystems, creative individuals contribute to competitiveness. According to Kohnová, the key to increasing the competitiveness of SMEs lies in the quality and agility of the workforce. The flexible attitude of employees is a critical determinant of business success, thus supporting the organisation in following dynamic changes and innovating [5]. In this short study, we will not deal with clarifying the two concepts, as there is a wealth of literature on this subject. Our focus is on understanding the two concepts and making them "tangible" through literature and indicators, and we have examined previous analyses that have focused on this research. We have attempted to review the international innovation and competitiveness indicators created by various organisations. In our changing world, we need indicators that reveal the national and regional aspects of the innovation and competitiveness performance of nations and regions, because their socio-economic dimensions are becoming increasingly important. We have undertaken to present this in a short study.

LITERATURE REVIEW

The authors examined the theoretical framework of interactions between innovation and competitiveness in order to explore the specific characteristics of different industries and business environments. Their study touched upon indicators of innovation performance. They pointed out that one group of experts disputes the validity of the measurement results by criticizing the indicators, while another raises methodological questions (e.g., mixing input and output indicators, weighting, etc.). The authors draw attention to the simplistic nature of innovation measurements and their compensating effect, which can hide the real situation [6].

Among the studies, we find one that also takes into account the history of innovation statistics, the legal background, and the limitations of early innovation statistics [7]. In 2010, the authors focused on approaches to measuring the innovation capacity of regions, concluding that the use of a complex set of indicators may be the appropriate choice. They recommended assessing the

potential of domestic regional databases and new indicators. They highlighted aspects that they recommended for consideration. They believed that corporate innovation results were difficult to capture and considered that the supportive role of economic policy at the micro-regional level should be recognized; they also recommended the use of more indicators describing the economic structure, which had not been available until then [8]. In 2013, Csugány examined data from EU member states and the United States in terms of technological progress. He concluded that the main reason for the weakness of European R&D&I is the role of the European state in catalysing scientific research, while the US relies more on the corporate sector. The author also pointed out that within Europe, Western countries are keeping up with the US, while countries in the Mediterranean and the newly joined countries are not [9]. In 2013, Keresztes examined the possibilities for measuring innovation activities and highlighted, among other things, that the need for continuous development of indicator systems is created by changes in the concept of innovation. He suggested that domestic economic organisations are not aware of the wide range of interpretations of innovation activities, which may lead to inaccuracy in the reports. He also suggested that it would be useful to recommend innovation indicators to companies that are easier to generate in relation to domestic methodologies, which would allow for a more sophisticated measurement of Hungarian innovation performance [10].

Based on interviews with corporate executives conducted in 2017, the author concluded that the "European paradox" phenomenon is also recognisable in Hungary. According to this, despite cutting-edge research being conducted in the EU, the results do not contribute to increasing competitiveness and have little practical impact. He pointed out that there were few innovations that could be included in international innovation surveys because they were simply not patented or not done in Hungary. He said that the most important tasks were to resolve the mistrust between economic organizations and researchers and to balance the differences in innovation attitudes between the two sides. He also said that easily generated innovation indicators should be recommended to companies in order to refine domestic innovation performance [11].

In his study, Borsi concluded that R&D activity in the business sector (in a significant part of EU countries) is less related to the proportion of innovative enterprises, while certain characteristics of the innovation system's functions are increasingly influenced by this. He thus draws attention to the innovation system, its functions and collaborations, through which the dynamism of innovation phenomenon can be better understood. It emphasises that in the age of knowledge-driven economies, it is within this framework that we must seek answers as to how to move forward in terms of a country's innovation performance. It points out that increasing a few selected indicators will not create miracles in this area [12].

In 2018, the authors provided a brief overview of the characteristics of human resource measurement that are essential for technological development. They examined which areas of human resources development could be used to launch technological catching-up in less developed countries, and the transition from imitation-driven growth to innovation-driven growth. They concluded that both quantitative and qualitative measurement are necessary for this [13]. In 2018, the author pointed out the decline in Hungarian innovation performance and referred to the socialist curse affecting post-socialist countries and the reproduction of factors hindering innovation. He also pointed out an example of inconsistency in the methodology of the indicators, which he found in relation to measurable innovation in education. In the case of the "total composite education innovation index 2000–2011," Hungary ranked an impressive 6th. International measurement data (e.g., TIMSS, PIRLS) played a prominent role in the index, in which the country performed well, while PISA, for example, played a minor role, which may have contributed to the good result [14]. In 2018, the author found that there is a deficit in innovation and knowledge in Hungary. He concluded that extending value chains, shifting towards innovative activities, and increasing the number of innovative jobs could help improve competitiveness. In this process, the creation of new value and knowledge produced domestically can play an important role, which can influence our competitiveness and improve our position in the international area. To this purpose, the level of investment in human capital and the efficiency of resource use need to be increased. The author's proposals for change also contribute to increasing budget revenues [15].

In 2020, the author researched methods for measuring innovation systems, summarizing three basic types according to their complexity. The first category includes innovation indicators, the results of which are evaluation tables that allow for the comparison of innovation systems in different countries and regions. In the second type of measurement methods, he mentioned statistical and econometric methods. In the third group, he highlighted the use of simulation methods that capture the complexity of innovation systems [16].

Alhusen and his co-authors proposed a new measurement concept in 2021, introducing a new set of indicators. They recommended this as a complement to the "Doing-Using-Interacting" (DUI) method for describing informal innovative activity and the "Science-Technology-Innovation" (STI) method based on a conscious approach to research and development [17]. The set of indicators (47 in total) provides a record of knowledge flows and the intensity of relevant facilitators across 15 categories. By highlighting the role of individual competitiveness and mentioning the tasks of the state in this area, the author clearly takes a position in support of competition based on knowledge and innovation. Csath presented new elements of the interpretation of competitiveness in his 2024 study (sustainability, resilience, preparedness for the future,

digitalization, and new technologies) and cited the main findings of recent studies by the most well-known competitiveness research organisations. He also focused on the MNB's Competitiveness Report, agreeing with its main findings, such as the shift from a quantity-based to a quality-based approach and the need to increase total national wealth [18]. Nádaí analysed the indicators of the European Innovation Scoreboard using Kohonen's self-organising maps method. He emphasised that increasing public R&D expenditure, the number of higher education students and SME innovation could help to influence the country's innovation weaknesses [19]. In his article, Juhász pointed out that changes in the economic performance of a country are not necessarily shown by moves up or down in the rankings [20].

THE ROLE OF INNOVATION IN REGIONAL DEVELOPMENT

D. Santos found that in his case study on the entrepreneurial ecosystem in Coimbra, the activities of incubators and local innovation stakeholders (e.g., science parks) played an important role in improving the city's competitiveness. As a result, university businesses were created (spin-offs, start-ups), the local innovation system became more business-oriented, massive networking began, and a deeper culture of cooperation developed. He emphasized that the spillover effect of new knowledge-based startups is beneficial for the development of local companies. He pointed out the role of urban and regional ecosystem building in improving the competitiveness of urban and regional economies [21]. J. Lopes and his co-authors drew attention to the need for a dominant entrepreneurial and free entrepreneurial culture in Europe, which would help overcome resistance to change and protect established interests. They emphasised that companies should play a greater role in the development of knowledge networks as a contribution to increasing innovation capacity. They concluded that the implementation of the Region Smart Specialisation Strategy (RIS3) has a positive impact on European innovation capacity [22].

Parrilli and his co-authors pointed out the role of regional characteristics when examining regional differences in broader technological patterns. They found that every region in Europe is seeking to move away from its current level of development, so those who are falling behind are trying to catch up. They highlighted that those in the modest innovator category need to improve their efficiency in applying scientific, technological, and innovation drivers, while moderate innovators need to improve their ability to create radical innovations and, at the same time, commercialise their innovations. It was noted that leading innovators and strong innovators can effectively use all drivers to maximum effect [23].

Kadlec and his co-authors pointed out that, based on an analysis of the past 20 years, there is a visible trend of patents being outsourced from less developed regions to regions where multinational companies are headquartered. They also observed how foreign companies exercising control over the national knowledge production of certain economically underdeveloped regions, based on the

outsourcing of patents. This may also point to weaknesses in the business sector that describe less innovative regions. It was highlighted that companies operating in regions characterised by strong basic research may be able to utilise the knowledge thus acquired, which can have a positive impact on the regional economy [24]. In their study, Halásková and her co-author examined NUTS 2 regions in Western Europe to identify groups of innovation performance and their spatial distribution. They found that innovation performance increases over time, but is characterised by regional inequalities, which may be influenced by public and private sector R&D indicators. They highlighted that innovation performance plays the most important role in the competitiveness of countries and regions [25].

ON THE COMPETITIVENESS VISIONS OF EU

The European Union has recognized that it needs a turning point in terms of competitiveness if it wants to maintain its economic and political weight and contribute to maintaining the standard of living of EU citizens. The first step in this process was to face up to the current situation, with Mario Draghi, former president of the European Central Bank, playing a central role in this regard with his report on the subject. The document, presented at the European Parliament's plenary session in September 2024, focused on three key factors through which the EU's competitiveness can be enhanced: Closing the innovation gap; Decarbonizing the economy; Reducing dependencies [26]. After the report was published, its analysis and discussion began in academic circles as well. In relation to the Draghi report, Juhász P. pointed out the lack of literature on the concept of competitiveness at the EU level, as well as the disputable nature of its conclusion based on the competitiveness of EU member states [20]. Ábel and his co-authors highlighted the areas of education, healthcare, and taxation in their study, which did not receive sufficient attention in the report. They drew attention to trends that can be observed in the educational performance of European countries and the health status of the workforce, which predict problems. They emphasised that the quality of human capital is an important condition for the effective functioning of the economy, as are physical infrastructure conditions [27].

In January 2025, the European Commission presented the Competitiveness Compass, which was intended to put the recommendations of the Draghi report into practice. In addition to the three pillars, five further horizontal instruments were identified to boost competitiveness in all sectors: *"1. Simplification and the creation of a more favourable business environment by reducing bureaucracy; 2. Removal of remaining barriers in the single market; 3. Ensuring more efficient financing with the products of the savings and investment union; 4. Filling the skills and labour gaps with the skills union; 5. Creating better conditions and implementing EU policies with the competitiveness coordination tool"* [28].

After honest reflection, the intentions of EU and the willingness of EU member states to act can help us

move forward in the field of innovation performance, thus contributing to increased competitiveness.

METHOD

We did not focus on clarifying the concepts of innovation and competitiveness, given the rich literature on the subject. Our interest is focused on making the two concepts "tangible" through indicators, and we examined previous analysis that concentrated on this. Our analysis of the literature touched on the role of innovation in regional development, the differences between European regions, and, briefly, the EU's vision of competitiveness. We then attempted to review the international innovation and competitiveness indicators created by various organisations, choosing those that appear regularly in the literature we reviewed.

INTERNATIONAL RANKINGS, REPORTS

Innovation performance has become a key indicator of the competitiveness of countries and regions, and indicator systems are necessary to understand it. The European Union's relevant performance indicators relate to research and innovation. The European Commission's *European Innovation Scoreboard* (EIS, annual) and *Regional Innovation Scoreboard* (biennial) are tools for assessing the innovation performance of the EU and its member states from an international perspective. EU member states can be classified into four categories based on their performance relative to the EU average: Innovation Leaders (EU average >125%), Strong Innovators (100–125%), Moderate Innovators (70–100%), Emerging Innovators (<70%). In the results for 2025, Hungary can be listed among the emerging, catching-up innovators, as it achieved 69.5% of the EU average, ranking 22nd among EU member states [29].

The *Regional Innovation Scoreboard* allows for a comparison of the research and innovation performance of EU Member States and other European countries at regional level. Budapest ranks 112th among the 244 EU regions, standing out from the seven Hungarian planning and statistical regions with its significant innovation performance, placing it in the moderate innovator category. The other Hungarian regions are in the emerging category. The Central Transdanubia region, where our university faculty is located, ranks 213th overall, placing it fifth among Hungarian regions. It stands out among European regions in a single performance indicator, the "Exports of medium and high technology products" category, in which it ranks second behind Budapest in the regional rankings, outperforming the EU average by 19.3% [30].

EU Member States can also be compared based on the *Eco-Innovation Index*, which measures eco-innovation performance between 2014 and 2024 in five thematic areas: eco-innovation spending, eco-innovation activities, eco-innovation outputs, resource efficiency outcomes, and socio-economic outcomes. The Index highlights a

country's innovation performance in the field of green technology and solution development. In this 2025 ranking, Hungary ranks 26th among EU member states [31].

According to *Hungary's 2025 Digital Decade Country Report*, our country has a very good digital infrastructure, but there is still work to be done in the area of business digitalisation [32]. The report highlights that access to e-health records is above the EU average. According to the report, the use of artificial intelligence is currently falling behind. We touched on the digital country report because of the link between innovation and digitisation.

The World Intellectual Property Organization (WIPO) evaluates global economies in the field of innovation based on their innovation capacity, as measured by the *Global Innovation Index (GII)*, which consists of approximately 80 indicators (grouped according to innovation inputs and outputs) [33]. Hungary currently ranks 36th out of 139 economies in 2025. Among the main findings of the report, it was highlighted that Hungary will perform better in terms of innovation output than innovation expenditure in 2025, with improvements in eight indicators in the short term and declines in three. Hungary currently has no clusters that could appear among the leading innovation clusters in the GII.

The *International Institute for Management Development (IMD) World Competitiveness Ranking* uses a complex matrix that takes into account political, social, and cultural dimensions to show the competitiveness of economies, with quality of life being an important factor [34]. Hungary ranks 48th in the 2025 ranking, moving up six places compared to 2024, but slipping two places compared to 2023. The report sees one of the challenges for Hungary in 2025 as raising awareness and promoting the potential applications of artificial intelligence in the business sector and society.

The *Global Talent Competitiveness Index (GTCI) 2023 report (INSEAD & Portulans Institute)* is an EU-accredited index that can serve as a source for understanding global talent competitiveness and as a basis for developing strategies to boost the economy [35]. The 2023 report covers 134 countries, with Hungary ranking 38th. The report predicts what we can expect in the next decade. For cities and regions, it states that it may pave the way for the development of new talent strategies and the emergence of talent-based innovation. If a municipality or geographical region wants to become a talent hub, quality of life and sustainability will be key to attracting talent.

Title	Scope	Indicator areas	Purpose	Methodology - data collection
European Innovation Scoreboard, EIS	Member States of the EU, other European countries and selected third countries	32 indicators, 4 pillars, 12 innovation dimensions. Human resources, Attractive research systems, Digitalisation, Finance and support, Firm investments, Investments in information technologies, Innovators, Linkages, Intellectual assets, Sales and employment impacts, Trade impacts, Resource and labour productivity	Evaluation of the innovation performance of EU Member States in comparison with other European and selected third countries.	quantitative
Regional Innovation Scoreboard, RIS	Regions of EU Member States	The same as EIS, but with results presented at the regional level.	Comparing the innovation performance of regions in EU Member States.	quantitative
Global Innovation Index, GII	Countries of the world (139 in 2025)	78 indicators, 7 pillars. Innovation Input Sub-Index: Institutions, Human capital and research, Infrastructure, Market Sophistication, Business Sophistication. Innovation Output Sub-Index: Knowledge any technology outputs, Creative outputs.	Assessment of innovation performance at national level for comparison at global level.	quantitative and qualitative
Eco-innovation index: (EEA EII)	EU Member States	12 indicators, 5 areas. Eco-innovation inputs, Eco-innovation activities, Eco-innovation outputs, Resource efficiency outcomes, Socio-economic outcomes.	Assessing a country's innovation performance in the field of green technology and solution development.	quantitative and qualitative
Hungary 2025 Digital Decade Country Report	EU Member States	16 Digital Decade KPIs, 4 core areas: Digital skills, Digital transformation of businesses, Digital infrastructures, Digitalization of public services.	Evaluate EU member state's progress toward the 2030 Digital Decade targets and identify challenges.	quantitative and qualitative
(IMD) World Competitiveness Ranking	Countries of the world (69 in 2025)	Total criteria: 262, including 170 data indicators and 92 criteria based on a survey of business leaders. Four main pillars: economic performance, government efficiency, business efficiency, and infrastructure.	Establish a basis for comparison and to identify the strengths and weaknesses of economies through the pillars.	quantitative and qualitative
Global Talent Competitiveness Index, GTCI	Countries of the world (134 in 2023)	69 indicators, grouped into 6 pillars and 14 sub-pillars: Enable, Attract, Grow, Retain, Vocational and technical skills, Global Knowledge Skills.	Summary of concepts related to human capital and competitiveness at national level, for the purposes of international comparability.	quantitative and qualitative

TABLE 1: Comparative table of international indicator systems
Source: edited by the author based on information found on the websites of international indicator systems

The EIS and RIS (based on Eurostat data, among other sources) are closely related. The EII, the index of the European Environment Agency (EEA), examines innovation performance primarily in the field of green technologies and solutions. The GII, the index of WIPO, examines the innovation performance of nations within a global framework. The EIS, RIS, and GII systems have in common that they deal with the role of human capital, R&D, intellectual property, and corporate innovation. The IMD World Competitiveness Ranking examines both hard and soft conditions in its assessment of competitiveness. The Global Talent Competitiveness Index perhaps better reflects the opportunities available for individual development. There are also differences in the data collection of the indicator systems examined, as all except the EIS and RIS (both are only quantitative) use quantitative and qualitative methods.

SUMMARY AND PROPOSALS FOR FURTHER RESEARCH

In our short study, we reviewed the results of studies analysing international indicator systems that focus on the relationship between innovation and competitiveness. We

analysed the literature on the role of innovation in regional development, the differences between European regions, and briefly touched upon the EU's competitiveness concepts. We then reviewed the domestic relevance of international innovation and competitiveness rankings created by various organisations. In our changing world, we need benchmarks and indicators that reveal the national and regional aspects of the innovation and competitiveness performance of nations and regions, as their socio-economic impact is becoming increasingly important. It is necessary to use indicators to understand the current situation so that interventions can be formulated to achieve improvements in areas that are falling behind.

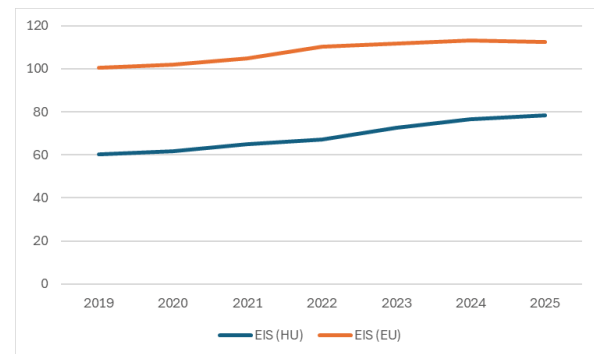


Fig 1: Hungary's EIS index development compared to the EU average 2019-2025

Source: edited by the author based on information found on the websites of EIS (European Commission, 2019-2025)

Hungary's innovation performance shows slight but steady improvement compared to the EU average, according to data from the European Innovation Scoreboard 2019–2025.

The economic strength of a country will be influenced by the readiness of its population and the state of its human capital. In addition to hard infrastructure investments, the government must also pay special attention to the development of soft infrastructure. People are the most important factor in the process of creating innovation.

As we enter the age of AI, we can use artificial intelligence to generate the ideas that can lay the foundation for innovation, but the birth of innovation will require a team of committed people, their belief and their confidence that the process can be completed with the creation of value.

The current research did not attempt to delve deeply into the details of the indicators, but it would be interesting in the future to conduct research comparing and analysing the methodologies of different rankings.

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