FUTURE POTENTIALS OBSERVATORY

Digital Futures

# Exploring the relationship among innovation, competitiveness, resilience, and future potentials based on literature review and international analyses

*Working Paper*

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**Exploring the relationship among innovation, competitiveness, resilience, and future potentials based on literature review and international analyses – Working paper**

This paper is a brief summary of the Hungarian-language study.

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# Introduction

This study presents the conceptual frameworks for innovation, competitiveness, resilience, and future potentials. The research aims to learn the key factors of each topic area with particular attention to national innovation.

The study primarily serves the purpose of exploring and establishing possible research directions. As a result, the presentation of the individual innovation measurement systems is not exhaustive, nor did we attempt to review all the analyses available in the given area, but provide the interpretative framework that is also used in the measurement systems presented in this study. This foundational research can support the precise delimitation of the research area and the identification of possible key areas for a comprehensive analysis to be carried out later.

The defining element of the study is bibliometric analysis, which involves processing the bibliometric data of the most important publications of the selected topic areas using the Web of Science database and creating network maps from it, which demonstrates the interconnectedness of the individual concepts and helps determine which areas fit in each topic area.

# Literature review

## Innovation

The concept of innovation is mostly based on the Oslo Manual. The first edition of the Manual was published in 1992, which defines product and process innovation.

What can be considered innovation? They point out that the exact answer depends on the ’particular objectives of measurement or analysis’. The Manual dealt with technological innovation and defined the framework of interpretation and approach. ’A product innovation is the commercialisation of a technologically changed product. Technological change occurs when the design characteristics of a product change in ways which deliver new or improved services to consumers of the product. A process innovation occurs when there is significant change in the technology of the production of an item. This may involve new equipment, new management and organisation methods, or both’ (OECD 1992).

In the second edition of the Manual, the concept of innovation has been further refined:

’A technological product innovation is the implementation/commercialisation of a product with improved performance characteristics such as to deliver objectively new or improved services to the consumer. A technological process innovation is the implementation/adoption of new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or a combination of these’ (OECD-Eurostat-European Union 1997).

The third edition expanded the concept of innovation by removing the term ’technological’ and including marketing and organisational innovation in the general definition:

’An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method inbusiness practices, workplace organisation or external relations’ (OECD-Eurostat 2005).

The fourth and latest edition of the Oslo Manual highlights the role of market introduction and application:

’An innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit’s previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)’ (OECD-Eurostat 2018).

The precise definition of concept is important for measuring innovation. This is also highlighted by the feasibility study of the European Commission (2023b) in connection with the European Startup Scoreboard: the data on startups are not comparable due to the lack of common definitions and indicators, which would make it possible to have comparable analyses on startups in addition to measuring innovation performance (EIS).

The best-known indices, the European Innovation Scoreboard (EIS) and the Global Innovation Index (GII), are based on the definition of Oslo Manual.

## Competitiveness

The innovation-driven economic structure is extremely important for sustainable national competitiveness. This is pointed out by Aiginger (2012), who distinguishes two ways to achieving competitiveness. The ‘low road’ strategy is based on low wages and taxes, while the ‘high road’ strategy is a version of achieving competitiveness based on the best-trained labour force, on excellent universities and on innovation. A highly skilled workforce leads to higher value added and to an increase in the quality of products and services. ‘Increased wages will be countered by productivity increases, leaving unit labour costs constant or even declining’

(Aiginger 2012). This means that although national competitiveness can be achieved without increasing innovation performance, competitiveness will not be sustainable and will only improve in the short and medium term. The relationship between corporate innovation and competitiveness shows a similar picture.

One of the best-known competitiveness indices, the World Economic Forum's competitiveness index (Global Competitiveness Index 4.0), defines national competitiveness ‘as the set of institutions, policies and factors that determine the level of productivity’ (WEF 2019).

The IMD, another renowned competitiveness research institute, ’analyzes and ranks countries according to how they manage their competencies to achieve long-term value creation. An economy’s competitiveness cannot be reduced only to GDP and productivity because enterprises also have to cope with political, social and cultural dimensions. Governments therefore need to provide an environment characterized by efficient infrastructures, institutions, and policies that encourage sustainable value creation by enterprises’ (IMD 2023d).

IMD has also recognised that there are other fields that require deeper analysis as they can complement countries' perceptions of competitiveness, such as digitalisation. IMD has developed its definition of digital competitiveness based on its own definition of ‘general’ competitiveness: ‘digital competitiveness is defined as the capacity of an economy to adopt and explore digital technologies leading to the transformation in government practices, business models and society in general. In this way, firms increase the opportunities to strengthen future value creation’ (IMD, 2017).

## Resilience

In recent years, the ‘soft factors’ have played an increasingly important role in the analysis of competitiveness. Magdolna Csath, one of the key figures of Hungarian competitiveness research, pointed out in a presentation held in 2018 that the implementation of the ‘high road’ competitiveness strategy requires resilience in addition to innovation (Csath 2018). A few years later, during the COVID-19 crisis, the role of external influences and countries' vulnerabilities became even more important, highlighting the importance of measuring national resilience. The term resilience is also used in many disciplines, including psychology, disaster management and environmental science. This phrase is also often used in the European Union's strategy papers, as they put it: 'resilience has become a new compass for EU policies with the COVID-19 crisis' (European Commission 2020a). According to the European Commission's 2020 Strategic Foresight Report, resilience is the ability of nations not only to withstand and cope with challenges, but also to undergo transitions in a sustainable, fair and democratic manner (European Commission 2020a).

The Commission highlights that foresight (as a discipline of exploring, anticipating and shaping the future) will support ambitious policy initiatives and EU policy-making and promote participatory and forward-looking governance (European Commission 2020a). This requires exploring the drivers that are expected to have the greatest impact on the future, these drivers are called megatrends. 14 megatrends are identified and analysed by the JRC, the European Union's Joint Research Centre (European Commission - JRC 2018):

1. Diversifying Inequalities
2. Increasing significance of migration
3. Aggravating resource scarcity
4. Increasing influence of governing systems
5. Continuing urbanisation
6. Increasing demographic imbalances
7. Climate change and environmental degradation
8. Diversification of education and learning
9. Changing nature of work
10. Accelerating technological change and hyperconnectivity
11. Growing consumerism
12. Expanding influence of east and south
13. Changing security paradigm
14. Shifting health challenges

The Commission recommends a resilience monitoring tool. This tool is called the Resilience Dashboards, which looks at resilience in four areas: (1) social and economic, (2) green, (3) digital, (4) geopolitical.

Resilience, like competitiveness, is a complex field and can only be examined through an interdisciplinary approach. This interdisciplinarity is also characteristic of measuring future potentials, since it is worth examining it across several disciplines, systematizing them, and exploring cause-effect relationships. Furthermore, resilience is a concept related to future potentials, but there are minor differences between these concepts. Resilience can be related to social futuring, but it is not conceptually synonymous with it and cannot replace it discursively (Aczél 2018).

## Future potentials

Many of the measurement areas/pillars of competitiveness and resilience, and even the concepts themselves, are future-oriented, as they prepare for the future in such a way that the outcome cannot always be predicted with certainty. In establishing the concept of social

futuring, Szántó (2018) draws attention to the significance of unexpected and potentially expected changes from the point of view of social futuring. Predictable changes include estimating the rate of global warming depending on knowledge of climate trends, or population forecasting based on demographic data.

Technological progress and changing global challenges offer innovation opportunities for countries that invest in research and development, foster creativity and adopt new technologies faster. Preparing for the future involves a combination of elements such as an educational environment, a culture that encourages creativity and adaptation to new technologies. Futuring is the ability of a country to successfully adapt to future changes and challenges is an important factor not only for survival, but also for prosperity and development.

The Future Potential Index (FPI), developed by researchers at the Future Potentials Observatory, examines four normative standards (Szántó et al. 2023): (1) peace & order, (2) attachment & community, (3) care & generativity, and (4) balance & health. FPI uses 22 indicators to evaluate these categories, such as fertility rate, life expectancy, income, and education quality.

## Bibliometric analysis

### Bibliometric analysis of publications on national innovation

The aim of the bibliometric analysis of publications related to the national innovation topic is to explore the conceptual system of the given field, to follow its changes, to define future research directions, and to determine the geographical scope of international scientific cooperation.

The following research questions were formulated:

- Which professional dimensions and subfields can be identified behind the conceptual framework related to national innovation?
- Can we talk about the evolution of the conceptual system of national innovation?
- How do GII and EIS innovation measurement systems appear in scientific publications related to national innovation?
- Which international co-author networks have been established in national innovation research?
- Which new topical research directions can be identified in national innovation-related research?

The data used for bibliometric analyses were extracted from the Web of Science Core Collection. In the first step, we performed a logical search for publications on national innovation using a combination of the following keywords: All Fields = "national innovation" or "innovation of nation*" or "innovation of countr*" or "country's innovation" or "International innovation" or "national innovativeness " or "Innovativeness at the Country Level".

After filtering by language (English), document type (journal article or conference paper or book chapter or review article) and research area (Business Economics), 954 papers were selected (Figure 1). By reviewing the titles, abstracts and keywords of the publications, we found 891 relevant. As a final step, bibliometric analysis was performed on these publications based on the title, name(s) of author(s) and corresponding authors' affiliations, journal name, abstract and referenced works, using VOSviewer software.

The network of scientific cooperation of countries, as well as the thematic map of keywords, was created using the *biblioshiny interface of the bibliometric package* in the R programming environment. Co-author affiliations (countries) were considered in the investigation.

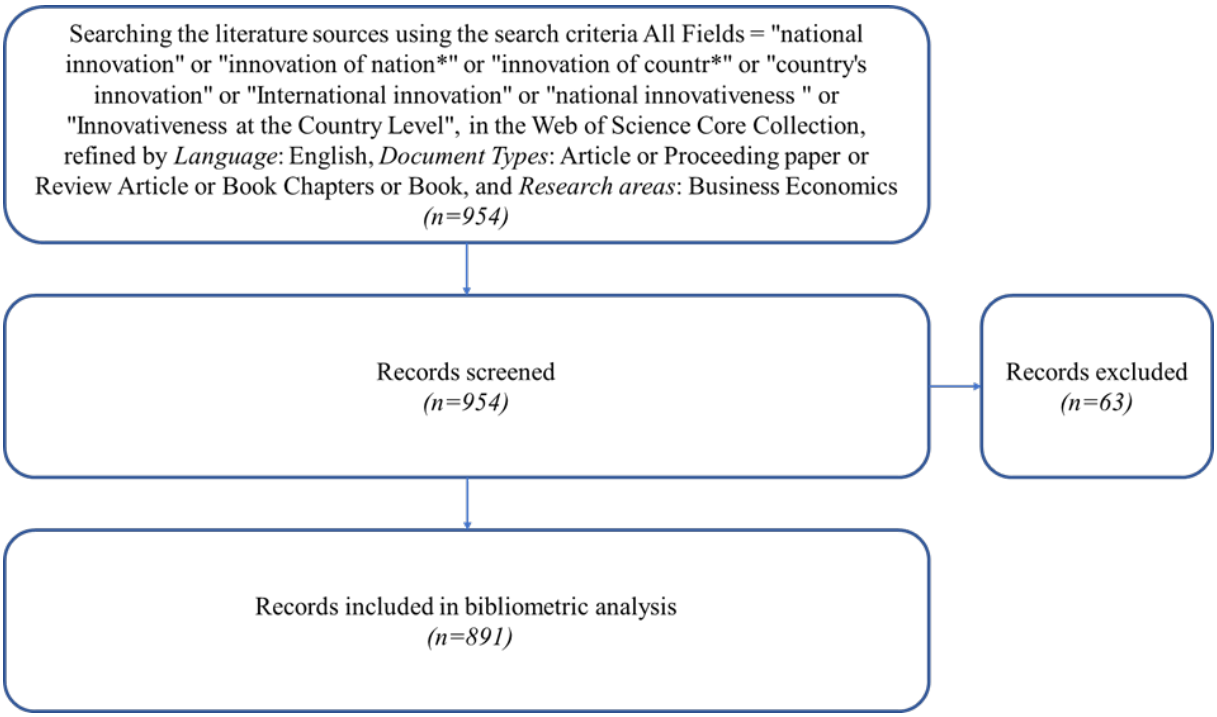



Figure 1. The process of extracting relevant data used for bibliometric analysis

Source: Own editing

The number of publications on national innovation gradually increased over the period under review, reaching a peak of 88 publications in 2019 (Figure 2). After a decline in 2020 and 2021, the number of publications on the topic again exceeded 80 in 2022 and 2023. However, it should be noted here that some of the publications in 2023 will be published in 2024, so the actual number of publications in 2023 may reach the peak of 2019. During the period under review, an average of 31.7 references were received for a publication, and the evolution of the number of citations follows the changes observed in the number of publications. The increase in both publications and citations suggests that the topic is important and timely in scientific research.

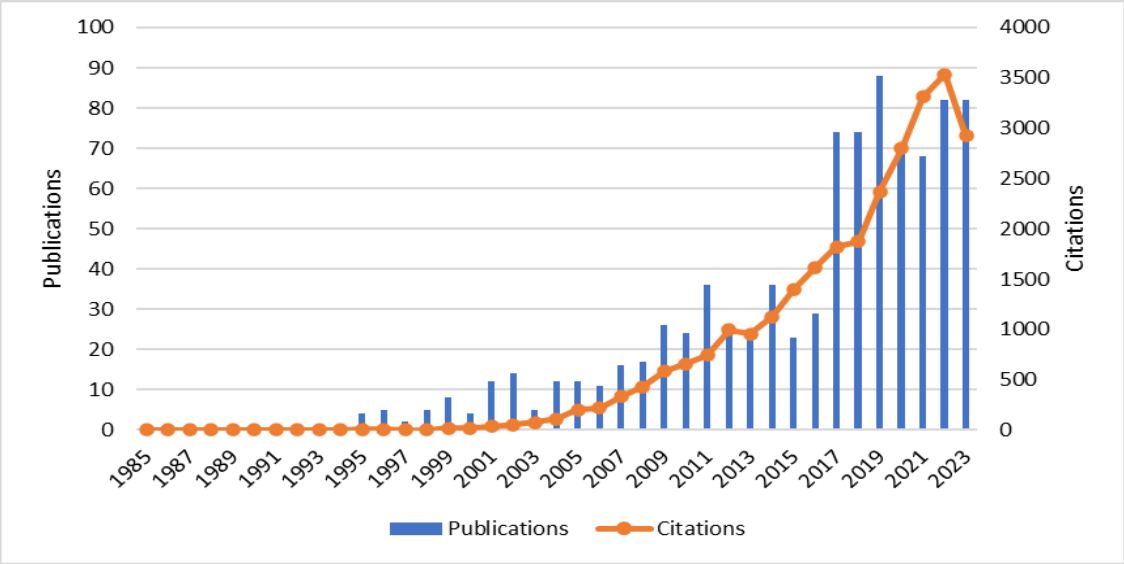
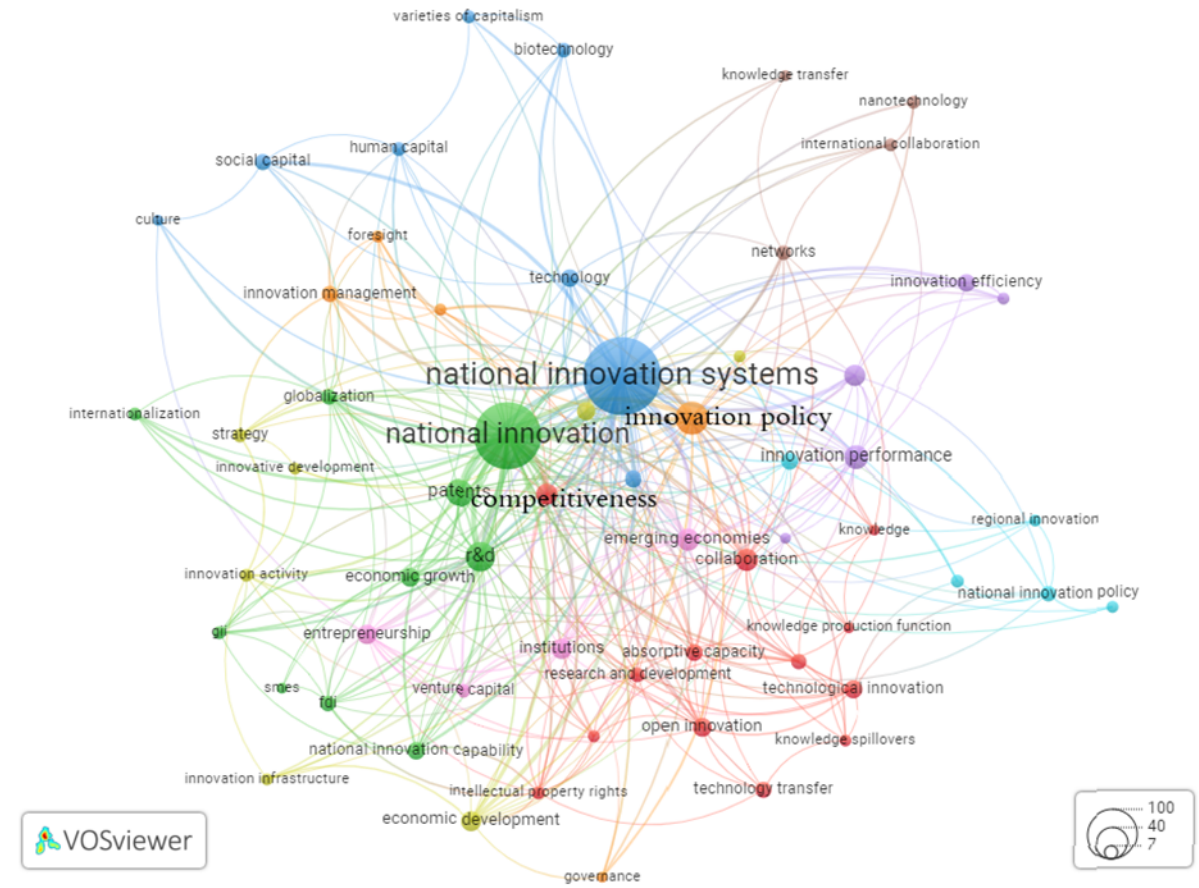



Figure 2. Number of publications published on national innovation and their citation rate between 1985 and 2023 (*n=891*)

Source: Own editing based on Web of Science Core Collection data

We can also examine which topics are related based on the co-occurrence of keywords or key phrases in the publications. Using VOSviewer software, nine clusters were determined based on the strength of the association among keywords (Figure 3). Keyword co-occurrence is indicated by the thickness of the lines connecting them. Circles of different sizes indicate the relative importance of different keywords and key phrases: concepts that occur more often have circles of larger diameter. The keywords most frequently used in the publications examined are National Innovation Systems (257) and National Innovation (191), followed by Innovation Policy (46), Research and Development (37), Patents (31), Innovation Performance (24), Cooperation (21) and Competitiveness (19).




- Knowledge-based Innovation Ecosystem
- Economic Development and Innovation
- Innovation and Societal Systems
- Innovation Ecosystem for Economic Development
- Innovation Evaluation and Systems
- Innovation Governance and Ecosystems
- Strategic Innovation Framework
- Global Knowledge Network
- Innovation and Investment Ecosystem

Figure 3. Keyword network of national innovation publications

Source: Own editing based on Web of Science Core Collection data, n=891

(Interactive version of the keyword network is available online: https://app.vosviewer.com/?json=https%3A%2F%2Fdrive.google.com%2Fuc%3Fid%3D18eFsNyB75xvBKDwwcTE1F0qngh8jxlYz)

**Knowledge-based Innovation Ecosystem**

Innovation challenges and opportunities are reflected in the keywords forming the Knowledge-based Innovation Ecosystem cluster. Knowledge, technological change, technological innovation, and research and development all capture the basic elements of innovation, such as the creation, dissemination, and application of new or improved knowledge and technology.

This cluster also includes keywords that describe inputs, conditions, and drivers that enable innovation. Innovation factors include absorption capacity, collaboration, open innovation, and

knowledge spillover. In the context of innovation, these keywords address the role of internal and external sources of knowledge and skills, the interaction between actors, and the networking between them.

The key outcomes of innovation are the outputs, outcomes and impacts that innovation generates for individuals, firms or society. The three keywords that reflect innovation achievements are productivity, competitiveness, and technology transfer. Innovation can produce positive outputs and outcomes, including improved efficiency, higher quality, improvements in market position, and a higher standard of living.

Keywords reflecting the challenges and opportunities of innovation include intellectual property rights, knowledge production function, and open innovation. These keywords relate to the problems and opportunities inherent in innovation, such as the protection of knowledge and technology, as well as cooperation and competition between different actors.

**Economic Development and Innovation**

In the Economic Development and Innovation cluster, keywords refer to the impact of innovation on the economic performance and development of countries and regions, providing a comprehensive framework for understanding the multifaceted nature of national innovation, encompassing economic, technological, and institutional dimensions, as well as the role of global interactions and cooperation.

These keywords are closely linked to different aspects of national innovation, which determine the effectiveness of a country's innovation ecosystem and its capacity to foster economic development.

**Innovation and Societal Systems**

This cluster concerns elements of national innovation such as the institutional framework, scientific developments, sociocultural factors and economic systems.

National Innovation Systems (NIS) are founded on collaboration among government, industry, and academia to advance innovation and technological progress. Biotechnology significantly contributes to national innovation by advancing health, agriculture, and industry. Cultural attitudes, particularly openness to new ideas and entrepreneurship, foster innovation by encouraging cooperation and creativity. Human capital, encompassing workforce skills and knowledge, is vital for innovation, with investment in education and training crucial for technological advancement. Social capital, represented by societal networks and relationships, enhances innovation by facilitating information sharing and collaboration.

Technology serves as the backbone of innovation, enabling the development and application of new tools, processes, and products. The Triple Helix model emphasizes collaboration among government, industry, and academia to drive innovation. Different forms of capitalism within countries can influence innovation through market structures, regulatory environments, and the role of the state in the economy.

**Innovation Ecosystem for Economic Development**

The elements of the Innovation Ecosystem for Economic Development cluster are scattered within the network of keywords. This may indicate that elements of this cluster serve as bridges between other keyword clusters. For example, social networks show a stronger link to universities among the other keywords belonging to the cluster based on the number of co-occurrences, but they show links with elements of the other four clusters: national innovation systems, innovation policy, cooperation, and regional innovation systems.

This group of keywords emphasizes the interaction of economic development, innovation activity, innovation infrastructure, innovative development, social networks, strategy and universities in shaping the innovation landscape of a country. A forward-looking approach to these elements is of paramount importance in order to foster sustainable innovation.

**Innovation Evaluation and Systems**

The key elements of the Innovation Evaluation and Systems cluster are innovation performance, efficiency, and regional innovation systems. The assessment of innovation performance provides insight into how successful a country is in turning its research and development (R+D) investments into concrete results. High innovation performance suggests the country's ability to stay ahead of technological developments and global competition. Regional innovation systems play a key role in creating a national innovation ecosystem across the country. They allow knowledge, resources, and industries to be concentrated in specific areas, facilitating the emergence of innovation hubs. Cooperation in the regions contributes significantly to the country's innovation capacity.

**Innovation Governance and Ecosystems**

The Innovation Governance and Ecosystems cluster consists of the innovation ecosystem, national innovation policy, regional innovation, and science. The cluster encompasses different levels of management and stimulation of innovation, including national and regional innovation policies and the role of science in innovation processes.

**Strategic Innovation Framework**

The Strategic Innovation Framework cluster includes key elements such as foresight, governance, innovation management, science, and technology that affect a country's ability to anticipate future trends, effectively manage innovation processes, and take advantage of scientific and technological developments for national development.

Countries that invest in research and development, protect intellectual property through patents, and create an environment conducive to innovation are likely to experience higher levels of economic prosperity.

**Global Knowledge Network**

The elements of the Global Knowledge Network cluster include international cooperation, knowledge transfer, nanotechnologies, and networks.

International cooperation is essential for national innovation, as it creates opportunities for countries to access a wider knowledge base, share good practices and access resources that are not available domestically.

Knowledge transfer is essential for national innovation: mechanisms for effective knowledge transfer facilitate the circulation of knowledge between universities, research institutes, and industry, contributing to the development of innovative solutions and technological progress.

In the context of innovation, networks can also include research networks, innovation clusters and collaborative platforms facilitating the exchange of ideas and resources.

**Innovation and Investment Ecosystem**

The Innovation and Investment Ecosystem cluster consists of emerging countries, entrepreneurship, institutions, and venture capital.

Encouraging and supporting entrepreneurial activities creates a dynamic environment for innovation, job creation, and economic diversification. Emerging countries often emphasize the development of entrepreneurial ecosystems to capitalize on their growing economic potential.

Supportive and well-functioning institutions create an environment for research and development and entrepreneurial activities. Venture capital provides financial support at the initial stage of new ideas and high-risk businesses, enabling innovative ideas to come to

market. A well-developed venture capital ecosystem attracts investment in emerging countries, supports entrepreneurial initiatives and acts as a catalyst for technological development.

Examining ***the evolution of keywords***, it can be concluded that in the period before 2015 (Figure 4) the emphasis was on protecting intellectual property (patents), promoting economic growth through innovation, supporting technological knowledge transfer, implementing national policies, and building cooperation networks.

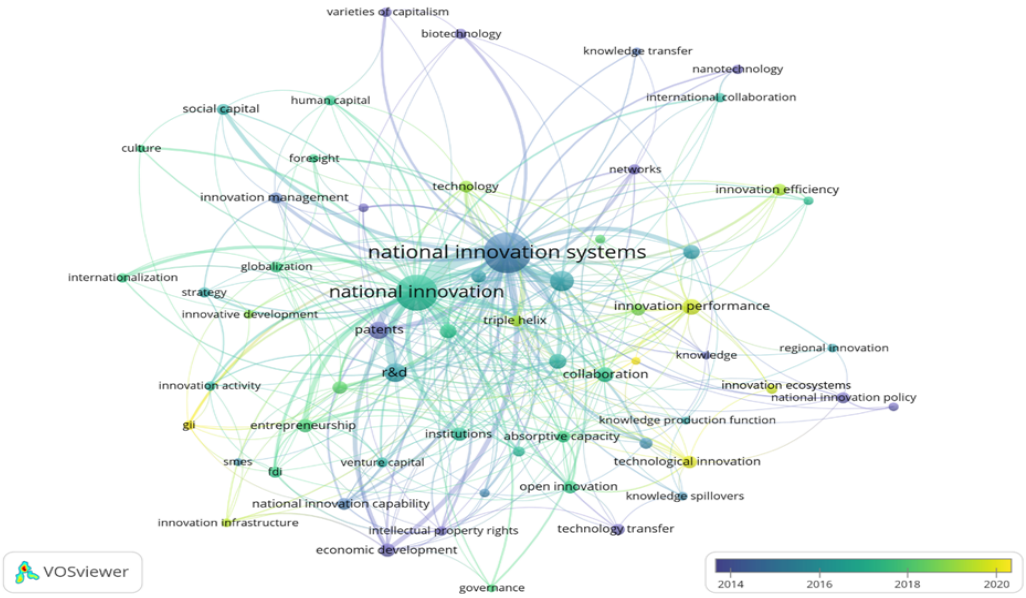



Figure 4. Evolution of keywords on national innovation

Source: own editing based on Web of Science Core Collection data, n=891

In the period 2015-2017, the focus shifted to understanding the systemic nature of innovation at the national level, R+D investments, developing innovation management strategies, recognising the importance of social relations and networks in stimulating innovation, and refining policies.

In the period 2017-2019, scientific publications on the topic focused on innovation based on cooperation and partnerships, integration of economies (globalization) and innovation on a global scale, attracting foreign investment (FDI) for national innovation, adopting open innovation approaches, increasing the internal capabilities of organizations, absorbing and using new knowledge (absorbive capacity), recognising the importance of skilled labour (human capital), understanding the impact of culture and formal structures (institutions) in innovation.

In recent years, more emphasis has been placed on developing physical and institutional infrastructure (innovation infrastructure) supporting innovation, promoting technology, applying the Triple Helix model to innovation based on cooperation between the government, academia and private sector, emphasising technological innovation, assessing innovation capabilities (GII) and developing interconnected innovation ecosystems between regions or industries.

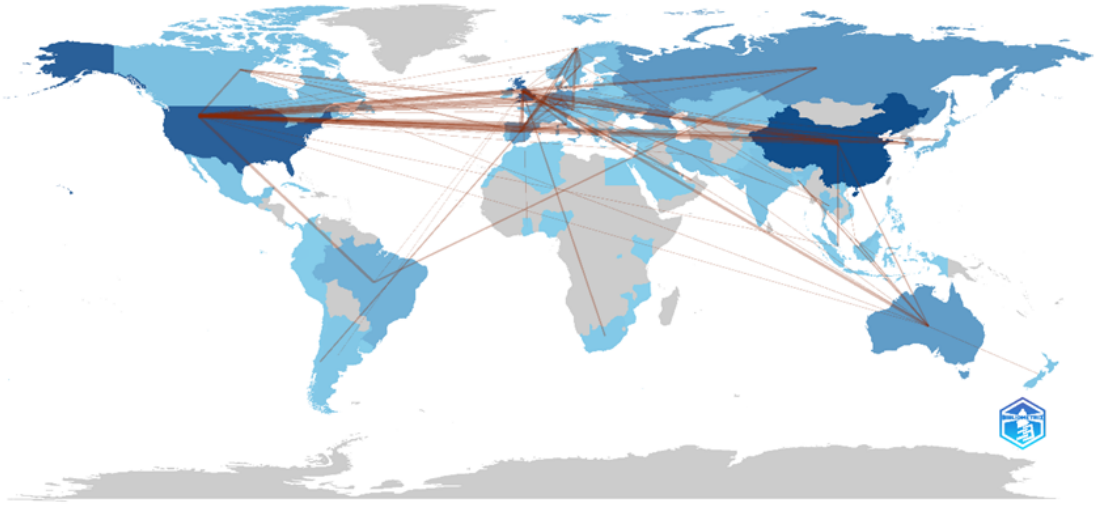


Figure 5. Network of countries' scientific cooperation on national innovation

Source: own editing based on Web of Science Core Collection data, n=891

In the international scientific cooperation network of research on national innovation (Figure 5), the USA-UK-China triangle can be observed. These countries are the most important actors in international scientific cooperation in this field. The brown lines connecting the states indicate the closeness of cooperation, based on the national affiliation of the co-authors.

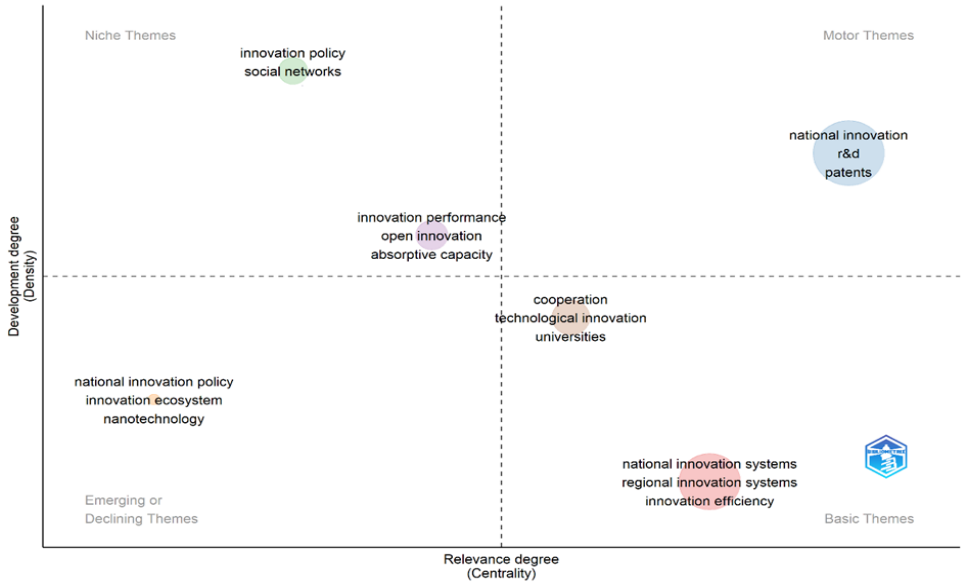



Figure 6. Thematic map of keywords appearing in scientific works on national innovation

Source: own editing based on Web of Science Core Collection data, n=891

In the thematic map, clusters (research topics) are structured and classified according to two dimensions (Figure 6): *density* (internal cohesion of the topic) and *centrality* (how "central" a topic is to the whole area). Based on these two dimensions (density and centrality), four groups of topics can be defined. Topic groups with high centrality value (right side of the diagram) can serve as bridges between other topic groups, playing a central role in current research.

The upper left corner ("niche topics") encompasses highly specialized, peripheral topics that are of secondary importance to researchers. Innovation policy and social networks, as well as innovation performance, open innovation and absorption capacity, are topics that are considered separately and are of only limited relevance in national innovation-related research.

In the lower-left corner are topics that are emerging or that are losing their importance. National innovation policy is an emerging topic in scientific research, as several recent publications have dealt with various aspects of national innovation policy. Innovation ecosystem and nanotechnology topics are also emerging topics.

The core themes (bottom right) are cooperation, technological innovation, universities, as well as national and regional innovation systems, and innovation efficiency.

The upper right corner (engine themes) includes topics that are of high importance in national innovation research. This includes national innovation itself, as well as R&D and patents.

Answering research questions based on the results of bibliometric analyses:

| Research question | Summary of research results related to this issue |
|---|---|
| Which professional dimensions and subfields can be identified behind the conceptual framework related to national innovation? | Nine professional dimensions have been identified, the individual dimensions are difficult to separate, which suggests that the factors determining the level of national innovation and its elements are often interwoven and mutually influence. |
| Can we talk about the evolution of the conceptual system of national innovation? | The evolution of the conceptual system has been easy to follow in the last ten years, and in recent years scientific publications have highlighted innovation performance, triple helix and technological innovation. The focus will shift to technology, and presumably technological solutions related to digitalization. The GII measurement system is also more prominent in recent scientific papers. |
| How do GII and EIS measurement systems appear in scientific publications related to national innovation? | GII and EIS measurement systems appear with varying intensities in scientific publications related to national innovation. The main reason for this is that the GII measures innovation at the global level, while the EIS measures innovation at the European level. |
| Which international co-author networks have been established in national innovation research? | The United States–United Kingdom–China international scientific cooperation triangle can be defined in research related to national innovation. |
| Which topical research directions can be defined in national innovation-related research? | International innovation itself, as well as R+D activities, patents, national innovation policies and innovation ecosystems, are topical research areas. |

## Bibliometric analysis of publications related to the two innovation measurement systems (GII, EIS)

The bibliometric analysis of the publications related to the two innovation measurement systems aims to explore the connection between these systems and the previously examined fields, innovation, competitiveness, resilience, and future potentials.

We formulated the following research question: Are there significant differences between the conceptual frameworks of GII and EIS measurement systems?

After filtering by language (English), type of document (journal article or conference paper or book chapter or review article), and research area (Business Economics), 250 papers related to the GII and 96 items related to the EIS were selected. By reviewing the titles, abstracts and keywords of the publications, we found 242 publications relevant for the GII and 94 for the EIS.

Among the elements of the keyword network linked to the European Innovation Scoreboard (Figure 7), the Community Sustainability and Innovation Framework cluster can be highlighted, which includes Community innovation, sustainable development, innovation policy and the European Innovation Scoreboard itself.

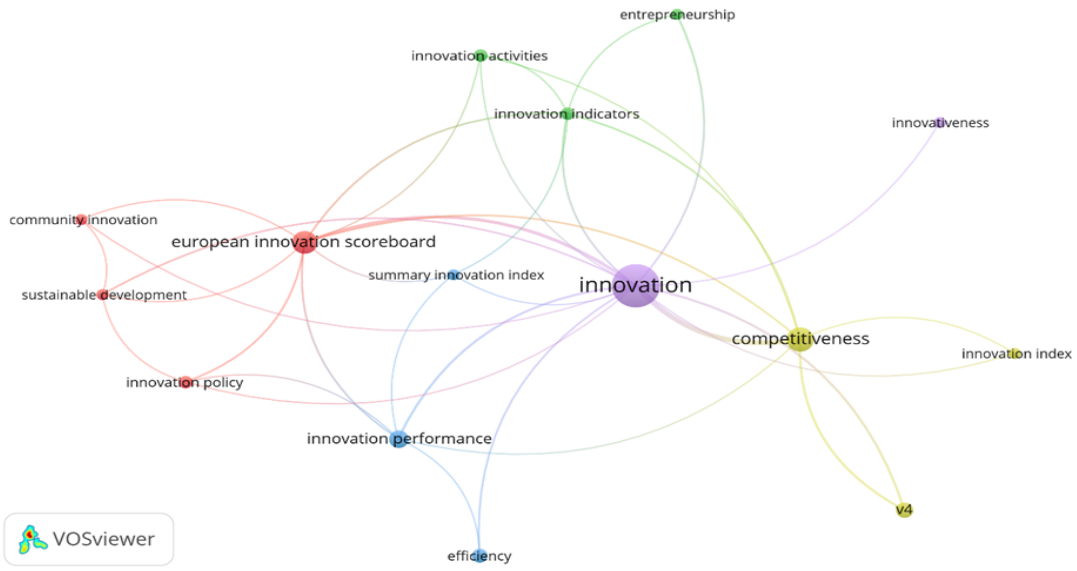



Figure 7. Keyword Network of EIS

Source: own editing based on Web of Science Core Collection data, n=94

(An interactive version of the keyword network is available online: https://app.vosviewer.com/?json=https%3A%2F%2Fdrive.google.com%2Fuc%3Fid%3D1J1WnLpDwne53d9X7FgEPf48aYnMgbz3f)

The GII is located in a keyword cluster with national innovation systems and innovation potential and capacity (Figure 8). GII is often associated with the concept of competitiveness.

The similarity between innovation and competitiveness is also indicated by the fact that these keywords were translated together in sixteen publications.

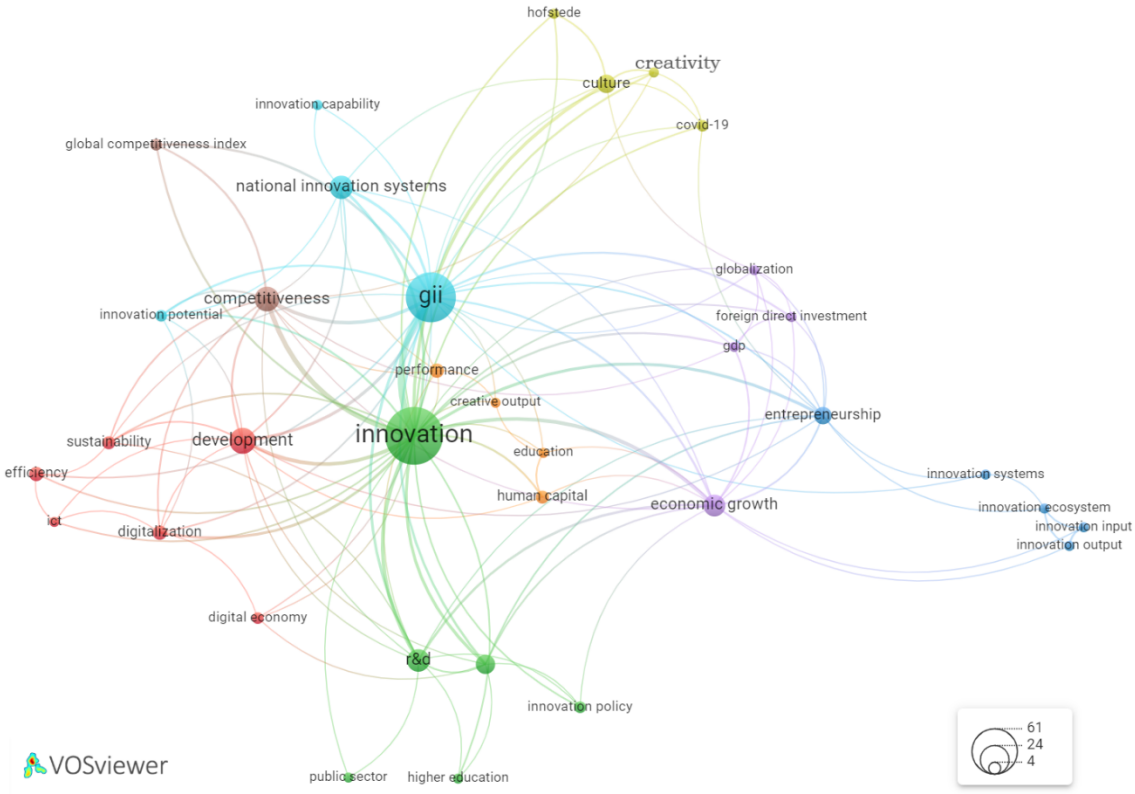



Figure 8. Keyword Network of GII

Source: own editing based on Web of Science Core Collection data, n=242

(An interactive version of the keyword network is available online: https://app.vosviewer.com/?json=https%3A%2F%2Fdrive.google.com%2Fuc%3Fid%3D1MxX86fqUX6QeurhIaAqzdZeEd13xkTCP)

The main limitation of comparing the keyword networks of the two innovation measurement systems is the low number of publications per system and the significant differences in the number of publications: the number of posts for the GII is more than double the number of writes for the EIS. Therefore, the research question about possible differences in the conceptual framework of the two innovation measurement systems cannot be exhaustively investigated by bibliometric analysis, further in-depth investigations are needed. It should be noted, however, that for keyword networks in both EIS and GII measurement systems, innovation and competitiveness, although not part of a common keyword cluster, show a relatively strong thematic link. This may indicate that scientific publications have highlighted

innovation-based competitiveness, which can be considered long-term, sustainable competitiveness instead of the short-term competitive advantage provided by cheap labour.

## Conclusions

This paper summarises the results of an exploratory research. The research focused on the interfaces among innovation, competitiveness, resilience, and future potentials. Through the analysis of the most well-known international analyses and measurements, it was found that these concepts are not independent of one another, nor are they substitutes, but rather complement one another.

In connection with the concepts studied, our findings indicate that the concepts themselves and the related measurements are changing, adapting to current socio-economic phenomena, which shows a kind of development trajectory. In connection with thematic measurements, this may manifest itself in the transformation of the methodology, for example as a result of the emergence of new indicators and measurement areas, or in the development of a new indicator system that complements the previous one. The latter solution can be seen, for example, in the competitiveness analysis of IMD, the Swiss competitiveness research organization: instead of radically revising the existing methodology, a new set of indicators reflecting technological progress was developed, which measures digital competitiveness and complements their 'general' competitiveness index. This points out that researchers and analysts need to keep up with the development of concepts and measurement systems, since they also need to be aware of changes in measurement methodologies to understand the measured phenomenon as thoroughly as possible.

Another illustrative example of the change/evolution of certain concepts and related measurements is the change in definitions in different editions of the Oslo Manual over the past 30 years. The change also affected the survey of statistical offices (Community Innovation Survey), individual questions, and surveyed areas. Since international innovation measurement systems take into account the data generated in this way (especially the European Innovation Scoreboard - EIS), the change of concepts is naturally followed by the indicators of the related measurements, which may have an impact on the overall results of national economies and their position in rankings.

The highlighted indicator system (EIS) therefore follows the changes appearing in the Oslo Manual, but in general, we cannot say that new topics entering scientific thinking will quickly appear in measurement systems. One of the reasons for this may be the lack of common

definitions and indicators recorded with the same methodology (e.g. European Startup Scoreboard), on the other hand, the complexity and measurability of the new field may also be an obstacle to appearing in measurement systems. For example, the analysis of 'soft' areas that are difficult to measure is very important from the point of view of the concepts studied, but these data are often criticized, due to subjectivity. Therefore, it is assumed that the parallel development of concepts and related innovation measurement systems may also depend on what data, data collection possibilities, and resources are available to measure a newly emerging area, and on the reliability of the data themselves.

Bibliometric analysis was also performed in the study, which confirmed that the concepts appeared together in scientific publications and researchers examine them in conjunction with each other. The analysis was carried out (due to time and scope limitations) in relation to the concept of 'national innovation'. The results highlighted the relationship between innovation and competitiveness, as these two concepts appeared together in several cases in the publications examined.

In the bibliometric analysis of national innovation, its relationship with resilience and future potential (or future in general), could not be demonstrated, but this does not mean that these concepts are not linked, but that they do not appear together (in the same publication) or only rarely appear. To analyse concepts that are indirectly related to each other, it is first necessary to explore the connection in detail. Another reason may be that, for example, the examination of resilience and innovation together is a new area, consequently, relatively few publications were identified. The development of concepts may lead to the emergence of new topic areas; therefore, it cannot be excluded that the connections between the concepts may develop and strengthen in the future.

## Limitations

The study's main limitation, particularly in the context of the bibliometric analysis, lies in the insufficient number of publications available for a comprehensive comparison of the keyword networks of the two innovation measurement systems, GII and EIS. The bibliometric analysis was constrained by the number of publications on the GII system, which is more than double those on the EIS system. This significant disparity limits the ability to thoroughly investigate potential differences in the conceptual frameworks of these two systems. Consequently, the study could not exhaustively explore whether there are differences in how innovation is

conceptualized and measured between GII and EIS. Further, more in-depth investigations with a larger and more balanced dataset are necessary to draw definitive conclusions.

Additionally, while the bibliometric analysis confirmed the co-occurrence of concepts such as innovation and competitiveness in scientific publications, it did not establish a strong relationship between national innovation and other related concepts like resilience and future potential. This suggests either a genuine lack of integrated research on these topics or a scarcity of publications addressing them together, indicating a new and emerging field requiring further exploration and study.

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