IV. Comparing research assessment models on a national level

This chapter presents a comparison of different approaches to the performance of research assessment on a national level in eight selected EU Member States (six 'new' and two 'old' ones), which are relatively similar in geographical, historical, and demographical respect but differ in terms of their innovation performance: Bulgaria, Poland, and Hungary are emerging innovators, the Czech Republic, Slovenia, and Lithuania are moderate innovators, while Netherlands and Austria are strong innovators (European Innovation Scoreboard 2021)[16].

The review of the national practices established that the research assessment and performance-based research funding systems are, in most cases, perceived as part of the political agenda of the country. This activity provides all participants in the national innovation ecosystem with strategic information and allows policy-making institutions to gain a better understanding which is needed to improve the formation of a research development framework and for initiating structural changes.

The effect achieved from the implementation of the research assessment system has to be monitored and evaluated in order to ensure the sustainability of the chosen political strategy and to meet the public needs. Equally important is to provide accountability for the public financial investments that have contributed to this effect.

Various methods are applied for the purpose of conducting research assessment. Researchers in Bulgaria tend to prefer expert evaluation compared to other approaches. Many of the current performance-based research funding systems rely on the analysis of different indicators as an alternative to the expert evaluation method. On the other hand, there is a tendency towards allocating a small part of the research funds according to defined indicators, and the imperfections resulting from this approach are not that significant. 'The informed expert evaluation', where experts use the best indicators available, coupled with other specific information, presents 'the best of both worlds'; this is also an opportunity to make a comparison between an indicator-based and a results-based assessment. To

16 https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3048

a certain extent this allows for 'triangulation' between the methods (Arnold & Mahieu, 2015).

In the performance of research assessment significant efforts are devoted to finding a balance between the different types of indicators in the individual research fields or a reasonable explanation as to why there are such differences. Systems that rely on expert evaluation use mechanisms which apply rating scales with equal importance, regardless of the discipline. In the metrics-based approaches, the person responsible for the design/preparation of the assessment has to create a bibliometric technique for the comparison of individual disciplines, and the principals often do not request an in-depth knowledge of their specifics. As a whole, it is easy to design a bibliometric technique which objectivises the subjective expert evaluation, but that is often avoided for political reasons. It is difficult to manipulate an impartial bibliometric technique, and even if it can be manipulated, the unethical practices can be easily identified via algorithms.

The most common type of financial support which research organisations receive is in the form of block grants and performance-based funding. The results-based contracts concluded between the research organisation and the funding organisation are very common, and in some cases they are implemented in combination with specific indicators. They are an important communication tool between research organisations and the policy-making and policy-funding institutions in the field (ministries, agencies). Performance-based systems, on the other hand, are essentially a political instrument and can be altered in order to reach a range of different strategic objectives, which determine the focus and scope of the assessment, its type (summative or formative), the selection of criteria, and the indicators.

An assessment methodology and a funding system function well when they respond to public needs, when public bodies and public policies are well-coordinated, and when there are reliable data and, respectively, reliable sources of information (Arnold & Mahieu, 2015).

1. Is there a common European model?

Research institutions in Europe are facing a number of challenges arising from the dynamic and constantly changing economic and public environment. That is why institutions need to adapt and change/transform the traditional ways of academic work. In this context, a number of issues arise in the performance of research assessment. According to a report by

Science Europe (2020), the European association representing the interests of big public organisations which conduct and fund scientific research, the transparency of the process is an extremely sensitive element in research assessment practices. Ongoing debates focus on the usefulness and application of quantitative indicators, ethical norms in the introduction of the 'open science' paradigm, etc.

The quality of research is perceived subjectively, depending on the specific context; that perception also evolves in time. The lack of a universal definition of research quality and the perception thereof has an effect on transparency. According to a 2019 study, 62 % of the researchers who participated in the survey cannot give a formal definition of quality; only 13 % of the big organisations give a definition of quality, but 38 % of medium-sized organisations and 53 % of the small organisations provide such a definition (Science Europe, 2020). Some institutions report that their assessment criteria are used for the purpose of defining quality, while others say that the definition of the quality of research is determined by the assessors conducting the assessment process. In the assessment criteria of organisations which reported using the term 'excellence' there is a lack of an official and/or universally accepted definition of the term.

The variations in the understanding of quality and which publications shall 'count' as research lead to markedly different behaviours in publication activity. The average number of publications at universities and countries where publishing in top journals is valued and where only those publications are important for academic growth is very small compared to the ones where there is a lack of an independent quality assessment and where quantity is prioritised.

Specific preferences were established in the performance of research assessment. The ones which are most frequently identified have to do with gender (82 %) and discipline (77 %). Others are related to specificities such as belonging (62 %) or position (49 %). Ethnicity is viewed as relevant by only 31 %, whilst 25 % of the organisations participating in the survey look at various types of disabilities.

The lack of cultural diversity among reviewers who conduct the assessment is noted by most organisations (68 %), whilst 32 % of them indicate that there is a need for a more active recruitment of candidates from groups with poor representation. It will be a good idea to acknowledge this finding by creating a portfolio of assessors who are representatives of different cultural communities in order to have conclusions which represent alternative

points of view. This will ensure that the assessment is realistic enough while also presenting specific details of the product subject of the assessment.

The same study also examines the 'stability' of the assessment process which is understood as the capacity for choosing processes for a reliable and fair quality assessment of the project proposals. A total of 72 % of the organisations-respondents have looked at the issue of stability of their assessment processes, and 44 % consider it present, whilst 28 % of the respondents have never evaluated the research assessment processes.

Due to the fact that different methods of introduction and popularisation of qualitative indicators in research assessment are used, qualitative review practices are often mixed with quantitative instruments; in particular cases a qualitative-turned-quantitative (through a scoring system) assessment is used and/or an entirely qualitative assessment is applied (Science Europe, 2020).

The research assessment processes and the variety of approaches to its performance are complicated, but regardless of that a number of research organisations share common evaluation practices in their desire to attract quality researchers.

The evaluation system, however, is under ever bigger pressure, and institutions face a number of issues in their attempts to conduct an efficient research assessment. That is why there is a need for changes in this process and for coordinated policies at national level.

The European Universities Association (EUA) believes that the review of research assessment procedures is a shared responsibility, and a coordinated approach is required for that purpose – one which brings together the main participants. Researchers, universities and other research organisations, funding institutions, and politicians have to work together in order to develop more accurate, transparent, and responsible assessment approaches (Saenen & Borrell-Damián, 2019).

2. The Anglo-Saxon research assessment model

As far as the Bulgarian national research assessment policy is influenced, to a certain extent, by the Anglo-Saxon model, we will first look at the specificities of this model before discussing other European practices. It is prevalent in the United Kingdom, and, regardless of the fact that Great Britain is no longer part of the EU, up until recently this model was part of the palette of European practices. The definitions, criteria, and

work methods used by the Research Assessment Exercise (RAE) and the Research Excellence Framework (REF) as of 2014 have evolved with each assessment cycle, but the founding principle has always been that public (state) funding has to be based on particular standards which take into account the quality and volume of studies, and the number of researchers who are considered 'active in terms of conducting research'. Three pillars of scientific research are analysed and respectively assessed: bibliometric and scientometric results from studies (i.e., books, articles, patents, software, performances, or any other form of scientific product), the quality of the research environment (infrastructure, policies targeted at support and research development), and prestige indicators (elements which prove the recognition of researchers in the academia and beyond). These common criteria are interpreted or developed from the point of view of individual disciplines and evaluated by different panels, which prepare their own framework documents also known as Panel Criteria or Work Methods (Détourbe, 2016).

According to Johnston (2008), the research assessment practice in the United Kingdom is an excellent example of an institutionalised process with a high impact not only on a researcher's individual career but also on the financial and intellectual status of a group of researchers (especially academic departments) and sometimes of entire universities and other institutions.

While the impact of research assessment varies, there is a visible trend relating to its effect on researchers. In particular cases a negative assessment which is not in line with the criteria set by REA has led to the discharge of research staff (Lucas, 2016). At the same time, researchers are encouraged to seek international recognition, for example, to become members of the boards of journals in different countries, to be invited as guest professors in foreign universities, to be evaluators in foreign research funds, etc. Even though this ambition may seem positive in general, some authors remark that there can be negative consequences, for example, a specialisation which is too narrow, a presentation of manuscripts only in international journals, or an increasing interest in external funding. This has forced some researchers to transfer to fields in which they do not traditionally work and to search funds outside their institution. An orientation towards applied research or commercial activities is observed at the expense of fundamental research even in the field of social sciences and humanities (blue skies research) (Lucas, 2016).

The Research Excellence Framework (REF) entered into force in 2014, and though it is a lot more different than RAE, it does build on the past practice to a certain extent. The main mission of REF is 'to provide accountability for public investment in research and produce evidence for the benefits of this investment' (https://www.ref.ac.uk/). There is no longer just talk about public funding of scientific research, but it suggests an opportunity for a return on investment by introducing a new criterion: the 'impact of scientific research' (Lucas, 2016). In this case, the focus is not on the creation of knowledge itself but on its active application. In his report "Encouraging a British Invention Revolution", Andrew Witty (2013) claims that universities are responsible for supporting the economic growth and that all institutions have to be encouraged to pursue this goal.

REF 2021 incorporates three main elements:

- **Outputs** – they represent 60 % of the assessment (reduced from 65 % in 2014), and results achieved by a given university during the assessment period (from 1st January 2014 until 31st December 2020) are examined.
- **Impact** – it adds up to 25 % of the assessment (an increase from 20 % in 2014) and encompasses study cases which describe the benefits of university research in detail. Impact is associated with the particular institution where the study has taken place, and it is not considered an achievement of an individual member of the research team.
- **Environment** – which amounts to 15 % of the assessment and describes the framework conditions which have to encourage the performance of research. These include a research strategy, staff development, cooperation both in the academia and outside, equality, and cultural diversity. It also looks at the revenue from the studies conducted and the successfully completed PhD studies.

Universities receive marks for each of those elements and, based on that, a grade point average (GPA) is formed. These elements are assessed for each structural unit at the university (units of assessment) and for the university as a whole. The GPA is the basis for calculating the amount of funding which the university receives.

3. National research assessment practices in EU Member States

This section contains a review of the specific national research assessment practices of several European countries, mainly from Central and Eastern

Europe, representatives of old and new EU members, and different in terms of the implementation of this activity. By the very nature of the type of assessments and the availability of information our analysis is more quantitative than qualitative, but we will be able to draw different conclusions than usually.

3.1. Austria

Regulatory framework

In 2011, the federal government of Austria adopted a strategy for the development of research, technology, and innovations (RTI). The strategy reflects the commitment of the Austrian government to support the development of scientific research, technologies, and innovations. It provides a framework for the goals and measures, the financial commitment for their realisation and the incentives related to it. Work is currently under way on a version of the strategy with a time horizon by 2030. The document focuses on sustainable economic development accompanied by transformations imposed by the new framework conditions. The strategy prioritises support for fundamental research, a reform of the funding model for universities, and increasing the funds attracted from external sources (Ecker et al., 2019).

The latest OECD documents highlight the structural weakness of the Austrian assessment system, which is the result of its limited implementation, including an insufficient access to, and an insufficient interconnectedness of, statistical data in public institutions which have been accumulated based on the financed research. The existing assessment practice does not include enough specific and primary micro data, nor is there a possibility for comparison of the individual sources of information. This leads to methodological limitations which significantly hinder the impact assessment and political interventions in the research field (Ecker et al., 2019). In order to resolve this problem, a Platform for Registry Data Research is being created for the purpose of providing data which correlate to research.

The Austrian Platform for Research and Technology Policy Evaluation functions in parallel, which ensures the transparency needed.

Funding

There are three main institutions which provide funding for scientific research, technologies, and innovations in Austria both on a federal and regional level. The main part of the funding on a federal level is provided by the following institutions: Austrian Science Fund (FWF), The Austrian Research Promotion Agency (FFG), and the Austrian Economic Service (Austria Wirtschaftsservice, AWS).

Public universities in Austria receive funding on the basis of results from negotiations with the Federal Ministry of Education, Research, and Science. A contract is signed for the performance of the commitments within a specific time period. Up until 2019, the federal ministry provided funding to state universities in the form of a fixed budget amount. The universities are free to use these funds providing that they fulfil the commitments agreed with the federal ministry in the respective implementation agreements. The post-2019 reform introduced a new funding system based on the capacity related to student training. The 2019–2020 implementation agreements are the first ones under the new funding system (OECD/European Union, 2019).

The funds provided are allocated in three fields: teaching; scientific research (for science-oriented universities) or progress and arts evaluation (for arts-oriented universities); infrastructural and strategic development. The reference value for the main indicators of the first and second pillar are negotiated in agreements with the higher education institutions. The reference values determine the portion of the joint budget for each university, which is based on specific indicators (OECD/European Union, 2019).

For the purpose of optimising the management of financial instruments, the principal funding structures (FFG and FWF) perform periodic evaluations (Eisenhut, 2020). Different quantitative and qualitative methods are used depending on the objectives and the scope of the evaluation.

Evaluation is the main instrument for an institution such as the FWF, which is required to justify its decisions to many different people: first, to the scientific community … and finally to the public: the taxpayer has the right to learn what is done with the money that ultimately comes from his or her pocket, and he or she should also expect to have this information communicated in an understandable way. Since its establishment, the FWF has set benchmarks for Austria in regard to the evaluation and decision-making procedures it employs.
Austrian Science Fund (Fonds zur Förderung der wissenschaftlichen Forschung, FWF)

Criteria

Austria uses the OECD/DAC criteria system and standards. The latter encompasses several main criteria – relevance, effectiveness, efficiency, impact, and sustainability.

Specific criteria are also taken into account in the assessment of research in the field of Humanities. They combine a total of 41 measures allocated in 5 theme-based fields: (1) Freedom of research, (2) Quality and measurement of productivity and efficiency, (3) Potential for international outreach, (4) Alternative environment for establishing contacts, and (5) Encouragement of researchers in the early stages of their career.

The following criteria are used in specific cases:

- Coherency: it reflects the coherency of policies and operational coherency (coordination with other participants during the implementation).
- Connectivity: the degree to which short-term humanitarian measures are implemented in a context where long-term and interconnected issues are reported (substituting the sustainability criteria).
- Scope: the extent to which the main vulnerable groups facing life-threatening events are influenced by humanitarian measures.
- Coordination: the extent to which the interventions of different participants are harmonised for the purpose of using synergies and minimising gaps, duplication, and resource-related conflicts (this is often part of the efficiency criteria).

It is important to highlight that in the Austrian research assessment practice there is no need to mechanically apply all possible criteria. Instead, the relevant indicators have to be selected for each individual case in correspondence with the specific expectations, objective, and subject of the assessment.

The research examining different indicators, which are applicable in the performance of research assessment, is accompanied by a short content analysis in regards to the most common terms related to research assessment in the existing national legal data bases.

Content analysis

Source: Authors' own elaboration.

Austria places a clear focus on technologies, and it can be assumed that the research assessment system has a positive effect on the country's economy. Proof of this are commonly used terms such as 'implementation; efficiency; development; economy-related services, sustainability'. The high share of resources provided by the business also contributes to the positive impact on the innovation ecosystem. Naturally, the political significance of these documents is clearly visible through commonly used terms such as research quality, objectives, financial instruments, and curating bodies.

3.2. The Netherlands

Regulatory framework

The research assessment at universities in the Netherlands is regulated by the Higher Education and Research Act, and it is jointly performed on a six-year basis by three institutions: the Association of Universities in the Netherlands (VSNU), the Dutch Research Council (NWO), and the Royal Netherlands Academy of Arts and Sciences (KNAW). They prepare

a Strategy Evaluation Protocol (SEP), which must be followed during each upcoming period.

An executive board, which consists of representatives of each university and the authorised organisations NWO and KNAW, decides which year the respective research unit is going to be assessed – institutions, departments, research groups, clusters, etc. The research unit is assessed in relation to the declared targets and the strategy, if there is one. The assessment supports organisations to improve the quality of their research and there is a focus on its benefit for the public.

Funding

Public universities and colleges receive block funding based on the number of research position awarded, including doctoral ones. They are free to decide how to use these funds in order to meet the costs for their ordinary activities: staff, equipment, and student accommodation. In addition, the government provides universities and colleges with subsidies for scientific research.

The grants from the government are not the only source of funding for universities and colleges. They receive financial support on a project-competition basis from the Dutch Research Council (NWO), local and international institutions, and not-for-profit organisations.

Criteria

The main document which forms the basic assessment represents a self-evaluation methodology prepared by the respective research unit. In addition, an assessment based on an on-site visit of the assessment team is prepared. There are three main criteria for the assessment of the research unit: (1) quality of the scientific research, (2) societal relevance, (3) viability.

As regards the quality of the research, it is monitored on an international, national, and, if appropriate, regional level. Research significance, academic prestige, and leadership in the relevant field are accounted for. The assessment is defended through a narrative reasoning by providing suitable evidence. The assessment protocol follows the guidelines of the Declaration on Research Assessment, adopted by the evaluating institutions.

The research assessment also reflects the societal relevance of the research and the commitments undertaken in economic, social, cultural, and any other relevant aspect. A lot more time is needed for the purpose of assessing the social impact; therefore in some cases the assessment can only reflect achievements from a previous period. Where possible,

the connection between teaching and scientific research is examined. The key scientific findings and achievements and the subsequent changes are described in a narrative form.

The viability criterion evaluates to what extent the targets of the research unit are scientifically and socially relevant, and it places a focus on whether the plans and resources are adequate in relation to the strategy applied.

Additional or specific criteria are the following: (1) open science, (2) doctoral training policy, (3) academic culture, and (4) human resources policy in accordance with the Strategy Evaluation Protocol 2021–2027. These provide clarity as to how scientific research is performed and how the research unit is managed. The specific criteria are not examined individually but adapted to the main ones. In addition, the evaluating team has the right to decide to what extent each indicator is suitable for the specific case.

The following criteria are also assessed:

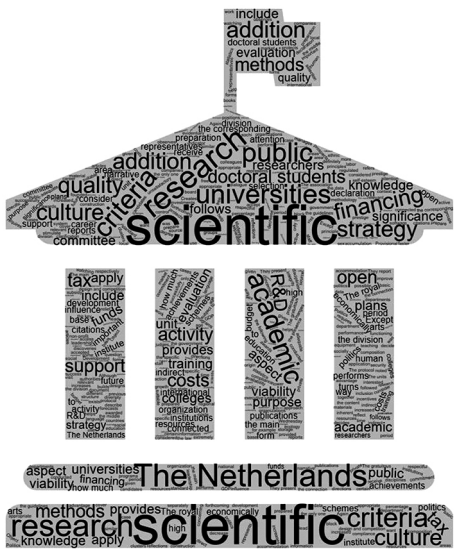
- Adherence to the 'Open Science' principles. It is assessed to what extent different stakeholders are included in the preparation and implementation of the strategy of a given research unit and to what extent the researchers are actively communicating with colleagues and public representatives. Subject to assessment are the storing of research data, the accumulation method, and the availability of materials and publications with an open access. Even if the research unit is not following the open science principles, the panel evaluates the plans for their future implementation.
- Subject to evaluation is the research unit's policy on the training of PhD students, the teaching methods, and the existence of a functioning quality and control system for this activity. The content and the structure of doctoral programmes, the candidate selection methods, the enrolment and tutoring, including how students are guided towards the labour market, the number of successful PhD candidates, and their career prospects and success are presented.
- Academic culture – the social security and the inclusion of the academic staff, research integrity, and the methods for creating such an environment are assessed.
- Human resources policy in accordance with the main assessment criteria – it accounts for the presence of cultural diversity in respect to gender, age, ethnic, and cultural origin, for the field of work, and for future action plans in relation to this topic. Units provide information about their

selection, training, career development, awards, and incentives policy (SEP 2021–2027).

The Royal Netherlands Academy of Arts and Sciences (KNAW) believes that the quality of research cannot be assessed solely on the basis of research publications and citation impact, because this approach is very unsatisfactory for a lot of research fields and the standard assessment methods do not reflect important aspects of research fields such as designs, software in construction disciplines, or books and articles in Dutch which are not included in the citation statistics.

In the wake of the proliferation of quantitative research assessment, prominent initiatives call for an increased focus on practices of responsible research evaluation. These focus on producing research metrics or indicators that adhere to certain principles such as transparency and diversity.
Petersohn et al. (2020)

Content analysis



Source: Authors' own elaboration.

The Dutch documents address socio-economic needs (culture, public, open, support) and place a focus on the high quality of research (quality), the research itself, financial instruments and incentives systems, and a clear link with the educational process, including doctoral training.

3.3. Czech Republic

Regulatory framework

The research system in the country is regulated through the 2019–2030 National Innovation Strategy and the Act on the Support of Research and Development of Public Funds (ACT No. 130/2002 Coll. on the Support of Research and Development from Public Funds). Through the 2019–2030 National Innovation Strategy of the Czech Republic the government approves the national priorities of scientific research, experimental development, and innovations. The law in support of R&D defines the forms of research funding, the state authorities responsible for the financing, and the procedures for the allocation and use of the funds. In addition, there are a number of by-laws.

The assessment of the activities conducted by state universities in the field of science and research is performed on the basis of the methodology of the Research, Development, and Innovation Council Department in the Czech Republic (last update in 2017). According to some researchers (Hasprová et al., 2018), the assessment process is complicated and often unpredictable. The conditions for assessing research results often change retroactively, the application of this methodology is limited only to the territory of the country, and it is difficult to ensure benchmarking. According to the authors, the main disadvantage of this assessment practice is its instability or the retroactive change of rules, but also the fact that the assessors can apply a subjective approach. Since the assessment also includes publishing activity, the number of publications increases, but their quality is questionable.

The Methodology for Evaluating Research Organisations and Research, Development, and Innovation Purpose-tied Aid Programmes started being applied after 2017. It aims to:

- accumulate information about the quality management of R&D at all levels and the subsidies foreseen in the longer term, which support a conceptual development of research organisations;
- establish a level of efficiency in the spending of public funds;

- support an increase in the quality and the international competitiveness of R&D;
- guarantee the accountability of stakeholders in R&D.

Funding

The Czech Republic actively encourages scientific research, developments, and innovations through various financial instruments. They are administered by different national institutions (Ministry of Education, Youth and Sport, Ministry of Industry and Trade, the Czech Science Foundation, and the Czech Technology Agency) or targeted EU financial instruments. Various incentives related to the development of R&D are applied in specific cases.

The Czech Science Foundation (also known as the Guarantee Agency of the Czech Republic, GA CR) supports research with a strong potential for achieving results with a high research quality, international research cooperation in the field of fundamental research, professional development of researchers from an early stage, and the efficient use of funding.

A number of incentives are offered in the country. For example, technological centres can receive investment incentives if they meet certain conditions.

Criteria

Research assessment is performed every 5 years and analyses the different missions of research organisations, their results, their impact, and their prospects. The specifics of various fields are accounted for and the institutions are assessed in a national and international context through independent expert assessments. Subject of analysis is also the way in which public funds, which are reserved for institutional development, are allocated. The research assessment is based on several main principles, which include a differentiation on three levels of management, the classification of institutions in three segments (universities, institutes of the Czech Academy of Sciences, research units of organisations), and an assessment of the quality, which suggests a bibliometrics analysis and on-site visits by the institutions.

Professional and expert panels composed of both Czech and foreign experts have been established for peer-review evaluations and to assess the quality of results … This approach was recommended by the international audit of research, development, and innovation in the Czech Republic carried out by Technopolis Group in 2011.
Good (2015)

The criteria applied are as follows:

Social importance:

- social importance / social benefit, which has been achieved through the work of the unit subject to evaluation (usually preceded by a self-evaluation);
- applied research projects (the unit subject to evaluation presents up to five of its most significant applied research projects conducted during the reporting period, and they present the results achieved or the potential of the project for practical implementation);
- results from other applied research;
- cooperation beyond the academic environment, including with business structures and transfer of technologies;
- recognition among the research community;
- actions aimed at promoting the research of the unit subject of evaluation.

Viability – this criterion assesses the research environment and the quality of management and internal processes of the university or the unit, as follows:

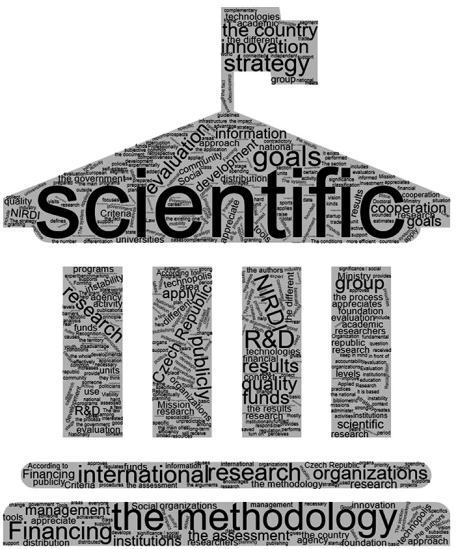
- organisation, control and support for research activity;
- availability of PhD programmes;
- national and international cooperation and mobility;
- human resources and career;
- structure of financial flows which support research, availability of a strategy for attracting funds through implementation of projects of a different scale;
- start-up development strategy;
- availability of research infrastructure and its quality;
- good practices applied in research.

Strategy and policy – this criterion assesses:

- the mission and vision for research development;
- the strategy and objectives for research development;

- instruments for the implementation of the research strategy;
- research examined in a national and international context.

Content analysis



Source: Authors' own elaboration.

The analysis of the documentary data base in the Czech Republic shows that there is a significance attached to the innovation system, the methodological approach, financing, and research and development, but there is a clear interest in international scientific research. The funding of technological activities is also one of the political interests of the state. Some of the priority terms, incorporated in its documents, are also quality, institutional structure, and organisations which curate research.

3.4. Hungary

Regulatory framework

The main document which regulates research development is the Research and Innovation Development Strategy. Its main objectives are as follows: to encourage research groups which conduct research according to interna-

tional quality standards, to accelerate international research integration, to support knowledge-intensive SMEs, etc.

The authority responsible for the development and implementation of the research policy is the National Research, Development, and Innovation Office (NRDIO). It is an independent organisation which is not under the control of a particular ministry, which differentiates it from the practice in other European countries.

In 2016, the European Commission published an expert assessment of the R&D and innovations system in Hungary. It states that in order to improve the achievements and the competitiveness of the Hungarian research system a focus should be placed on project and competition-related funding due to the existing structural weaknesses in the funding of the research system until now (European Union, 2016). This required the establishment of a new administrative structure to coordinate policies promoting research and innovations development.

Funding

State funding of scientific research in Hungary is provided by the National Research, Development, and Innovations Fund (NRDI Fund).

The main sources of funding for the Hungarian research system are:

- the National Research, Development, and Innovations Office (NKFIA), which consists of two funds: Research and Technological Innovation Fund (KTIA) and Hungarian Scientific Research Fund (OTKA);
- structural funds through their operational programmes and targeted schemes.

In Hungary, more than half of the funds for research and development are provided by the private sector (reaching 53 % in for 2018); the funds from the public sector represent approximately one third of the total amount of expenses. Private companies are the main innovators, over 70 % of the funds for research and development are absorbed by them. Higher education institutions and research institutions receive 13 % of the funds for R&D (Moldicz, 2020).

In 2020, NRDI was divided into two parts. The Research unit finances community-oriented research projects and programmes in support of high achievements in higher education and research institutions and of individual researchers. The Innovations unit supports business innovations and market-oriented research; the cooperation between the business and academics is supported through different investment programmes.

The National Research, Development, and Innovations Fund assess the project proposals which are announced based on a multi-phase evaluation system in accordance with its regulatory framework.

Criteria

The assessment criteria for the results of individual researchers are defined pursuant to decree No. 395/2015. Based on the decree, the employees at higher education institutions undergo a regular efficiency evaluation. The applicable evaluation criteria analyse:

- educational and research results;
- other activities related to educational activity, such as supervision of dissertations;
- publication and patenting of results from research;
- promotion of science and participation in conferences with a guarantee for publishing the articles approved for the report;
- visibility on international data bases;
- funds attracted for the purpose of conducting research;
- active contribution towards the development of young and gifted scholars and doctoral studies;
- results from students' evaluation of the study process;
- public activities.

Researchers from higher education institutions are not evaluated based on their public impact, the commercialisation of results from research, and entrepreneurial activities. No incentives for engaging in industrial participation or the transfer of technologies are offered.

Researchers working at the institutes of the Hungarian Academy of Sciences are evaluated based on procedures and criteria determined by internal regulations, whereas the common standards for university employees do not apply to them.

… most importantly, the experts tasked with evaluating individual researchers' performance should look behind the curtain and examine the qualitative aspects of researchers' publications.
Csomós (2021)

Content analysis

The review of the documentary data base in Hungary has found that importance is attached to activities related to innovations, standards, funding and financial instruments, and science and research, but also to efficiency and implementation method. This also corresponds to the new vision of the country aimed at improving the innovation ecosystem.

Source: Authors' own elaboration.

3.5. Bulgaria

Regulatory framework

Due to the diverse national innovation system which covers universities, two national horizontal research structures, both of which function under a specific law – the Bulgarian Academy of Sciences (BAS) and the National Centre for Agrarian Science (NCAS) – research institutes which are part of different ministries, and research-based companies, there are a number of legislative acts adopted in the country: Promotion of Research Act, Higher Education Act, 2017–2030 National Research Development Strategy of the Republic of Bulgaria, Bulgarian Academy of Sciences Act, the Law and structural framework of the National Centre for Agrarian Science, and the Ordinance on the conditions and procedure for assessment, planning,

allocation and spending of the funds of the state budget for the purpose of financing the ordinary research or artistic activity of state higher education institutions. Each year, an assessment of the results from the research or artistic activities of higher education institutions is performed, and based on this assessment the funds for research in state higher education institutions are allocated.

There are also rules for the assessment of scientific research, applicable to higher education institutions and two horizontal research organisations (BAS and NCAS), but there are still no sustainable and systemic results from the assessment for a longer monitoring period because the initiative is part of a pilot project and is only implemented for one year.

The European Commission supported the country through a new assessment instrument, PSF, in the years 2015–2018. This mechanism allowed for the performance of a summative analysis of the state of the national research system, and important recommendations and proposals were made for improving the research ecosystem (Vutsova et al., 2021).

It is good that the strategy mentions the need to involve foreign researchers in an objective accreditation … a European assessment is required – one which is performed by universities which are more advanced than the Bulgarian ones.
Dichev (2020)

Funding

The funds for research promotion are provided by the state budget and by other sources in line with the targets and priorities established in the National Research Strategy. The state provides the funds for the implementation of national research programmes and projects and supports the creation of a research infrastructure and the access to electronic research data bases.

The National Research Fund is the second financial source for supporting scientific research. Additional sources of funding are operational programmes under the Structural Funds, European Programmes as framework programmes (Horizon 2020, Horizon Europe, COST), other initiatives which support scientific research and innovations (INTERREG, Central and East European Initiative, etc.), programmes promoting bi-lateral research cooperation, etc.

Criteria

The assessment criteria systems of the individual research organisations are similar but not entirely identical. An independent external assessment – although not comprehensive – of universities is carried out by the National Evaluation and Accreditation Agency and also through the university ranking system, which includes a research assessment component. BAS and NCAS are assessed internally and independently, while the other research institutes do not have a structured assessment system. In this sense, Bulgaria does not have a uniform research assessment system.

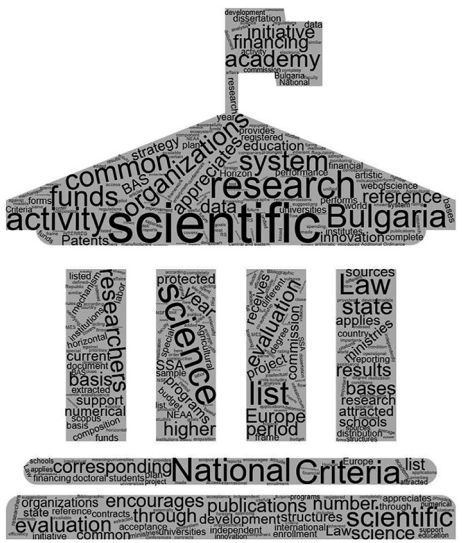
The criteria which are most frequently applied to different research structures cover the following assessment groups:

- Bibliographical (publications, including monographs, share of publications in co-authorship with institutions in other countries, independent citations visible in international data bases).
- Patents and useful models (registered patent applications and a list of registered patents extracted from international data bases according to the up-to-date list of the organisations which are subject to evaluation).
- Funds attracted (under national and international programmes/projects, contracts with Bulgarian or foreign enterprises and/or organisations, license agreements with companies/agricultural producers for the purpose of creating intellectual products).
- Results with regards to the academic development in Bulgaria (successful defence of dissertations, including the acquisition of an academic title as 'doctor of sciences', availability of an up-to-date strategy for the research development of the organisations).

Part of the recommendations under the Policy Support Facility (PSF)
• We recommend the adoption of a broader view on the term 'quality' with regards to research, and also, by taking into account the importance of research for the industry and society, to perceive it as inherent to the concept of 'quality' of the research and in the case of 'targeted' fundamental research.
• We recommend making the necessary corrections in the assessment methodology before using it for the allocation of institutional funding for research. Significant improvements are needed, especially in the approach towards the normalisation of data according to research fields, the definition of indicators and the definition and the differentiation of data sources.
• The current use and design of the scientific impact' indicators should undergo a thorough review. It is our opinion that the use of indicators based on the journal impact factor (JIF), and the h-index, is ill-advised. We recommend that these indicators be excluded from the assessment methodology.
• We recommend to the Bulgarian authorities to review the practice abroad and to apply foreign professional practice on a wider scale. We especially recommend to look for the support of experts on bibliometrics for the purpose of designing citation indicators.
• We recommend developing an assessment system which will ensure uniform impact of indicators in the calculation of evaluations according to assessment criteria, as well as an improvement of the strategic value of the results from the assessment and transparency of the assessment process.
Peer Review of the Bulgarian Research and Innovation system, 2015 under the Horizon 2020 Policy Support Facility

Since the beginning of 2022, the Ministry of Education and Science initiated a redesign of assessment criteria towards research quality. The main impetus is given upon the quantitative criteria, and severe debate was started this year.

Content analysis



Source: Authors' own elaboration.

In the national strategic documents, Bulgaria places a clear focus on national criteria, which is related to national policy, publications, and science and research; the importance of organisations curating research is also evident. Interestingly enough, concepts such as 'innovation system' and 'technologies' are almost absent.

3.6. Poland

Regulatory framework

The main regulatory framework in Poland includes the Higher Education and Science Act, also known as the Science Constitution, or Act 2.0, adopted in October 2018. The Act imposes significant changes in the research system: it creates better conditions for research and didactic achievements, ensures the sustainable development of the academic centres in the whole country, introduces doctoral schools, and provides universities with the suitable tools necessary for an efficient management. Research is in line with the national strategy, the Strategy for Innovative and Efficient Economy – Dynamic Poland 2020, in force for the 2013–2020 period, and with the Programme for the Development of Higher Education and Science for the years 2015–2030. The following four main measures are foreseen according to this last programme:

- increase in the quality of training at higher education institutions, which should be adapted to social and economic needs;
- improvement of the quality of the research conducted at national research institutions;
- reforms in the organisation, management, and funding of higher education and science;
- a more tangible impact of research on the social and economic environment.

The data about the results from the activities of Polish researchers and higher education institutions are collected through an integrated system (Information System on Higher Education – POL-on) (Euraxess Poland), created in 2011 in order to guarantee real accountability and transparency with regards to the efficiency of public spending for science and education.

The main participants in the national innovation system are universities and research institutes, but also commercial and not-for-profit companies of different sizes. There are over 400 public and private universities in

Poland, and the national research system also includes the following institutions: National Agency for Academic Exchange, National Centre for Research and Development, and National Science Centre (Ministry of Science and Higher Education, Poland).

Funding

Research funding is mainly provided through the state budget in the form of statutory funding and grants. They are primarily granted to institutions of the Ministry of Education and Science depending on the results from the national assessment which is performed every 4 years. The level of funding depends on the category awarded to the institution.

Block subsidies for university departments amount to around 10 % of their annual budget, while for fundamental and applied research institutes it is up to 30 % of their annual budget.

The National Centre for Research and Development finances the implementation of national and international programmes, including strategic programmes, which implement the state research and innovation policy. The centre allocates funds under operational programmes for the 2014–2020 financial framework: Operational Programme 'Smart Growth' (SG OP), Operational Programme 'Knowledge Education Development' (KED OP), and a beneficiary under Operational Programme 'Digital Poland' (PO PC).

The Polish National Agency for Academic Exchange (NAWA) funds activities related to the process of internationalisation in Polish higher education institutions and research institutions, and it supports the establishment of international partnerships, capacity-building, and the creation of the relevant organisational infrastructure.

The National Research Centre supports fundamental research; it funds research projects implemented by researchers and/or research teams and post-doctoral internships and provides PhD scholarships.

Additional funds are attracted from European structural funds and framework programmes for research and development: Horizon 2020, Horizon Europe, and other European initiatives.

Criteria

Research assessment focuses on four basic criteria: research and artistic achievements (for example, monographs, journal articles, patents), research potential, material effects from the research (for example, external financing) and other effects/results from research, and a few specific elements

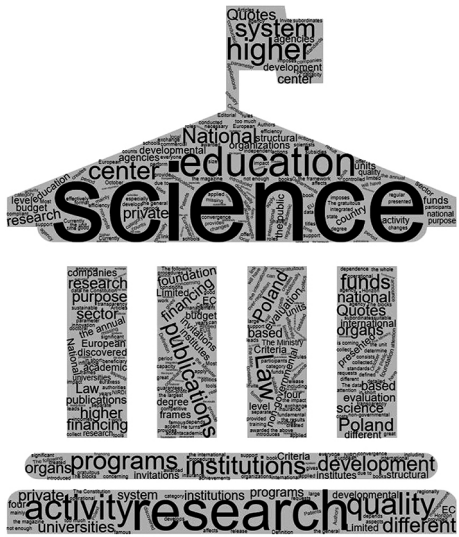
('accents') presented by the unit which is subject to evaluation (Kulczycki et al., 2020). Publications (national and international) account for 60 to 80 % of the total research efficiency of the unit which is subject to evaluation. The number of citations, however, especially international ones, do not have a significant impact. Apart from publications, data about several other parameters are collected for assessment purposes (Korytkowski & Kulczycki, 2019).

The assessment criteria also include:

- a selected number of publications presented by the research unit and their authors;
- a limited number of research books;
- editorial participation in research editorial teams;
- articles in science journals, indexed in JCR or ERIH;
- recognised patents (patent applications are not taken into account in the assessment).

Content analysis

Based on the documents in Poland, apart from the main terms related to research, the following stand out: research quality on a European level, scope, targeting, institutional structure, funding, including private, and the tools for that; also a correlation between the educational process and the regulatory framework was established. There is no clear focus on innovations or technologies, but there is one on the development and the role of business as represented by company structures of a different calibre.



Source: Authors' own elaboration.

3.7. Lithuania

Regulatory framework

The main law in Lithuania which regulates research is the Law on Higher Education and Research (2009, updated as of 2017). There is also the Research and Innovation Smart Specialisation Strategy, and the Guidelines for the evaluation of research and experimental development and artistic activities of Lithuania, approved by the Ministry of Education, Science, and Sport, are also covered by the regulatory framework. The institution which prepares recommendations on the development of national research and higher education, monitors and analyses their condition, and participates the implementation of various policies is the Research and Higher Education Monitoring and Analysis Centre (MOSTA). In addition, there are a number of by-laws regulating the functioning of the research system in the country.

Lithuania applies a dual research assessment system:

- annual, which is based on statistics of the results from research in terms of publications, patents, and other applications, and

- an international reference assessment, which is qualitative and is entirely performed by international experts every five years.

Funding

The Ministry of Education, Science, and Sport funds higher education institutions and research institutions on the basis of the results from the assessment, which is performed every 5 years. 60 % of the funds for research are allocated according to the quality parameters of a comparative expert assessment, and the remaining 40 %, according to the quantity indicators of the official assessment. Funding according to this assessment model has been provided to research and educational institutions since 2019.

Criteria

The criteria system in Lithuania consists of three types of criteria:

- quality of the scientific research – which is assessed in a given research field or group of research fields;
- economic and social impact – which is assessed only in the field of the research;
- potential for development.

Data which have to be provided depending on the research field include:

1. List of the best results from the research;
2. List of the best reports presented at conferences abroad;
3. List of the most important national and international awards for research and development received;
4. Data about PhD students;
5. List with the results from research which have had the biggest social and economic impact, and the requests for R&D by the business sector (both Lithuanian and foreign);
6. List of the most important participations of researchers representing the unit which is subject to assessment, in working groups or panels created by state authorities, state or municipal institutions and organisations, and companies;
7. List of the consultations provided by the unit which is subject to assessment to the public or economic actors;
8. List of the most important research conferences and events organised by the unit, which is subject to assessment;

9. List of the most important memberships in editorial teams of science journals by researchers representing the unit which is subject to assessment;
10. List of the most important memberships in international working groups and associations, participation in international expert groups, etc. by researchers representing the unit which is subject to assessment;
11. List of the most important results from the promotion of science.

Content analysis

Source: Authors' own elaboration.

The main focus in Lithuania is placed on research development on an international level, its quality, funding, and the institutional environment. Research is examined in the context of economic results. Interestingly enough, the organisations curating this activity are missing from the priority terms.

3.8. Slovenia

Regulatory framework

The main documents relating to the performance of scientific research in Slovenia are the Resolution on the Strategy for Research and Innovation in Slovenia, completed in 2020, an Open Access Strategy and a Road Map for Scientific Research Infrastructure, a 2021–2030 Research Strategy, the Scientific Research and Development Act, a Decision for the establishment of a public research agency of the Republic of Slovenia, a National

Research and Development Programme and the creation of a European Research Area, and a Guidance on (co)funding and assessment procedures for scientific research and monitoring of the implementation of scientific research. The Resolution on the 2021–2030 Scientific Research and Innovations Strategy in Slovenia is due to be adopted.

The Ministry of Education, Science, and Sport, the Slovenian Research Agency (ARRS), and the Research and Technologies Strategic Council are responsible for the development and coordination of the research policy. The Research Agency is an independent organisation for public funding and provides tools which allow for a stable funding of scientific achievements.

Funding

Research funding supports the following types of research:

- research programmes;
- fundamental, applied, and doctoral research projects;
- training of young researchers in research organisations;
- international cooperation in the field of research;
- attracting recognised foreign researchers.

Research and development funding is provided through the state budget and from other sources in line with the objectives and priorities indicated in the Research and Innovations Strategy. Institutions participating in the provision of funds are the Slovenian Research Agency, the Slovenian Public Agency for Entrepreneurship, Innovation, Development, Investment, and Tourism, and the Slovene Science Foundation. In addition to national funds, funding under operational programmes through European Structural Funds is also provided.

Criteria

The assessment criteria system includes:

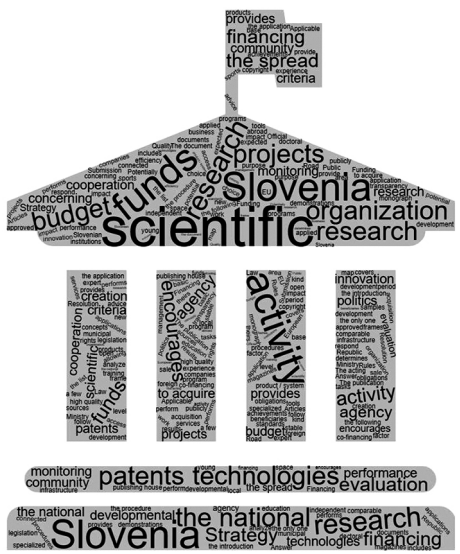
- funds attracted for the implementation of projects requested by businesses;
- funds attracted from projects financed by the EU and other international organisations;
- funds acquired through national or municipal budgets;
- number of new products, technologies, services, or concepts with an innovation potential and which have been developed or implemented in local or foreign companies;

- number of international patents applications and number of acquired patents;
- funds acquired through the transfer of copyrights on technologies or patents, samples or a specialised one-of-a-kind product/system and technological demonstrations;
- publication of a research monograph by publishers recommended by the agency;
- articles in impact factor journals.

The Slovenian model of research evaluation needs to be understood in light of the specific challenges which small research communities face and of its specific historical background. It is hence relevant that the bibliometric system affords certain advantages in terms of objectivity and transparency in a situation where research funds are limited and where consistent quality review by peers, domestic or international, is difficult.
Hojnik (2019)

Content analysis

A similarity with the terms used by Austria is observed in Slovenian documents. Apart from the compulsory presence of research, funding, and funding instruments, criteria, organisational/institutional environment, the role of technologies, and patent activity, which contribute to the country's economic development, is also evident.



Source: Authors' own elaboration.

The countries which are subject to this study are examined and compared based on the main factors which influence the innovation ecosystem: regulatory framework, funding including incentives, and the existence of a system for ensuring accountability to the society, i.e., assessment procedures and main assessment indicators. Table 4.1. presents these key factors. It clearly shows the differences which indirectly characterise the status of each country as an innovator.

Table 4.1: Key factors of the national innovation ecosystems

Country	Regulatory framework			Funding			Assessment	Criteria		
	General	Specific	High level of coordination with the remaining legal basis	Public	Private	Public/private ratio	Compulsory	Optional	Additional	Compulsory
Austria	☑	☑	yes	☑	☑	bigger share of private funding	☑			☑
Bulgaria	☑	☑	no	☑	☑	bigger share of public funding	☑			☑
The Czech Republic	☑	☑	relatively coordinated	☑	☑	comparable	☑			☑
Hungary	☑	☑	yes	☑	☑	bigger share of private funding	☑			☑
Lithuania	☑	☑	relatively coordinated	☑	☑	bigger share of public funding	☑			☑
Netherlands	☑	☑	yes	☑	☑	bigger share of private funding	☑		☑	☑
Poland	☑	☑	yes	☑	☑	comparable	☑			☑
Slovenia	☑	☑	yes	☑	☑	comparable	☑			☑

Source: Authors' own elaboration.

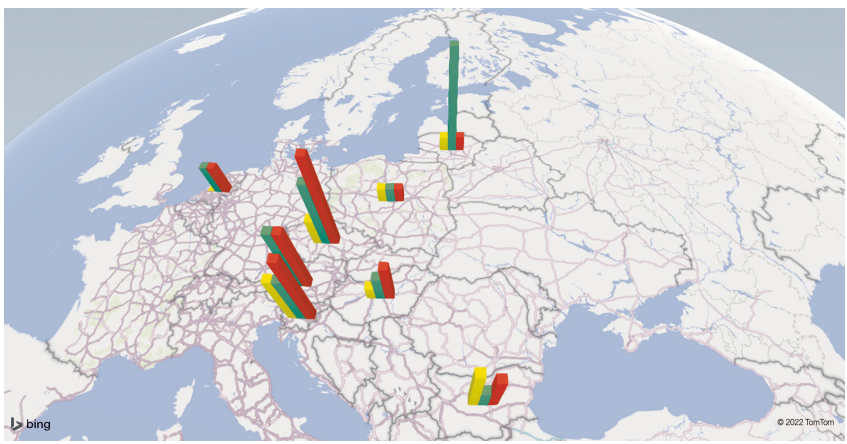
Based on the above, each country works with a different volume of legal documents, general and specific (e.g., special laws), but part of them is not coordinated with the remaining relevant documents due to the fact that community research policy is a horizontal one, and there is no obligation for full synchronisation. In some countries given documents are the result of an accidental initiative. In all of the countries studied, funding consists of both public and private sources; however, the ratio between the public and the private sources varies significantly per country. A significant share of private investments is observed in Austria and the Netherlands. The criteria system applied also varies per country. Additional criteria, apart

from the basic ones, are applied in the Netherlands, while in Austria it is not compulsory to consider all of the indicators of the criteria system.

4. Main research assessment indicators influencing the innovation ecosystem

The next section presents various dissections of comparisons between the research assessment systems of the individual countries, and different aspects are visualised. National practices are compared with a focus on the criteria used. The participation of the countries in the Seventh Framework Programme and Horizon 2020 is discussed, both in terms of the number of projects supported and in terms of the funding share; such data demonstrate the ability of research organisations to attract external funding, which is a clear evidence of their research capacity and competitiveness.

Figure 4.1 illustrates the diversity of indicators which are applied in the research assessment of the individual countries and shows their relative significance.



Source: Authors' own elaboration based on national documents.

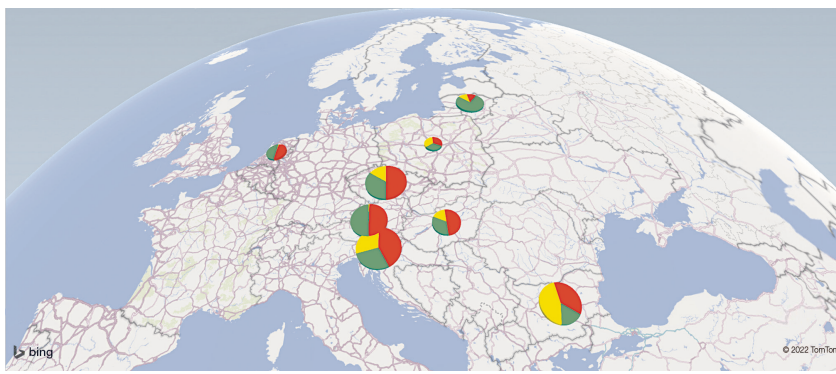
Figure 4.1: Number of indicators which are assessed in research assessments[17]
Source: authors

The significance of human resources is more clearly defined as an indicator with impact in the old Member States (the Netherlands and Austria).

17 Yellow: number of bibliometric indicators; green: number of human resources indicators; red: number of infrastructure indicators.

In the Czech Republic, Austria, Slovenia, and Hungary the existence of a contemporary research infrastructure also plays an important role. In Poland, there is a relative balance between the three categories of indicators under review, and only in Bulgaria there is a distinct inclination towards bibliometrics. Despite that, the national standards in Bulgaria only imitate what 'in the West' is understood as bibliometrics; thus an article in a top-ranking journal equals three reports at local conferences, which publish all of the proceedings. Bibliographical criteria receive the least attention in the Netherlands and Austria, but they are included in the quality assessment.

The functioning of the assessment system through the prism of the number of indicators, which is relevant to the size of the markers, is illustrated in Figure 4.2. This is a comparison of relatively aggregated indicators allocated in several main groups.



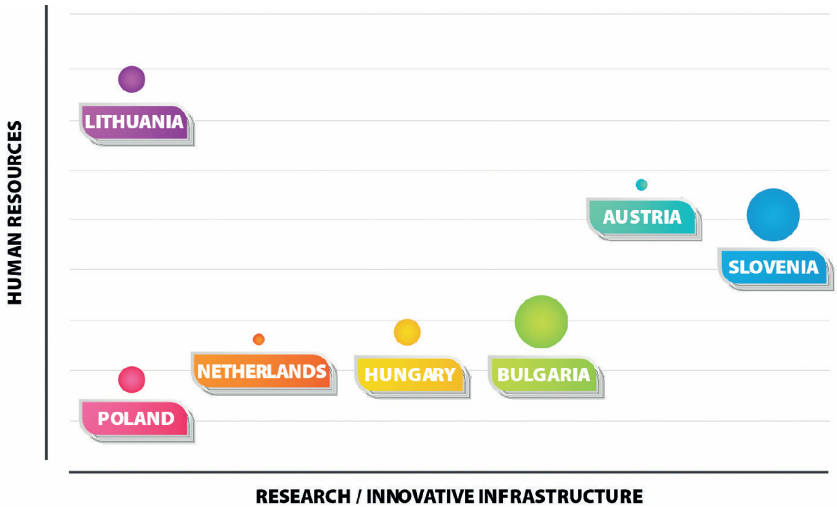
Source: Authors' own elaboration based on data from Innovation Scoreboard.

Figure 4.2: Research assessment (based on groups of indicators)[18]

The new Member States (Bulgaria, Hungary, and Slovenia) apply more indicators compared to the EU-15 countries. This can be explained with the lack of a systemic and holistic assessment practices and a search for the most suitable one; so this characteristic can truly reflect the up-to-date state of the research system.

Figure 4.3 shows the impact of the different categories of indicators; the size of the markers corresponds to the impact of the bibliometric indicators.

18 Yellow: number of bibliometric indicators; green: number of human resources indicators; red: number of infrastructure indicators.

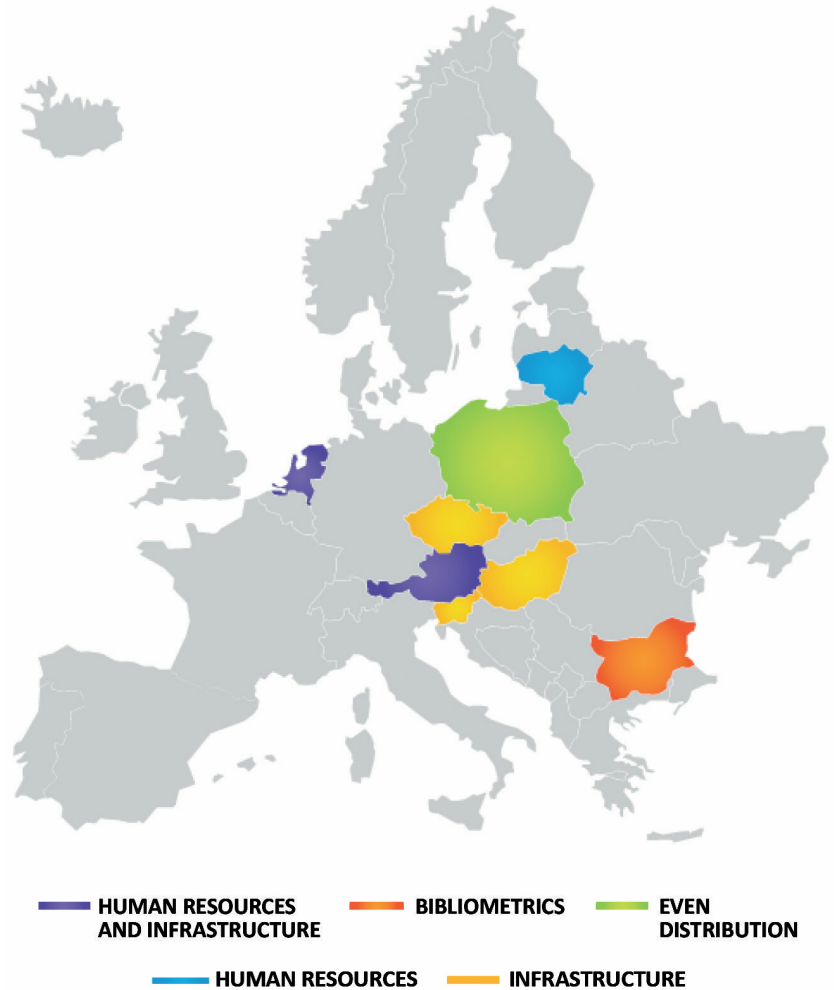


Source: Authors' own elaboration.

Figure 4.3: Distribution of the categories of research indicators according to impact

Slovenia and Bulgaria attribute the highest level of importance to bibliometrics, but Slovenia ranks high the availability of a modern research infrastructure. In Lithuania, the quality of human resources is especially important, while the other countries maintain a relatively good balance with regards to the importance of the individual criteria. Austria and the Netherlands do not consider bibliometrics as especially important indicators.

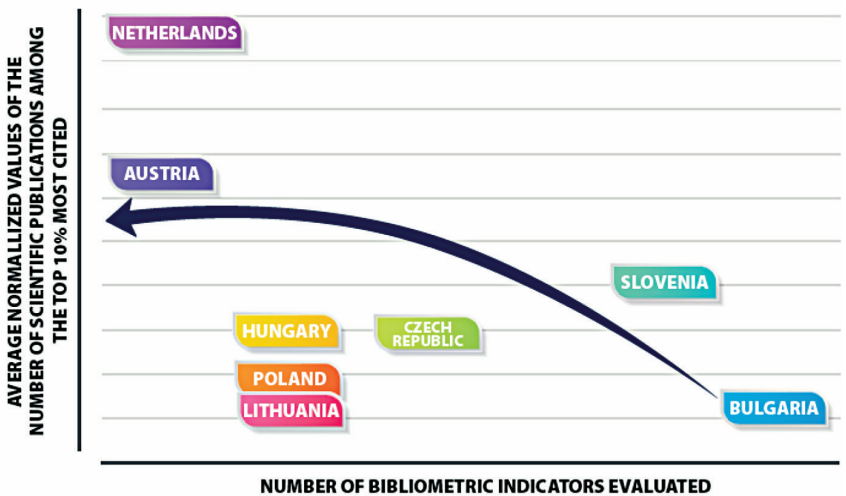
Figure 4.4 illustrates the significance of the different categories of indicators used in the performance of research assessment in the countries under review. Bulgaria's preference towards bibliometrics is evident, but we need to note once again that these do not necessarily reflect quality. Years ago, Romania managed to increase the quality of Romanian research thanks to well-formulated bibliometrics, incentives, and sanctions related thereto.



Source: Authors' own elaboration.

Figure 4.4: Level of importance of different indicators

As is illustrated in Figure 4.5, we observe a declining relationship between the assessments and the results for the criterion bibliometrics.



Source: Authors' own elaboration based on data from Innovation Scoreboard.

Figure 4.5: The link between assessment and results for bibliometrics

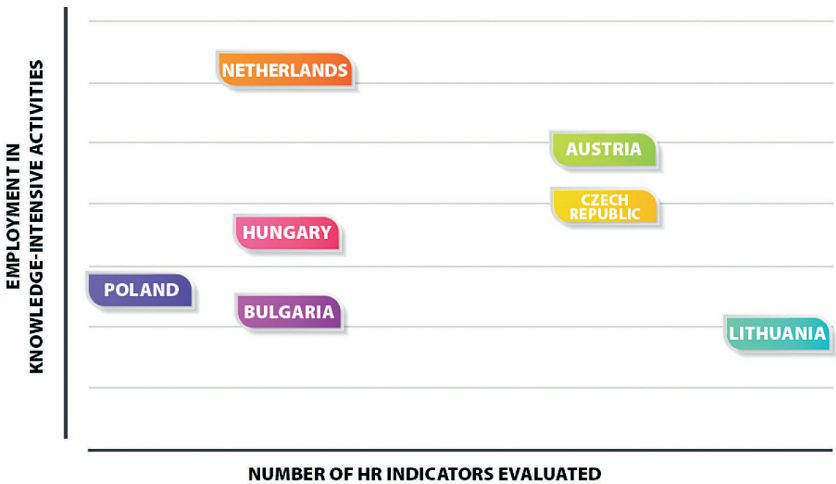
There was a search for a link between the importance of bibliometric indicators and their impact on researchers' publication activity. Our study analysed the link between the number of the bibliometric indicators applied and the average normalised values of the number of articles in the 10 % of the most cited.

Regardless of the focus which Bulgaria places on bibliometrics, the country has the lowest number of cited articles in comparison to the other countries. The opposite trend is also observed: both Austria and the Netherlands, where the importance of bibliometric indicators is the lowest, are best positioned in terms of publication activity. One plausible explanation of this state of affairs lies in the specific academic culture. In Austria and the Netherlands, the underlying expectation is that a quality paper with new ideas and concepts would be referenced and its authors would be credited. In Bulgaria the culture is a bit different. Even the PhD students might not refer to papers of their advisors[19]. Ideas are often borrowed as one's own, and citations would rather be on empirical data instead of conceptual ideas or purely on personal relationships (you cite a friend even if the source is

19 This was prior to the introduction of minimal citation requirements for career development. After that a huge influx is observed.

not relevant to the study). This directly undermines the importance of the 'human resources' factor.

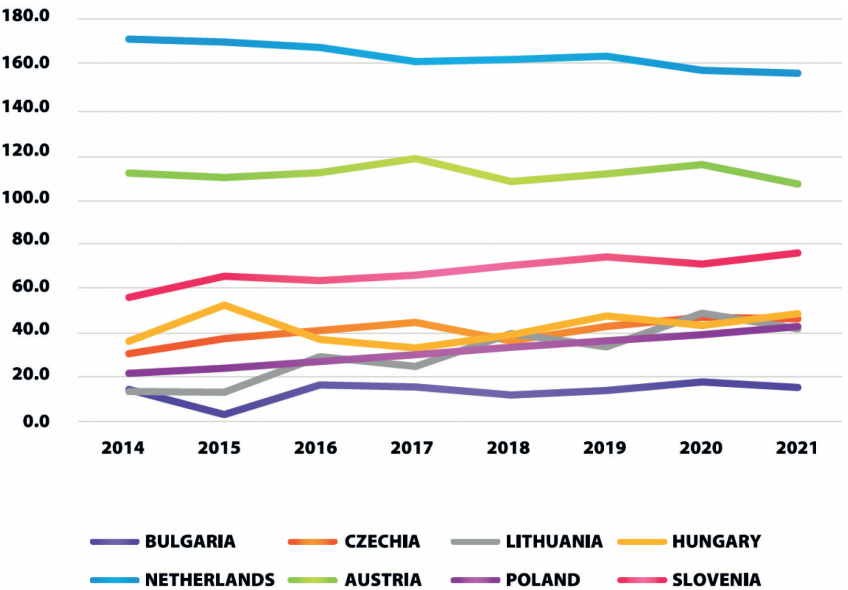
Figure 4.6 illustrates the dependency between the impact of the indicators which evaluate human resources and the level of employment in knowledge-intensive sectors.



Source: Authors' own elaboration based on data from Innovation Scoreboard.

Figure 4.6: Dependency between the number of HR indicators and the employment in knowledge-intensive industries

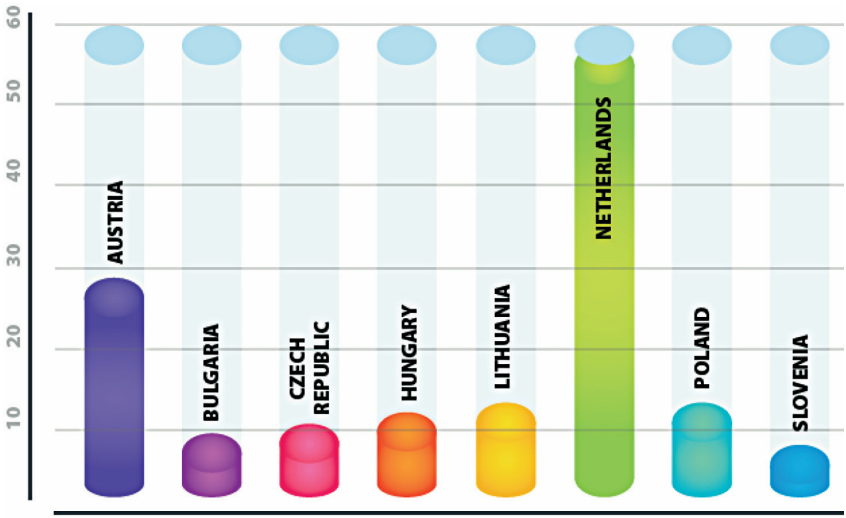
There is no clear link which can be applied to all of the countries subject to the analysis. As was observed, there is a clearly defined relation between these indicators in the Netherlands, and we see a certain dependency with regards to the indicators studied in Austria and the Czech Republic, but, at the same time, a discrepancy between both comparable indicators in Lithuania. As for Bulgaria, a clear focus on the importance of human resources is lacking, and, respectively, there is no clear trend with regards to the employment in knowledge-intensive sectors.



Source: Innovation Scoreboard.

Figure 4.7: Scientific publications among the top 10 % most cited relative to EU in 2014

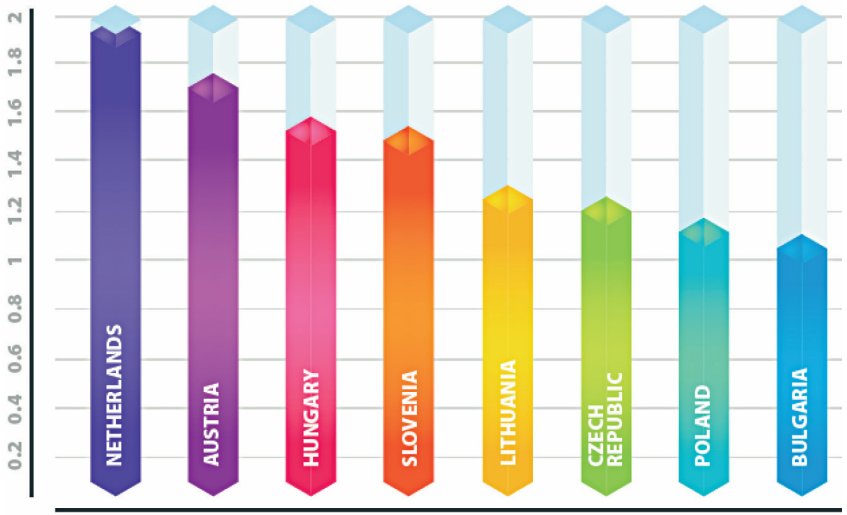
As concerns the citability of research publication in the top 10 %, Austria and the Netherlands are the leaders. An increase for this indicator is observed in Slovenia, which remains a level above the other countries reviewed here. For most of them there has been a moderate increase over the years. Regardless of the efforts in relation to the research assessment with a focus on bibliography, Bulgaria has the lowest share of articles among the most cited ones. It is evident that the old Member States, which have a more open assessment system, remain at the top and continue keeping this trend.



Source: Scimago.

Figure 4.8: H-index per country, 2020

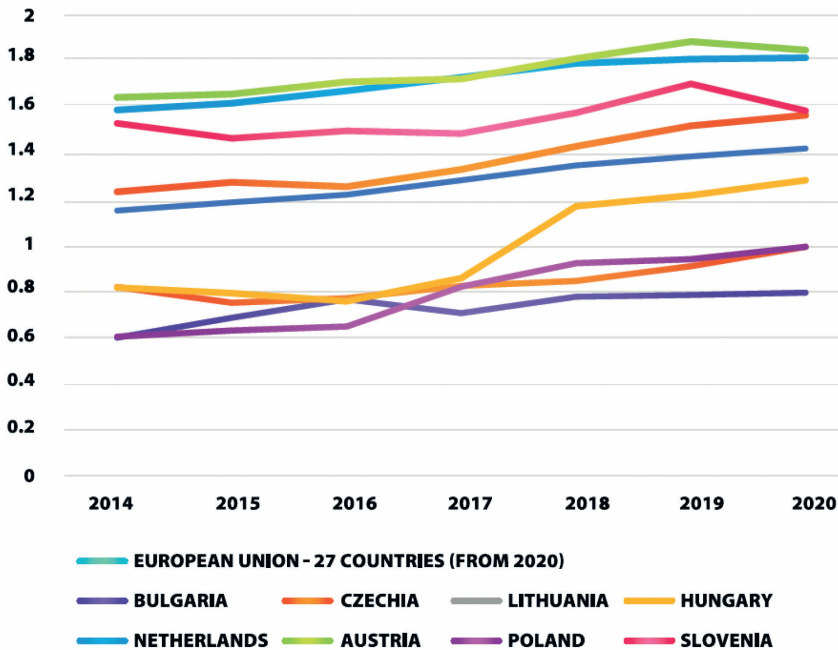
The countries with the highest H-index are again the Netherlands and Austria. The other countries have relatively similar indicators. The data for Bulgaria, which are not the most favourable, show that, despite having a clear focus on the importance of bibliographical data and the introduction of respective incentives, no notable progress is reported.



Source: InCites, Web of Science, 2022.

Figure 4.9: Impact Relative to World

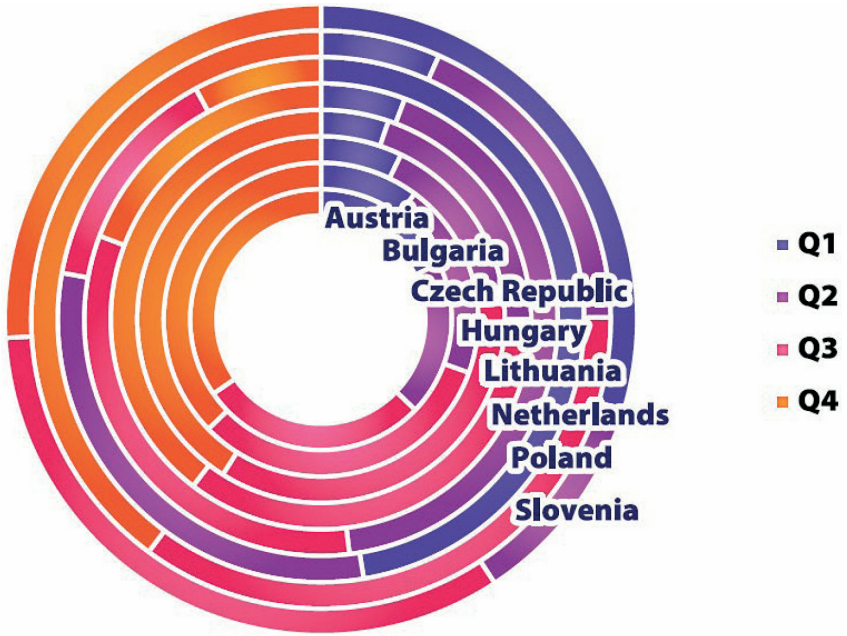
'Impact Relative to World' is an indicator published by InCites, Web of Science. It reflects the impact of citations as a ratio to the average impact of this criterion for the world over the last 5 years. According to this specific criterion, the best positioned countries are once again the Netherlands and Austria; Hungary and Slovenia have relatively good indicators, and Bulgaria has the lowest ranking. The latter suggests that the criteria system applied in Bulgaria has to be reconsidered.



Source: Eurostat (2021).

Figure 4.10: Employees in R&D

Figure 4.10 reflects the trend with regards to the staff employed in R&D as a percentage of the population in the work force equivalent to a full-time job. Austria has the best indicators, followed by the Netherlands, which also has higher indicators with regards to the H-index and Impact Relative to World. A positive trend is observed in Hungary which, to a certain extent, is related to the above-mentioned good indicators. The case of Slovenia is interesting: despite having a lower H-index, it is better positioned with regards to Impact Relative to World, but this is again relevant to the good positions with regards to its research staff.



Source: Scimago.

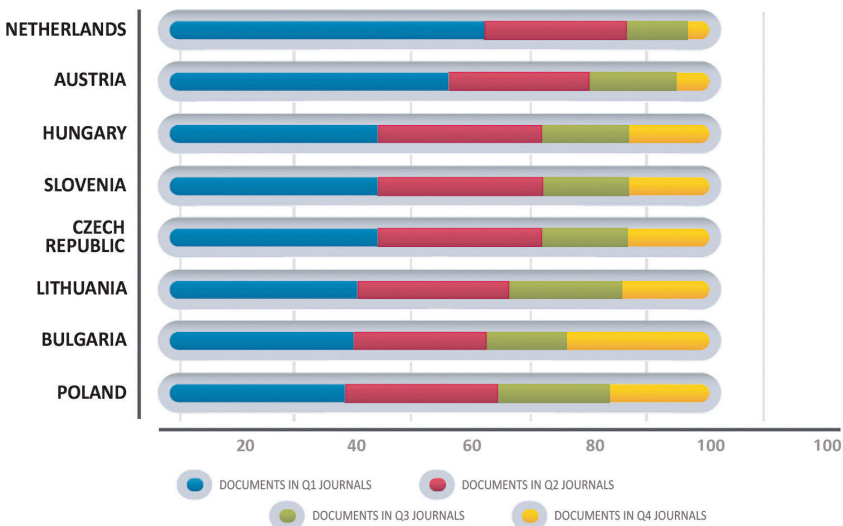
Figure 4.11: Share of publications in the individual quartiles, 2020

Figure 4.11 above illustrates the share of journals for each country in the individual quartiles of Scopus, where quartile 1 contains the most prestigious and cited journals, and quartile 4, the ones with the lowest citation rate. The Netherlands again has the best indicators. Bulgaria occupies a middle position in this ranking. Attention should be brought to the fact that the push for publications in more prestigious international journals further marginalises national journals, many of which are not indexed in international data bases or have a low impact factor; consequently, they are unattractive to domestic authors. It would be a good idea for the responsible authorities involved in policymaking to balance the focus on bibliographical indicators by introducing incentives for the development of quality national science journals.

In specific sectors, though, you might have quite surprising results. Bulgarian social science researchers and those in aesthetics and art criticism,

for instance[20], will feel under-represented in the global databases, but the reality is that Bulgaria is ranked 12th by publications in category 'art' (by searching art in Web of Science) in 2021 with results close to Germany and Netherlands. This is since *Art Readings*, a journal, which publishes papers from an annual conference, was included in Emerging Sources of Web of Science.

Figure 4.12 shows that the countries with the highest share of publications in quartile 1, which contains the most prestigious journals in Web of Science, are the Netherlands and Austria, followed by Hungary, Slovenia, and the Czech Republic. The highest percentage of publications in quartile 4 is typical for Bulgaria.

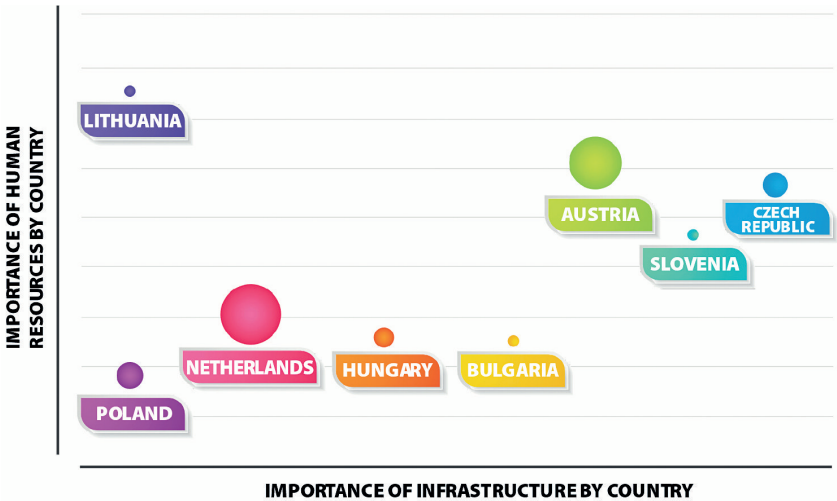


Source: InCites, Web of Science, 2022.

Figure 4.12: Percentage of documents in journals from the individual quartiles of Web of Science

The following figures examine the countries' capability to attract financial resources from EC framework research and innovation programmes.

20 Petar Plamenov (2017) is regarded one of the best national opera and ballet critics, teaching and publishing in aesthetics fields with authoritative articles and books in Bulgaria, but he has never published in outlets visible in Web of Science and Scopus.

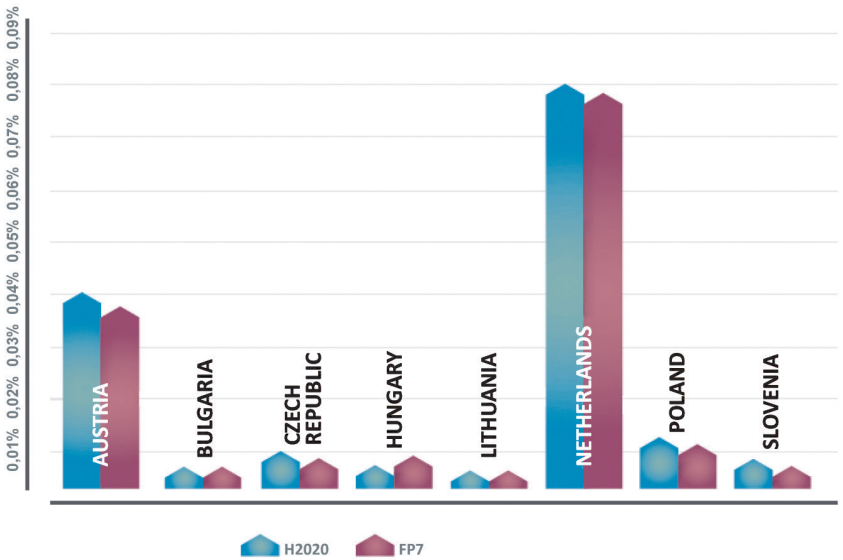


Source: Authors' own elaboration based on national documents and Horizon 2020 Dashboard.

Figure 4.13: Share of the funds attracted under the Horizon 2020 programme

In Figure 4.13, the size of the markers shows the share of funds attracted under Horizon 2020 against the availability of a modern infrastructure and quality HR. The Netherlands and Austria are obvious leaders with the highest share of funds attracted under the Horizon 2020 programme. The most important success factor in those countries is the balance between the significance of the individual indicators. Bulgaria has an extremely low share of funds attracted, and only Lithuania has lower results, but the fact that the latter has a smaller population and respectively a smaller number of researchers than Bulgaria must be taken into account.

Figure 4.14 illustrates the funds attracted under two consecutive Horizon 2020 programmes and the 7th framework programme. The share of funds attracted under the two framework programmes is comparable, and in both cases Austria and the Netherlands once again have the highest share.

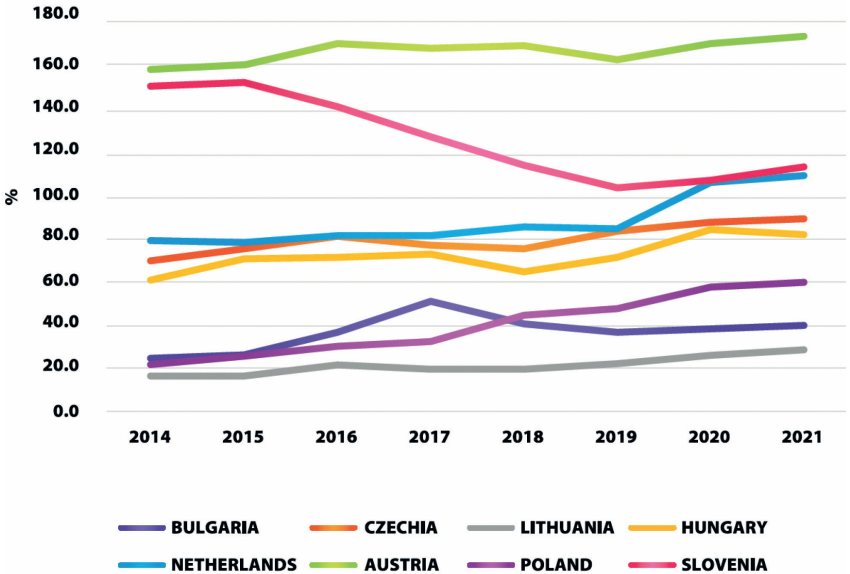


Source: Horizon 2020 Dashboard.

Figure 4.14: Share of the funds attracted under the Horizon 2020 programme and the 7th framework programme

The portfolio of funds attracted is of great importance for a sustainable research system, and a very convincing criterion for a well-functioning system is the size of the funds attracted from the business. The criteria applied in research assessment do not usually take into account the total amount of funds attracted, and only some countries examine the funds attracted per type of source.

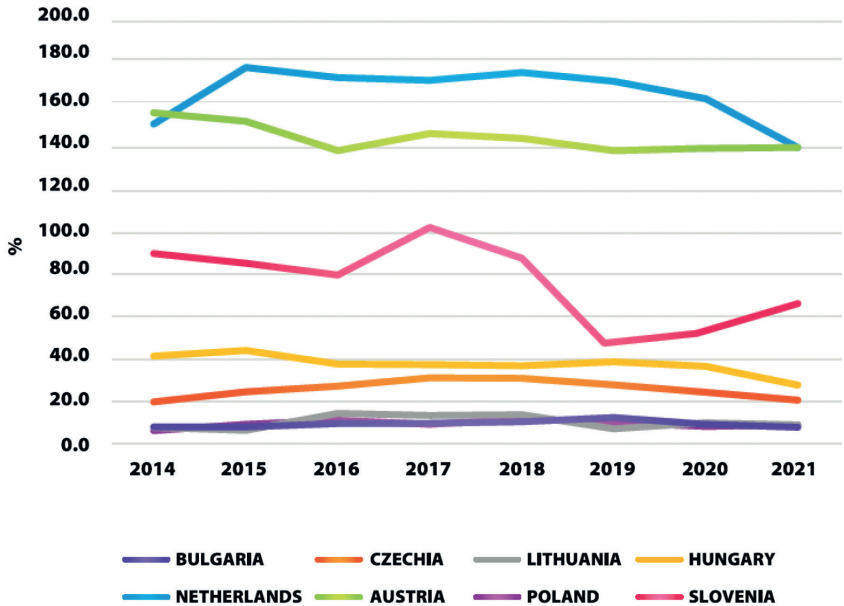
Figure 4.15 illustrates the share of funds provided by the business in comparison with the total amount of expenditures for R&D.



Source: Innovation Scoreboard.

Figure 4.15: R&D expenditure in the business sector

Austria has the highest share of funds for R&D invested by the business. The percentage of funds is calculated based on the average EU values in 2014, which are accepted as 100 %. An increase is also observed in the Netherlands, while there is a decrease in Slovenia. There is no notable increase in the Czech Republic and Hungary, but a positive trend is observed in regards to the development of the innovation ecosystem. No positive trend is observed in Bulgaria, and the lack of proactivity on the part of the business predetermines the lack of visible intervention on the innovation ecosystem.



Source: Innovation Scoreboard.

Figure 4.16: PCT patent applications

Figure 4.16 illustrates the percentage of patent applications based on the 2014 EU average values. It is evident that the activity of the new Member States is much lower than that of the Netherlands and Austria. In terms of activity, Slovenia is, to a certain extent, an exception, but over the last three years a decrease and an unstable behaviour with regards to this activity have been observed. Bulgaria, Poland, and Lithuania show the lowest activity. Such results may be due to both a lack of understanding with regards to the management of intellectual property products and a lack of proactivity on the part of SMEs. The lack of incentives for increasing this activity is also an important factor. The legal basis with regards to the storing and management of intellectual products is harmonised and so the reason for the low level of activity in those countries might be due to the low share of R&D investments in the GDP. Inevitably, the lack of dedicated funds for patent application and maintenance further worsens the situation.

5. Participation in partnership networks

One of the signs for the system's research capacity is the participation of individual units in various partnership networks. In several editions of the framework programmes there is a specialised tool called ERA_NET, which stimulates and supports the creation and/or participation in this type of networks. The tool supports only horizontal activities, and the specific research of the participants is a contribution of their countries.

The number of international networks in which each of the countries has participated is illustrated in Table 4.2. It shows only the networks created within the Horizon 2020 programme.

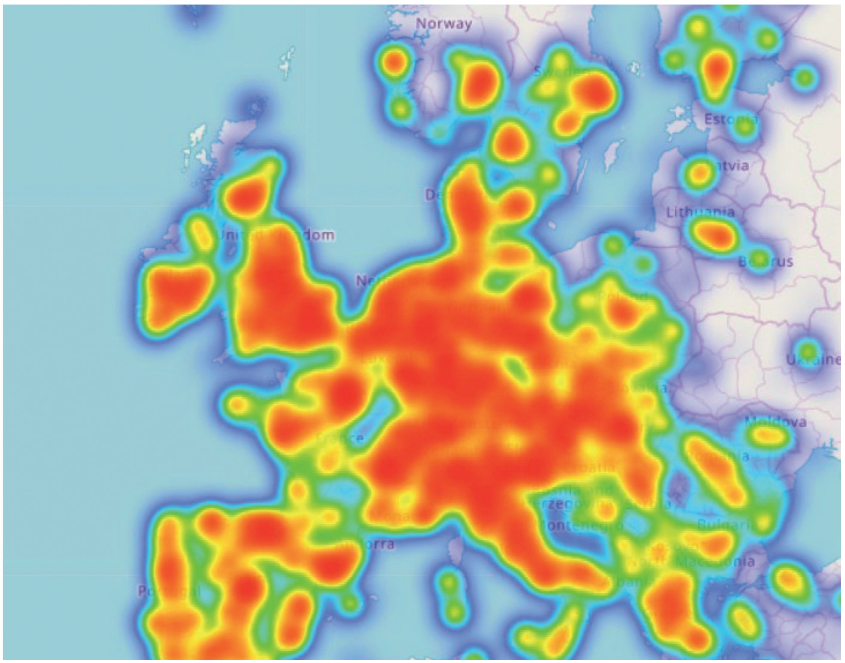
Table 4.2: ERA-NET Partnerships under Funding Programme Horizon 2020

Country	**Partnerships**
Austria	62
Bulgaria	22
Czech Republic	31
Hungary	31
Lithuania	29
Netherlands	71
Poland	64
Slovenia	39

Source: ERA-Learn, network information, https://www.era-learn.eu/network-information/networks/view.

The Netherlands and Austria are once again the leaders in this respect, while the other countries, with the exception of Poland, have a very low number of participations in networks. Bulgaria has one of the lowest results. This can be explained with the lack of funding for research here (under 1 % of GDP allocated to research) and with the decreased activity of researchers with regards to applying for European financial instruments. The countries which have a similar indicator actually share a similar issue. They should, first of all, increase the competitiveness of their research teams through different approaches; secondly, they should introduce specific incentives for participation in European initiatives (the existence of an increasing number of national instruments which are less competitive consid-

erably reduces the activity of researchers with regards to competing in European initiatives).



Source: Cordis datalab – Collaboration network, https://cordis.europa.eu/datalab/datalab.php.

Figure 4.17: Partnership networks

The map in Figure 4.17 illustrates the networks established for cooperation between individual organisations. The most saturated zones have a higher number of participants in networks. As regards the countries subject of this study, the Netherlands and Austria are the most active ones, followed by Slovenia, while Poland, Lithuania, and Bulgaria show lower rates of participation.

Those countries which have a well-developed innovation ecosystem do balance their indicators without placing an unnecessary focus on bibliometrics; instead, they emphasise the importance of having a modern research infrastructure, human resources, open science and a broad portfolio of financial income, without it being dominated by public funding. Moreover, if these findings were juxtaposed to the countries' ranking in

terms of their innovation profile according to the European Innovation Board, their position would largely confirm the conclusions made above.

Over the past decade, the aim of research assessment has supported the management of research institutions and has ensured clear accountability before the public. According to Jappe (2018), this function has one focus for organisations, where an indicator-based assessment is implemented, and another focus in the process for evaluating researchers. In many cases, when the interpretation of individual indicators according to different disciplines is determined by external sources, such as scientometricians and data providers, the standards for research achievements are not analysed by experts in given fields (Szomszor et al., 2021). As regards research of political or industrial interest, the usability and applicability are assessed, not the academic references. Moed (2005) believes that the analysis of citations clearly distinguishes good and bad studies but is limited with regards to differentiating between good and excellent ones. Citations increase over time and at different rate with regards to individual disciplines, and they are also influenced by cultural specificities (Szomszor et al., 2021). In most cases, the research assessment pays attention to research achievements, which in turn depend on the context in which they are studied (Nature, 2018). The indicators for novelty and usability of research also vary, but they can be perceived in a very different way.

The entities implementing the research assessment should take into account the levels of international cooperation, the impact of local factors, national specifics, and cultural traditions, and the analysis must include a full set of data, not just momentary metrics (Szomszor et al., 2021). The Institute for Scientific Information (https://clarivate.com/webofsciencegroup/solutions/isi-institute-for-scientific-information/) relies on indicators such as public expenses for research, patents, publications, citations, open access, and the existence of an active international cooperation (Adams & Rogers, 2021).

References

Academy of Agricultural Sciences Act, https://www.lex.bg/laws/ldoc/2134696961

Act on the Bulgarian Academy of Sciences, https://www.lex.bg/laws/ldoc/2132584961

Adams, J., & Rogers, G. (2021). *The Annual G20 Scorecard – Research Performance 2021*. Institute for scientific information, https://clarivate.com/lp/the-annual-g20-scorecard-research-performance-2021/

Arnold, E., & Mahieu, B. (2015). *R&D Evaluation Methodology and Funding Principles: Summary Report*. Technopolis Group, https://www.technopolis-group.com/wp-content/uploads/2020/02/Reform-of-the-research-assessment-and-institutional-funding-system-in-the-Czech-Republic.pdf

Austrian Platform for Research and Technology Policy Evaluation, https://fteval.at/

Austrian Platform for Research and Technology Policy Evaluation (2019). *Evaluation Standards in Research, Technology and Innovation Policy*. Vienna. DOI: 10.22163/fteval.2019.344

Broek-Honingh, N. G., van den Koens, L., & Vennekens, A. (2020). *Totale Investeringen in Wetenschap en Innovatie 2018–2024*. Den Haag: Rathenau Instituut, https://www.rathenau.nl/sites/default/files/2020-04/TWIN-rapport%202018-2024.pdf

Cornell University, INSEAD & WIPO (2020). *The Global Innovation Index 2020: Who Will Finance Innovation?* Ithaca, Fontainebleau, Geneva, https://globalinnovationindex.org/

Council for Research, Development and Innovation (2019). *Innovation Strategy of the Czech Republic 2019–2030*. Office of the Government of the Czech Republic, https://www.vyzkum.cz/FrontClanek.aspx?idsekce=867922

Csomos, G. (2021). *A critical review of the proposed reforms of the academic performance indicators applied in the assessment of researchers' performance in Hungary*. Retrieved February 13, 2022 from the arXiv database. arXiv:2110.13459

Détourbe, M. A. (2016). From Public Funding to Public Investment in Research: A Study of Research Funding Policies and their Impact through two Research Assessment Campaigns in the United Kingdom. *Revue LISA/LISA e-journal*, 14 (1) [Online]. DOI: https://doi.org/10.4000/lisa.8903

Dichev, I. (2020). Zashto Bulgaria nyama top universiteti (Why Bulgaria does not have top universities). *DW*, https://p.dw.com/p/3eN4O

Ecker, B., Brunner, P., Christmann-Budian, S., Fischl, I., Gassler, H., Gogola, G., Hartmann, E., Heckl, E., Kaufmann, P., Krabel, S., Mayer, K., Mozhova, A., Pechar, H., Radauer, A., Reiner, C., Ruhland, S., Sardadvar, S., Schneider, H. W., Schuch, K., Sturn, D., Tiefenthaler, B., Warta, K., & Welp-Park, E. (2019). *Austrian Research and Technology Report 2019*. Federal Ministry of Education, Science, and Research, Federal Ministry for Transport, Innovation, and Technology, Federal Ministry for Digital and Economic Affairs, https://www.zsi.at/object/publication/5340/attach/Austrian_Research_and_Technology_Report_2019.pdf

Ecker, B., Reiner, C., & Gogola, G. (2017). *HEInnovate in Austria: Background report*. WPZ Research GmbH, www.bmbwf.gv.at

Economic and Social Research Council, https://esrc.ukri.org/

Eisenhut, T. (2020). The regional research policy of the Austrian federal states. *Central European Economic Journal*, 7 (54), 227–241, https://doi.org/10.2478/ceej-2020-0012

Euraxess Poland, https://www.euraxess.pl/

European Commission (2015). Preissler, S., Mahr, A., Henriques, L., et al. *Peer review of the Bulgarian research and innovation system: Horizon 2020 policy support facility*. Publications Office, https://data.europa.eu/doi/10.2777/17938

European Commission, Directorate-General for Research and Innovation (2016). *Peer Review of the Hungarian Research and Innovation system*. Publications Office of the European Union. DOI: 10.2777/236994, https://rio.jrc.ec.europa.eu/library/peer-review-hungarian-research-and-innovation-system

European Commission, Directorate-General for Research and Innovation (2017). *Peer Review of Poland's Higher Education and Science System*. Publications Office of the European Union. DOI: 0.2777/193011, https://rio.jrc.ec.europa.eu/sites/default/files/report/PSF-Peer_review_Poland_FINAL%20REPORT.pdf

Eurydice, https://eacea.ec.europa.eu/national-policies/eurydice

Federal Ministry of Education, Science, and Research. (2018). *Austrian National Development Plan for Public Universities 2019–2024*. Vienna, https://bmbwf.gv.at/wissenschaft-hochschulen/universitaeten/der-gesamtoesterreichische-universitaetsentwicklungsplan-2019-2024/

Fonds zur Förderung der wissenschaftlichen Forschung. *Evaluation in the FWF*, https://m.fwf.ac.at/fileadmin/files/Dokumente/Entscheidung_Evaluation/EN_evaluation-fwf/evaluation-en_fwf.pdf

Global Incubator Network Austria (GIN), https://www.gin-austria.com/

Good, B., Vermeulen, N., Tiefenthaler, B., & Arnold, E. (2015). Counting quality? The Czech performance-based research funding system. *Research Evaluation*, 24 (2), 91–105, https://doi.org/10.1093/reseval/rvu035

Government Strategic Analysis Centre (Lithuania) – Strata, https://strata.gov.lt/en/

Hasprová, O., Brabec, Z., & Rozkovec, J. (2018). Intangible assets disclosed by public universities in Czech Republic. *Journal of International Studies*, 11 (1), 67–79. DOI: 10.14254/2071–8330.2018/11–1/5, https://www.jois.eu/files/5_303_Hasprova%20et%20al.pdf

Higher Education and Research Act (Netherlands), https://wetten.overheid.nl/BWBR0005682/2021-01-01

Hojnik, J. (2019). Evaluation of academic legal publications in Slovenia. *Evaluating Academic Legal Research in Europe*, 341–383. DOI: 10.4337/9781788115506.00017

Hollanders, H. (2020). *European Innovation Scoreboard 2020 as part of the European Innovation Scoreboards (EIS) project*. Luxembourg: Publications Office of the EU, https://ec.europa.eu/docsroom/documents/42981

Jappe, A., Pithan, D., & Heinze, T. (2018). Does bibliometric research confer legitimacy to research assessment practice? A sociological study of reputational control, 1972–2016. *PloS One 13*, e0199031. DOI: 10.1371/journal.pone.0199031

Johnston, R. (2008) On Structuring Subjective Judgements: Originality, Significance and Rigour in RAE 2008. *Higher Education Quarterly*, 62 (1–2), 120–147

Korytkowski, P., & Kulczycki, E. (2019). Examining how country-level science policy shapes publication patterns: the case of Poland. *Scientometrics*, 119 (3), 1519–1543, https://doi.org/10.1007/s11192-019-03092-1

Kulczycki, E., Korzeń, M., & Korytkowski, P. (2017). Toward an excellence-based research funding system: Evidence from Poland. *Journal of Informetrics*, 11 (1), 282–298, https://doi.org/10.1016/j.joi.2017.01.001

Kulczycki, E., Rozkosz, E. A., Szadkowski, K., Ciereszko, K., Hołowiecki, M., & Krawczyk, F. (2020). Local use of metrics for the research assessment of academics: the case of Poland. *Journal of Higher Education Policy and Management.* DOI: 10.1080/1360080X.2020.1846243

Lucas, L. (2006). *The Research Game in Academic Life*. Maidenhead: Open University Press & Society for Research into Higher Education.

Methodology for assessing applications to invitations. Slovenian Research Agency, https://www.arrs.si/en/akti/metod-skupna-12.asp?ZaTisk=Da

Moed, H. F. (2005). *Citation analysis in research evaluation*. Dordrecht, Netherlands: Springer.

Moldicz, C. (2020). Hungary economy briefing: Science and technology innovation mechanisms in Hungary. *China-CEE Institute*, 32 (2), https://china-cee.eu/2020/09/18/hungary-economy-briefing-science-and-technology-innovation-mechanisms-in-hungary/

Naredba za usloviyata i reda za otsenkata, planiraneto, razpredelenieto i razhodvaneto na sredstvata ot darzhavnia byudzhet za finansirane na prisashtata na darzhavnite visshi uchilishta nauchna ili hudozhestvenotvorcheska deynost (Ordinance on the conditions and procedure for assessment, planning, allocation and spending of the funds of the state budget for the purpose of financing the ordinary research or artistic activity of state higher education institutions), https://www.mon.bg/bg/59

National Innovation Office (2014). National Smart Specialisation Strategy, https://nkfih.gov.hu/english-2017/strategy-making-by-the/strategic-documents

National Research, Development, and Innovation Office, https://nkfih.gov.hu/about-the-office

National Science Centre, Poland, https://ncn.gov.pl/en/

National Science Fund (NSF), Bulgaria, https://www.fni.bg/

Natsionalnata strategia za razvitie na nauchnite izsledvania v Republika Bulgaria, 2017–2030 (2017–2030 National Research Development Strategy of the Republic of Bulgaria), https://www.mon.bg/bg/143

Nature (2018). Science needs to redefine excellence: the concept of research excellence is ubiquitous, but its meaning depends on context (editorial). *Nature*, 554, 403–404. DOI: 10.1038/d41586–018–02183-y

Netherlands Code of Conduct for Research Integrity, https://www.vsnu.nl/files/documents/Netherlands%20Code%20of%20Conduct%20for%20Research%20Integrity%202018.pdf

Netherlands Organisation for Scientific Research (2018). *Connecting Science and Society, NWO strategy 2019–2022.* Hague, https://www.nwo.nl/sites/nwo/files/documents/NWO_strategy_2019-2022_Connecting_Science_and_Society.pdf

OECD & European Union (2019). *Supporting Entrepreneurship and Innovation in Higher Education in Austria*. OECD Skills Studies. Paris: OECD Publishing, https://doi.org/10.1787/1c45127b-en

Office of the Government of the Czech Republic (2018). *Methodology for Evaluating Research Organisations in the University Sector*. Government of the Czech Republic.

Order on the Adoption of The Annual Regulation on Research and Experimental Development and Evaluation of Artistic Activities by Universities and Research Institutes, https://www.e-tar.lt/portal/en/legalAct/69270ef0a8d411e78a4c904b1afa0332

Petersohn, S., Biesenbender, S., & Thiedig, C. (2020). Investigating Assessment Standards in the Netherlands, Italy, and the United Kingdom: Challenges for Responsible Research Evaluation. *Shaping the Future Through Standardization*. IGI Global. DOI: 10.4018/978–1–7998–2181–6.ch003

Plamenov, P. (2017). Ecstasy and Trembling, or On the Inner Mobility of the Aesthetical. *Philosophical Alternatives*, 2017/4, 116–129.

Polish National Agency for Academic Exchange, https://nawa.gov.pl/en

Research Excellence Framework, https://www.ref.ac.uk/

Research, Development, and Innovation Council Department (2018). *Methodology for Evaluating Research Organisations and Research, Development and Innovation Purpose-Tied Aid Programmes*. Office of the Government of the Czech Republic, https://www.vyzkum.cz/FrontClanek.aspx? idsekce=695512

Rules on the Procedures for the (Co)financing and Assessment of Research Activities and on Monitoring the Implementation of Research Activities. Slovenian Research Agency, https://www.arrs.si/en/akti/20/prav-sof-ocen-sprem-razisk-dej-okt20.asp

Saenen, B., & Borrell-Damián, L. (2019). *EUA Briefing: Reflections on University Research Assessment – Key concepts, issues and actors*. European University Association, Brussels, https://eua.eu/downloads/publications/reflections%20on%20university%20research%20assessment%20key%20concepts%20issues%20and%20actors.pdf

Science Europe (2020). *Position Statement and Recommendations on Research Assessment Processes*. Science Europe AISBL, Brussels, https://www.scienceeurope.org/media/3twjxim0/se-position-statement-research-assessment-processes.pdf

Scientific Research Promotion Act, Bulgaria, https://www.lex.bg/laws/ldoc/2135472978

Slovenian Research Agency, https://www.arrs.si/en/

State agency CzechInvest, http://www.czech-research.com/

Sturn, D., Dall, E., Degelsegger-Márquez, A., Lampert, D., & Schuch, K. (2018). Zwischenevaluierung des Programms "Beyond Europe" (Interim evaluation of the Program "Beyond Europe"). Vienna, https://www.zsi.at/de/object/publication/5158

Szomszor, M., Adams, J. Fry, R., Gebert, C., Pendlebury, D. A., Potter, R. W., & Rogers, G. (2021). Interpreting Bibliometric Data. *Frontiers in Research Metric Analysis*, https://doi.org/10.3389/frma.2020.628703

Technopolis Group, https://www.technopolis-group.com/

The Austrian Research Promotion Agency (FFG), https://www.ffg.at/en/FFG/The-FFG

The Royal Netherlands Academy of Arts and Sciences (KNAW), https://www.knaw.nl/en

VSNU, KNAW & NOW (2020). *The Strategy Evaluation Protocol 2021–2027 – SEP*. Hague, https://www.vsnu.nl/files/documenten/Domeinen/Onderzoek/SEP_2021-2027.pdf

Vutsova, A., Arabadzhieva, M., & Hristov, T. (2021). Impact assessment of research evaluation in Bulgaria. *COLLNET Journal of Scientometrics and Information Management*. DOI: 10.1080/09737766.2021.1962767

Website of the Republic of Poland, https://www.gov.pl/

Witty, A. (2013*). Encouraging a British invention revolution: Sir Andrew Witty's review of universities and growth*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/249720/bis-13-1241-encouraging-a-british-invention-revolution-andrew-witty-review-RI.pdf