II. Research Impact Assessment

1. Impact assessment – General definition

The routes of impact assessment could be traced back to the cross-impact assessment proposed by Gordon and Helmer in 1966 (Gordon, 1994), the environmental impact statements since 1970 (National Environmental Policy Act), and technology assessments (Coates, 1971). All these methods of futures studies aimed to develop plausible scenarios and strategies to cope with the growing uncertainty.

The impact assessment is an ongoing process of monitoring and analysing the social, economic, and ecological changes which occur as a result of the implementation of a given activity. The objectives of an impact assessment are usually aligned with the functions of a given organisation, and in specific cases they are independent of regulatory factors (ecological assessments are an exception, for example). The impact assessments usually look beyond the standard horizon of planning of the activities.

An impact assessment usually surpasses the boundaries of the 'gross' results and impacts foreseen in a given policy, programme, project, or initiative. Sometimes impact assessments are conducted within the larger context of foresight studies, which are trying to back-cast what should be done in order to reach a desirable future or to avoid undesirable one. The time-horizons are always extending and the overall uncertainty grows, thus calling for foresight-based capacity to react to uncertainty shocks. The impact assessment could be considered also as a part of broader agenda of 'evidence-based policy making'. It also can be used to measure programmes implementation alternatives and their innovativeness.

In general, 'impact assessment' deals with the effects of proposed and/or planned actions (Porter & Rossini, 2019). The International Association for Impact Assessment (Fargo, North Dakota, USA) accepts that the impact assessment is the process of identifying the future consequences of a current or proposed action through which social justice and quality of the environment are achieved to a certain extent. According to this association, the impact assessment is one of the approaches for analysing policies and programmes, and is also complemented by a technological assessment and a risk assessment (International Association for Impact Assessment). Impact

assessments (IA) should be participatory, i.e. engaging all stakeholders, and independent from the programme sponsor. At the same time impacts could differ substantially (academic impact as the intellectual contribution to the field, economic effect on direct users of the research, and various indirect socio-economic effects).

According to the European Commission, the impact assessment "must identify and describe the problem to be tackled, establish objectives, formulate policy options, assess the impacts of these options and describe how the expected results will be monitored" (European Commission, Directorate-General for Research and Innovation, 2017). This process provides decision-makers with data regarding the advantages and disadvantages of the various proposed solutions on the basis of their potential impacts.

In some countries, manuals have been developed to assess the impact on regulations, as they are a tool which contributes to the formulation and implementation of better public policies. In this way, the process of making better and better decisions (operational, strategic, normative) is improved. Strategic decisions have a lasting effect in the long run and their implementation has a transformative effect on society. The principles IA adheres to are transparency, reasonableness, efficiency, and effectiveness. The handbooks on preparing an impact assessment are defined as a tool for examining the effects of different versions of actions aimed at resolving existing issues from the point of view of costs, benefits, and related risks.

The impact assessment cannot be categorically referred to only one of the stages of the public policies cycle. Elements of it can be found in the development of policies, the formulation of the objectives thereof, the decision-making process, and the analysis and assessment of these decisions. There are both scientific and purely practical justifications for such a diffusion.

The European Commission, Directorate-General for Research and Innovation (2017) proposes seven consecutive analytical steps for implementing the impact assessment:

1. Definition of the problem;
2. Clarification of the policy objectives;
3. Proposal of alternative options;
4. Examination of the economic, social and ecological impacts;
5. Comparison of the options;
6. Proposal of a preferred option;
7. Definition of monitoring and assessment indicators/procedures.

The impact assessment incorporates the advantages of both the rational and the incremental decision-making model in order to achieve a combined search for decisions or decision-making (Etzioni, 2001).

The regulatory impact assessment is proposed and developed as a tool by the Organisation for Economic Co-operation and Development (OECD Committee on Science and Technology Policy / OECD Working Party on Innovation and Technology Policy (TIP), 2009), and it is used for better regulation in the context of the economic policies. This assessment aims to improve the effectiveness and efficiency of governments so that they can improve competitiveness and economic results in the innovative and globalised economy.

The impact assessment of a given policy originates from the concepts of environmental protection, sustainable development, and environmental rights of citizens. At the end of the 20th century a number of countries introduced this approach in the analysis of some sectoral policies such as construction, transport, energy, agriculture, etc. This is an assessment of the long-term impact of people's business activity on the environmental components. Later on, the impact assessment was extended to other policies, unbounded to ecology, for instance horizontal ones (education, science, communication).

The impact assessment is recognised equally well by the entities financing certain activities (donors) and by the entities responsible for implementing programmes, because both sides can learn what the expected results are and improve the effectiveness and efficiency of their work.

As a conceptual framework, the impact assessment has three main elements:

- impact chain model;
- specification of the levels on which the impacts are assessed;
- definition of the types of impacts which have to be assessed.

According to some authors (Tran & Daim, 2008; Newson et al., 2018), an important aspect of the impact assessment concept is the choice of suitable methods and the development of tools for data analysis. Qualitative tools are suitable for the analysis of the processes, while quantitative research and analytical methods are used for checking achievements and impacts. The following qualitative methods are frequently used:

- secondary analysis of existing data;
- management (semi-structured) interviews;

- standardised (structured) interviews;
- model research.

The question which methods to choose depends on the task and the objectives of the assessment, but as a whole the qualitative and quantitative research methods have to be combined.

For example, when analysing the objectives of a project and the interventions thereof, the data from the project documentation has to be analysed. The results from these analyses shall be used to trace the anticipated effects against the objectives or the degree to which they are achieved.

In the case of counterfactual impact assessments, facts and opposing assumptions are compared with the aim of looking for an answer to the question 'What would have happened, if …?'. When we consider whether to introduce a new policy or to attempt to assess to what extent a given pilot programme has been successful, we look at a variety of opposing questions: 'What if the policy was introduced?', 'What if the policy did not exist?' (Cartwright, 2003).

Counterfactual analyses are based on the idea that, in order to determine the net effect (contribution) of a given policy, programme, or intervention, the assessment has to be constructed on an inexistent (counterfactual) situation in which this intervention was not conducted. The assessment of the net effect is based on the assumption that every reason on its own can influence the result, i.e., it is accepted that the reasons are independent and complementary as an effect (Ragin & Sonnett, 2005).

The 'difference-in-differences' approach applied in the impact assessment suggests the presence of data about the results of two control groups, an experimental one and a control group, before and after a given intervention, regardless of the fact that this is applicable to the counterfactual analysis as a whole. In order to apply this method, data about the beneficiaries and non-beneficiaries is needed before and after the intervention (EVALSED, 2013). The following is examined:

- difference between beneficiaries and non-beneficiaries;
- difference (between beneficiaries and non-beneficiaries) in the period before receiving support and after that.

The 'propensity score matching' approach aims to eliminate the impact of side factors through control on the characteristics which describe the units in the experimental and the control group.

'Contribution analysis' is another approach for measuring the results and is widely used in the financial assessment of business activities and products and, to a lesser extent, in other fields such as analysis of a media campaign, medicine, ecology, etc. According to Mayne (1999), the 'contribution analysis' is characterised by the following specificities:

- identification of issues by measuring the specific contribution of a given programme with regards to what has been achieved, and mainly reporting the impact of other factors;
- analysis and presentation of the logic behind the programme through logic models which trace the cause-effect relations and identify important external factors;
- identification, measurement and documentation of the expected changes in behaviour;
- use of indicators which can help determine the contribution of a given intervention;
- tracking the implementation over time or the location by searching for an answer to sample questions: Are the results achieved after the intervention?, Do the results disappear after ending the intervention?, Are the biggest results achieved?, etc.;
- examination and discussion of possible alternative explanations;
- collection of additional data;
- review and confirmation of the contribution (Mayne, 2008).

Apart from the above-mentioned approaches, practice has established the application of some econometrics. For example, the 'discontinuity design' approach is applied in the cases where there is a threshold/condition for participation in a given policy.

In practice, a lot of assessments establish whether a result has been achieved and, if yes, what is the role of the programme analysed in this. In order to determine the contribution of a given programme, it is important to see what advantages and added value have been demonstrated and whether they provide an opportunity to make decisions regarding its future development (Mayne, 2001).

Some of the impact assessment models allow for a factor and regression analysis in view of searching for the degree of impact of different factors on individual indicators of specific systems (for example, the higher education system). However, they are rarely applied to the scientific research system in particular.

In logic models there are elements which are linked in a standard succession:

- **inputs/resources** – human, financial, organisational resources which are going to be invested in a particular programme;
- **activities** – projects/interventions/measures, which are foreseen under a given programme;
- **outputs** – direct outputs of a given programme which shall contribute to achieving outcomes;
- **outcomes** – a change in the condition of persons, institutions or territories;
- **impact** – impact means a long-term change in the condition of persons, institutions, or territories.

Typical for these models is that they not only recreate cause-effect relations but also deal with specific categories and create a specific framework. In this sense, when using logic models, the grouping of elements of a given programme is just as important as tracking the cause-effect relations.

Process Monitoring of Impacts (PMI) (Hummelbrunner, 2006) is based on the 'results monitoring' approach. The key characteristic of this concept is that it does not follow the usual cause-effect relations but rather focuses on the importance of beneficiaries and the target groups for achieving the expected effects (Earl et al. 2001). This approach is a combination of concepts which have been initially developed for programmes in developing countries and have subsequently been adapted to the needs for monitoring projects or programmes in the field of structured policy. The main assumption on which the method is based is that the inputs and the outputs have to be used in order to achieve the desired effect. An advantage of the PMI approach is that it examines the resources and the achievement of the effects in a dynamic way, and it takes into account that it is necessary for them to be used by specific stakeholders in order to reach the objectives of a given programme. The external factors are also considered as a key element, but in some cases there is a possibility that the relation between outcomes and impact may be unclear (Nigohosyan & Vutsova, 2018).

2. The assessment of scientific research and its impact on higher education systems and horizontal research organisations

2.1. Importance of research assessment for universities

Over the past few decades, an increase in the number of universities (private and public) has been observed (predominant in EU and more detailed in new member states (NMC) and associated countries (ACs)). They have a different coverage in terms of resources, scale, and mission (Martin, 2012; Watts, 2017).

To a certain degree this increase is a result of the Bologna Process. On the one hand, it equated the master's degrees of universities and vocational colleges such as Fachhochschulen (FHS), making it possible for magistrates from these Higher Education Institutions (HEI) to transfer to a university and develop a doctoral thesis (FHS usually does not offer doctorates); on the other hand, the pursuit of open mobility – one from the postulates of the Bologna Process – influences the increase in the number of HEI seeking partnership with European universities. The Bologna Process initiated transformation processes regarding legislative changes, simplification of the procedures for opening new HEI structures, entry of private investments into this process, etc., which also contributed to the increase in the number of universities.

The latest trends in relation to the market-oriented development of the higher education system show changes compared to the classic understanding of what a university is. In the context of a global economic environment, universities compete to attract students, staff, and income, and the latter comes from different financial resources: fees, preferential transfers, research grants, etc. On the other hand, the official results presented (obtained from audits or annual reports), which concern teaching, research, and employability of the alumni, allow users to be informed through different rankings in order to make an informed decision on the basis of the quality offered and the price requested. This forces universities to apply a management approach similar to the corporate one (Buckland, 2009; Hemsley-Brown & Oplatka, 2010; Ayikoru et al., 2009).

Those universities which are natural research centres are perceived as an inseparable part of the regional, national, and international economies. This is why evidence has to be presented to ascertain their contribution to specific economic results. Therefore, in order to justify publicly financed studies, they have to generate impact which leads to an improvement in the

economic or social environment (Brown & Carasso, 2013; Gaffikin & Perry, 2009).

The market approach applied to higher education requires an 'effective' management of universities. A lot of publications (Lasakova et al., 2017; Orr, 1997; Naudé & Ivy, 1999) state that the fate of individual universities depends on management which has to plan adequate activities and make strategic investments. At the same time, the productivity of lecturers (research 'outcomes', the quality of teaching, and other aspects of their work) have to be comparable with their competitors' outcomes.

Some researchers find that the modern corporate management of universities threatens 'academic freedom' and reduces collegiality (Thomas 2018; Williams 2016). The result from the general understanding of the 'achievements' and the presence of benchmarking indicators creates conditions for some lecturers to be very successful, while for others there is an increased sense of failure (Clarke & Knights, 2015). Moreover, the need for 'quality delivery' creates potentially damaging consequences, including in ethical terms. For example, the same data are used in different ways by the same researchers in order to be presented to different types of audiences (Thomas, 2018).

The penetration of international financial flows in research centres, intended for the implementation of research activities and the subsequent effects from the 'impact', concerns not only academic researchers but the management bodies of the main structures as well. For the latter, the reputation of the institution is very important and is related to its ability to perform well in research assessment. Universities aim to increase their results as much as possible and take leading positions in world rankings (Yudkevich et al. 2016). For academics, the career development perspectives are influenced not only by the ability of a given researcher to publish and attract research grants but also by his/her ability to generate impact (Bastow et al. 2014).

Research financing systems which are results-based do not usually differentiate their assessment approach with regards to disciplines or research fields (Hicks, 2012) though there are significant differences between disciplines, and there is also the so-called non-academic impact (Bastow et al., 2014). Public agencies financing research and research organisations bear a great responsibility for a more comprehensive impact of the studies which they support financially. Regardless of the fact that there are tools for research impact assessment, little is known and shared about how these organisations apply these activities in practice.

Despite the need for accountability on the part of organisations which finance different scientific research, there is not enough information about how such an assessment is performed in practice within research organisations. Kamenetzky and Hinrichs-Krapels (2020) believe that there is no empirical basis for impact assessment of institutional policies, especially in relation to structures financing scientific research. Research organisations play an important role in determining the impact assessment procedures, but they are not efficient enough, because the materials published on this topic lack data and recommendations about the practical application in the context of complex research financing systems (Kamenetzky & Hinrichs-Krapels, 2020).

Non-academic impact is studied in more detail where universities with contrasting missions (Hewitt-Dundas, 2012) and their relations with knowledge-intensive industrial sectors are analysed (Banal-Estanol et al., 2015; Bozeman et al., 2013, 2015). Other scholars study the links of universities with sectors which do not require a high qualification (Thomas & Ormerod 2017) and believe that greater control should be exercised over the dynamic of research impact in different contexts (Thomas, 2018). They also presume that academic researchers are too busy applying different strategies for disseminating their work (Marchant, 2017) at the expense of their academic independence and critical approach (Watermeyer, 2016).

3. *Methods for assessing research impact*

Studying assessment practices is important for a number of reasons. A big part of research literature which studies the impact of scientific research is theoretical in nature, and the term 'impact' is comprehensive. Even though there are models and tools for assessing research impact, the guidelines as to what works and for whom are limited.

Benefits of research would go beyond the academia over a number of different areas, visualised in Figure 2.1. Usually researchers have to plan activities specifically related to enhancing impact.

Source: Adapted from The University of Sheffield, Research Services, https://www.sheffield.ac.uk/rs/impact/pathways.

Figure 2.1: Benefits of Research beyond academia

Impact assessment of scientific research is a difficult task and has to take into consideration political and socio-economic factors. This type of impact assessment usually has four main objectives:

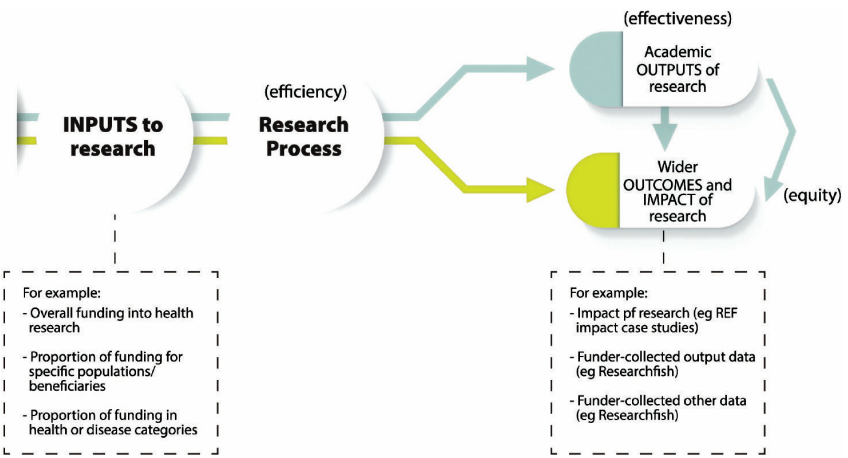
(1) **Performance** – to allow universities and research organisations to monitor and manage their performance and to consciously disseminate the results and contribution to their local, national, and international communities.
(2) **Accountability** – to demonstrate the social and economic value of the performed research to the government, stakeholders, and the wider public. Governments aim to report (justify and legitimise) the spending of public funds by demonstrating their contribution with regards to socio-economic benefits to tax payers, voters, and society (European Science Foundation, 2009; Davies et al., 2005; Nutley & Walter 2005; Hanney & Gonzalez-Block, 2011).

(3) **Informed financing** – to become aware of the socio-economic value of the research and to consequently make an informed decision for a given financing. Assessing the research contribution could facilitate better targeting of the future financing which will allow specific areas to achieve the desired impact. As Donovan (2011) comments, the impact assessment is a powerful tool for creating evidence-based actions on the part of the governments for the purpose of a strengthened research support.

(4) **Understanding** – to make sense of the method and the ways in which research leads to or would lead to impacts, and to develop better methods for achieving impact.

Clear presentation of the impact from research may allow for accountability before financing organisations and consumers (Kelly & McNicoll, 2011).

Hinrichs-Krapels and Grant explore the **e**ffectiveness, **e**fficiency and **e**quity (3Es) of research impact assessment. On the figure below the 3Es are illustrated. Inputs, process, outputs, and outcomes of the research process are shown. The authors view research equity as aligned with wider impact to certain social goals such as inclusion and equality. They believe that research assessment is necessary to achieve such equity.

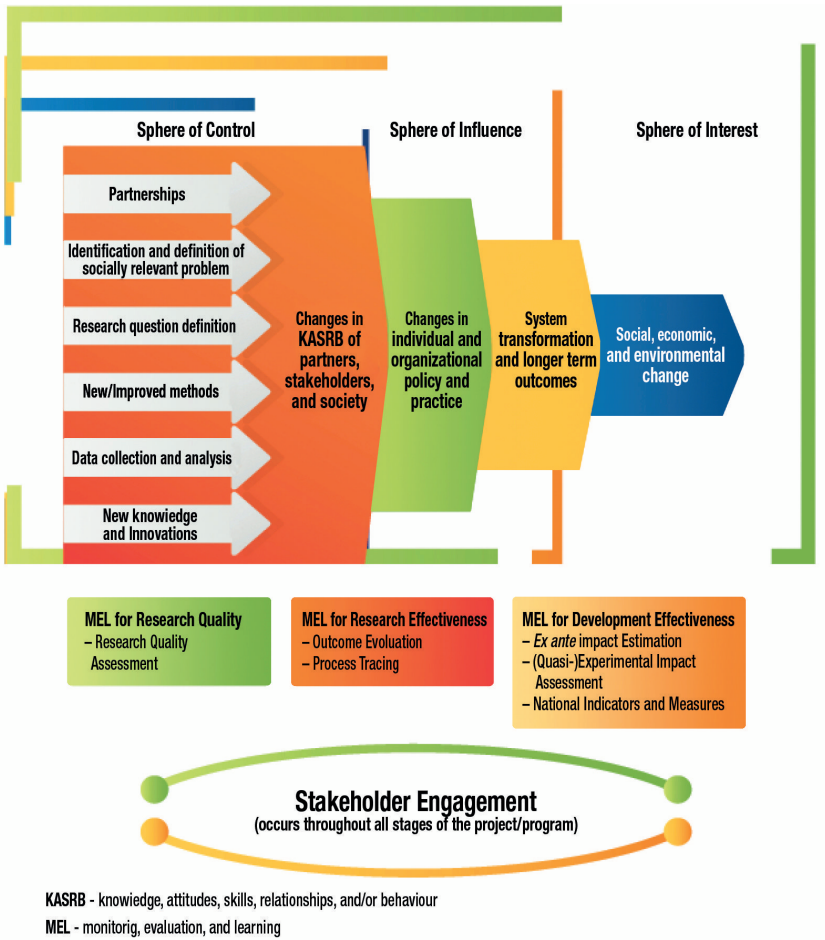


Source: Hinrichs-Krapels & Grant (2016).

Figure 2.2: Essential inputs, outputs, outcomes, and impact of the research process

Impact assessments are not acceptable for some researchers because they mainly focus on disciplines and topics where the impact can be easily proven and can be validated from an economic point of view. This type of approach may lead to a certain devaluation of the significance of fundamental scientific research. Understanding what impact there is in different fields of a given study and appreciating the diversity of indicators used as evidence is necessary for achieving a reasonable assessment.

Some authors (Joly & Matt, 2017) believe that more recent approaches towards research impact assessment take into consideration the complex and interactive nature of innovation and shift towards addressing societal needs. The following figure represents simplified impact pathways of research according to Belcher (2021). The main aim of research in general is to generate new knowledge and innovation, which has its impact through the different spheres of control, influence, and interest. New knowledge and innovation lead to changes in stakeholders and policies and, eventually, to social, economic, and/or environmental transformation. All processes are underlined by monitoring, evaluation, and learning as integral part of achieving real impact. In addition, stakeholder engagement is highlighted as a continuous process.



Source: Belcher (2021).

Figure 2.3: Research to impact pathways

Bibliometrics can be used to demonstrate the benefits of scientific research in the academic environment, and they are often part of a larger impact spectrum observed on an international level. For example, within Excellence in Research for Australia and the use of Star Metrics in the USA, quantitative measures are applied for the purpose of assessing impact, publications, citation, and revenue from scientific research. These 'traditional' bibliometrics can be perceived only as an element of the full impact (Bornmann & Marx, 2013) without reflecting the cause-effect relation. Some

authors (Vonortas & Link, 2012) believe that the standard approaches, which are actively used in the assessment of research programmes, such as studies, cases, bibliometrics, econometrics and statistical analyses, content analysis, and expert evaluation, have certain shortcomings with regards to measuring impact.

The assessment which reflects a wider socio-economic impact uses a new type of indicators, such as registered intellectual property and generated trade income (Australian Research Council, 2009). In the UK, impact assessments which study bigger socio-economic benefits were applied for the first time in the field of biomedical and health sciences (Grant, 2006) – fields which have the ambition to justify the significant investment they have received.

Impact assessment frameworks have been developed and are being applied, taking into account the specific requirements of the organisation and the stakeholders. This is the reason why a lot of different impact assessment models are on offer. Some of the most popular models which demonstrate a contrast in the approaches available are the following:

Penfield (2014) describes several models related to impact assessment.

- The Payback Framework. Buxton and Hanney formulated the model at Brunel University at the end of the 20th century. Penfield (2014) recognises it as one of the most often applied approaches for impact assessment. The model uses healthcare field and includes an impact assessment of academic results and benefits for the society (Donovan & Hanney, 2011). As described by Hanney and Gonzalez-Block (2011), the payback framework model systematically links research to the benefits thereof and can be examined at two levels. The first level correlates specific research results and their potential for dissemination, as a general framework for assessing the overall research impact. The second level refers to a multidimensional classification scheme, which allows the assessment of the various research outputs, outcomes, and impacts. The method continues to be of interest and discussed by researchers (Rollins et al., 2020).
- Social Impact Assessment Methods for research and funding instruments through the study of Productive Interactions (SIAMPI). The model is a result of the Dutch project 'Evaluating Research in Context'. It aims to assess the social impact of academic work analysing different research areas (Spaapen et al., 2011). This approach enables a more in-depth understanding of social impact through a focused examination of the

links between the (involved) researchers. It studies formal and informal networks formed amongst scientists. However, the method is relevant only for assessing specific research aspects.

- Research Quality Framework (RQF). The approach is one of the first attempts to evaluate the quality and socio-economic impact of scientific research in Australia. The government aimed to construct a framework to distribute funds for research in a justifiable way. Researchers used a case study to demonstrate the economic, social, ecological, and cultural impact of their work, then checked by an expert group (Duryea et al., 2007). Such assessment was piloted on the Australian Technology Network, and the authors believed that qualitative and quantitative evidence was gathered. However, more recently the method was criticised because it was based on assessing non-academic impact and because of aspects of its methodology (Gunn & Mintrom, 2018).

There is no consensus on the topic of measuring impact assessment, and different national systems are still looking for the best combination of criteria, varying from method to method. For instance, both national Bulgarian instruments, contributing to research and innovation activities, are based on competition but apply different approaches. While the National Research Fund operates mainly with quantitative measures such as publications, citations, etc., thus outlining academic impact only, the National Innovation Fund aims to assess full impact and measure predominately socio-economic impact, neglecting to some extend academic impact. In addition, the set of applicable criteria is not balanced very well. Some quasi approaches are applied to national research programmes, where elements of socio-economic impact are part of binding criteria. But there is not enough data from evaluation due to the fact that the national programmes have been reported the first performed period only.

The BETA-EvaRIO method aims to assess the impact of different aspects of research infrastructure (Bach & Wolff, 2017). It focuses on specific groups of actors and the relationship between types of effects – effects on performance, capacity effects, direct and indirect effects. Its benefits lie in combining qualitative and quantitative tools and various types of metrics from diverse sources; in this way the consistency of results is ensured.

The START programme in Austria proved to be quite successful for researchers starting their careers. To assess the results, the evaluators of the programme applied mixed approaches, for example surveys and case studies, with the goal to overcome the limitations of the individual ones.

Again, quantitative and qualitative data were used, relying on different sources (Seus & Bührer, 2017).

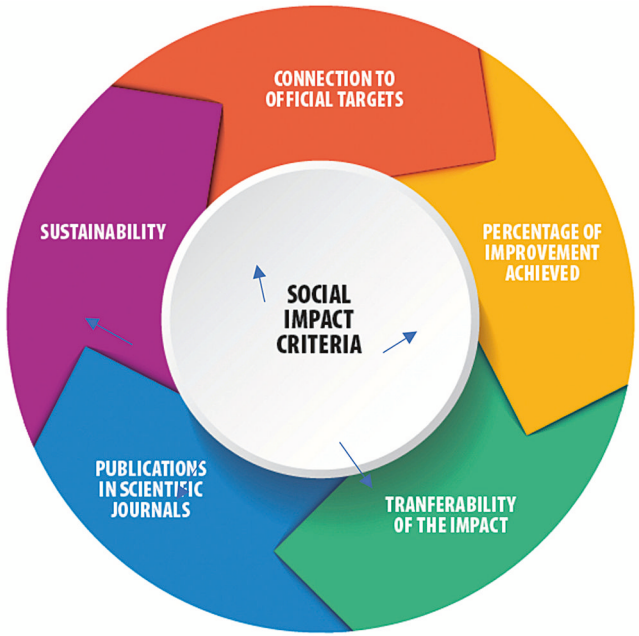
Some prospective impact assessment practices include general equilibrium models, data links, scientometrics, indicators based on research and in combination with econometric analyses, and case studies. These different methodologies are still developing, but they have set the foundation for a new type of research.

The scope and diversity of the developed frameworks demonstrate the difference in the objective of the assessment and the type of expected impact. Studies on econometric benefits from biomedical and health research (Penfield et al., 2014) show that the different methodologies provide different approaches for establishing those benefits. There is still a big discussion on the benefits and shortcomings of a number of assessment tools (bibliometrics, economic norm of return on investment, reviewing, case study, logic-based modelling, and comparative analysis), which are examined in detail by Grant (2006). To assess the impact of research at different levels – micro, meso, and macro at the same time – and to scale-up the results remains a challenge (Jolly & Matt, 2017).

4. Social impact of research

Despite the fact that there was a prolonged period devoted to the development of methodologies for measuring and assessing research impact, there are still gaps with regards to the techniques applied.

Social impact criteria can be formulated in different ways, as illustrated in Figure 2.4.



Source: Adapted from Sorde (2015).

Figure 2.4: Social impact criteria

The main issue with regards to understanding the impact on the social environment is the lack of satisfactory analytical tools to monitor the cause-effect relation and the scale of the effects of research on social changes.

Economic assessments of scientific research and technologies usually fall into two related categories: social norm of return on investment and analysis of the collective output. The approaches with regards to the social norm for return on investment can be used in a different context and aim to evaluate the social benefits accumulated from the technological changes by linking the value of the intended benefits with the price of the investments made. Measuring the social norm for return on investment is most often done by using the analysis of costs and benefits in order to make an assessment at project and programme level (for example, Link, 1996a, 1996b; Ruegg, 1996; Audretsch et al., 2002; Saavedra & Bozeman, 2004). The second category – analysis of the collective output – has an impact on the formulation of economic development policies. This category is usually

focused on the contribution of technologies to the national or regional economy (for example, see Solow, 1957).

Despite their many advantages, the methods based on economic assessment show limitations with regards to measuring the social impact of scientific research. The methods based on cost-benefit or a percentage of return on investments only give a limited idea about the creation of research capacity or the transformative aspects of the research. They are largely focused on the specific products of research projects such as articles in journals or sellable products. Such a focus is best applied when there are specific limitations (for example, a research and development project). The assessments which are based on an economic approach are usually static, despite the efforts to examine future benefits. They rarely take into account the changes which appear in the 'products' that are being evaluated and even more rarely the changes in institutions or the human resources which have produced them. In addition, many of the social acquisitions and costs for science and technologies are not well evaluated in financial terms.

While it is possible to identify the difficulties in conducting a valid assessment of the end social impacts of a given research, it is not possible to measure them completely. The studies conducted show that often only one factor for measuring social results is identified, and it is rarely among the most significant ones. Regardless of whether the standard economic-based approaches, such as cost-benefit analysis, monitoring of social indicators, social accounting, or model studies of cases, are used, the clear definition of the cause-effect relation for complex social impacts is always difficult.

Determining and measuring the various benefits for society from investments in scientific research is not an easy task. This is due to the fact that a lot of key scientific discoveries have been made by accident ('serendipity'), and a lot of applications of scientific research have found a place in fields which are different to the initial intention of researchers. Moreover, the time needed to generate all benefits from publicly financed research activities may be very long, and so in specific cases measuring the impacts may be inaccurate because it is premature and/or partial. Last but not least, non-economic impacts from research are more difficult to measure. For example, measuring health results is not an easy process; thus, it complicates the efforts to link health results to public investments in scientific research and development. Similar difficulties occur with regards to the investments in research aimed at the national security sector.

The econometric analysis of the link between research activity and the results thereof is usually based on the concept of linear innovation. Pre-

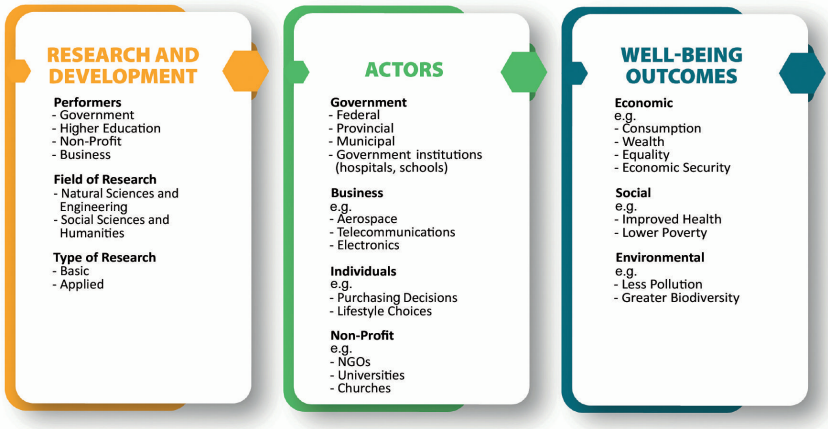
sumably, part of the innovations could start from basic research followed by applicable ones and end with the production and dissemination of new products and processes in the economy. It is common knowledge, however, that innovations are linked to different participants in the process, they are the result of a mixture of public and private investments, trade interests, and many other factors. Innovations require a more comprehensive approach for measuring and analysing the economic and social impacts.

It would be useful to realise the significance of impact assessments with regards to decision-makers, while ensuring that the assessment methods and indicators applied take into account the changing environment, the increasing number of stakeholders and the level of intersectoral coordination. Increasing stakeholders' trust in the impact assessment is also important and could be improved through their conscious inclusion in the early stages of the process (OECD, 2009).

Over the past few years, researchers and governments have become interested in the non-economic impacts of publicly financed scientific research. There is a certain degree of consensus among researchers that one of the first steps towards a better understanding of the non-economic impacts is to determine a framework which links the investments and the well-being of a given country (Sharpe & Smith, 2005). Cozzens (2007) claims that the indicators for social results from research are neither difficult, nor rare, and are related to the public objectives of the research. According to her, what is missing are not results indicators but the logic which links them to scientific research and innovations.

The question about the typology of the impact should be defined in more detail by examining not only the social impact, for example, but the economic, non-economic, health impact, etc. Figure 2.5 presents an analysis of the effects which are linked to the main representatives involved in the process.

Sharpe and Smith (2005) develop a common framework for assessing the impact of research on the well-being of a given nation. This framework (Figure 2.5) links investments with the well-being, where the latter is measured by the increased knowledge of social actors generated by the scientific research conducted. Generally speaking, this common framework can be applied to different types of financial studies the results of which are used by different social actors and which influence different factors of well-being (OECD, 2009). The approach includes examining the results in three aspects: economic, social, and environmental.



Source: Sharpe & Smith (2005).

Figure 2.5: Framework for analysis of the effects of research on well-being

5. *Practical comments*

Quality of impact assessments depend significantly on adequate selection of target groups to be studied. Then a gap analysis should be conducted identifying existing deficits, their significance, and to what extent the state intervention is suitable in such cases. Since state intervention may gradually change the behaviour of the stakeholders in different ways (negative or positive), it should be determined which of the methods used are still suitable.

By taking into account the fact that each national innovations system is to a certain extent unique and the impact assessment methods cannot be universally applied, it is advisable to highlight part of the problems and the possible solutions which have been identified. For example, there are difficulties related to achieving the expectations of all stakeholders (a result from the dynamic environment and the increasing number of stakeholders). The discrepancy between the stakeholders' objectives can be a reason why some initiatives may either fail or lead to the best possible results and/or solutions. There is a need for an adequate development of a new policy based on the impact assessment and a better understanding of the motivation and the possible behaviour of the stakeholders.

The combination of different methods and the inclusion of a number of stakeholders in the assessment process can help overcome the individual

shortcomings of the various approaches. Not all assessments use clear and time-consistent efficiency indicators, and the integration of the field-related specificities is not transparent in most cases.

The policy with regards to determining the scientific research programmes and the levels of financing, respectively, continues to be unstable as a trend. The level of financing of fundamental research has to be determined by considering the needs of other stakeholders who also make a contribution and usually follow a different deadline and priorities.

It is possible to focus the development of programmes on a comprehensive portfolio of studies, rather than on individual short-term programmes or projects, in order to provide flexibility with regards to the changing environment. This could ensure a more long-term focus on multi-disciplinary studies.

In general, it is expected that studies will add value, but the more important question is how exactly they do and how it is measured. Empirical studies confirm the common-sense expectation that members of clusters have higher innovation capacity (Angelov, 2021). The industry has an absorbing capacity for using the outcomes from scientific research, and a significant part of the research organisations directly work with companies in order to demonstrate the results from scientific research and build a capacity for a future transfer of knowledge, instead of immediately realising its potential. However, earlier studies (Bankova & Mihaylova, 2014) identified serious incompetence in cluster management in Bulgaria. The same study recommends actions targeting trust, responsibility, and relationship management with the external environment.

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