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DETERMINANTS OF GENERATING IMPACT ON THE ENVIRONMENT AS A PUBLIC VALUE OF SCIENTIFIC PROJECTS – EXPERIENCES WITHIN THE UNIVERSITY OF LODZ

Magdalena WIŚNIEWSKA

University of Lodz; magdalena.wisniewska@uni.lodz.pl, ORCID: 0000-0002-4967-9881

Purpose: The paper aims to discover how the stakeholders of research processes carried out within universities perceive the possibility of generating the impact of scientific projects on the economy, society and the environment.
Design/methodology/approach: For the purpose of the paper, several steps were executed. First, the desk method was implied. On the basis of the literature operating of the university in a wider context was presented, as well as economic theories on the relationship between human activity and the environment, also the concept of public value and Responsible Research and Innovation (RRI) concept were discussed. The empirical part was the study in the form of focus group organized to obtain information on the perception of the potential impact generated by scientific projects.
Findings: The study proved that such an impact is exerted and that appropriate activities disseminating the results of research work have a chance to achieve sustainable positive economic, social or environmental changes. It was possible to identify the factors which affect the efficiency of such processes.
Research limitations/implications: The focus group was carried on a relatively small sample and the participants were already involved in socially/economically/environmentally accountable activity. Nevertheless, it was possible to acquire the main ideas on how the scientific and innovation processes developed within the university can generate public value by positively influencing economic, social and environmental surroundings.
Practical implications: The paper provides insight into possible changes in the processes of universities' generating impact on their environment.
Social implications: Society is a part of the environment of universities, therefore society would benefit if this impact were optimized. The paper brings findings in this area.
Originality/value: The paper combines the theory of the economy with Responsible Research and Innovation and the public value concept in the field of generating impact on the environment by higher education institutions.
Keywords: impact, Responsible Research and Innovation (RRI), R&D, university, public value, quadruple helix.
Category of the paper: Research paper.

1. Introduction

Over time, the university's function has changed. Modern universities are involved in the social and economic spheres in addition to teaching and performing science. In order to promote sustainable development and the conservation or restoration of natural resources, they also take the environment into account.

The theory of economics has gained sufficient explanations on how R&D or innovation processes can influence the surroundings. A useful approach to evaluate R&D initiatives is a public value concept which was first introduced by Mark Moore (1995). Responsible research and innovation (RRI) concept, promoted recently by both scientists as well as policymakers refers to a research and development process integrating research into a broader social context (Owen, 2013; von Schomberg, 2013). The paper presents findings of focus study carried in the form of focus group in the University of Lodz to better understand how the R&D and innovation stakeholders perceive the public impact of scientific and innovation processes.

2. Method

For the purpose of the paper, several steps were executed. First, the desk method was implied. On the basis of the literature, university operating in the wider context was presented, as well as economic theories on the relationship between human activity and the environment, also the concept of public value and Responsible Research and Innovation (RRI) concept were discussed. The empirical part was the study in the form of focus group organized to obtain information on the perception of potential impact generated by scientific projects. The focus group proved that such an impact is present and that appropriate activities disseminating the results of research work have a chance to achieve long lasting positive economic, social or environmental changes.

3. The mission(s) of the university and its impact on the external environment in the theory of economics

Universities have a long history of generating and disseminating knowledge through education and scientific publications. Furthermore, relationships with the corporate world were typically not institutionalized in the conventionally defined higher education institution (HEI) (Matusiak, 2010). From the perspective of the modern economy, universities' traditional role is

insufficient. According to Howard (2005), a university can participate in the following types of knowledge transfer, sharing, and technology commercialization:

- Diffusion of knowledge. By facilitating the widely accepted adaptation of scientific discoveries to industry through communication, education, training, and the development of norms and standards for production and distribution, universities and research institutes produce expertise that is both commercially and socially beneficial.
- Knowledge creation. Universities and research institutions create socially and business-relevant knowledge by selling or licensing research results. Knowledge becomes a commodity for sale – intellectual property is directly used on the market. This is the standard model of commercialization.
- Creating knowledge relations. Universities and research institutions create economically useful knowledge by providing services indirectly through the use of intellectual property. Platforms for the exchange of expertise, know-how and so-called "hidden" knowledge are being created. The emphasis is on cooperation, joint ventures and partnerships.
- Engagement-based knowledge transfer. University communities and their surroundings are viewed as secondary producers of useful information. In order to create collaborative projects with different socioeconomic system stakeholders, the goal is to transcend the conventionally perceived limits of the university's operations.

There can be identified eight dimensions of this third role of the university (Laredo, 2007):

1. Human resources with the focus on transfer of embodied knowledge in Ph.D. students and graduates.
2. Intellectual property with the focus on codified knowledge produced by the university and its management (patents, copyright.
3. Spin-offs with the focus on knowledge transfer through entrepreneurship.
4. Contracts with industry - knowledge co-production and circulation to industry. This is taken as the main marker of the attractiveness of universities for existing economic actors.
5. Contracts with public bodies with the focus on the ‘public service’ dimension of research activities.
6. Participation in policy making focusing on involvement in the shaping and/or implementation of policies (at different levels).
7. Involvement in social and cultural life reflected in involvement of the university in ‘societal’ (mostly ‘city’) life.
8. Public understanding of science focusing on interaction with society.

All of these activities are based on the operations of HEIs that get public funding, thus it makes sense to understand how they affect society, the economy, and the environment both now and in the future. The economic theory explains this kind of HEI influence.

The activities of persons or public bodies have an impact on the external environment. The research impact is "the demonstrable contribution that excellent research makes to society and the economy" (The Economic and Social Research Council, ESRC) and includes academic effects, which are the proven contributions of excellent social and economic research to changing the understanding and progress of scientific methods, theories and applications across disciplines, and economic and societal effects, which are the proven contributions of excellent social and economic research to society and the economy and their benefits to individuals, organisations or nations. Impact is a change in the results of an organization. The impact can be positive or negative, intentional or not, direct or indirect. The latter features of the impact are a consequence of the nature of the economic mechanisms and can be illustrated by the value chain of the impact, in which inputs understood as financial, human and material resources are converted into activities (actions through various inputs) which are converted into products (transformations, also products, capital goods and services) and outputs are converted into results (usually or achieved short-term or medium-term effects) and ultimately converted into impact understood as positive or negative, primary or secondary, direct or indirect, intended or unintended. The theory of the economy (externalities, spillovers, multipliers) explains the mechanisms of the social, economic and spatial (including environmental) impacts of university activity. The impact of any social (including economic) activity of a human being can be described by external theory (Hołuj, 2021). Externalities arise from the production or consumption of goods or services, resulting in costs or benefits for a third party unrelated to them, i.e. they occur and affect an entity that is not directly related to the production or consumption of a particular good or service. External factors can be positive or negative.

„Externalities are always accompanied by spillovers. {…} In general, spillover effects occur when a phenomenon spreads (usually it is knowledge) in various spatial systems or structures in an uncontrolled, unconscious, unintentional, and freeway. The spillover effect may concern experience, prediction skills, good practices, or local customs. Spillover effects can occur on several different levels and in different configurations. They can be individual, private, mixed, social, or economic spillover effects, generated by individuals or businesses" (Hołuj, 2021).

The impact that university activities can have on the regional economic, social and spatial systems can also be described from the perspective of multiplier effect. "A regional economic multiplier is defined as the total economic effect that occurs in a region by unit of the direct economic change that caused the effect" (Stevens, Lahr, 1988). In other words, the multiplier effect indicates that the implementation of new expenditures (e.g. exports, public expenditures, or investments) can lead to new expenditures and investments, as part of the new expenditures themselves will be used to generate income for other entities (entreprises, individuals, local governments). The latter will also spend part of their income and it will again create income for others. For example, "every time a local economy generates a new job by attracting a new business, additional jobs might also be created, mainly through increased demand for local

goods and services" (Moretti, 2010). Moreover, "the input of science and technology innovation factors leads to the multiplier effect of economic development" (Cheng Hui, Wang Bei, 2019).

4. Public Value and Responsible Research and Innovation (RRI)

When evaluating the efficacy of public institutions, the idea of public value is a powerful one. The creation of this value occurs when a society that simultaneously invests in the operations of public organizations and, like the corporate sector, is essentially their "shareholders" achieves the status of a fulfillment of needs that are expressed and accepted collectively through the activities of these public organizations (Wiśniewska, 2018). This concept was introduced in 1995 by Moore (Moore, 1995) and was developed in the following years (Mahdon, 2006; Blaug et al., 2006; Stoker, 2006; Bozeman, 2007; Botterman et al., 2008; O'Flynn, Alford, 2009, Kelly et al., 2002).

In the private sector, public value is comparable to shareholder value (Coats, Passmore, 2008). Public managers can more precisely define their operations by making it the organization's primary purpose. This includes determining the value of the services offered to residents and how to best utilize them. In order to secure increased trust in public institutions and satisfy citizens' rising expectations, this enables public managers to interact with service users and other stakeholders to enhance the quality of decision-making. Three questions, according to Coats and Passmore, determine whether public managers adopt public value as a determinant of their actions (Coats, Passmore, 2008):

1. What is my organization used for?
2. To whom is he accountable?
3. How do you know we're doing well?

Public managers cannot provide the solutions to these problems alone; rather, they must collaborate with the "shareholders" of the public organization and, by extension, of society. Getting "authorization" is essential for the public to take certain acts. To ascertain what value is and whether it can be attained by certain behaviors and not others, a standard procedure is required.

When societal expenditures (financial resources as well as the sacrifice of some liberties and regulations in the name of the common good) result in outcomes that outweigh the costs to public opinion, and when the government is directed by society to take a particular action, then public action will be valuable. The concept's authors contend that political election outcomes are insufficient. Constant communication with stakeholders is necessary, as is their ongoing endorsement of public authorities' actions.

Businesses can and should be included in the concept of public value for a number of reasons, including (a) being significant stakeholders, (b) providing public goods on behalf of the public sector, and (c) being organizations that generate public value through their operations, particularly when businesses are founded on knowledge generated and funded by public funds. Additionally, business operations may provide value to the public (Meynhardt, Gomez, Schweizer, 2014; Moore, 2003; Talbot, 2011). The concept of value is not alien to the literature of the business sector. The following concepts are used: total and marginal utility, stakeholder value, economic value, added value, shareholder value, and corporate social responsibility (CSR) perspective.

According to Meynhardt, Gomez, and Schweizer (2014), businesses' effects on society are just one of many facets of their operations. They consider this effect to be an integral component of their operations, influencing consumer encounters as well as internal company culture. According to them, exchanges in which business plays a major role lead to a "viable" society. These authors suggest a method that measures how businesses affect public values in order to quantify their social contribution. The University of St. Gallen is where the Public Value Scorecard (PVSC) was created. Based on the psychological theory of needs, PVSC is marketed as an enhancement of the balanced scorecard. In this context, "public value" refers to the values that define the individual-"society" interaction and establish its quality (Meynhardt, 2012). Five dimensions are used to make the assessment (Meynhardt et al., 2014):

1. Usefulness.
2. Profitability.
3. Political acceptance.
4. Positive experience.
5. Decency.

In each of the above mentioned dimensions, the potential chances and risks are evaluated.

As a result, PVSC enables the evaluation of a company's operations from the perspectives of politics and morality in addition to utility. According to Meynhardt (2012), practitioners would not accept the absence of a financial factor.

One must remember that HEIs creating spin-offs and spin-outs contribute to the business sector and thus it seems relevant to evaluate their activities through public perspective.

The idea of Responsible Research and Innovation (RRI) is in line with the notion of public value, but it is only relevant to the process of research and innovation. Responsible Research and Innovation is a concept that has gained particular significance in the European Union (EU) in the last ten years. It integrates research into a broader social context (Owen et al., 2013; von Schomberg, 2013). In order to examine how science and technology may best contribute to the construction of a desirable society for future generations as well as the resolution of today's issues, the RRI encourages open multilateral cooperation between scientists, citizens, policy makers, corporations, and third-sector groups. “Responsible innovation evokes a collective duty of care, first to rethink what we want from innovation and then how we can

make its pathways responsive in the face of uncertainty" (Owen et al., 2020).Von Schomberg (2013) defines RRI as "a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products, in order to allow a proper embedding of scientific and technological advances in our society" (von Schomberg, 2013). RRI approach is in line with the quintuple helix concept incorporating in the cooperation not only business, academia, public bodies and public (the quadruple helix model), but also the natural environment (Carayanni et al., 2015; Alfonso et al., 2012). As RRI tries to answer most important contemporary problems, seven 'Grand Challenges' as one of the three main pillars of the Horizon 2020 program serve as a background of the research and innovations efforts with accordance to RRI requirements (https://ec.europa.eu/commission/presscorner/detail/en/MEMO_13_1085). These "Challenges" are:

1. Health, demographic change and wellbeing.
2. Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy.
3. Secure, clean and efficient energy.
4. Smart, green and integrated transport.
5. Climate action, environment, resource efficiency and raw materials.
6. Inclusive, innovative and reflective societies.
7. Secure & innovative societies.

Creating a society whose R&I procedures and outcomes are dedicated to attaining sustainable, morally acceptable, and socially desirable outcomes is the goal of RRI. All individuals and organizations that are impacted by and dedicated to research and innovation bear responsibility for our future, according to the RRI framework. Predicting the outcomes of research and innovation processes in the future is the goal of the RRI. Results are the outcome and/or present in the description of the process requirements rather than being decided independently. As a result, it is important to consider how RRI's processes and outcomes are integrated. Four clusters can be used to characterize the RRI process (Table 1).

Table 1.
Four clusters of RRI process requirements

Cluster	Description
Diversity and inclusion	For normative democratic reasons, diverse and integrated RRI procedures must widen and diversify sources of expertise, disciplines, and views, as well as involve a wide range of stakeholders in the early development of science and technology. In this sense, a range of activities ought to result from inclusive practices. Different practices, on the other hand, are more likely to involve everyone.
Openness and transparency	Accountability, liability, and thus responsibility are contingent upon openness and transparency. Building public confidence in politics and science requires this. More transparency does not, however, inevitably translate into more trust; in order for stakeholders to understand information, it must be tailored to their needs.

Cont. table 1.

Anticipation and reflexivity	Anticipation entails imagining the future and comprehending how current dynamics of research and innovation methods influence it. As a result, future difficulties can be addressed. Reflection is also necessary in order to respond wisely and to remain receptive to changes in direction. Learning about the problem definitions, commitments, practices, and institutional and individual attitudes, presumptions, and routines is part of this reflection.
Responsiveness and adaptive change	Being responsive entails adapting to new information, viewpoints, norms, and attitudes. Adaptive change is contingent upon responsiveness. In order to adapt to shifting conditions, fresh perspectives, stakeholders, and public values, RRI necessitates the capacity to modify or mold current procedures, organizational structures, and systems.

Source: Kupper, Klaassen, Rijnen, Vermeulen, Broerse, 2015.

5. Public value of scientific projects – experiences within the University of Lodz

As part of the activities of the University of Lodz in RiEcoLab project, a participatory approach of various stakeholders (internal and external) was applied to the process of integrating the concept of RRI into higher education. RiEcoLab stands for Responsible Innovation-led Entrepreneurial University Transformation Centres (Ecosystem Integration Labs). The project was developed under Horizon 2020 and was supported by EIT (European Institute of Innovation & Technology) within HEI Initiative: Innovation Capacity Building for Higher Education. The main aim and an overall joint vision of the RiEcoLab project (https://riecolab.eu) is to develop a novel way R&D is being performed in universities to ensure immediate commercialization (spinoffs) and involvement of a large number of internal stakeholders (academic and non-academic staff, students).

For the purpose of gathering information on how HEIs can influence socio-economic and environmental systems, the focus group was organized.

The aim of the focus group was, among others, to answer the question of how to identify the impact of R&D in various areas.

The scientific team applying for the focus group was presumed to have research interests that depended on the clever specializations of the Lodzkie region. Smart specializations reflect the publicly important research areas from a regional point of view. After an open recruitment process, researchers from eight scientific initiatives that aligned with the Lodzkie region's smart specialization participated in the focus group:

- 1 project in compliance with “IT and personalized design”,
- 2 project in compliance with sustainable agriculture and agri-food industry,
- 5 projects in compliance with “innovative medical industry, pharmaceuticals and cosmetics".

The recruitment was also addressed to internal and external stakeholders of University of Lodz. Networking and pre-existing connections with the institution, professors, partners, and stakeholders were the primary means of recruitment. The following stakeholder groups participated in the study:

1. Academia.
2. NGO.
3. Industry.
4. Public sector.
5. Internal.

A total of 40 participants took part in the study. During the study the attendants worked in groups consisting in 6-7 people. They were provided with sheets of paper and worked on the following issues:

1. Impact of research and innovation (R&I) projects on environment.
2. Impact of R&I projects on economy.
3. Impact of R&I projects on society.
4. Impact of R&I projects on public policies.
5. Impact of R&I projects on quality of life.

The above-mentioned questions were not closed lists and motivated participants to brainstorm, lively discussions, ideas and experiences. Four moderators assisted participants in generating ideas and clarifying or collecting them. The ideas were marked on the small adhesive stickers. This enabled a broader discussion and presented the results of the brainstorming in groups.

6. Results

The focus group demonstrated that scientific research has an influence and that adequate dissemination of research findings has the potential to produce long-lasting positive social or environmental impacts. Changes in enhancing the social inclusion of individuals with disabilities, enhancing social integration, promoting healthy eating habits to improve population health, developing strategies for territorial unit development that take scientific perspective and accomplishments into account, and many more are examples.

In particular, the focus group revealed that:

1. In terms of impact on environment – there is a significant and constant need of networking and system monitoring for research, investment and impact areas. The possible impact can be achieved in the fields like:
   - preserving or improving biodiversity,
   - response to climate change, inhibition,

- decrease in energy costs,
- clean environment,
- reduction or elimination of nuisance – air pollution, soil, noise reduction, light pollution).

2. In terms of impact on economy- there is a necessity of a) efficient network of b2b and b2c needs, but also b) the education of deficit labour groups, c) SMEs orientation, d) constant contact with venture capital providers, e) identification of the needs of the economy at the initial stage of implementation of scientific projects. The possible impact can be achieved in the fields like:
   - decrease in employee absenteeism,
   - economic recovery,
   - multiplier effects (Creation of new companies, new jobs, increase in investment, GDP).
4. In terms of impact on society the focus group underlined the fact, that impact can be understood as 'usefulness'. For such effect, there is a necessity of a) information and knowledge network, b) communication, c) targeting on 'ususal issues', d) trends monitoring, e) information exchange among stakeholders f) social capital building and very important: g) improving public awareness of the importance of research and trust in science.
5. In terms of impact on public policies – HEIs should use benchmarking to improve efficiency, keep relations with self-government as well as with other stakeholders, build trust for science and importance of knowledge resulting from science and building awareness of the variability of the environment and thus the need to adapt public policies to changing conditions. The possible impact can be achieved in the fields like:
   - decrease in public costs,
   - more effective local and regional development strategies,
   - sustainable spatial planning.
6. In terms of impact on quality of life - scientific research and investment should be oriented on the basis of quality of life studies. The possible impact can be achieved in the fields like:
   - reducing social exclusion,
   - lifespan,
   - improving social inclusion,
   - building social capital.

Additionally, the focus group generated a consensus regarding the necessity of identifying the anticipated social and environmental impact at the research planning stage. However, this calls for some awareness-raising or occasionally formal and legislative adjustments, which may be followed by a more extensive discussion among R+D process stakeholders on

universities' environmental responsibilities. Though they need to be systematized and included into the strategic and operational framework of scientific units, there are currently trends in the scientific community toward this way of thinking. As previously mentioned, steps must also be taken to systematically monitor social and environmental demands through the use of networking mechanisms and the involvement of several internal and external stakeholders.

7. Discussion

There are several flaws in the research that is being provided. The sample size used for the study was relatively small. Furthermore, because the researchers represented projects that adhered to regional specializations, the participants were already engaged in socially, economically, and environmentally responsible activities. Additionally, the stakeholders were contacted via channels connected to organizations that already had some sort of relationship with academia. It is crucial to conduct broader study on a sample representative of the entire quadruple helix community, including scientists who are not interested in "responsible science", even though it was possible to capture the essential concepts regarding the impact of research and innovation processes carried out in academia. Future research should concentrate on the following potential issues:

1. What are the most efficient routes of networking in a quadruple helix context?
2. How to monitor the wider impact of HEIs and how make such activities comparable in an inter-HEI context?
3. How to efficiently involve business in research project orientation to better fulfill the needs of this sector?
4. How to improve social awareness of the importance of research and trust in science?
5. How to foster the cooperation between academia and the public sector to better answer public challenges through the results of scientific projects?

8. Summary

The third mission of university should not only be a slogan but a deeply understood idea which is executed in university’s practical activities, for example in R&D and innovation processes. The theory of economics explains the mechanisms of how such practices can influence the surroundings of academia. The concept of public value allows for a broader look at the activities of universities. It is an approach that, enriched with the concept of Responsible Research and Innovation (RRI), brings a new perspective on the impact of HEIs on economy,

society and environment. The study carried out for the purpose of this paper brought some more insight in the field.

The focus group demonstrated that scientific research has an impact on the economy, society, and environment and that proper activities are required to disseminate the findings of research. This would make it possible to make long-lasting improvements to the environment or society. A widespread grasp of the necessity of indicating the desired social and environmental impact already at the study planning stage was also produced by the focus group. However, this calls for some awareness-raising, sometimes formal and legal, which can then be accomplished by a more extensive discussion amongst R+D process participants regarding the university's environmental responsibilities. The scientific community is already seeing trends in this direction, but they need to be organized and incorporated into the operational and strategic framework of the scientific institutions. As previously said, it is necessary to take steps to systematically monitor social and environmental demands through networking mechanisms and the involvement of different internal and external stakeholders.

Considering the limitations and shortcomings of the study, deeper research in the field of external, publicly valuable impact of academia should be carried out.

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For more information about a project, please refer to the following website: https://riecolab.eu

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