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RESARCH NOTE

PROVIDING EVIDENCE OF THE IMPACT OF UNIVERSITY RESEARCH

Prof Christian Nielsen

Universities are under increasing pressure from funders and taxpayers to maximise the benefits of their research programmes and deliver value for money. Prof Christian Nielsen, the Head of Aalborg University Business School, offers recommendations on how to conceptualise, articulate and communicate the value and impact of academic research to university stakeholders.

INTRODUCTION

To make an impact, or to have an impact, is a question of conducting research that makes a difference and influences someone or something. The impact of universities' research can be defined as the long-term effects of the outputs created. Making an impact is at the core of universities' 'third mission', with the first and second missions being research and education. The impact of university research and education has become an objective for universities across all disciplines. This third mission focus is reconfiguring the relationship between universities, the state, the private sector and society.[1]

From a global perspective, universities are being compared and ranked more than ever for their research quality and third mission activities. In the EU, the *Horizon Europe* program focuses on academics' contributions to solving grand challenges and achieving missions. It uses a revamped indicator framework built around a set of Key Impact Pathways, including scientific, societal and economic measures.[2] The UK has an established research assessment process, the Research Excellence

1. Gunn and Mintrom, 2022
2. Bruno and Kadunc, 2019

Framework (REF), which aims to secure the quality of research outputs. An element in the process is assessing reach and significance, meaning the impact of a particular piece of research across a wide range of areas.[3] There is an increasing focus on impact in research assessment exercises, particularly across continental Europe and Australasia, where New Zealand's Performance-based Research Fund is a prime example. Australia's Excellence in Research for Australia (ERA) is undergoing revision for the 2023 exercise.

Academics are incentivised to publish their work in high-quality journals and actively enhance the number of citations received. Doing so engages with the scholarly community and influences other academics' work. These aspects are also the basis of career assessments. On an individual basis, researchers measured by their H-index. However, while valuable, such indicators do not fully capture the broader influences of research outputs, that is, impact. Research assessments in several countries have begun determining funding distribution to universities, increasingly using evaluations of influence, reach and making a difference to society in their distribution mechanisms, as is the case in the EU's framework programs.

Therefore, focusing on enhancing the potential impact of research will, in due course, positively affect universities' budgets. The UK REF in 2019[4] provides several examples of potential impacts, including research that leads to enhanced disease prevention, measurable by evidence of enhancing patient experiences. Other research impacts could include generating new ways of thinking that influence creative practices, developing policies that alleviate poverty or enhance sustainability, and creating spin-offs and new businesses that generate revenue or profits. Research is recognised in the REF as contributing to innovation and entrepreneurial activity by designing and delivering new technologies, products, services and business models. These are just a few examples of research's potential impacts and demonstrate that impacts are not simply equivalent to publications or citations.

The critical point is that no universal measure of impact exists. However, the notion of impact in a broader sense is set to become even more crucial in the future, regardless of university managers' academic discipline or performance management system.[5] This research note aims to clarify the terminology around impact, including applying phrases typically used in funding programs, such as exploration, commercialisation, valorisation,[6] and sustainability of actions. In the critique of this focus on research impact and value for money, let it be noted that expecting all types and categories of research to somehow, at the time of their production, be potentially connected directly to impacts is an unrealistic idea that may even threaten the foundation on which universities stand. Therefore, we must be careful that focusing on impact and the third mission does not overlook funding for basic research and academic freedoms.

DEFINING THE IMPACT

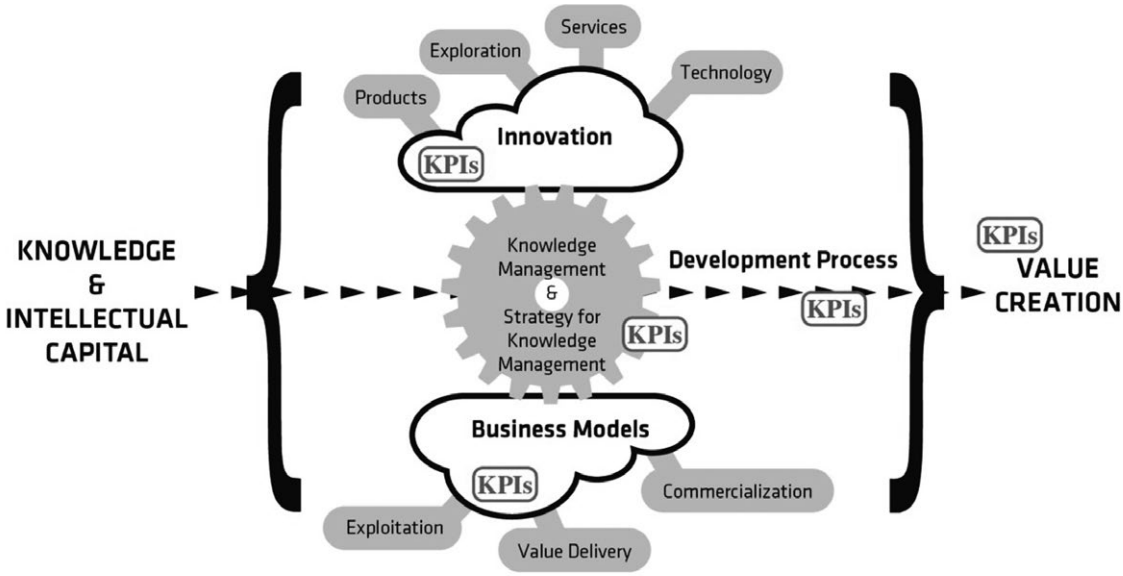
For university research, the impact is synonymous with the notion of *contribution* and is related to the advancement of knowledge and the reach and significance of this knowledge advancement. The impact is defined as the last stage along three dimensions: outputs, outcomes and impacts. Here, outputs are the direct, measurable results of inputs and activities and may constitute different types of results; some more qualitative and some related to interpretations of previous research results. Examples of outputs are analyses, demonstrations and other prototypes, software programs, databases and publications. Outputs are often difficult to relate directly to impacts because they must first be translated into outcomes.

3. REF 2019/02
4. REF 2019/02
5. Martin-Sardesai et al., 2020
6. Valorisation – the act of thinking or stating that something has value or is valuable.

Outcomes are what the outputs achieve, for example, by assessing the output in terms of its short- and long-term effects on stakeholders. An outcome is thus how a given innovation addresses a problem for a given stakeholder. In the short term, for a researcher, this could be access to global real-time data on water temperature; for a patient, it could ease the phantom pain of a missing limb. Hence, the impact is reflected in the long-term effects and outcomes of each research output. In the two examples above, the associated impact is, in the former case, the ability to construct more valid weather-prediction models that increase farming productivity and, in the latter case, a better overall quality of life. Output and outcome are measurable effects and can be helpfully distinguished when formulating key performance indicators (KPIs).

As a critique of the causal output-outcome-impact model, Nielsen[7] articulates that research and innovation outputs have many possible forms, for example, products, exploration, services or technologies. Some of these dimensions and their relations are illustrated in Figure 1. Ensuring that research makes a difference (has an impact) requires that it becomes adequately captured, anchored, measured, managed and developed.[8] Outcomes relate to the effects of outputs on stakeholders (i.e., users, customers and the broader set of stakeholders).[9] Outcomes can be exploited, value-enhanced or commercialised through business models. In this sense, Figure 1 captures impact through the notion of value creation. This entails considering the long-term effects of the research on, for example, work-life

FIGURE 1: KPIS IN A VALORISATION PROCESS (NIELSEN, 2019)



7. Nielsen, 2019
8. OECD, 2010
9. White, 2009

balance, quality of life, the environment, the business environment and society.[10]

Examples of impacts of research that the broader society and business environment might desire might include enhancing future innovation and research capacities, creating new market opportunities, strengthening competitiveness and the potential growth of companies, addressing issues related to climate change or the environment; and developing other benefits for society and the wellbeing of citizens. Many of these aspects directly relate to creating value for specific stakeholders. Evaluators in funding bodies such as the EU will require the notion of value to be framed and defined.

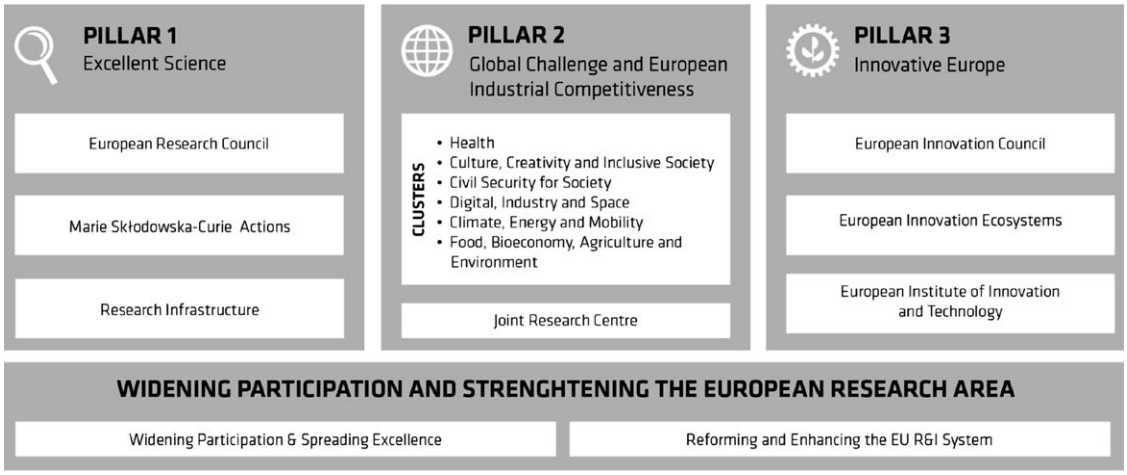
BREAKING DOWN HOW IMPACT CAN BE ACHIEVED

This section provides insights into how governments and funding bodies perceive impact work packages to be organised, and links to a *Horizon Europe* program case in section 4.

In contemporary research-funding programs such as *Horizon Europe*, an additional and mandatory condition is the inclusion of a plan for valorising a project's results, including proposed KPIs that will help achieve the project's expected impact. Applying the Marxist idea,[11] valorisation is the increase in the value of capital assets through the application of value-forming labour in production. Such a valorisation plan should typically contain measures implemented during and after the project.

Focusing on the *Horizon Europe* framework illustrates the central links between outputs, outcomes and impacts. In the current program, the impact will underpin the evaluation metric deployed across the three funding pillars depicted in Figure 1: 1) *excellent science*; 2) *global challenges and European industrial excellence*; and 3) *innovative Europe*. *Horizon Europe* thus exemplifies a funding scheme with a mission-driven approach that links critical societal challenges and relevance

FIGURE 2: ***HORIZON EUROPE*** FRAMEWORK PROGRAM (EUROPEAN UNION, 2019)



10. Nielsen *et al.*, 2019
11. Marx, 2004

to a broad range of stakeholders, including citizens, to an 'investment mindset' and project portfolio approach at the supra-national level.[12]

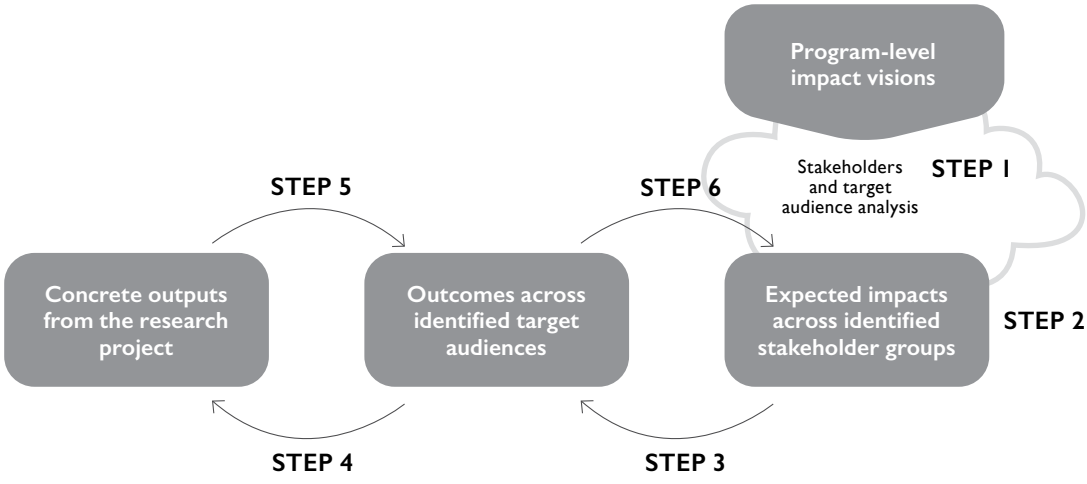
The *Horizon Europe* program focuses on impacts by distinguishing between *expected impacts* and *measures to maximise impacts*. These are now considered separately in the context of outputs, outcomes and impacts. The *Horizon Europe* program explicitly states that proposals should address impacts using quantified indicators and targets; furthermore, creating value from innovation should be underlined by relevant performance measures.

Horizon Europe defines expected impacts on a program level for each specific topic. Thus, the first objective is to describe how the project contributes to those impacts on which the EU wishes to focus. The EU states that the 'plan for disseminating and exploiting the project's results (in the form of outputs and outcomes) is key to maximising impact. This plan should describe, concretely and comprehensively, the area in which you expect to make an impact and who are the potential users of your results'.[13] This value-for-money perspective means that impacts ultimately must lead to value creation and delivery to recipient stakeholder groups while aiming to capture value. In other words, the designated solutions should be complemented with a viable, sustainable and potentially profitable output model, also known as a business model.[14]

Analysing and improving the impact

Evaluators seek to validate expected impacts by linking them with proposed outputs and outcomes. One way to improve impacts is to identify recipient stakeholders who will benefit from the outputs and outcomes. Alongside expected impacts, it is also possible to identify potential problems, risks or lost opportunities from not achieving impact. This analysis should include how each potential receiving stakeholder sees benefits and costs. Subsequently, the

FIGURE 3: PROCESS OF TRANSLATING IMPACTS INTO RELEVANT OUTPUTS AND OUTCOMES



12. European Union, 2019
13. European Union, 2019, p. 3
14. Shakeel et al., 2020

expected outputs and their associated outcomes can be described. Figure 4 offers a seven-step process through which universities can work on improving the connections between outputs, outcomes and impacts. If necessary, steps 2 to 7 can be repeated in the light of new insights into any element of the process.

Designing for life after funding

On a societal level, the transformation from an invention society based on technologies, products and patents into an innovation society is significant. It is also crucial that more innovations survive through the Valley of Death.[15] For this to occur, innovation must be considered a more integral part of the value propositions of research projects. Chesbrough[16] argues that 'a mediocre technology pursued within a great business model may be more valuable than a great technology exploited via a mediocre business model'.

Designing for a 'life after funding' in the *Horizon* program context is called *sustainability of action*. A plan for sustainability of action should outline how a project will be sustained until it leaves the funding scheme. This could be by ensuring it is mature enough for commercialisation or another round of funding and may require further research and development, such as broader testing or refinement of outputs to form a developed technology or business model. Such improvements will most likely require additional investments, sponsorship or donations. Prospective exploitation may also need a set of other conditions to be satisfied, including the adoption or adaptation of regulations, the diffusion of results and technologies into certain value chains, or public reception of the results. A sustainability plan's objective is to ensure that the output will lead to some form of value creation for society.

This sustainability plan could include elements such as technology maturity, for example, using a relevant capability maturity model[17] and an assessment of the current maturity of the expected research output in this context. An assessment of commercialisation in terms of the quality and maturity of the output may include a depiction of how the chasm between early adopters (technology enthusiasts and visionaries) and the early consumer majority (pragmatists) can be bridged.[18] Alternatively, securing investment capital for commercial purposes from an initial position of limited funding will be handled.

AN EXPLOITATION WORK PACKAGE EXAMPLE

This section exemplifies how an exploitation work package undertaken in a *Horizon Europe* program was organised. *Exploitation* refers to how the benefits of the research can be maximised, for example, by selling the generated intellectual property or relating a company around it. Note that the design of exploitation strategies is highly dependent on the type of project and the output produced, whether these are supporting infrastructures, data, tools, models, technologies or solutions. Research projects vary in type and focus, meaning their outputs foster different types of potential exploitation. Types of output from university research could include any of the following:

- preliminary investigations and pilot studies;
- ground-breaking research and exploratory studies;
- models that explain phenomena;
- tools that apply to processes;
- solutions that embrace multiple perspectives;
- empirical testing and validation of data and datasets (e.g., related to technologies or models);

15. Gomper and Lerner, 2001
16. Chesbrough, 2010, p. 354
17. Paulk et al., 1993
18. Moore, 2002

- new technologies;
- supporting infrastructures;
- demonstrations, showcases and minimum viable products;
- prototypes;
- use cases of prototypes and beta versions;
- production-ready products and services.

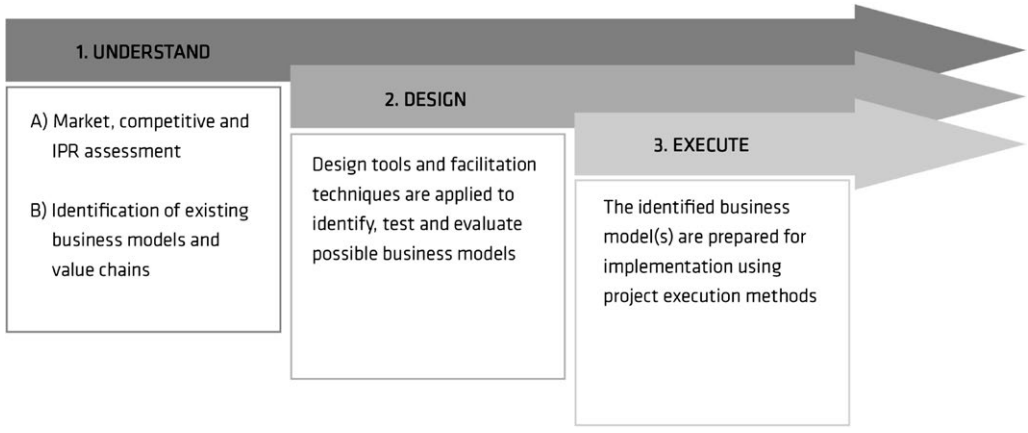
The type of exploitation necessary will depend upon the potential value propositions of the outcomes, which again depend on the targeted stakeholders. Often, a portfolio of actions must be designed to foster valuable outcomes. Such actions include sampling critical stakeholders in a business ecosystem to explore potential users' needs, co-designing interfaces with potential users, and gathering usage data on technologies or models adapted to local contexts and tested locally. Exploitation set-up depends on the maturity level of the output, for example, whether it is in the format of an idea, an innovation or a working prototype. In one completed project, the exploitation work package was guided by the question: 'How can it make money from the technological solutions and related Intellectual Property generated through the project?'

To answer this question, it was first necessary to understand the competitive landscape of the industrial setting where these technologies would be deployed and the business models currently being applied in the relevant industries. The next step was to study how the IP created in the project was of value to (i) users of the technological solutions and (ii) other potential corporate stakeholders.

The objective of the exploitation work package was to develop a sound set of business models around the technologies being developed. This research phase consisted of three primary stages: 1) understanding, 2) designing, and 3) implementing. These dispersed across two periods throughout the project. The initial understanding stage was addressed in the early stages of the project in order to identify possible models for structuring the exploitation objectives. The resulting knowledge was fed back into the parallel clinical development phases through the status reports shared in the project.

The **understanding phase** consisted of two parts. First, quantitative desk-research-based assessment exercises were undertaken, including a market assessment and an intellectual property rights

FIGURE 4: THREE GENERIC EXPLOITATION PHASES



(IPR) assessment. The market assessment included analysing and evaluating potential market sizes and the potential for profit, growth and competition, with macroeconomic and political factors also considered. Next, consideration was given to a more qualitative assessment of the existing business models applied in the market, the qualitative aspects of the applied revenue models, preliminary customer insights and analysis of value chain structures and strengths. This understanding phase provided a detailed overview of the environment where the technologies would eventually launch. It is essential to be explicit about these factors while developing new products.

Next was the **design phase**. This was primarily based on qualitative methods and utilised interventionist and non-interventionist studies. Initially, a reference group comprising potential users, developers and professionals in the industry was established. The design phase was facilitated through a series of workshops that combined design thinking techniques, documentation, external experts and tools to assist in identifying innovative business models. The central tools were value propositions, customer insights, business model canvasses, stakeholder maps and motivation matrices. The identified business models were tested at the outset of this phase using a springboard and investor panels.

Finally, in the **execution phase**, the identified business models were adjusted, optimised and prepared for implementation to develop concrete exploitation strategies for the technologies. This phase involved the development of detailed plans for the business and execution of the project, including the organisation of the resulting company, responsibilities of partners and identification of the competencies deemed necessary to its financial viability.

The three phases of the exploitation work package described here led to six specific tasks with two milestones, one for the early stage and one for the later stage.

Task 1: Market assessment

Assessment of market size, profitability, growth potential and the competitive landscape.

1. Preliminary market assessment
   An early, preliminary assessment of the market and IPR situation for specific technologies was carried out. This provided up-to-date information to help define a clinical protocol and refine the technologies.
2. Updated market analysis was completed, and exploitation strategies were developed.
   The value chain updated IPR situation and market (size, trends, opportunities, and end users' needs and interaction) were analysed. Each partner's specific exploitation plans, strategies and potential business models were developed.

Task 2: IPR assessment

Task 3: Evaluation of existing business models

This entailed evaluating existing business and revenue models and generating preliminary customer insights, value chain structures and strengths.

Task 4: Design and execution of potential business models

This entailed the design and testing of potential business models and the development of business model execution plans.

Task 5: Assessment of the exploitation potential of the involved companies, assessment of potential business models and the requirements for testing, and the development of execution plans for the models.

Task 6: Development of a business plan, including spotting the business opportunity, analysing the market space, providing a company overview, and describing the financials and the execution plan.

IMPLICATIONS AND CONCLUSIONS

This research note aims to raise awareness of the need to reflect on the impact of research and its integral part in universities' third missions. The stark reality of academia is that public and private funding sources increasingly emphasise value for money. This applies whether research is funded by universities or external sources. The fact is that funding bodies are increasingly looking to fund research projects and innovation activities that can make a 'real' difference. Evaluators of project proposals (and academics themselves) are looking for the 'reach and significance of impacts on the economy, society and/or culture that were underpinned by excellent research' (REF 2019/02, pp. 52). In addition, they want to ensure that research projects deliver on their aims and that the money invested creates actual returns. In other words, they want to have their cake and eat it too!

The breakdown of impact work provided in Section 3 illustrates that value creation is central in an impact-oriented paradigm (recalling its relatedness to performance and value for money). Therefore, when identifying impact, it is helpful to use a framework that ensures coherence between outputs, outcomes and impacts and to identify KPIs that are anchored across three dimensions; they should reflect: 1) the resources that go into the process; 2) the actions and activities performed, and 3) the effects of these.

Awareness of the contemporary evaluation paradigm is vital as its influence on what counts as meaningful research and research with impact continues to grow. The objective here has been to describe the processes involved in this transformation. It is essential to understand that evaluators are seeking projects that identify and deliver on clear and concise impact measures.

An important insight for policymakers and evaluators is that addressing valorisation processes and designing viable business models should not be left until after a research project has been completed. Instead, business development processes should be integrated concurrently and iteratively into research projects to ensure valorisation. This advice should be included in the guidelines provided by funding bodies or at least be mentioned in evaluation guides.

It is advantageous for evaluators to receive structured accounts of the expected impacts of a project. The impact analysis should list expected impacts and their qualities, matching impacts to specific stakeholders and what they value. For each expected impact type, the benefits of achieving it and the potential risks and costs, if it is not completed, should be explained from the perspective of each stakeholder. Those evaluating the potential impact of research should be helped in validating the connections between the proposed outputs and their desired outcomes and impacts and relate them to the impacts identified. Ideally, the description should be sufficiently precise for evaluators to assess the probability that the described outputs and outcomes will have the desired influence.

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