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WORKING PAPER
AALBORG UNIVERSITY BUSINESS SCHOOL

How can I enhance, and provide evidence of, the impact of my research?

Christian Nielsen[1]

Abstract

The purpose of this conceptual paper is to assist researchers in connecting with the notion of impact.Funding bodies, governments, and taxpayers are currently seeking value for their investments in research and a value for money perspective is dominant. Impact is therefore no longer merely a question of number of scientific publications, building a community of interest or counting patents. Rather, impact now emphasises the delivery of value to stakeholders, and innovative research must encompass this aspect. This paper surveys the literature on research impact, and presents guidelines for researchers on how to conceptualise and work towards providing evidence of the impact of their own research. The paper rests on a structuring and improvement of guidelines issued by funding bodies for creating impact. It clarifies the link between outputs, outcomes and impacts and how this can be applied to clearly communicating the evidence of overall research impact. In doing so, it aims to clarify the continuum from research exploration and output to exploitation and commercialisation. Finally, it identifies policy implications of the value - for - money perspective currently emphasised by funding bodies.

Keywords: font: Research output, impact maximisation, exploitation, commercialisation, business plan, business model

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1. Introduction

Impact has become an increasingly important output variable for researchers, regardless of their discipline and profession. A particularly rigorous and demanding research assessment process has been firmly established in the U.K.. This process, termed the Research Excellence Framework (REF), aims at securing the quality of the outputs of research conducted across the full academic spectrum within UK higher education through a process of expert review. A significant element in the process is the assessment of the 'reach and significance', i.e, the impact, of a particular piece of research across a wide range of areas (REF 2019/02). The focus on impact in research assessment exercises is currently increasing, particularly across continental Europe and Australasia, where new Zealand's Performance-based Research Fund is a prime example and Australia's Excellence in Research for Australia (ERA) is currently undergoing revision for the 2023 exercise.

Many academics are driven by the aim of publishing their work in high-quality journals and increasing the number of citations they receive. This is important because it illustrates that the research is engaged with the scholarly community and it has made a contribution to the work of other academics. However, such indicators, while valuable, do not fully capture the potential impact of research output. Research assessments are an important means of determining the distribution of funding to universities, both at the national and transnational levels, and funding bodies are increasingly placing impact at the center of their distribution mechanism. In fact, this is already the case in the European Commission's framework programmes as well as in the research evaluations of numerous other funding bodies. Whether research is funding intensive or desk research, it is highly likely that this movement towards measuring impact will affect individual researchers at some point in their careers. The purpose of this paper is thus to provide researchers with a platform to reflect upon the notion of impact in regard to their current and future research portfolios, regardless of their type. In addition, it suggests multiple ways of contributing to large-scale research programmes.

[1] NN Market Data is one of Denmark's leading knowledge banks.

The REF provides a number of concrete examples of potential impacts (1), including research that leads to enhanced disease prevention, measurable by evidence of enhancement of patient/user experiences. Other impacts of research could include the following: generating new ways of thinking that influence creative practices, the development of policies which alleviate poverty or enhance sustainability, and the creation of spin-outs and new businesses whose viability is confirmed by the generation of revenue or profits. Research is also recognized in the REF (1) as contributing to innovation and entrepreneurial activity through the design and delivery of new technologies, products, services and business models. These are just a few examples of impacts that researchers can have and clearly demonstrate that impacts are not simply equivalent to publication or citation counts.

These examples also illustrate that impact is influenced by discipline, profession and the type of research conducted. For instance, the impacts of business scholars might be to improve the success of a firm, assist in performance management, or legitimize policy, among others. Meanwhile, the impact of scholars in medicine might be entirely different. The key point is that no universal measure of impact exists. Rather, being impactful and thereby ensuring future success in academia, in terms of attracting funding, getting tenure, being recognized etc., is central to the careers of all academics. However, impact is already important and will become even more crucial in the future, regardless of the academic discipline.

The objectives of this paper, therefore, are twofold. First the paper provides clarification of the terminology around impact, including the application of phrases typically used in funding programmes: exploration, commercialization, and sustainability of action. Second, it provides guidelines for scientists, administrators, evaluators, and policy makers to understand how to evaluate the impact of research projects and how best to guide the immense amount of work carried out in terms of impact, dissemination, and exploitation of work packages. The paper is divided into the following sections: section two defines impact and relates it to outputs, outcomes and

the development of performance measurements that reflect these categories. Section three looks in depth at research carried out in accordance with the Horizon Europe programme, as an example of how to break down impact work into a series of manageable stages. It provides a guide for exploitation strategies according to the type of output expected from a typical research project. In Section four, the concluding remarks in the form of policy and general recommendations are provided.

2. Defining impact

When used in the context of research, impact is often synonymous with the notion of contribution and is thereby also related to the advancement of knowledge (2). However, knowledge advancement can be measured in terms of three dimensions: 1) outputs, 2) outcomes, and 3) impacts (3) These are often perceived to relate to each other in a causal manner (4). Outputs are directly measurable results stemming from inputs and activities. In the context of the advancement of knowledge, outputs can be understood from multiple perspectives 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 programmes, databases, and publications. Outputs are often difficult to relate directly to impacts because they must first be translated into outcomes.

Outcomes are what is achieved or performed by outputs, i.e., the application of the output in terms of its short- and long-term effects for stakeholders (3). An outcome is thus how a given innovation addresses a problem for a given stakeholder. In the short term, for a scientist, this could be access to global real-time data on water temperature; for a patient, it could be the easing of pain caused by a "phantom" missing limb. Furthermore, impact is also reflected in the long-term effects of a given output and its outcomes. 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 all measurable effects and can be helpfully distinguished when key performance indicators (KPIs) are formulated.

2.1 Linking research, impact and performance measurement

The framework in Figure 1 articulates that research and innovation outputs have many possible forms: products, exploration, services, or technologies. Knowledge management is an important part of organising, structuring, and embedding these outputs to ensure that they are properly captured, anchored, measured, managed and developed. Outcomes relate to the effects of outputs on the receiving stakeholders (i.e., users, customers, and the broader set of stakeholders). Through the formation of viable business models, outcomes can take the forms of exploitation, value delivery or commercialization. Fi-

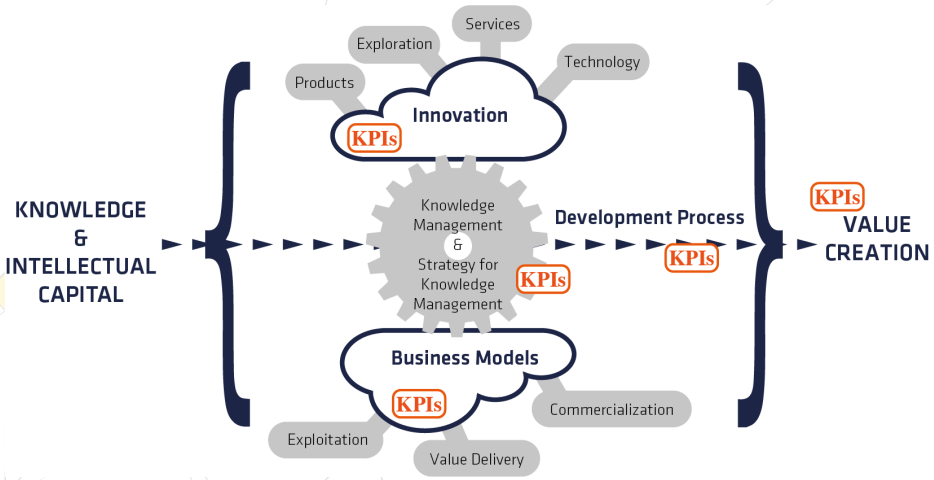

Figure 1: KPIs in the innovation output/outcome process

nally, impact is captured in this framework in terms of value creation. This entails considering the long-term effects of an innovation and its associated business model on, for example, work-life balance, quality of life, the environment, the business environment, and society (5).

In addition, Figure 1 also illustrates how to extract multiple performance measures derived from the development of outcomes and impacts from research outputs. These can be applied to subsequent processes of performance measurement. This framework forms the basis for identifying relevant performance measures in terms both of inputs to and output from innovative research, such as improved performance and knowledge construction (2). Outcomes can be of varying types such as the effect of the innovation on users or financial outcomes.

When identifying performance measures using this overall model, two pieces of advice can be followed. First, performance measures, or KPIs as they are sometimes called, should be SMART, i.e., Specific, Measurable, Attainable, Relevant, and Timely. Second, these measures should reflect the three central elements of a narrative, namely the beginning, the story, and the end (6). In practice, this means that performance measures should reflect the resources required by a process, the actions and activities performed, and the resulting effects (7). Realizing this is a difficult task. Nielsen et al. (8) provide a series of inspirational tables depicting performance measures in terms of resources, activities and effects across six basic business model categories: value propositions; customer segments and customer relations; activities, processes, and assets; configuration of the partner network; value capture and financial elements; and sales channels and communication.

2.2 From research to business

The exploration-exploitation dichotomy suggests that it is difficult for an organisation to handle the perspectives of innovation and commercialization simultaneously (9,10). This is also the case for many research projects. To illustrate the differences between research output and creating impact, we can start by distinguishing between results, outputs, outcomes, and impacts in the following sequential manner:

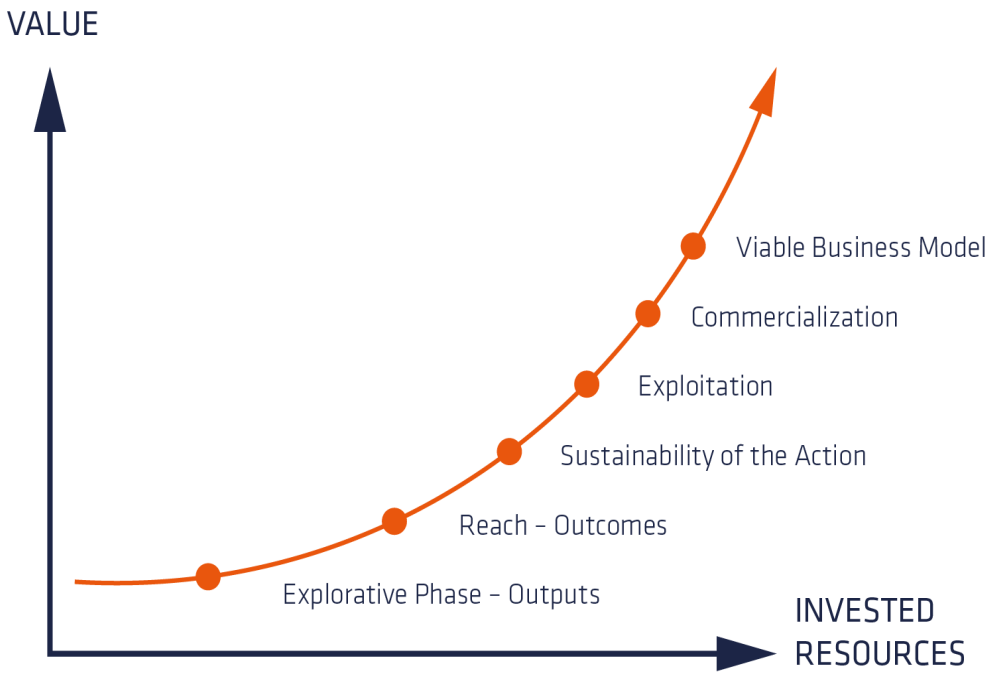

Figure 2: From research to business

Explorative results provide a significant contribution and add new knowledge. These are measured through presentations, publications, citations, and interaction with the scientific community. These contributions are outputs.

Results (outputs) can be built on and thus develop a reach (outcome). They may transcend other programmes or funding-types and continue in other formats or settings. Alternatively, a scientific community may be built around the research, indicating a spread in its network effects. However, the inflow of resources may be sporadic and predominantly dependent on specific contacts from the original scientific team.

The action should be sustainable, i.e., it receives a stable inflow of resources and financing alongside regular attention from a broader community of scientists. A prerequisite of this is effective dissemination and communication of research, including community-building and creating reach.

Exploitation strategies are built upon the initial explorative actions to utilise and benefit from the outputs. They depend on the actionable element of research, which enables a given output to be put to use for the good of a recipient stakeholder. This product or knowledge may be for free, or for a reciprocal value stream such as stakeholder feedback.

In the commercialization phase, the reciprocal value stream returns to the creator in the form of monetary value, principally for financial gain. Alternatively, a resource such as data that can be transformed into monetary value may also hold further potential value. This means that the output has a value proposition towards a customer segment and that a business model can be formed around this value proposition (11).

The last step is the creation of a viable business model, where a company can capture long-term value from its products/services while it delivers value to a set of stakeholders and can sustain its chosen financing model through its shareholders.

The explanation above is complemented by figure 2, illustrating the sequential nature of these outputs, ranging from early-stage exploratory research results to a viable business. Value creation for society is a question of moving as far to the right of this figure as possible.

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3. Breaking down the impact work – the Horizon Europe programme

This section considers how the above processes are realised in the context of the Horizon Europe programme (12). Examining this programme provides insights into how governments and funding bodies perceive impact work to be organised. In many current research-funding programmes such as Horizon Europe, an additional and mandatory condition is the inclusion of a plan for the dissemination and exploitation of a project's results that illustrates how the proposed measures will help achieve the expected impact of the project. The plan should contain measures to be implemented both during and after the project.

In section 2.2, the first three steps outlined in the model relate to outputs and outcomes: 1) Explorative phase, 2) Reach and 3) Sustainability of the action). This paper focusses on Horizon Europe to illustrate the central links between outputs, outcomes, and impacts. In the programme, which is currently being planned and launched, impact will underpin the evaluation metric deployed across the three pillars of funding 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. This approach links key societal challenges and relevance to a broad range of stakeholders, including citizens, to an 'investment mind-set' and project portfolio approach at the supra-national level (12).

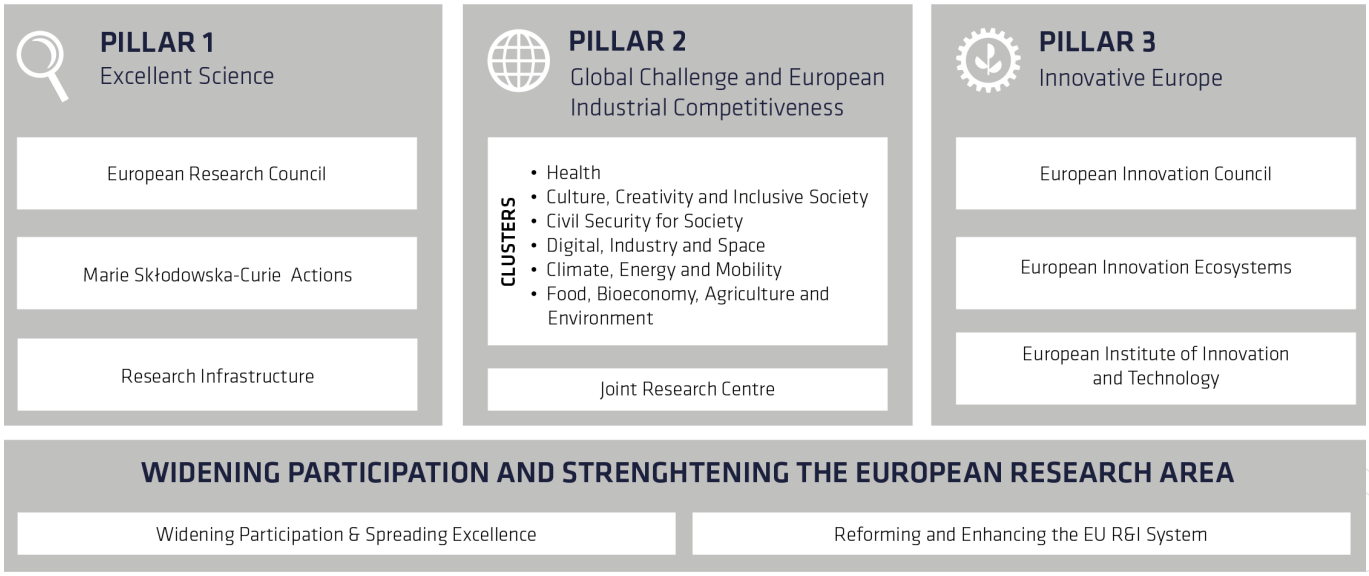

Figure 3: Horizon Europe Framework programme (12)

The Horizon Europe programme specifically focuses on impacts by distinguishing between expected impacts and measures to maximize impacts. These are now considered separately in the context of outputs, outcomes, and impacts. In the Horizon Europe programme, it is specifically stated that proposals should address impacts using quantified indicators and targets; furthermore, the process of creating value from innovation should incorporate performance measurement. Guidance on identifying relevant quantified indicators was provided in section 2.1, again illustrating the conceptual link to performance measurement.

Horizon Europe defines expected impacts on a programme level for each specific topic. Thus, the first objective is to describe how the project contributes to those impacts that the European Commission wishes to focus on. The European Commission states that the "plan for the dissemination and exploitation of the project's results (in the form of outputs and outcomes) is key to maximizing impact. This plan should describe, in a concrete and comprehensive manner, the area in which you expect to make an impact and who are the potential users of your results". This value-for-money perspective means that impacts ultimately need to lead to value creation and value delivery to recipient stakeholder groups while aiming to capture value. In other words, the creation of innovative solutions should be complemented with a viable, sustainable and potentially profitable output model, also known as a business model (13). The work on securing impact in such larger-scale cross-disciplinary research programmes can be achieved through five types of plan:

1. An impact maximization plan
2. A dissemination and communication plan
3. A sustainable action plan
4. A business plan
5. An outline for exploitation of the work

It is quite likely that only one or two of these plans will be relevant to a particular research project.

3.1 The impact maximization plan

One method of maximizing impacts is to first list the expected impacts and their qualities in as much detail as possible. In addition, particular impacts should be matched to the particular stakeholders who will benefit. Next, the benefits of achieving each expected impact should be noted alongside the potential problems, risks or lost opportunities (pains) of not achieving the impact. This should explicitly state how benefits and pains are seen by each potential receiving stakeholder. Subsequently, the expected outputs and their associated outcomes can be described. Evaluators seek to validate the connections between what is proposed and the expected impacts listed, so the description should be sufficiently precise for this purpose.

A precise description can be achieved by following the clock-wise process depicted in Figure 4.

Step 1. Identify relevant stakeholder and target audiences. Use this overview as a basis for creating insights into stakeholder and target audience needs through surveys, qualitative interviews or focus groups, for example. Focus on primary stakeholders and primary target audiences.

Step 2. Translate your insights from the stakeholder and target audience analysis to prioritise impacts within the scope of the call for funding.

Step 3. Use the anticipated impacts to develop actions that are outcome-related and hinge upon your target audience insights from step 1.

Step 4. Use the anticipated impacts and outcomes to develop actions that are output-related. Develop measures of success for your outputs that hinge upon your target audience insights from step 1.

Step 5. Develop measures of success for your outputs.

Step 6. Develop measures of success for your outcomes.

Step 7. Develop measures of success for your impacts.

If necessary, steps 2 through to 7 can be repeated in the light of new insights into any element of the process.

Desired impacts include the following: enhancing future innovation and research capacity; creating new market opportunities; strengthening competitiveness and the potential growth of companies; addressing issues related to climate change or the environment; and bringing forth other important benefits for society. From a business perspective, many of these aspects are directly related to creating value. Evaluators require value to be framed realistically and clearly; they will require evidence that applicants have the required level of competence to carry out the tasks. Thus, evaluations will look for realistic descriptions of potential barriers to creating viable business models, such as existing patents and regulation, public acceptance issues, workforce considerations, financing of growth, and hindrances to cooperation with other partners in the value chain.

3.2 Dissemination plan and communication activities

Second, the dissemination plan should describe how

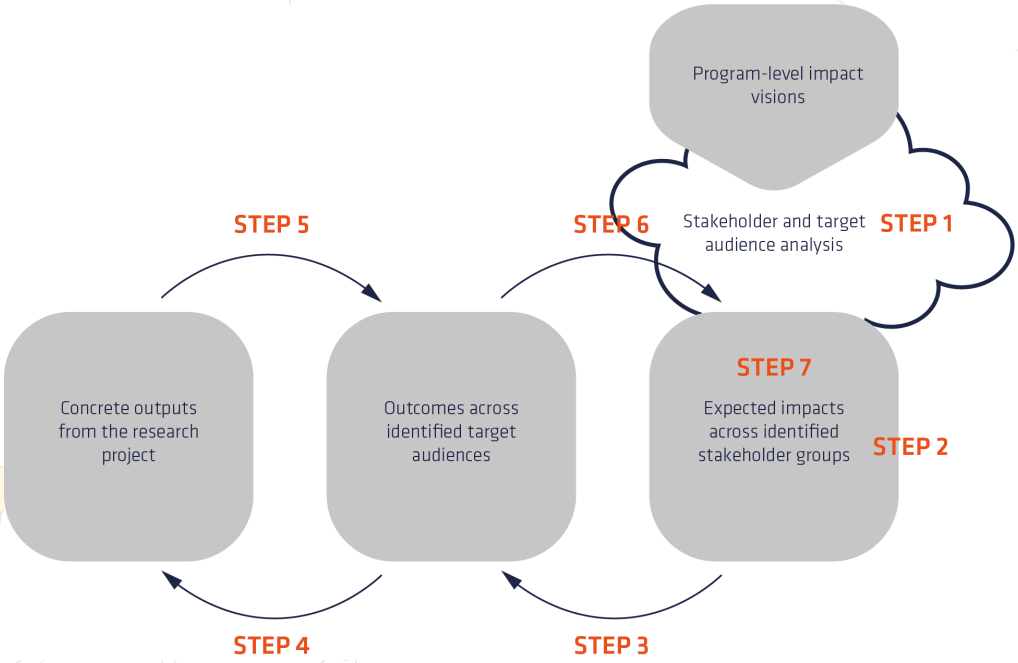

Figure 4: Process of translating impacts to relevant outputs/outcomes

the appropriate channels will be used to optimize interaction with potential users during the project. The full range of potential stakeholders, or target audiences, should be addressed. These include other researchers, research communities, potential commercial users and buyers, potential corporate strategic partners and value-chain participants, potential investors, social and environmental organisations, policymakers, standard-setters and educational organisations.

These potential stakeholders will most likely be reached through various channels and may overlap. When describing the proposed means of promoting the project and its findings during the grant period, this should be kept in mind. It is a good idea to conduct an overall stakeholder analysis which specifies which stakeholders will be contacted at specific points in the process. Dissemination should be proportionate to the scale of the project and should contain clear objectives tailored to the needs of different target audiences.

A well-organised dissemination plan is crucial to most collaborative research planning because feedback from it helps to focus the project and identify key audiences. As research outputs begin to materialize, the initial dissemination plan should allow the project team to review and adjust the plan accordingly and begin to implement it efficiently. The following eight steps should be considered in a dissemination plan.

1) State what will be disseminated

In specifying the potential research outputs, findings, and products, the plan should explicitly state what the research aims to clarify or change. How do these objectives address the context or challenges that have been identified? This can be used to identify anticipated key messages which include explanation of the research results, how they complement and extend existing research, and what actions should be taken as a result of them (14). It should be noted that key messages are not simply a summary of the expected results.

2) State the objectives of the dissemination activities

Next, the objectives of the dissemination plan should be clarified. What will be achieved in disseminating this research project? The long-term goal of the research may relate to policy change, climate change, consumer practices, or even culture, all of which are considered to be impacts. However, it is also important to include the supporting, shorter-term goals, i.e., the outomes of the research.

	NAME	PREFERRED COMMUNICATION CHANNEL AND FREQUENCY
Primary Stakeholders	•	•
	•	•
	•	•
	•	•
Secondary Stakeholders	•	•
	•	•
	•	•
	•	•
Primary target audience	•	•
	•	•
	•	•
	•	•
Secondary target audience	•	•
	•	•
	•	•
	•	•

Figure 5: Stakeholder and target audience listing

3) Identify stakeholders and target audiences

This step includes stakeholder mapping and prioritization: it is important to note that stakeholders and target audiences may differ. Stakeholders include groups that may be affected by impacts, whereas the target audience is affected by outcomes. Both groups may be important targets of dissemination activities, and mapping should be as specific as possible to identify potential users of the research. It may be advantageous to divide the two lists of stakeholders and target audiences into primary audiences (more important) and secondary audiences (less important) and allocate dissemination efforts accordingly.

Having been identified, representatives from the primary stakeholder/target audience groups should be asked which type of communication they prefer and with what frequency they would like to receive it.

4) Identify influencers (within and outside of target audiences)

After identifying an adequately diverse set of representatives, the next step is to create a second list of potential influencers who can boost the uptake of the research results. Influencers should be credible people or organisations with a positive view of the objectives. The dissemination plan should identify how to engage with influencers, such as in workshops, seminars, conferences, newsletters, and other outreach activities. In addition, influencers can help market the research and bring examples to the appropriate channels. This could be through, for example, social media activity, conference calls, websites, or newspaper articles.

5) Create a detailed communication plan

The detailed communication plan specifies the activities, channels and timing of communication, and identifies individuals responsible for it. Communication activities are those activities undertaken to reach each target audience. They can include press releases, newsletters, posts, briefings, and presentations. Communication channels should be chosen to support activities and can include printed materials, web sites, online stories, videos, and podcasts.

A good communication plan has activities that reach each target audience and considers their attitudes, habits, and preferences. Messages should be clear, simple, and action-oriented, and the style and content should be tailored for each audience. Messages should be based on what an audience wants to know, rather than on what the researcher thinks it should hear (14). In addition, successful communication plans go beyond using only traditional vehicles such as publication in scholarly journals and encompass activities that promote a two-way dialogue. Face-to-face meetings or briefings are a very effective way to reach decision-makers. It is advisable to schedule meetings either regularly or in conjunction with main activities to ensure that communication commitments are being met and that activities have the desired effects.

6) Outline obstacles

It is advisable to identify potential obstacles to disseminating the research so these can be tackled more effectively if they arise.

TARGET AUDIENCE/ STAKEHOLDER GROUP	COMMUNICATION CHANNEL APPLIED	FREQUENCY	TASK DIVISION AND RESPONSIBILITY

Figure 6: Detailed plan of communication activities

TARGET AUDIENCE/ STAKEHOLDER GROUP	OBJECTIVES	COMMUNICATION CHANNEL APPLIED	MEASURES OF SUCCESS TOWARDS THIS OBJECTIVE

Figure 7: Monitoring communication objectives across each stakeholder group

7) Establish a budget

Time and budget requirements for dissemination and communication are frequently underestimated. Effective dissemination involves the careful consideration of budgeting for aspects such as travel, layout and printing costs, translation, equipment, access costs to media and databases, costs of food and drink, IT support, and rental costs of locations (14). The employee resources (hours, times and pay rates) needed to plan and coordinate communication activities should be identified as precisely as possible.

8) Establish monitoring and evaluation

The process of evaluating the dissemination and communication plan should be clearly stated. This begins with articulating how the success of dissemination efforts and outcomes will be determined, and identifying measurable criteria for each communication activity on this basis. Plans for providing and obtaining feedback to and from end users should be made at this stage.

Lastly, the evaluation should consider the possible, and most probable, development trajectory of the project. The European Commission states, "Your dissemination plan should give due consideration to the possible follow-up of your project, once it is finished." Such a follow-up can be in the form of a plan for sustainability of action or further exploitation and commercialization, as described in sections 3.3 and 3.4.

3.3 Plan for sustainability of action

A plan for sustainability of action outlines how a project will be sustained until it is mature enough for commercialization. This may require further research and development such as wider testing or refinement of outputs to form a developed technology or model. Such improvements will most likely require additional investments such as research funding, sponsorship or donations.

Prospective exploitation may also require 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. The objective of sustainability plan is to ensure the output ensures that a business plan with the goal of commercializing this output can be established.

This sustainability plan should include the following elements:

- A depiction of the maturity stages present in the current context (e.g., research or technology maturity) using a relevant capability maturity model (15) or similar model.
- An assessment of the current maturity of the expected research output in this context.
- An assessment of commercialization in terms of the quality/maturity of the output. This may include:
    - Discussion of how the chasm between

early adopters (technology enthusiasts and visionaries) and the early consumer majority (pragmatists) can be bridged (16).
    - Discussion of the process of securing investment capital for commercial purposes from an initial position of limited funding, known as the infamous Valley of Death (17).
- The development and protection of intellectual property (IP).
- The development of ownership agreements between researchers, their universities, and funding bodies, including rules for later dispersion and sale of ownership rights, and the establishment of governance structures around the ownership
- An assessment of the maturity of the environment and context. Suggested measures may include the creation of a temporarily protected niche market via collaboration with government to adapt legislation (18), assessing maturity in the industry, or raising consumer awareness in order to bridge adoption chasm mentioned above (16).

Service perspectives are of increasing interest to traditionally product-oriented industries. This process of servitisation offers an alternative to competing purely on low product prices, since the service component is key to creating and capturing value. (19). One nuanced discussion of the differences between innovation types (i.e., business model innovation, product, and process innovation) expands this point, showing that the types of intellectual capital involved in an exploration exercise influence the business model innovation process (20).

On a societal level, the transformation from an invention society based on technologies, products, and patents into an innovation society able to commercialize innovation, is of great significance. It is also crucial that more innovations survive through the Valley of Death (17). For this to occur, these services must be considered a more integral part of the value propositions of research projects. Chesbrough (18) 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".

3.4 The business plan

The business plan should answer the key question:

How can a profitable business be created from the output?
This broad question can be broken down into its constituent elements. The extant literature on business cases and business plans is indicative of the following fivefold structure, which has been fine-tuned to match the typical requirements of research projects. Many required elements of the business plan can be directly derived from the research proposal, but the plan also contains elements that go beyond the research and planned outputs, outcomes, and impacts: it may be difficult to analyse before the final stages of a project.

1) Opportunity

(This entails relating the knowledge of anticipated outputs, outcomes and impacts to the relevant stakeholders.)

- What is the concrete output and which needs does it address? (jobs to be done)
- How is this different from current solutions and why would a given customer wish to pay for this solution? (pains/gains)
- Why is the researcher the best choice to do this?
- Which business model can capture value from this opportunity?

2) Market space

(This entails using knowledge of the innovativeness of the proposed solutions to argue against the continued use of existing solutions.)

- Which alternatives are currently present in the market?
- Which customer segments do the solutions address?
- What are the size and growth prospects of the target market?
- What is the market's profitability? (see Porter's Five Forces model [21])
- How do other competitors compare?
- What is the marketing plan and how will the business be promoted?

3) Company overview

(This entails an honest appraisal of the of the consortium's competence to execute the business plan,.)

- Who are the key employees and what are the key competences?
- Who will be on the management team?
- What will the governance and reporting structures be and who will serve as advisors?
- How will the consortium/ownership agreement and the ownership and access to key knowledge, intellectual property rights (IPR), research data IPR, and IPR protection be handled?
- What are the details of the organisation, including its operations, sales planning, locations, and facilities?
- What is the wider business scenario (include, for example, a PESTEL and SWOT analysis)?

4) Financials

- What are the economics of the business case
  i. What are the expected revenues and costs? What is the profit and loss forecast?
  ii. How will the business make money?
  iii.What are the key metrics?

- What is the capital requirement to start the business?
  i. What sources of capital will be sought for which phases?
  ii. What is the expected cash burn rate?

5) Execution

- What are the vision and strategic objectives?
- How will a milestone plan be articulated?
- What is the execution plan for the following six months, including goals and consequences and how this will be reported?
- How is the business model expected to evolve?

3.5. An exploitation work package example

Exploitation refers here to the process by which the benefits of research can be maximised. This section exemplifies how an exploitation work package can be organized and thus the potential for business scholars to support such projects. The impact work package should reflect the relevant exploitation strategy for the project. The design of exploitation strategies is highly dependent on the type of project and the type of output being produced, whether these are supporting infrastructures, data, tools, models, technologies, or solutions. In section 2.2, the last three steps in the impact/exploitation continuum relate specifically to exploiting the output. Section 3 discussed different elements of the impact of work and the types of plans that a research project could utilize to convince the funder that a valuable return on investment will be obtained.

Research projects vary in type and focus, meaning their outputs foster different types of potential exploitation. Types of output include the following:

- Preliminary investigations and pilot studies
- Ground-breaking research and exploratory studies
- Models that explain phenomena
- Tools that are applicable to processes
- Solutions that embrace multiple perspectives
- Empirical testing and validation of data and datasets (e.g., related to technologies or models)
- New technologies
- Supporting infrastructures
- Demonstrations, showcases, and minimum viable products (MVPs)
- Prototypes
- Use cases of prototypes and beta versions
- Production-ready products and services

It is assumed that the type of exploitation undertaken will depend upon the potential value propositions of the outcomes, which, in turn, are dependent upon the target stakeholders. Often, a portfolio of actions is designed to foster outcomes. Such actions include sampling key 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 and tested in local settings. The exploitation set-up also depends on the maturity level of the output; for example, whether it is in the format of an idea, an innovation, an MVP or a working prototype.

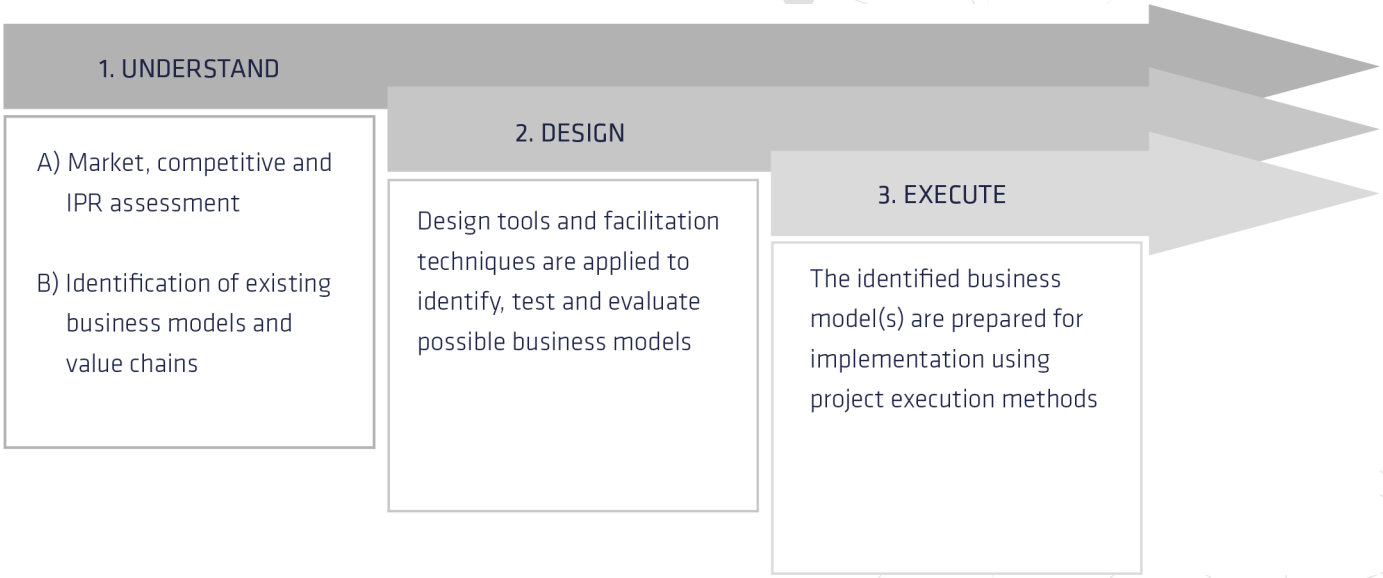

Figure 8: Three generic exploitation phases

In one completed project, the exploitation work package was guided by the question:

'How is it possible to make money from the technological solutions and related IP 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 as well as 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 (1) users of the technological solutions and (2) 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 phase of the research consisted of three basic stages: (1) understanding, (2) designing, and (3) implementing. These were dispersed across two periods over the course of 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 that were shared in the project.

The understanding phase consisted of two parts. First, a series of quantitative desk-research-based assessment exercises including market assessment and an IPR assessment exercise was undertaken. Market assessment included the analysis and evaluation of potential market sizes, as well as the potential for profit, growth and competition, with macroeconomic and political factors also considered. Next, a more qualitative assessment of the existing business models being applied in the market, the qualitative aspects of the applied revenue models, preliminary customer insights, and analysis of value chain structures and strengths were considered. This understanding phase thereby provided a detailed overview of the environment in which the technologies would eventually be launched. It is important to be explicit about these factors during the development of new products.

Next was the design phase. This was primarily based on qualitative methods and utilized both 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. Among the central tools applied were value propositions, customer insights, business

model canvasses, stakeholder maps, and motivation matrices. At the outset of this phase, the identified business models were tested using springboard and investor panels.

Finally, in the execution phase, the identified business models were adjusted, optimized, and prepared for implementation with the aim of developing 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 competences 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 of the exploitation work.

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. Specific exploitation plans and strategies for each partner and potential business models were developed.

Task 2: IPR assessment

Task 3: Evaluation of existing business models
This entailed the evaluation of existing business models and existing revenue models, generating preliminary customer insights, value chain structures, and value chain 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

4. Implications and conclusions

The objective of this paper is to raise awareness of the need to reflect on the impact of research. The stark reality of academia is that public and private funding sources are increasingly emphasising value for money, i.e., what they term impact, in their decisions: this criterion applies regardless of whether research is desk-based (funded by university research time) or includes activities that are funded by external sources. Increasingly, therefore, funding bodies are looking to fund research projects and innovation activities that can make some kind of a difference. Evaluators of project proposals (and indeed, academics themselves) are looking for "advanced and high-quality research that can make a real impact on society". In addition, they want to ensure that projects deliver on their aims, and that the money invested creates real returns. In other words, they want to have their cake and eat it too!

In addition, the breakdown of impact work provided in Section 3 indicates how business academics can contribute to research projects in other disciplines such as the natural sciences and humanities. This is because in an impact-oriented paradigm (recalling its relatedness to value for money), performance measurement and management are of particular importance.

Awareness of the evaluation paradigm is important as its influence on what counts as meaningful research continues to grow. The current paper has aimed to illuminate the values and processes that are involved in

this transformation. It is key to understand that evaluators are seeking projects that identify and deliver on clear and concise impact measures. For researchers looking to apply for any type of competitive funding, an overview of how to organise work to create impact is provided by this paper. First, the differences and linkages between outputs, outcomes, and impacts were explained, alongside those of innovation and commercialisation and how to identify relevant measures of impact. These ideas indicate the need to build impact-narratives around existing research. Showing a strong impact-focused CV may help to support future job or funding applications. Moreover, administrators need precise plans so they can assist researchers in meeting goals and conducting activities. Therefore, a breakdown into distinct impact-related plans is suggested. Not all research projects are expected to implement all plans and the example in section 3.5 illustrates how plans 1, 2, and 4 were combined for a specific project.

This paper also provides important insights for policymakers and evaluators. With the innovation/commercialization process, it is crucial to keep in mind that impact and creating viable, sustainable business models, is not something that should be approached sequentially and left after a research and innovation exercise has been completed. Rather, the processes must be integrated concurrently and iteratively into the entire research project. This advice should be included in the guiding documents 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. Such an impact analysis should list expected impacts and their qualities, matching impacts to specific stakeholders. For each expected impact type, the benefits of achieving it and the potential pains if it is not achieved should be explained from the perspective of each potential receiving stakeholder. From this outset, the project description should articulate the expected outputs and the outcomes to which they will lead. Evaluators should be able to validate the connections between the proposed outputs and their expected outcomes and impacts, as well as relate them to the impacts listed in the call. Ideally, the description, or impact maximisation plan, should be sufficiently precise for evaluators to assess the probability that the described outputs and outcomes will make the desired impacts.

Subsequent plans should cover the dissemination and communication of research, its sustainability the overall business operation and the exploitation outline. Articulating these in the guidance for applicants in research calls would lend transparency to the process, improving understanding among researchers, administrators, and evaluators. The goal of policymakers should be to construct guidance that enables applications to easily tie together aspects of the impacts of a project.

When identifying impact and performance measurements, it is helpful to use a framework that ensures coherence between outputs, outcomes, and impacts (see example in Section 2.1). In addition, KPIs should be SMART and anchored across three dimensions; they should reflect 1) the resources that go into the process, 2) the actions and activities performed, and 3) the resulting effects.

In conclusion, policy makers need to be aware that the impact/exploitation continuum is not of equal relevance to all projects, and guidelines should therefore be flexible. Paying close attention to the positioning of research in the maturity and financing gap is an important part of evaluators' work which should be precisely articulated in guidance documents. In securing sustainability and viability, research funding bodies may need to work proactively to create funding combinations. For instance, granting research access to seed capital organisations as part of funding schemes relatively early in the process and establishing fora to facilitate these types of matches.

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