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Research impact seen from the user side

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Abstract

Impact assessment research has developed theory-based approaches to trace the societal impact of scientific research. Impact assessment typically starts from the perspective of a research investment, organization, or project. Research users, non-academic actors involved in knowledge production, translation, and application, are well represented in many of these approaches. Researcher users are usually positioned as contributors to research, recipients of research outputs, or beneficiaries of research-driven outcomes. This paper argues that impact assessment would benefit from a more comprehensive understanding and analysis of research valorization processes from the user perspective. The first half of the paper reviews key impact assessment literature to identify how research users are positioned and portrayed in relation to valorization processes. In the second half of the paper, we use the results of this review to propose a set of principles to guide a systematic approach to constructing user perspectives on research impact. We suggest four concepts for operationalization of this approach. The paper concludes that the addition of a more comprehensive research user perspective on research valorization would complement and enhance existing impact assessment approaches.

Keywords: impact assessment; research users; valorization; user perspective; methods.

1. Introduction

Scientific research is valued for both its contribution to knowledge and understanding and its contribution to human well-being. The field of research evaluation, in its efforts to assess the contribution to society of investments in scientific research has built plausible models and credible explanations regarding the effects of research in and for society. In so doing, it has built a bridge between the scientific and societal contributions of research. In this paper, we advocate for more attention to be placed on the society side of this bridge, by constructing a more thorough 'user perspective' on research impact.

The image conveyed by the term 'research impact' suggests an origination cause (the research) yielding results as of its own momentum. Yet, this is seldom the way in which societal benefits from research accrue. To contribute to economic and social changes, research results need to be used. We can therefore argue that 'research impact' and 'impact assessment' are fundamentally about the **use** of research—the commercialization of new products and services, the implementation of new policy directions, the improvement of healthcare and more. Research users are thus critical to processes of creating value (valorization) from research. Yet, while the roles, actions, and motivations of researchers are relatively well understood, those of users involved in generating value from research are sometimes missing and usually underplayed in the models, methods, narratives, and explanations employed in impact assessment methodologies. The main rationale for impact assessment remains the identification and measurement of the socio-economic impacts of specific bodies of research. How research results are used and how this allows research users to pursue knowledge driven objectives remains less well understood.

Important progress has been made in analysing the roles research users play in valorization efforts. But, as we will argue, there remains a further step to be taken to develop a fuller understanding of the generation of societal value from the user perspective. Research evaluation continues to be dominated by approaches that take as their starting point an investment in research and the activities and outputs that are subsequently generated. Whether one focuses on the processes of knowledge production and application by tracing forward from the research investment or tries to estimate the economic returns it has generated, the window this perspective offers is necessarily partial. The proxies of value used in such approaches, such as scientific outputs, patents, or economic additionality, focus on the economic (and scientific) impact results of specific investments, often to the exclusion of more difficult assessments of public value (Bozeman and Sarewitz 2011). When research investments in a single infrastructure can run into the billions of euros,[1] it is understandable that the public institutions authorizing such expenditures may not be satisfied by the knowledge that 'there is always a chance' that such investment will yield social or economic returns. The political need to have evidence of positive impacts prompts and reinforces evaluation approaches that have as their starting point a specific research investment. So, what is missing from this picture?

In what follows, we argue for a more extensive investigation of the user perspective as part of process-oriented approaches to research impact assessment. We do this by first identifying and analysing relevant contributions to the research evaluation and impact assessment literatures. We then build on this analysis to describe a set of principles to guide the design of a methodological approach focused on the user perspective on valorization and impact. Subsequently, we introduce four concepts for the operationalization of these principles.

As we will see below, evaluative studies have typically taken as a point of departure specific research projects or

programmes, or a research group or organization whose impact is assessed. Much less often, the point of departure will be a specific technology or a policy decision; from here, the evaluative studies 'trace back' to the results of the scientific research that have contributed to such technology or decision. In this perspective the evaluative goal is to assess the contribution of scientific research to estimate the extent to which such investment appears to be justified. Neither of these perspectives take, as a point of departure for their assessments, the motivations and activities of the research users. Our review is not intended as a comprehensive or critical assessment of the literature that implies the existing approaches 'fall short' of constructing a user perspective. None of the literature we reviewed made any claims to develop an approach starting out from, or focused on, the user perspective. In this sense, our objective was to develop the basis of an approach that complements and adds to the current focus on research investments and/or knowledge diffusion.

We used the available approaches to establish a general understanding of how research users are positioned and framed in current thinking about evaluation and impact. The literature included in the paper is what we consider most relevant for our purposes and is also sufficient, in that additional literature that we read does not change the results of our analysis or the substance of the methodological principles and concepts for operationalization that we outline in the second half of the paper. The review process followed a broadly historical sequence, which traces a rising general concern of research and innovation (R&I) policy to involve research users and beneficiaries as key actors in problem definition, research valorization processes, and the (co-)production of beneficial outcomes for society (Schot and Steinmueller 2018). In the following three sections, we present selected literature in line with this evolution, but grouped according to work that departs from the perspective of a research investment (Section 2), that which starts with a specific application (Section 3), and an approach that takes a user perspective on the analysis of knowledge generation and application as a value-generating process (Section 4). Section 5 contains a short summary discussion of our review, while Section 6 then presents our methodological principles and concepts for operationalization, followed by a short concluding discussion (Section 7).

2. Research investments as the departure point for impact assessment

In this section we review two dominant and contrasting approaches to research impact assessment, which take investments in research as their starting point. Economic models of research impact seek to compare two points in time and connect these in terms of changes in quantitative indicators. Contributions and pathways models focus on processes, sets of interactions between interested actors, and systemic feedback loops and adaptation mechanisms. Whereas the former type of model pays little attention to research use and research users, the second type of model has been instrumental and influential in bringing researcher users towards the foreground of impact assessment.

2.1 Economic models and linearity

Efforts to quantify the returns to R&D investment have a long tradition. Quantitative analyses, mainly focusing on economic returns, have tried to estimate the returns on specific investments or, at a macro (national/international) level, the overall effect of R&D expenditure (Productivity Commission 2007). These models rely on a narrow set of well-defined indicators available through existing datasets or bespoke questionnaires. R&D expenditure is taken as the main indicator of research effort, while its impact can be observed through the differential growth in GDP, or in employment, sales, patents, patent income, technological balance of payments or other quantitative indicators. Whilst increasingly technically complex, such models are based on a sequential understanding of the effect of R&D, the first step of the sequence being the effort invested in research, and the impact being an attributable improvement in a measurable variable of consequence. Emphasis on identifying 'additionality' linked to investment may focus the assessment on what is important from a current perspective while missing uncertain long-term benefits (Luukkonen 1999).

These methods have flourished in sub-fields such as agricultural economics. Here the knowledge generation and application process can be plausibly presented in a simple linear way: the research effort invested in the development of a new crop variety leads to the development of new seeds, which once farmed will lead to new products being grown or increased productivity in the production of existing crops. This type of impact assessment has led to hundreds of articles and studies. Two decades ago, a literature survey of studies on the impact of agricultural research identified 289 studies of economic returns to agricultural research yielding 1829 different estimates of return rates (Alston et al. 2000), suggesting results are highly dependent on model specifications.

Critics argue that the long chain of events linking knowledge to decisions, actions, and outcomes, mean these types of measures are flawed (Barré 1999) and that available indicators are limited and can only offer a partial window on reality (Molas-Gallart and Ràfols 2018). The way in which impact estimates are obtained through statistical modelling cannot offer an understanding of the processes by which such impacts occur, so the role(s) played by research users remain largely invisible. Impact measurements can be obtained; but without a clear grasp of how the estimated returns have come about.

2.2 Identifying processes and contributions

The major limitation of economic models is the invisibility of long-term processes involving intricate forms of interaction among the producers and users of research knowledge. Several research impact assessment approaches emerged that were specifically designed to examine these complex processes (Barré 1999). Some attempt to establish a model of the process leading from the research results to their eventual application and its effects. They define the stages in the process, the relationships between them and the feedback loops and the contributions of different actors (including users) at the different stages. The 'payback model' (Buxton and Hanney 1996; Donovan and Hanney 2011) was developed to assess the return to biomedical research investments and has been used extensively in this and other sectors. It 'attempts to combine elements of the rational, linear model with a more interactive approach' (Buxton and Hanney 1996: 38). Payback formally structures the development of new drugs and other therapies into a sequence of stages that eventually yield new medical treatments or innovations. The model envisages the

participation of potential users at all stages, even 'topic identification could involve, at least partially, the wider environment and include policy-makers, healthcare professionals, patient representatives, etc.' (Donovan and Hanney 2011: 181). The timeliness of a stakeholder's involvement in the impact process shapes the roles available to them (Hanney et al. 2007).

Each stage of the payback model process includes 'permeable interfaces' between researchers and potential users in the healthcare system. These include 'negotiations between research customers and contractors; brokerage between researchers and the policy community; the involvement of stakeholders; and effective dissemination' (Buxton and Hanney 1996: 37). The conceptualizations of value that these diverse stakeholders can seek to realize at the different stages of the process will be determined to some extent by the affordances embedded in outputs from previous stages. Research users can thus participate in the co-creation of value, but simultaneously, by being positioned close to and informed about the innovation process, research users are also envisaged as brokering new medical treatments for the benefit of constituent audiences, for example.

The 'social impact of research' (ASIRPA) approach uses a standardized case study method to evaluate the impact of agricultural research conducted by the French National Institute for Agricultural Research and Environment (INRAE). ASIRPA traces how a research output is further developed, adapted, applied through interactions involving different stakeholders (Joly et al. 2015; Matt et al. 2017). ASIRPA starts from the premise that scientific knowledge as such is not useful, but is made useful through a series of transformations performed by different actors (Callon 1986; Joly et al. 2015: 441). Research value is produced by networks of actors and resources that 'translate' knowledge through four ideal-type impact pathways. More than interactions *per se*, what matters are the timing of translations, the type of problematization that is made, and the consequences for the impact pathway constructed (Matt et al. 2017: 210). Each impact pathway involves users in different configurations of value creation and their roles shift between co-production, a variety of intermediary activities, and application of research in a primary context of use. One actor's context of end use can be an intermediary to another use context. The roles of actors in these processes can shift over time, from observers/participants, to users, and eventually to key actors in the 'scaling up or out' of the research results. The diverse impact pathways constructed also tend to produce different configurations of outputs (valuable objects, products, methods, and processes) (Matt et al. 2017: 216–17). ASIRPA thus constructs a theory-based approach to tracing long-term processes in systematic detail, as the basis of a comparative longitudinal case study methodology that foregrounds processes of research use and provides generic lessons on value creation from agricultural research (Joly et al. 2015; Matt et al. 2017). Initial applications of ASIRPA have assessed the impact of very specific discoveries in the agricultural area (for instance a new plant variety). The ASIRPA method shows that even in seemingly straightforward cases (the use in new crops of the new varieties and the consequent increases in productivity or sales), the impact processes are protracted, complex, involving actors from many different fields, and having effects that go far beyond the economic returns generated by increased yields or the market success of new products.

While 'Payback' and ASIRPA revolve around setting a structured framework to analyse the whole process from the generation of research results to the societal returns obtained from their application, other impact assessment approaches focus on studying a specific element of this process. The 'social impact assessment methods for research and funding instruments through the study of productive interactions between science and society' (SIAMPI) project centres its attention on the interactions between users and researchers through which research is defined, conducted, and applied. SIAMPI developed a conceptual framework and set of tools to assess the generation of research impact through 'productive interactions' defined as 'exchanges between researchers and stakeholders in which knowledge is produced and valued'. Depending on their context (De Jong et al. 2014), interactions may be strongly institutionalized and coordinated, for example in a project, or rely on more informal and opportunistic bottom-up interactions (Spaapen and van Drooge 2011: 2014). Stakeholders include 'all those involved in achieving social impact: researchers, industry, public organizations, the government, the general public' (Spaapen and van Drooge 2011: 212). As a community of potential research users, these stakeholders are positioned close to research and researchers and may be drawn from all sectors of society.

Projects typically include different types of productive interactions among stakeholders with different interests and expectations, views may be different and even competing, and opinions can vary on the positive or negative implications of certain impacts (Spaapen and van Drooge 2011). Fluidity may also emerge in the roles of academic and stakeholder communities (Molas-Gallart and Tang 2011: 224). For instance, an academic can act as a researcher, a paid consultant, a 'talking head' in a TV show, a reviewer, etc. . .The focus on interactions enables the researcher to distinguish these roles and the part they play in the production of knowledge and impact (Spaapen and van Drooge 2011: 213).

While SIAMPI focuses on the study of interactions among actors, other approaches have focused on systematically analysing the different contributions that different actors make to the valorization process and how these are aligned to generate impact. Originating in the healthcare sector, 'contribution mapping' presumes that realizing value from research requires contributions to 'evolving, complex and open systems in which change is continuous, non-linear, multi-directional and difficult to control'. Contribution mapping focuses on 'the actors that are involved in, or directly interact, with a research project and aims to assess contributions instead of impacts' (Kok and Schuit 2012). The added value of interactions along a 'research and action pathway' depends on actors 'alignment efforts' to enhance their contributions (Kok and Schuit 2012). Aligning diverse contribution on a research and action pathway 'turns a novel combination of knowledges into a 'going concern' as a part of practices, a component in successful innovation or an element in decisions and their implementation' (Kok and Schuit 2012).

Key alignment efforts are principally the domain of 'involved' and 'linked actors' who participate in or are close to research projects. From these groups potential key users emerge to undertake translation, brokering, and dissemination activities, including ensuring research outputs can be accessed by unlinked potential users (Kok and Schuit 2012). From the contribution mapping perspective then, 'changes in action achieved are the result of the distributed agency of

multiple actors' (Kok and Schuit 2012), a conceptualization that builds on the pioneering work of Callon (1986) in a way somewhat similar to the ASIRPA approach.

The assessment of how an intervention contributes towards outcomes and impact has generated a broad impact assessment literature with several complementary approaches emerging. While 'contribution mapping' focuses on the contributions of different actors or stakeholders to a specific outcome, 'contribution analysis'. Mayne (2001) provides a structured method to assess the contribution of different factors to programme outcomes. Contribution analysis has been used in programme evaluation in different fields, including being adapted and modified for use in the assessment of research impact. For example, it has been complemented with 'process tracing' (Befani and Mayne 2014), a method in which a pathway, described as a Theory of Çhange, is traced from the intervention to the outcome and then each link of this chain is assessed for plausibility and strength. The combination of contribution analysis and process tracing has been applied to an assessment of how forest management practice was influenced by research (Delahais and Toulemonde 2017). Morton (2015) also adapted contribution analysis, developing a 'contribution analysis framework' which reintroduces the roles played by research users in the analysis of research impact.

Some approaches have focused on assessing the impact from specific types of research. Outcome evaluation (Belcher, Davel and Claus 2020) develops a theory-based approach to assessing impact from transdisciplinary research, defined as research that actively engages with societal actors as part of the research process. Societal actors involved in research will likely emerge as users or beneficiaries of such research; therefore, outcome evaluation, because of its focus on transdisciplinary research, is particularly relevant to our discussion. Outcome evaluation emphasizes that research projects can be most effective by trying to influence actors at the project boundary ('boundary partners') to contribute to and support the 'higher level' objectives of the project (Belcher, Davel and Claus 2020: 4). Interactions and shared activities among constellations of scientific and societal actors can shape research impact in the 'sphere of influence' surrounding the project, particularly among users of research outputs and services that are close to the project boundary (Belcher, Davel and Claus 2020). The outcome evaluation of transdisciplinary research projects thus focuses attention on identifying and consulting 'target audiences', including representatives from government, NGOs, civil society organizations, communities, researchers, and the private sector (Belcher, Davel and Claus 2020: 12) that could be affected by the research.

In the models highlighted, impact processes do not only relate to how knowledge is transferred and valorization efforts proceed, but also to how scientific knowledge evolves (Morlacchi and Nelson 2011) and is influenced by knowledge gained in interactions with potential beneficiaries (Spaapen and van Drooge 2011). Such feedback loops are viewed as leading to circuitous knowledge generation and application processes. The approaches reviewed approximate the analysis of these processes from different perspectives, but they all take as the subject of their approximation a specific research initiative. The role of users and beneficiaries is analysed as it concerns its influence on the valorization of this research. In other words, each approach understands research users as key actors in valorization processes, anchored on specific research investments (mainly research projects and programmes). They have also been developed in specific domains of research impact including healthcare, agriculture, and socio-economic development that condition their approach. Nevertheless, they contain common elements including the identification and positioning of research users, attention to problematization processes, and descriptions of mechanisms for research valorization, which can contribute to the formulation of a more general approach to research impact seen from the user side.

3. Starting from the application

For all their diversity, the approaches described in the previous section share the characteristic that their focal point is the research activity: an investment in research, a specific research programme or project, or a specific research result. They are, therefore, well-suited to the evaluation of research investments, and can centre their attention on a set of well-defined and bounded actors and activities. Very often, however, the application of new knowledge, be it through a new product or service or through the implementation of new policies and practices, will draw from different research sources. Therefore, relevant interaction networks are likely to appear more diverse and distributed when starting our enquiry from the application area perspective. Frequently, there will be a broad set of 'productive interactions' a detailed analysis of which may be made impossible by the sheer variety of direct and indirect engagements with research that the users have entered. Therefore, to identify and describe in detail the ways through which research value is generated, starting from the entry point of an specific application becomes an even more challenging research proposition.

Tracing from the research activity or result allows for a well-bounded subject: although the impact pathway will become complex over time and involve an increasing set of actors, the community under investigation remains identifiable. In comparison, starting with a specific application (be it a technology or a policy decision) and analysing the contribution of different lines of influential research is likely to generate a much broader set of potential lines of enquiry. For instance, a specific product will draw on wide set of technologies present in its components and productions processes, which will be underpinned by several research strands and their results. Similarly, a policy decision will be based, often implicitly or even inadvertently, on a wide body of theoretical assumptions and research results. Therefore, tracing backwards from specific applications becomes particularly challenging.

3.1 Tracing back from products and technologies

A seminal and influential attempt to trace backwards from products and technologies to the research advances that had enabled them was Project Hindsight (Sherwin and Isenson 1967; Isenson 1969). It was funded by the US Department of Defence and had an explicit evaluative intention: to assess the extent to which the Department of Defence was justified in its support for basic research. The study identified 710 'events' that had enabled the development of a set of defence technologies. It concluded that more than 90% of these events were attributable to technology development projects rather than scientific research initiatives, and almost all the latter were targeted scientific efforts. The effect of undirected scientific research was found to be almost negligible. Sherwin and

Isenson found that for efficient research utilization the key mechanism was 'recognized need' on the part of users, who then 'made the researchers aware of the nature of the problems but did not dictate the nature of the solutions' (1967: 1574). Recognized need was the 'key to efficient utilization', but such a recognition was the preserve only of experts in specific systems (Sherwin and Isenson 1967: 1575).

In response to the Hindsight findings, the National Science Foundation led a similar study (The Illinois Institute of Technology Research Institute 1968), which reached very different conclusions. The TRACES study started from a different selection of products (a smaller number of key innovations) and took a longer temporal window. A total of 340 scientific 'events' were traced, contributing to five key innovations over a period of 50 years. In contrast to Hindsight, TRACES found that 10% of the events it traced were the result of technological development, while 70% were considered to be the result of basic research.

The debate on the contribution of basic research to technological development and the solution of social and economic problems that the differing estimates from the Hindsight and TRACES projects exemplified rages on half a century later (Sarewitz 2016). From a methodological point of view, both projects deployed a set of conceptual and methodological tools that could allow for the comparative analysis of research contributions to different innovations. That these approaches have not been used very often reflects their labour-intensive nature, as well as the existence of some methodological limitations.[2] These event-based, backward tracing techniques attempted to link technologies and applications to specific research outputs, thus focusing on the identification of how different forms of research contributed to, mainly, technological developments rather than the role of users in the knowledge generation and application process. By just identifying and counting research roots, the techniques concentrate on the research results rather than on the ways in which they are used. They tell us neither *how* specific decisions, policies, technologies, have drawn on the practice of scientific research and its results, nor how research users have contributed over time.

3.2 Knowledge use in policy decisions

In the 1980s a different strand of the literature studied how knowledge (mainly the result of scientific research) contributed to policy decisions. Seminal studies were carried out by Carol Weiss analysing how the social sciences contributed to policy decisions focusing on the use that policy makers made of them. Although these studies were not, strictly speaking, evaluations trying to identify and assess for specific policy purposes the impact of the social sciences, the concepts developed by Carol Weiss in her analysis of the use of research evidence in policy decisions have remained particularly influential in evaluation research. She identified different functions of social research, one of which was particularly important in a policy context although difficult to pinpoint empirically: the 'enlightenment function' (Weiss 1977, 1986). In its original article, based on three case studies, Weiss argued that 'that the major use of social research is not the application of specific data to specific decisions. Rather, government decision makers tend to use research indirectly, as a source of ideas, information, and orientations to the world. Although the process is not easily discernible, over time it may have profound effects on policy' (Weiss 1977).

Subsequent authors later added other forms of policy use. Pelz (1978) distinguished between instrumental, conceptual, and symbolic use, drawing on the work of Rich and Caplan (1976) and Knorr (1977). Conceptual use is closely aligned with Weiss' enlightenment function, while the use of research results to legitimate and sustain existing decisions was described as symbolic use and instrumental use referred to the direct and specific application of research results. This distinction has been operationalized in quantitative empirical studies of the use of university research (Amara, Ouimet and Landry 2004; Olmos-Peñuela, Castro-Martínez and D'Este 2014), user-centred qualitative analysis (Edler, Karaulova and Barker 2020; Tellmann and Gulbrandsen 2022), while other studies have employed slightly different definitions and classifications of types of use (Molas-Gallart, Tang and Morrow 2000).

Second, Weiss described how the enlightenment function was to come about. Instead of a direct application of specific bits of knowledge, research knowledge 'crept' into policy use by a slow process of 'accretion' (Weiss 1980). Consequently, it was difficult to identify and trace the indirect applications of research results to policy decisions. It would follow, in today's language, that trying to trace an 'impact pathway' was a doomed mission. Instead of a piece of research generating an impact through an identifiable process of generation, co-generation, adaptation and application, results from different strands of research would intermingle and become part, often in an unintentional manner, of the policy-maker framework.[3]

Where would this knowledge 'accrete' from? Different authors have used the metaphor of pools or reservoirs of knowledge that are fed from scientific research and irrigate the world of applied practice in the indirect manner described by Weiss. 'Knowledge reservoirs' become 'key intermediary variables in the process of realizing societal value of research from which users would draw', and the analysis of this process should identify the 'epistemic communities' that 'carry' the reservoirs, describing their structure, growth and how they are accessed (Rip and van der Meulen 1995). There has been little research on how this process of drawing from the pool occurs in practice, and besides the image it portrays may be misleading: with the pool standing in between the researcher and the user the image is given of research activities being detached from use, with a role emerging for brokers who are knowledgeable of the pool and are able to connect the research base with users (van Langenhove 2011; Frost et al. 2012). This 'two communities' perspective stresses the existence of distinctive values and ideologies that characterize user systems and distance them from knowledge production systems (Beyer and Trice 1982).

4. A user-centred perspective: developing value through research use

Public Value Mapping (PVM) was developed by Bozeman and colleagues to analyse how practitioner and scientific organize themselves in 'communities' that generate and add value to research knowledge. PVM is presented as an evaluation approach that can start out from either a body of research or a set of social problems that research addresses (Bozeman 2003: 37), In both cases PVM proposes to focus the analysis on how scientific and societal stakeholders are organized around particular bodies of knowledge from which they try

to realize value (Bozeman 2003). To this end, PVM introduces the concept of 'knowledge value collectives' (KVC) to include 'first order' users of knowledge, persons who either use knowledge to create additional information (including technology), who support the use and application of knowledge or who are self-conscious end users and exclude 'second order' knowledge users, those who use the knowledge or its embodiment (e.g. technology) 'without seeking to fundamentally add to or reshape the knowledge or create new uses' (Bozeman 2003: 27–8). Ordinary citizens can move from being second order users to being part of the KVC when they actively seek to use or support further use of knowledge, e.g. by lobbying to change policies or practices (Bozeman 2003: 28). Unlike the tightly controlled key topics of a scientific community with its strong norms about how to advance knowledge, in the KVC relevant topics fluctuate, are multiple, and valorization efforts can proliferate, as can the roles taken by the participants in these processes.

Within valorization processes, PVM prioritizes knowledge embedded in people over other forms, with scientific and technical human capital (STHC) being the sum of all the social, cognitive, technical, political, and cultural qualities and skills individuals can deploy to generate public value from research (Bozeman and Rogers 2002). Valorization within the KVC is distinctive, with value being conceived as it is actively configured through the transformation of scientific information into useable knowledge. The reach of a KVC can be monitored in terms of the variety of problems it engages with, the range of clients who benefit from its various types of knowledge outputs, and the contribution these make to value creation in the users' own operational domain.

5. Discussion: how are research users approached in the research impact assessment literature?

The studies cited in this article show that, whether the analyses take as their point of departure research activities, or an application of their results, they often involve at some point a consideration of the user's role in impact and valorization processes. We can differentiate two main ways in which such role is conceptualized: (1) users are involved in processes of knowledge generation and application through interactions with scientists and other participants in the processes, (interaction models); and (2) users are involved as takers of available knowledge (take-up models). In the former, processes of interaction and collaboration between users and researchers are used to describe how research is conducted and the research results have an impact on applied practice. In the latter, the focus is placed on the access of users to codified outputs or artefacts as a necessary step in the impact process. These are two very different models in which to define the role of the research user, yet both implicitly recognize researchers as identifiable, distinct agents, and the research they conduct as the potential main source of impact. In other words, with the exception of Public Value Mapping, they primarily seek to identify to what extent and how researchers (often further categorized as scientists) contribute to the public good. It just happens that these processes often require the active participation of multiple other stakeholders belonging to other communities.

The same language we have been using connotes this bias: these stakeholders are customarily described as 'users' or 'beneficiaries' (a rather passive term suggesting they are availing themselves to the value generated elsewhere) and the objective of the enquiry is to determine 'research impact' (or the socially valuable results of the activity of the researchers). Yet, the conclusions that many of these studies have reached question the reliance on such a narrow focus. The emphasis on collaboration, interactions, and the 'user role' implies that users are crucial to the processes by which research has impact. We should express this differently: as stated in the Public Value Mapping approach, the communities who are directly working on the application of new knowledge to practical purposes play an important role in the processes by which new knowledge acquires value. Therefore, a focus on users calls for developing an understanding of how practitioners generate and add value to knowledge in their own terms. Such a focus is of course not entirely new, but the step that needs to be taken now is to move beyond user roles to develop a more comprehensive 'user perspective'.

As our review has illustrated, research users, beneficiaries, and their roles in the generation of value from research, are framed and conceptualized in a variety of ways. Differences are to some extent dependent on the research field and linked societal 'problem area' addressed. There are strong impact assessment contributions designed for the fields of agriculture and health, and what we know about research impact is skewed towards these areas. A methodological approach that can serve as a starting point in any field could help overcome this limitation by enabling the construction of a more generic grammar of understanding of the user perspective on how knowledge acquires value.

Differences are also to some extent theory driven, shaped by the theoretical understanding of value creation that underpins each approach whether implicitly or explicitly. Table 1 summarizes the characteristics of the diverse evaluation approaches we analysed. The following section then outlines a set of general methodological principles derived from analysing the strengths and weaknesses of these approaches. These principles are designed to guide research designs as the basis for an expanded user centred component within impact assessments.

6. Elements of a user perspective for the analysis and evaluation of research impact

Building on our discussion above, we now propose a set of methodological principles regarding the user perspective on valorization processes that generate societal impacts from research. By user perspective we mean evaluation approaches that take as their starting point a set of users with an interest or stake in a problem area. These principles provide a general methodological framework for the study and analysis of multi-actor knowledge valorization processes from the user side. We finish the section by identifying four concepts for operationalizing these principles in order to construct the foundations for a research user perspective within impact assessment.

1) *Consider research user identities as actively and relationally defined.* In the interaction models of research impact, the research user is defined relationally at any moment by their position in the configuration of processes and actors that interact to generate knowledge and value from research. In the take-up model of

Table 1. Research users, user roles, and value creation in the evaluation and impact assessment literature

Literature	Key research users	Positioning of research users	Mechanism of value creation	Roles of users	Conceptualization of value	Pathway to impact
Payback (Buxton and Hanney 1996; Donovan and Hanney 2011)	Healthcare policy-makers; healthcare professionals; patient orgs; etc.	Close to and/or with direct interests in the design, conduct, and outcomes of health research	Sequence of interfaces between researchers and healthcare system stakeholders along impact pathway	Contributing to topic selection and problem definition; disseminating results; brokerage to beneficiaries Linked to sequence of interfaces/stages	Health treatments Researcher led User informed and influenced based on constituent audience needs	Five forms of payback to research and healthcare systems and to society
ASIRPA (Joly et al. 2015; Matt et al. 2017)	Heterogeneous actors in agriculture sector	As initial end-users, end-users, or lead-users of agricultural research In user networks with distributed agency	Translation Problematizations: from the wild to the lab and from the lab to the wild	Configured by translation network, as intermediaries mobilizing new user contexts	Configured by translation networks	Scaling out (more initial end-users in expanded territory); scaling up (greater diversity of end-users) Changes in adoption scale, in the diversity of effects, or in learning processes
SIAMPI (Molas-Gallart and Tang 2011; Spaapen and van Drooge 2011; De Jong et al. 2014)	Interdisciplinary researchers; industry; public organizations; government; general public	With direct and/or indirect links to research and/or researchers	Productive interactions: direct, indirect, or financial exchanges between researchers and stakeholder	Engagement with researchers; take up of research outputs	Stakeholder defined through interactions with researchers and/or research	When 'productive interactions' result in stakeholders doing new things or doing things differently
Contribution mapping (Kok and Schuit 2012)	Key actors in healthcare networks	As potential key users among actors linked to a research project	Contributions to interactive networks catalyzing a 'going concern'	Evolving with relational network Scenario construction and development	Key user identified and mobilized	Alignment, bi-directional adaptation to integrate contributions
Outcome evaluation (Belcher et al. 2020)	Societal actors using research outputs and services	As boundary partners close to research projects	Transdisciplinary contributions to 'high level' objectives and actions	Boundary spanning	Transdisciplinary co-construction; boundary partner mobilized	Influencing diverse societal actors at the project boundary throughout the research process
Hindsight Sherwin and Isenson 1967; Isenson 1969)	Innovation actors	In systems design and development	Needs recognition	Identifying and communicating system problems	Ultimate user defined; system design driven	Recognized need
Two communities (Weiss 1977, 1980, 1986; Beyer 1997)	Practitioners and policymakers	In user communities with distinctive values and ideologies	Accretion; direct linkages and brokering between knowledge production and user systems	Sensing, searching, diffusing	User community framed; user system defined	Institutionalization
Public value mapping (Bozeman and Rogers 2002; Bozeman 2003)	Heterogeneous first order and second order users	In knowledge value collectives connected by their relation to a body of information	Scientific and technical human capital (STHC)	Transforming or supporting the transformation of information	Plural; defined in active use of information	Knowledge value alliances; STHC mobility

research impact, users access research outputs intermediated through brokers or artefacts like publications that take up and convey knowledge from a 'reservoir' of research results. There are important differences between research users defined by their relation to other actors involved in research and users defined by their relation to research outputs. Whereas the former may play different roles in the value generation processes, the latter are involved in an effort to generate value from pre-existing research results., in which the active take up of research results may be an outcome of intentional search and engagement processes or may be the outcome of diffuse processes of 'knowledge creep' (Weiss 1986), in which the research user role may be a relatively passive one. An important difference between a user defined by their relation to research outputs and one defined by their relations to other actors is that the former encounters a set of affordances (Hellström and Jacob 2017) that are already consolidated. The concept of value that can be designed and developed by the research user will flow in a considerable part from the affordances of the research output taken up. This contrasts with our first model, in which the possible affordances of the research are constructed—at least some of the time—through the set of interactive processes through which (multiple) conceptions of value from the research are being actively configured.

There are thus two key relations that should be investigated according to this principle. First, how research users are positioned in relation to research and researchers should be specified. In the approaches we reviewed, research users are positioned at different distances from research spatially and temporally and from researchers in terms of values, ideologies, and objectives.[4] Many of the approaches reviewed start from research projects or programmes in which users are positioned relatively close to research, even contributing directly to it. In other examples, users are positioned on a second ring as interested stakeholders, while end users (or beneficiaries) are situated much further away. Therefore, the magnitudes of the distances that position research users vary considerably. Understanding research impact from the user side requires a systematic and detailed approach to the multiple relevant dimensions that configure the positioning of research users relative to knowledge production, translation processes, and research outputs.

Second, how research users' positioning and roles are configured by their relation to problematization processes should be closely investigated and documented. The positioning of research users, and the possibilities inscribed in their roles, are particularly importantly configured by their relation to processes of problematization (Franssen 2022). In many of the approaches reviewed, research users are positioned as close to, or part of, research teams or projects. A key variable is whether (and to what extent) potential users are part of the definition of the knowledge problem to be addressed. Problematization from the researcher user side is often narrowly defined as solution oriented. However, this suggests that problems are both *a priori* known and that research users are narrowly focused on overcoming this problem. However, problematization is not just about overcoming immediate obstacles but also about new ways of thinking through and understanding problems and the potential emergence of multiple responses and solutions (Barry 2021).

In the case of persistent or 'wicked' problems, this would include understanding how a current problematization context relates to previous struggles to overcome or ameliorate a problematic situation and the flow-on effects (positive and negative) from these efforts. Users who actively participate in collective problematization processes, particularly at an early stage, are understood to enjoin the effort to conceptualize the value that could flow from the research—both as solutions but also as valorization opportunities. This can mean reflexively aiming for a problematization process that is open to plural concepts of future value. Conversely, users who are external to the process of problematization are positioned as working to conceptualize and realize value from existing research outputs or outcomes. The set of affordances embedded in these outputs will, to some extent, pre-determine the value potential for users who 'take up' research results, as discussed above.

Although problematization is an important aspect of many of the approaches reviewed, we consider a more thorough account of the timing and qualities of problematization processes from users' perspectives would be beneficial. The process of problematization has been thought through in terms of scientific and technical challenges, forms of organization, and cooperation mechanisms, primarily from the perspective of scientific stakeholders. Yet, the process is likely to be seen differently when viewed from the user perspective. A comprehensive model tracing the process of problematization and its effects from the perspective of research users would include cognitive, technical, social, and institutional dimensions, among others.

2) *Assume that the role of a research user is not fixed but changes over time*. There are no *a priori* 'research users', entities that simply exist 'out there' in society waiting for a research result to drop off the end of the knowledge production line. Insisting on a separation between science and society or between researchers and communicators, when it comes to understanding how value is generated from research will, at best, generate an incomplete view of how these processes unfold. If we understand research value as actively generated by multiple actors then precisely which actors are using research knowledge, and for what, will vary across time and as the effort to articulate different conceptions of value plays out. This principle can be seen in the 'impact pathways' approaches reviewed, in which evolving sets of actors make contributions to problematization and knowledge processes. For instance, actors whose primary objective is knowledge translation may at times engage fully in knowledge production activities, thus shifting their relational identity. Even when users are seen as taking a relatively passive role, they are not confined to the fixed role of research user. For example, by disseminating and interesting other actors with capabilities relevant for generating value from the research they have taken up, 'users' transform their role to one of brokerage. Actors can also have multiple simultaneous roles; while one role may be foregrounded at any point in time, this does not mean other roles have disappeared. From

this perspective, understanding how research impact occurs requires greater focus on the conditions that best allow a variety of actors to shift fluidly through different roles to extend and diversify valorization processes.

3) *Reveal how research users pursue objectives relevant to their main field of operation by contributing to the generation of value from research*. Improving the capacity of research impact assessments to understand problematization from the user side is important to trace the conceptualization of value possibilities and the value that can be realized in users' own areas of operation. The methods of contribution analysis (Kok and Schuit 2012) and impact process tracing (Spaapen and van Drooge 2011; Matt et al. 2017) have been particularly useful in highlighting how users make contributions, based on competences grounded in their own field of expertise. They tend to illuminate the contribution of research to outcomes and, based on models and theoretical assumptions, link these to broad benefits in society, often bypassing the details of the process of realizing value. A more complete understanding of research valorization needs to address how research valorization contributes to the accumulation of capitals that are the stakes of the game in research users' main fields of operation and how this benefits their position in that field (Bourdieu 1990). What is at stake for researcher users in their main field of operations, and what constitutes for them a 'success' in those terms, thus needs to feature more strongly in understanding conceptualizations of value on the user side.
4) *Situate research users as part of valorization networks with distributed agency*. Research users are involved in their own innovation, product development, service provision, and other types of networks. Concepts such as 'knowledge value collectives' (Bozeman 2003) and 'techno-economic networks' (Callon 1990), highlight the formation and dissolution of multi-actor collectives that work to valorize research. For example, the launch on the market of a new pharmaceutical requires a complex valorization process involving many different types of actors. Not all the actors involved in the valorization process are equally concerned with the efficacy of the drug and its effects on public health. Contributing to the valorization process may allow an actor to take an enhanced position in struggles for ascendency in their own field, for example patent law or marketing, regardless. As the case of the marketing of the painkiller OxyContin in the USA illustrates, drug valorization efforts can also have severely negative societal impacts that are best understood by focusing on the activities of users not researchers (Radden Keefe 2021).
However, impact assessment often does not adequately connect research users to the various allies they mobilize to drive valorization in particular directions. Another task for empirical studies of impact centred on research users should thus be to better map and understand the forms of distributed agency that valorization processes assemble, including whether they are relatively transitory or durable in their struggles to realize value from research. Impact assessment from the user perspective needs to reveal those 'hidden' actors or networks mobilized by research use; including entities involved in valorization processes that do not leave formal traces of their participation (e.g. projects, publications, patents).
5) *Seek to identify final beneficiaries of research value that shift identities to become research users engaged in valorization processes*. We understand beneficiaries as the publics or entities who have benefitted without actively contributing or struggling to configure value from research (Bozeman 2003). They can also, under certain conditions, shift identities to become research users engaged in valorization processes. For instance, consumers of knowledge-based commercially available mass-produced goods are often beneficiaries of the 'black-boxing' of science and technology into a mass-market product, and yet, sometimes consumers engage in customization or adaptation of such products shifting their identities to end users (von Hippel 2005). The shifting contours of those who are content to be 'locked in' to the Google or Apple 'experience' and those who produce and share workarounds, hacks, and add-ons is a perfect example of how research value mobilizes evolving cohorts of consumers, users, and beneficiaries. As Callon, Lascoumes and Barthe (2009: 70, 105) summarize, '[t]ranslation is a machine for changing the life of laypersons, but without really involving them in the conception and implementation of this change. . .it is in fact difficult, indeed impossible, to distinguish the production of knowledges strictly speaking from the production of social identities'. It follows that an important task to be addressed from the perspective of the research user is when, how, and why identities shift from beneficiary to user, from being detached from the 'knowledge value collective' to being attached. Bringing to the centre of analysis transformations in these identities is an important step towards better understanding the extension, diversification, and persistence of valorization efforts.

Table 2 summarizes four concepts that could be operationalized in work to construct a research user perspective on valorization of R&I, building on these methodological principles.

Strategy refers to mapping systematically the connections and involvements that research users have with research and innovation (R&I) and what roles they play in these engagements. Important dimensions of this concept include: forms of connection such as collaborations, projects or contracts; the durations and configurations (bi-lateral or multi-lateral) of relationships with R&I actors; the fields of knowledge,

Table 2. Concepts for analysing the research user perspective in R&I valorization processes

Concept	Description
Strategy	Research users' active engagements in/with research and innovation contributing towards their core objectives
Problematization	Research users' involvements in problem articulation, definition, and operationalization processes in R&I
Translation	Research users' efforts to conceptualize and realize value in their main field(s) of operation that involves them in research and innovation valorization processes
Capitalization	Additional partners, capabilities, or other resources mobilized by research users to realize value in their main field(s) of operation

technology and society in which these involvements are embedded; and the extent to which a researcher user's combined engagements amount to a portfolio with its own strategic objectives. Strategy is also intimately related to the 'identity' of research users. The 'translation' of research knowledge into different uses concurrently shifts users in socio-economic space. *Problematization* refers to understanding the direct involvement of research users in activities to shape R&I at a stage the possibility to conceptualize value is relatively open and unconstrained. As Franssen (2022) describes, problematizations are also 'proposals for how the future might look' and important dimensions of this concept thus include qualitative understandings of when and how research users were able to integrate their conceptualization of future value possibilities in research and/or valorization activities, and how this was negotiated with other interested actors (both researchers and research users).

Translation refers to the efforts research users make to realize value in their main field or fields of operation. Dimensions of this concept include the dedication of financial budget, human resources or other forms of capital. Understanding translation also requires a qualitative delineation of the field in which the user is seeking to realize value, how they define a concrete value proposition, and what criteria they consider critical in assessing whether these efforts have succeeded or have the prospect of being successful. A closely related dimension of translation is then understanding how researcher users evaluate progress in their efforts 'in-the-run', in order to make decisions about continuing, modulating or discontinuing current investments, Finally, *capitalization* refers to how research users reach beyond their own organizational or individual boundaries to enrol other participants, skills, or investments that they consider are needed to realize value in their own main field(s) of operation. Dimensions of this concept include the types of resources mobilized and the types of organizations or other entities that contribute these resources. Wherever possible the objectives and/or conceptualizations of value that motivated organizations and entities that provide such resources to make contributions should also be documented. This can point towards extended processes of diffusion of value and impact. In this process it should also be possible to develop a qualitative understanding of the role(s) research users play in mobilizing such networks of resources, for example as knowledge brokers, lead investors or consortium managers. These dimensions of capitalization efforts and their manifest effects on translation should provide a systematic approach to understanding of how research users are embedded in their own enabling productive networks. To conclude, it should be reiterated that we view our attempts to map out a framework for assessing impact from the user side, including the principles and the operationalization concepts and their dimensions, as initial proposals that we would expect to be transformed through use and the development of researcher and evaluation practitioner expertise about the strengths and limitations of our various components.

7. Conclusion: developing a research user perspective for evaluation and impact assessment

In the first part of this paper, we reviewed selected research evaluation and impact assessment literature. We found that work in this area has developed a variety of sophisticated approaches, often tailored to a particular problem or policy context. These approaches construct plausible and credible sets of sequences linking research to societal outcomes—despite enormous technical problems related to time-lag and appropriate causal-type attribution. This literature has also been successful in identifying and testing relevant institutional, organizational, and individual factors that appear to influence the translation of research results and/or their take up by research users. These approaches have tended to treat the roles of research users, end users, and beneficiaries as functionally appended to research- or researcher-driven impact trajectories, as either contributors to research, recipients of research outputs, or beneficiaries of research-based outcomes.

However, while the approaches reviewed enable us to account reasonably well for the roles of users in research valorization, they are not designed or intended to provide a systematic understanding of the user perspective. We would suggest that adopting a user perspective on the generation of value from research, by starting from the principles and concepts for operationalization we have outlined, will create opportunities to expand what we know about research impact to complement the strengths and insights of the evaluation and impact assessment approaches we reviewed.

Of course, we do not consider the principles and concepts we have proposed to be exhaustive in scope or consolidated in form, rather they constitute an initial attempt at their formulation. Our impression from undertaking this work is that there is considerable potential for expanding research evaluation and impact assessment agendas to consider user roles, expectations, and dynamics more fully. We have noted the importance of understanding both researchers and users as occupying shifting roles and identities. But what determines or shapes the fluidity of role and identity shifts in contexts of research value generation and realization from the user perspective? It is apparent from the approaches we reviewed that the affordances of research results are important here, but systematic work to connect the epistemic, material, and symbolic affordances of research with the active struggle to conceptualize value by research users seems needed. At the same time, the 'fitness' of different knowledge agents to cycle through the research user role is not well understood. Neither are users' 'intentionality' or capacity well understood in relation to problematization processes and how the value of research is conceptualized in relation to users' own main fields of operation. A perspective emphasizing such user perspectives could provide a complementary way of seeing that enriches current theory-based assessments of the effects of specific research investments, organizations, programmes, and activities.

We also consider that relevant policy insights may eventually be developed from our proposed approach. For example, from a policy perspective our first principle implies that to generate research value effectively, a variety of different actors, with relevant capabilities and distinctive objectives, should be able to cycle fluidly through the role of research user. This is different to stating that a diverse set of actors should interact and collaborate. The effort to realize value from research need be neither narrowly or *a priori* locked in, nor a 'survival of the strongest' contest underpinned by a zero-sum logic. It follows that some translation measures that are considered 'efficient' could limit research valorization in other institutional fields in which additional potential research users are primarily interested. A different policy approach would start from a user-centred vision of research

valorization as inherently multiple and pluralizable. We argue that our discussion here thus contains elements of potential interest for those policymakers concerned that their 'impact agenda' could be refreshed by an infusion of thinking that takes the user perspective as both its starting and anchor point.

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Notes

1. CERN, for instance, requires an annual investment around €900 million, and the building costs of the Large Hadron Collider exceeded €7 billion.
2. Comparisons were based on the number of events that could be classified as resulting from one type of research or another (mainly, basic research, applied research and technological development). This comparison, though, was based on the assumption that each event was of equal value and this assumption was bound to increase the weight attributed to research conducted earlier because, as we move backwards in time, the 'roots of the tree' that constitute the ancestors to each innovation become wider (Marjanovic, Hanney and Wooding 2009).
3. John Maynard Keynes is often quoted in this regard: 'Practical men who believe themselves to be quite exempt from any intellectual influence, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back' (Keynes 1936).
4. Although none of the approaches to the assessment of research impact mentioned here treated 'cognitive and other types of 'distance' in depth, 'proximities approaches' have been developed for the evaluation of biomedical research (Molas-Gallart et al. 2016; Bone et al. 2020).

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