Engaging scientists : organising valorisation in the Netherlands

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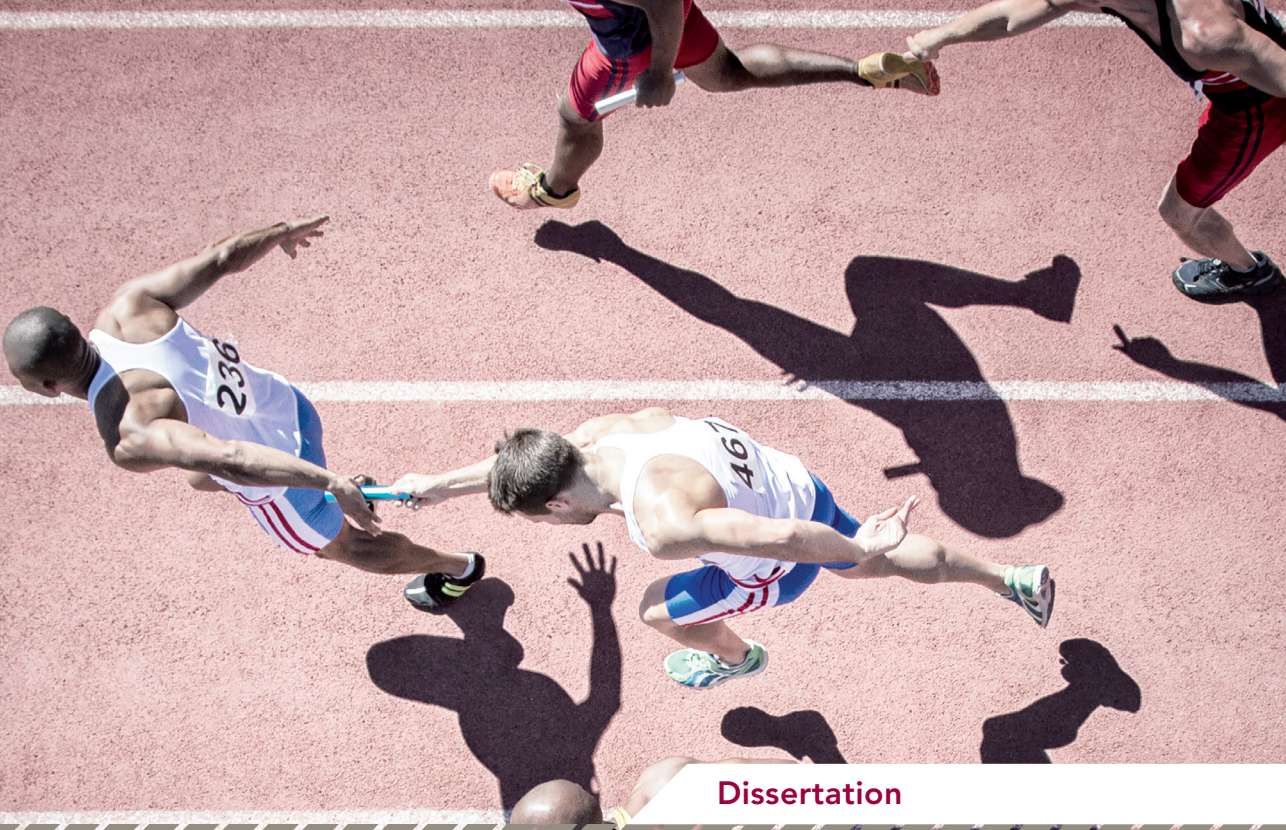

Dissertation

Engaging Scientists

Organising Valorisation in the Netherlands

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Rathenau Instituut

The **Rathenau Instituut** promotes the formation of political and public opinion on science and technology. To this end, the Institute studies the organization and development of science systems, publishes about social impact of new technologies, and organizes debates on issues and dilemmas in science and technology.

Engaging Scientists

Organising Valorisation in the Netherlands

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Voor Oma uit Rotterdam
Cogito ergo sum

Content

Prologue

My first experiences in academia are set against the background of the former agricultural University of Wageningen in the Netherlands. In the summer of 2001 I and 83 other freshmen and –women had the pleasure of beginning our journey in the field of biology in one of the many old university buildings scattered over the small provincial town. We were among the last generations of students who began the day in a 'The New Building' lecture hall with a lecture on evolution theory, cycled home for lunch and in the afternoon did microbiological experiments in a monumental 'Amsterdamse School' building overlooking the legendary river forelands. For reasons related to efficiency and prestige, I assume, this idyllic picture has now been consigned to the past. The university, along with its staff and students, has left the heart of the city, as a brand new multi-million euro campus has been erected on the outskirts of the city. The campus is not only home to the university, but also hosts companies, public research institutes and a university of applied sciences. Wageningen University is far from unique in its quest for scaling and creating partnerships with other actors in the science and innovation system.

Although I enjoyed most subjects, whether we were dissecting a shark to understand its anatomy or studying cell structures using an electron microscope, *savoir pour savoir* was not enough for me. I believe I wasn't the most popular student among teaching staff, as I would regularly raise my hand and ask: *'That is all very interesting, but what can we use this knowledge for?'* I can't remember getting a satisfying answer, which in hindsight indicates a discrepancy between the university's aspirations and the everyday practice of its employees. Interested in science and motivated to bridge science and society, I pursued my master's in the field of innovation studies at Utrecht University. Utrecht's campus showed what Wageningen's campus would look like in a few years: located outside the heart of the city, and sharing the site with a university of applied sciences and companies. Hoping to finally get an answer to my relevance questions as a biology student, I decided to explore the relevance of biology in my master's thesis. I discovered the intricate relationship between science and society and the influence they have on one another. Enjoying the process of doing research and fascinated by the interplay between science and society, taking the next step and applying for a position in a scientific environment seemed like the only logical thing to do.

I decided to continue my study on the value of science for society, which by then was labelled 'valorisation' in science policy spheres. Policy makers at government and university level considered valorisation as a way out of the 'knowledge paradox' (Europe produces high-quality scientific knowledge, but lags behind in applying that knowledge). During recent years I have gained the insight that valorisation is a difficult issue for most academics, despite their willingness to contribute to society. Also, valorisation is a burdened issue for them, which seems to be related to its origin in policy spheres. Based on these insights, my interests gradually developed into a wish to understand the relationship between science policy and scientific practice as regards valorisation of scientific research. This dissertation is the result of my quest and an important step in sharing my results. The aim is twofold. As it is not obvious that scientists are aware of and understand science policy, the first goal is to contribute to the understanding of

how science policy translates to academic practice. Since valorisation is considered a difficult task by scientists, the second aim is to provide insights into how to improve valorisation of academic research.

1 Introduction

The goal of this first chapter is to introduce a focus for the empirical chapters and concluding chapter of this thesis. To this end, I will first consider the practical and scientific discussions about valorisation. First, I will provide a consise policy overview of valorisation as well as the response of academics to this policy in public debate (section 1.1). Then, I will discuss New Public Management (NPM) as a policy paradigm which has greatly influenced public sector policy-making, including science policy-making, in the past three decades (section 1.2). Next, I will consider the relationship between government and science. NPM is influenced by Principal-Agent Theory (PAT), which can be used to conceptualise the relationship between government and science as a principal-agent relationship (section 1.3). Understanding the characteristics of NPM and PAT will help us to understand the rationales behind valorisation policy, as well as the potential tensions between the policy and academic practice. Subsequently, I will discuss literature about the organisational (section 1.4.1) and evaluation aspects (section 1.4.2) of valorisation. After that, I will discuss the research questions of this thesis (section 1.5.1). I will explain how the insights from sections 1.1-1.4 have resulted in the research questions. Also, I will introduce the methodology and empirical chapters (section 1.5.2) and comment on the social robustness of the study (section 1.5.3). Finally, in section 1.6 I will indicate where this thesis aims to add to existing scientific literature.

1.1 Valorisation policy and the resulting debate in the academic community

In this section I briefly discuss the most important policy documents concerning valorisation. The purpose of this discussion is not to reconstruct or precisely understand how valorisation policies were developed, but rather to provide an overview of the policy documents that influenced the debate in the academic community.

In 2004 Dutch Minister of Science Van der Hoeven issued a policy paper (Wetenschapsbudget 2004) (Ministry of Education, Culture and Science 2004) in which the use of academic knowledge for the benefits of society was appointed a core goal of science policy in the Netherlands. The Minister was among the first to use the label 'valorisation' to describe the legally prescribed third task of universities: transferring knowledge for the benefit of society (Higher Education and Research Act (WHW) 1992, article 1.3). Terms such as societal impact, societal relevance, societal value and societal benefits had previously captured this task. Valorisation was introduced as a term in response to the European Lisbon Treaty to underline the importance of universities collaborating with private organisations in order to close the 'knowledge gap' (Ministry of Education, Culture and Science, 2004). It was announced that additional valorisation policies would be issued during the following years. Subsequent communications from the Ministry broadened the scope of valorisation by also including non-commercial activities (e.g. Ministry of Science 2005). The official definition of valorisation used by Dutch government is *'the process of creating value from knowledge by making it suitable and/or available for economic and/or societal use and translating it into competitive products, services, rocesses and entrepreneurial activity*[1]*'* (Nederland Ondernemend Innovatieland 2009).

1 Since 2009, the word 'competitive' has been omitted.

Minister Van der Hoeven may have been the first to use the label of valorisation, but she was not the first Minister of Science to touch upon the relevance of science for society. As early as 1974, in a bill on science policy (Nota Wetenschapsbeleid) Minister of Science Trip had questioned whether the investments in basic science since the Second World War had resulted in the desired consequences. The bill stated that the most important goal of future science policy would be to align research to society's priorities (Faasse 2011). To this end, three new policy instruments were introduced: Advisory Councils on Research, national research programmes in areas with societal and economic relevance, and foresight exercises. In 1979, Innovation-Oriented Research programmes were introduced; in the 1980s the government set up strategic research programmes and the research council introduced priority programmes to link basic research to societal challenges (Van der Meulen & Rip 1998); and in the 1990s the Fund for the enforcement of the Economic Structure (FES) supported science with the aim of strengthening the position of the Dutch knowledge economy.[2]

Nevertheless, the introduction of valorisation in 2004 was the first time contributions to societal benefits were expected across the entire spectrum of academic research: from basic science to applied science, from the humanities to physics and from the level of single projects and individual researchers to the level of large-scale research programmes and organisations. As announced, additional valorisation policies were developed and implemented. Examples are the Top Sector policy[3], the performance agreements between government and universities and the Science Vision 2025[4]. The growing importance of societal relevance in the Standard Evaluation Protocol (SEP) and the introduction of the knowledge utilisation paragraph by the Dutch research council NWO are a further results of the valorisation policy announced in 2004 (Nederland Ondernemend Innovatieland 2009). Gradually the term valorisation penetrated the vocabulary of Dutch academics.

In my personal vocabulary, valorisation refers to the ongoing process of academics interacting, before, during and after working on a specific research project, with individuals and organisations outside their own peer community, to realise a change in the way of thinking and/or acting of themselves and the individuals and organisations with which they interact, with the ultimate goal of contributing to a change in societal practice(s). This can be in direct interaction with individuals and organisations in society, but also by facilitating research by academics in other research fields.

Nowadays, hardly any Dutch discussion about science is held without explicitly or implicitly referring to valorisation, usually followed by critical remarks. It is discussed as a difficult task, which evokes many questions and sometimes even frustrations. I would like to discuss the

2 http://www.rathenau.nl/nc/web-specials/de-nederlandse-wetenschap/financiering/overheid/fes-programmas-voor-kennis-en-innovatie.html

3 The goal of the top sector policy is to intensify collaboration between public research and industry in nine sectors (http://topsectoren.nl/home accessed 10-07-2014). Since 2011, a significant share of the research council's annual budget has been earmarked for collaboration with private partners from one of these nine sectors.

4 As the Science Vision 2025 (Wetenschapsvisie 2025) of the Dutch Minister of Science (Ministry of Education, Culture and Science, 2014) was published after this thesis was written, it is not discussed in detail.

following examples to illustrate the – at times very emotional – reactions that valorisation evokes.

In 2013, four prominent Dutch scientists were invited to take part in a prime-time talk show (De Wereld Draait Door). They were asked to nominate a word as a candidate for abolition. One of them, a full professor in astronomy, nominated valorisation. According to this scientist, the Dutch research council NWO uses the label of valorisation to make academics promise commercial benefits of their research in advance of the research being carried out. As he said, simply hearing the word valorisation is reason *'…to get my Kalashnikoff'*. The other three academics participating in the discussion held similar, albeit less extreme, views. As we will see in Chapter 2, NWO does not use the label 'valorisation', but rather 'knowledge utilisation'. Also, NWO has a broad understanding of knowledge utilisation which is not limited to economic benefits. NWO even offers an opt-out for fundamental research without any opportunities for valorisation. This example shows that even experienced and prominent academics do not know exactly what is expected of them, which causes valorisation to be considered problematic.

The Young Academy (De Jonge Akademie, an independent platform of junior top scientists within the Netherlands Royal Academy of Arts and Sciences (KNAW)), (NRC 2010) reasons along the same lines. It argues that the term valorisation is mainly used to refer to the short-term application of knowledge for commercial benefits or governmental policy-making, of which the outcomes should be predictable and easily demonstrable. The Young Academy fears that valorisation will be detrimental for basic research. Again, this example demonstrates that valorisation is misunderstood. Additionally, it shows that academics fear the policy may interfere with academic practice and - most likely - not for the good.

Platform H.Nu (a platform of academics that strives for reformation within Dutch universities) describes the contemporary university as *'…a knowledge plantation where inspectors, control and Taylorism enforce as much valorisation as possible.'* The authors call for a change which entails universities as organisations that stimulate knowledge development and exchange (Halffman & Radder 2013). This example shows that academics experience valorisation policy as a negative influence, although they support the idea of knowledge exchange.

The Science in Transition (2013) movement (a collective of academics advocating a range of changes in the Dutch science system) holds another perspective. It suggests that there is a bitter taste to the term 'valorisation.' The movement argues that scientists are too involved with knowledge production for small peer communities, and calls for more societal influence on the scientific research agenda. It suggests valorisation (for instance a public lecture from time to time) is used as an excuse to continue niche research (De Groene Amsterdammer 2014). In other words, the movement invites academics to take their societal responsibility seriously.

Then there are those academics who muddle through, some more successfully than others, aiming to contribute to society by valorising their research. Their struggle becomes visible during such events as valorisation symposia that have been organised in recent years, for example by the Rathenau Instituut in collaboration with the Young Academy in 2011 and by the Department of Social Sciences of Utrecht University in 2014. The discussions during these

symposia show that, regardless of normative standpoints towards the policies, the practical aspects of valorisation are also ground for questions. Just a few examples of such questions are: Can academic autonomy be maintained when collaborating with a company? How much time should be devoted to valorisation? Will scientific quality suffer from valorisation efforts? Will valorisation activities add to academic reputation? The gut feeling concerning the answers to these questions differs per academic. In short, academic communities have not yet reached consensus about how to include valorisation in academic practice, and individual academics are struggling to include valorisation in their research.

The selection of responses by the scientific community to valorisation policies discussed above makes clear that science policy is not easily translated from government via intermediary organisations to academics. It is evident that valorisation policies and their intentions are not taken for granted. Is it the term, which suggests it is about commercialising research and making money, that accounts for this? Or is it the perception that another task is added to an already full agenda? Also, how to valorise research is not evident as the questions from academics indicate. Nevertheless, the idea of adding value to society is not readily rejected. To change the status quo we need to understand how valorisation policy is translated from government to academics and how valorisation can be included in academic practice.

1.2 Public sector policy-making: the decades of New Public Management

Science policy, including valorisation policy, is embedded in larger policy paradigms, which in turn reflect dominant political philosophies. In this section I position the current valorisation policy in the policy paradigm of New Public Management (NPM), which reflects the political philosophy of neoliberalism. First of all, this will help us to identify where tensions between valorisation policy and academic practice may originate from and as such bring focus to the research questions. Second, the larger policy paradigm is the frame in which recommendations to improve the current situation should be implemented. A basic understanding of this frame and its influence on science policy is important if we wish to formulate useful recommendations.

1.2.1 Origin and characteristics of New Public Management

In the mid-1980s a wind of change in policy-making, called New Public Management, gained force in the UK and then blew over the rest of Europe and other OECD countries. The basic idea of NPM entails that clear goals, control and evaluations, and market forces will result in an efficient and effective public sector (Pollit & Bouckaert 2000 cited by Braun 2005). NPM is inspired by two major theoretical sources of inspiration.

The first source can be found in economic theories. A basic idea is that government should let the market organise itself, and interfere as little as possible. It should only structure and steer the market in such a way that competition between organisations is increased. NPM introduced this element of competition to the public sector, aiming to lower costs and increase quality, which ultimately should result in a more efficient use of public funds. In a competitive market environment, the focus is on efficiency and achieving results. To operate in such an environment, the management of public sector organisations has become more autonomous and more powerful. Management behaves in an entrepreneurial fashion and focusses on inputs and

generated outputs rather than processes. It searches for new ways to enhance performance and explores business opportunities to scout for resources other than government funds (Braun 2005).

The second source of inspiration for NPM is principal-agent theory (PAT). PAT can be used to conceptualise the relationship between government and science as a principal-agent relationship in which government delegates the task of conducting research to science in return for such conditions as financial support. As the relationship between government and science is central to this thesis, the origin of PAT and its value for understanding the interaction between government and science will be discussed further in section 1.3.

The influence of PAT on NPM can be recognised in the delegation of tasks through contracts and monitoring. Despite increasing autonomy, public organisations are still largely funded with public resources. This gives government the right to formulate the goals that should be achieved and evaluate whether they actually are achieved (Braun 2005). Contracts include goals, and time-span and incentives are used to stimulate compliance. In some instances, even penalties are included for poor compliance. A well-known Dutch example is the financial penalty imposed on the Dutch railways (NS) if the percentage of trains that arrives late at their destination is higher than agreed. Monitoring is used to detect and counter non-compliance and, if necessary, to alter contracts. The delegation of tasks and monitoring of compliance resulted in the strengthening of hierarchical relationships, both between government and public organisations and between managers and employees within public organisations. As a result of the latter, monitoring within organisations has increased (Ferlie et al. 2008). This general trend is labelled 'accountingisation' (Power & Laughlin 1992, cited by Hood 1995).

Concluding, NPM gave the public sector more operational autonomy to function in a market environment. Simultaneously, the use of contracts to delegate tasks and the use of monitoring to secure compliance increased, which strengthened hierarchical relationships.

1.2.2 The influence of New Public Management on science

Science, among other public sectors such as telecommunications, health care, transport and education, has been subjected to NPM (Schimank 2005; Hansson 2002). What are the implications of the above-described NPM management style on science policy and science?

Before the NPM paradigm, roughly between 1945 and 1980, the relationship between government and science was one of 'blind delegation' (Braun 2003). The inspiration for this relationship of blind delegation was Bush's report 'Science – The endless frontier' (1945). Bush was the first to propose large-scale government funding for fundamental research in times of peace. The underlying assumption of the report is that science should produce knowledge for the benefit of society. In order to facilitate these benefits, Bush suggested that the US government should grant the science system access to long-term public funding as well as a large degree of autonomy and self-regulation (Guston 2000 cited by Lengwiler & Simon 2005; Brooks undated). The system was protected from market and political influences and allowed to produce knowledge in isolation. Results were believed to diffuse to society without any intervention and in this way contribute to societal progress in areas such as health care, safety and industry (Bush

1945). Hence, there was no need for government to develop additional science policies to steer scientific activities into a specific problem area or to stimulate knowledge transfer to society. Although the means in this post-World War II science policy were different, the goal is comparable to the goal of contemporary science policy: the production of scientific knowledge for the benefit of society.

However, in the 1980s it was realised that in economic terms Europe was falling behind the USA and Japan because of poor use of scientific knowledge. Policymakers had to address this gap and started exploring new ways to arrange knowledge production and diffusion (Braun 2005). The expectation of societal benefits from science can be recognised as early as the 1940s (e.g. the Manhattan project), but under NPM the emphasis on such results expanded greatly.

At the same time, policymakers had to address national financial deficits, which provided room for a more efficient and cost-conscious management style in science (Braun 2005). This allowed for external influences in academic quality control and an increase in assessments in all phases of research (Cozzens & Turpin 2000; Braun 2005). In the past, peer review within institutions aimed at assessing scientific validity and novelty was the norm in scientific quality control. Nowadays, assessments are organised at national and even international level and are intended to inform governments and stakeholders of scientific progress. In addition to scientific criteria, other criteria, such as societal relevance and viability of the research group, were introduced to verify whether goals of efficiency and societal value are met (Funtowicz & Ravetz 1993; Gibbons et al 1994; Elzinga 2012; VSNU, KNAW & NWO 2014).

The decreased trust in public services (science was no longer granted the monopoly on knowledge development), the importance attached to societal benefit, government budget cuts (scientists had to find ways to tap into other funds) and new forms of quality control gave society, as a consumer[5] of the science system, greater influence on science (Schimank 2005). Society's involvement can be in managing science, for example in boards of universities or research councils (Mayntz 2002; Ferli et al. 2008; Braun 2005), but also in the actual research process, which is described as participatory science (Braun, 2005; Funtowicz & Ravetz, 1993; Gibbons et al. 1994). The changes in peer review in science and the actual representation of society's voice within academic organisations shows the NPM body of thought is not exclusive to the domain of policy making at ministries. Another example is the focus on efficiency ('rendementsdenken') which university administrators have adopted and which currently is subject to heavy critique within Dutch universities. The critique is most visible at the University of Amsterdam (UvA) where the president of the board resigned as a result of the debate. Also, NPM-related vocabulary introduced by government policy makers is well known to academics, for instance 'knowledge competence cash' ('kennis kunde kassa'). Such words stick with academics and have resulted in uncertainties about the remaining opportunities for fundamental

5 Consumers in a market environment in the sense that their demands influence what is produced and offered. In the literature, multiple conceptualizations of society and members of society in relation to science can be found. For example, society and members of society can be conceptualized as consumers, stakeholders and societal actors. There are subtle yet important conceptual differences between these notions. These differences are discussed in box 3.

research. This shows NPM is not just a notion used to formulate policies at the level of government with limited effects outside ministries. Instead, NPM-inspired policies have resulted in some important changes in the Dutch science system, as discussed in box 1.

Box 1: Changes in the Dutch science system resulting from NPM

In recent decades, Dutch scientists, too, have lost their autonomy and have increasingly had to accept external influences. A first clear sign of the influence of NPM in Dutch science policy is recognisable in a policy paper from 1985 in which universities were given more organisational autonomy in return for conditional funding based on performance (Himanen et al. 2009). The same policy paper stimulated universities to define areas of strength that deserved priority and at national level research priorities were identified that would receive more funding (Geuna & Martin, 2003. From then on, government regularly published new initiatives to steer and monitor universities (Gornitzka & Maassen 2000 in Himanen et al. 2009). In 1993, the reformed Higher Education and Research Act moved away from a focus on facilitating science and instead focused on the output performance of the system. Furthermore, societal actors entered university boards at the expense of collegial governance (Ferlie et al 2008; De Boer 2003). Other examples are the Technological Top Institutes that were established from the late 1990s onward and the large scale national research programmes that ran between 1995 and 2014 (Van der Meulen & Rip 1998). The institutes and programmes are both alliances between science, industry and government which aim to enhance the societal application of research. The governmental valorisation policy introduced in 2004 which is the subject of this thesis is also an example of the increased involvement of societal actors in science. The most recent examples of NPM influences are the 2012 performance agreements between government and all thirteen Dutch universities.

1.2.3 Potential tensions resulting from New Public Management

The influence of consumers on science and the focus on results and assessments that characterise NPM and can also be recognised in the valorisation policy create a number of possible tensions for academics. The influence of consumers and the focus on results may direct science towards short-term, low-risk research, especially now that societal benefits are expected across the entire research spectrum. An often voiced fear is that this development could be unfavourable to science's role as the developer of a pool of new knowledge of which in some cases applications only follow decades later. Another tension is whether science can be held responsible for its results in terms of societal benefits. The conversion of scientific knowledge into societal applications is a difficult process involving many actors. Nevertheless, scientists convincingly have to show the benefits of their research and seem to be solely held responsible for the occurrence of these benefits.

1.3 Relationship between government and science

As briefly mentioned in the previous section, PAT was an important inspirational source for NPM. NPM introduced a principal-agent relationship to the interaction between government

and science. Some scholars argue that despite NPM influences scientists have retained their autonomy and describe the relationship between government and scientists as a 'two-way street' (Braun & Guston 2003). Others argue that NPM without a doubt introduced hierarchies to science, both within science and between scientists and society. It is argued that deans and rectors have become more powerful within universities and governments, and societal actors have become more influential in science (Schimank 2005). Both viewpoints share the idea of a relationship in which science is influenced by government. In this section I will discuss what PAT entails and how it influences the relationship between government and science. This will help to reveal potential tensions in this relationship. These tensions serve as an input to the research questions. Understanding the principal-agent relationship will also facilitate interpreting the results and formulating recommendations in the final chapter.

1.3.1 Origin and characteristics of principal-agent theory

PAT has its roots in agency theory, which aims to describe relationships in which tasks are delegated by one actor (the principal) to another actor (the agent), using the notion of a contract (Jenssen & Meckling 1976). Agency theory concerns two potential problems in relationships between principals and agents. The first relates to agency costs, which occur when the goals of the principal and the agent differ and it is difficult for the principal to examine what the activities of the agent entail. This refers to the costs of monitoring. The second concerns risk sharing. A potential problem is that the principal and the agent may behave differently because of different risk attitudes. This may cause the agent to behave differently than desired by the principal. In other words, the agent may not necessarily comply with the principal's goals. The unit of analysis is the contract between the principal and the agent in which the conditions of the relationship are agreed upon. The theory centres around the question: which contract is most efficient, given the context of the relationship? Specific, whether a contract should be behaviour (process) or outcome (output) oriented (Eisenhardt 1989.)

There are two streams within agency theory: positivist agency theory and PAT. Of these two, PAT is the most relevant for understanding the relationship between government and science as it concerns general principal-agent relationships. However, this stream is also quite abstract (Eisenhardt 1989.) We therefore need to specify PAT to the context of the relationship between government and science.

1.3.2 Theorising the government-science relationship as a principal-agent relationship

Guston (1996) introduced PAT to the field of science policy studies in an attempt to theorise the relationship between government (the principal) and science (the agent). In this relationship, government delegates the task of research to science, and in exchange for performing this task, science receives financial support (Braun & Guston 2003). Guston (1996) states that *'the problem of science policy is the problem of delegation.'* In other words, science policy is about how society can get scientists to do what society needs. For government this is a relevant question, since although science may inherently result in benefits for society, scientists may also have their own goals. The specific elements of the relationship between government and science in the Netherlands are discussed in box 2.

In its relationship with science, government has to make a number of choices, one of which is the degree of autonomy granted to scientists. Should scientists be autonomous in pursuing their own lines of investigation? Or should they be directed towards areas most likely to result in benefits for society? And if they should be directed, how much direction should be provided? A balance is required between directing scientists towards society's needs and allowing them the autonomy they need to thrive and develop new high-quality knowledge (Braun 2003).

The behaviour of scientists in their relationship with government can range from performing exactly as agreed upon to fully pursuing their own goals. The first option secures the promised financial support, but may be sub-optimal in terms of scientists achieving their own goals. The second option may provide more room for scientists to reach their own goals, but it carries the risk that government may cut funds. Performing as agreed upon is referred to as compliance, whereas successfully pretending to perform as agreed upon is referred to as symbolic compliance. If scientists were to fully pursue their own goals, this would be referred to as shirking or defecting. Another option open to scientists is to re-negotiate the contract that is at the basis of the relationship (Guston 1996; Van der Meulen 1998; Leisyte 2007).

In principal-agent relationships, information a-symmetry makes it difficult for the principal to control the behaviour of the agent. In the case of the relationship between government and science, scientists have knowledge about the practice of science that representatives of government do not. This information a-symmetry is the basis underlying two potential problems. The first is adverse selection: because government representatives lack expertise and in-depth insights in scientific research, government has difficulties selecting the right scientists to perform the task. The second is moral hazard: since government delegates a task without the expertise to verify whether the selected scientists perform the task as agreed upon, the scientists may behave in an undesirable manner. They may deliver poor quality, or may choose not to deliver at all (Guston 1996). Because of the internal(ised) motivation of scientists to adhere to standards set by the scientific community (Ryan 2014), moral hazard in the sense of not doing research is less of a problem in this specific principal-agent relationship. However, scientists also have their own goals. Therefore, the moral hazard problem in this relationship is more about whether the chosen research directions are the most promising ones (Schubert 2009). To restore the information symmetry, government acquired the right to monitor scientists' activities in exchange for its financial support (Coleman 1990, cited by Van der Meulen 1998).

Van der Meulen's (1998) conceptualisation of the principal-agent relationship between government and scientists as a game helps us to understand the dynamics created by monitoring. Central to the game are successive cycles of action-reaction in which government and scientists both try to maximise their outcomes of the relationship. In the beginning, government can choose a strategic position on a spectrum ranging from trusting scientists that they will perform as agreed upon to intensive monitoring. Scientists can also choose a strategic position, ranging on a spectrum from full compliance to maximal shirking. However, the trade-off is that if government suspects or detects shirking, this will result in an increase in monitoring. Assuming that the available financial resources to be spent on science remain equal during the game, both actors have good reasons to maintain a balance between their two strategies. The larger the share of the available resources that are required to be spend on monitoring because

scientists are suspected of non-compliance, the smaller the share available for performing the actual task of knowledge development. As such, both parties have an incentive to keep monitoring to a minimum, while safeguarding their own goals.

Within this game, intermediaries have a balancing role (Van der Meulen 1998; Guston 2000). They serve as a bridge between government and science. Usually, they employ peer review to solve the potential problems of adverse selection and moral hazard. There are several types of intermediaries, each serving a specific (set of) purpose(s). Important intermediaries concerning the valorisation policy are research councils, research evaluation systems, research programmes and universities. I will now briefly discuss their respective roles in the relationship between government and scientists.

Research councils serve as intermediaries where scientists select the best peers to perform a certain task and as such have a role in minimising adverse selection (Fernandez-Carro 2007). Additionally, agreements with selected researchers may be formalised in contracts to prevent moral hazard (Caswill 2003). However, the selection of researchers is not without cost and may be as large as twenty-five per cent of allocated funds (Van Arensbergen et al. 2013). The challenge for research councils is to maintain their intermediary position. Behaving too much in line with the goals of either government or scientists will create distrust on the part of the other party and harm the relationship with this specific actor (Van der Meulen 2003). An example is the balance between adopting the indicator culture and managerialism associated with NPM on the one hand and facilitating academic advancement on the other hand (Sa et al. 2013).
Research evaluation systems address moral hazard. These systems may employ indicators, peer review or a combination of the two and serve as a performance verification. During the past three decades, an increasing number of countries worldwide have adopted national research evaluation systems to increase efficiency through competition and accountability of academic research. Evaluations can be used to allocate funds (e.g. in the UK) or as a managerial tool (e.g. in the Netherlands). Also in this specific form of monitoring there are discussions about the financial costs involved. Their efficacy is debated as well, as competition might, for example, lead to homogenisation of research (Geuna &Martin 2003), which may be at the expense of deviating yet promising research lines.

Research programmes are a form of temporary intermediaries, often combining the functions of research councils and research assessments in a specific problem area. They allocate funds and monitor the progress of funded projects. As such, they can be understood as a means to coordinate the behaviour of a selection of scientists (Van der Meulen & Rip 1998; Wardenaar et al. 2014).

Finally, also research organisations, such as universities and other public research institutions are sometimes considered as intermediaries, brokering between the interests of government and scientists (Morris 2002). They translate government policies to academic practice and have a role in training and selecting scientists as well as monitoring their research activities.

Box 2: Relationship between government, intermediaries and scientists in the Netherlands

Current relationships between government, scientists and intermediaries in the Netherlands are characterised by aggregation and consensus building. The dense level of well-interconnected intermediaries and consensus building between representatives of different disciplines diminishes the steering capacity of government. For example, despite the emphasis on relevance, researchers were for a long time able to neglect this emphasis and continue to pursue their own goals. Increasingly, societal organisations are involved in the circuit of consensus building. For example, the Confederation of Netherlands Industry and Employers (VNO-NCW) was involved in developing the national valorisation agenda (Nederland Ondernemend Innovatieland, 2008.) If consensus between government and intermediaries is reached, horizontal co-ordination does not usually require much effort nor are strong incentives from government required to implement policies. Rather, the Dutch government has the task of setting up and facilitating fruitful interactions between intermediaries (Rip & Van der Meulen 1996; Van der Meulen and Rip 1998).

1.3.3 Potential tensions resulting from the principal-agent relationship between government and science

Conceptualising the relationship between government and scientists using PAT allows us to identify several issues concerning valorisation policies introduced by government. The first issue is whether scientists understand what the additional task delegated to them entails. Without a clear understanding, scientists may not be able to execute the task as intended. The second issue is how adverse selection and moral hazard can be minimised through monitoring in ex-ante and ex-post assessments by intermediaries in such a way that a balance between scientists' autonomy and government's direction is maintained. In the past decade, valorisation criteria have been introduced by research councils in a number of countries (Dance 2013) and ex ante assessment systems (e.g. in the UK and the Netherlands). Too much control and direction towards (certain areas of) valorisation may have a negative effect on science. The third issue is how scientists can unite the valorisation task with their own goals. Scientists have to redefine the balance between the development of new knowledge in promising areas and the production of benefits for society. The fourth issue is the role of intermediaries. They serve as a bridge between government and scientists by translating government policy to scientific practice on the one hand and by translating scientists' needs to government on the other hand. In the case of valorisation policies, intermediaries run the risk of becoming too much associated with government if they place a strong emphasis on valorisation. Conversely, if they do not implement valorisation policies, government may perceive them as being too closely associated with the scientific community.

1.4 Societal benefits of scientific research

From NPM management literature, we learned that government expects scientists to be susceptible to the influence of their consumers in society to generate societal benefits; scien-

tists are also expected to show that these benefits actually occur and are generated efficiently (Hicks et al 2004 cited by Donovan, 2007 and Donovan, 2007). PAT literature introduced two notions of uncertainty concerning these expectations. The first is adverse selection. In the context of valorisation, adverse selection is about the selection of scientists most capable of doing research in such a way that it leads to societal benefits. The second uncertainty is moral hazard. In the context of valorisation that is about whether scientists follow a research approach that is most likely to result in societal benefits. In section 1.4.1 I discuss why involving societal actors in scientific research is believed to induce societal benefits. Transdisciplinarity is discussed as an approach that is acknowledged as being an effective approach in this respect. In section 1.4.2 I discuss research evaluations as a means to stimulate, or even direct, scientists into involving societal actors and producing societal benefits. In both sections I will identify problems associated to current practices. These problems serve as an input for formulating the research questions.

In international scientific discussions, valorisation is best captured by impacts or benefits. As the meaning of valorisation is framed by the Dutch policy context, the meanings of the internationally used terms and valorisation do not perfectly overlap. To prevent misunderstandings, I will follow international scientific literature and use societal benefit in this section. Instead of the perhaps more often used term societal impact I use the broader term of societal benefits to describe the ultimate results of valorisation processes. Societal benefits refer to all benefits to society resulting from scientific research. They include specific societal impacts in the sense of changes in the behaviour or thinking of societal actors (Spaapen & Van Drooge 2011), but also more generic benefits such as an improved knowledge infrastructure.

1.4.1 Generating societal benefits

Involving societal actors to induce societal benefits
Government expects scientists to include societal actors in research to adapt knowledge production to their needs and to stimulate their use of academic knowledge. The involvement of societal actors is believed to contribute a practical perspective to science, as societal actors are not driven by scientific rewards but by rewards related to the solution of specific real-world problems (Podestá 2013). Indeed, their involvement has been linked to the production of research results with a practical application (e.g. Walter et al. 2007; Raftery 2009; Meagher 2008; Rogers 1995; Clark and Holmes 2010; Jolibert & Wesselink 2012). I use the term societal actors rather than the NPM concept of consumers or the much used notion of stakeholders when describing the influence of society on science. Box 3 offers an explanation for this decision.

Box 3: About consumers, stakeholders, societal actors and non-peers

NPM refers to consumers when discussing the influence of society on science. Within science studies, individuals and organisations in society are often referred to as stakeholders of science. In this box I will explain why in my opinion these terms fail to capture the diversity of roles actors from society can have in scientific research and hence why I

prefer the term societal actors. Also, I will explain why in some cases non-peers can have a similar role to societal actors.

'Consumers' suggests a rather passive role of society in generating societal benefits. A consumer can be defined as the final user (an individual or organisation) whose use does not improve the product. A consumer has the option to buy or not to buy and thereby may influence what is produced, but is not involved in developing the actual product. In other words, positioning society as a consumer excludes society from having a role in generating societal benefits.

The notion of a **stakeholder** introduces a dynamic element to the role of society in knowledge development. Freeman (1984:46) defines a stakeholder as *'any group or individual who can affect or is affected by the achievement of the organisation's objectives.'* In contrast to the rather passive notion of a consumer, a stakeholder can influence the development of societal benefits. However, the notion also suggests a division between user and producer. A stakeholder does not take responsibility for the actual process, but rather expresses needs or exerts influence from the side-line, awaiting the effects of the outcomes of the process. As such, the actual involvement of society in the primary process of knowledge development seems to be poorly captured using the notion of stakeholders.

Therefore, I prefer to use the term **societal actors** to describe the role of organisations and individuals in society in scientific research when discussing how societal benefits of science are generated. Acknowledging that science and scientists are part of society as well; 'societal' in societal actors emphasises that these actors' core activities are not within the realm of science. Their primary responsibilities can be found in other areas, for instance in policy-making, business or in public debate. Nevertheless, scientific knowledge may help them execute their tasks. 'Actor' in 'societal actors' emphasises society, and the individuals and organisations it is composed of may have an active role in the primary process of knowledge development and in generating societal benefits. In some instances this may even be as an equal partner to scientists, sharing full responsibility for both the research process as well as its outcomes.

Non-peers, academics from a different research domain, can have a role in valorisation similar to societal actors. Despite their prime responsibility being in research, this responsibility is within a different research domain. To improve their scientific work, non-peers may benefit from insights from other disciplines. For example, the results of this thesis may be used by academics outside the peer community of science policy studies to improve their valorisation practices. Non-peers have contributed to this thesis with their questions, data and experiences and will hopefully benefit from the insights from this thesis. In chapter 4 an explanation will be given of how valorisation between academics can lead to societal benefits.

To fully benefit from the involvement of societal actors, the literature suggests they should be involved in all phases of research (Pohl & Hirsh Hadorn 2008; Voinov and Brown Gaddis 2008; Peer & Stoeglehner 2013). But what are their specific contributions? According to the literature, in the initiating phase of a project, their involvement is believed to help orient the research towards practical applications by generating societally relevant research questions and contributing contextual knowledge (Rietchel et al. 2009; Brousselle et al. 2009; Molas-Gallart & Tang 2007; Phillipson et al. 2012; Jolibert & Wesselink 2012; Siegel et al. 2003). In the phase of actual research, societal actors can provide access to real-world cases, including otherwise difficult to obtain data (Voinov & Brown Gaddis 2013; Molas-Gallart & Tang 2007; Phillipson et al. 2012). In disseminating and implementing results, the involvement of societal actors is found to enhance the understanding of local contexts of application concerning issues such as practical constraints and the language used (O'Fallon & Deary 2002; Weichselgartner & Kasperson 2010).

Transdisciplinary research

A research configuration in which societal actors adopt an equal role to academic researchers is called transdisciplinary research. A uniform definition is not available (Pohl 2011), but a general description can be provided (Carew & Wickson 2010; Walter et al. 2007; Wagner et al. 2009; Wickson, Carew & Russel 2006). Ideally, it differs from traditional disciplinary research in several ways. Instead of scientific problems, the focus is on societal challenges, like climate change, healthy aging or sustainability. In transdisciplinary research researchers are no longer rewarded based on traditional academic rewards structures with their emphasis on publications and citations as identified by Merton (1957) (Carew & Wickson 2010). Also, the strict boundary between science as knowledge producer and society as knowledge user is relinquished. In these shifts, we can recognise the changes intended by NPM: science contributes to solving societal problems, loses its autonomy in doing research and is oriented to the market for rewards. The development of transdisciplinary research is recognised, but not necessarily labelled as such, by concepts like 'post-normal science' (Funtowicz & Ravetz 1993), 'Mode 2' (Gibbons et al. 1994) and 'Triple Helix' (Etzkowitz & Leydesdorff 2000).

Although it is a generally accepted belief that transdisciplinary research is conducive to generating societal benefits, it is less clear whether and how the two are linked to one another (Jolibert & Wesselink 2012; Phillipson et al. 2012). Understanding this link will help to develop quality criteria for the involvement of societal actors in academic research (Carew & Wickson 2010). However, Weingart (1997) questions whether there are any empirical examples of research that is in actually organised in a transdisciplinary research mode. For example, he argues that although research programmes may formulate transdisciplinary goals, projects within these programmes are still organised along disciplinary structures. According to Weingart, at best examples may be found of multidisciplinary research in which the research process is broken up into disciplinary sub-projects which are eventually integrated.

Altogether, it remains unclear whether research is organised in a transdisciplinary fashion on a large scale, whether research that is labelled as transdisciplinary is actually organised in that specific manner, and how transdisciplinary research results in societal benefits.

1.4.2 Demonstrating societal actor involvement and societal benefits

Evaluation as a part of life

Within the NPM paradigm, evaluation is believed to be a key mechanism to control public organisations (Lane 1993). An evaluation is usually characterised as a process in which four basic elements can be identified: 1) an evaluand, 2) a form of assessment based on a number of criteria, 3) a methodical approach to assemble the information on the performance of the evaluand on the criteria and 4) a clear aim for the use of its results. The process of evaluation considers day-to-day practice using unconventional viewpoints to analyse it. In that role, they provide room for questions and reflections that may lead to new interpretations and change of day-to-day practice (Dahler-Larsen 2011.)

Dahler-Larsen (2011) argues that we live in an evaluation society. In such a society, evaluation is institutionalised in everyday life. There are tools specifically designed to evaluate (evaluation methods), people who dedicate their professional life to evaluating (evaluators) and even systems which increasingly take over evaluating from individuals (Rist and Stame 2006). Also, evaluation is ongoing and has become an administrative routine (Hellstern 1986.) Evaluations facilitate learning and improvement and as such are believed to be inherently good and therefore are difficult for individuals to oppose as a phenomenon (Dahler-Larsen 2011). In other words: evaluation has become part of our culture.

The institutionalisation of evaluation and the belief that evaluation is a way to learn and improve may lead to unfounded optimism. There is the idea that evaluation based on a poor understanding and measurability of the process is better than no evaluation, as it will at least provide some insights. The then remaining measurement issues can be dealt with along the way. However, these good reasons to introduce evaluations may have unexpected and undesired consequences (Dahler-Larsen 2011).

The large-scale evaluation of societal actor involvement and societal benefits as a new phenomenon

As described above, in the post-World War II era, science was believed to inherently result in societal benefits by automatic diffusion of knowledge to society. Hence, assessment of societal benefits and the processes leading to these benefits were generally considered irrelevant. Nevertheless, the assessment of the societal benefits of specific mission -oriented programmes, such as travel to the moon, were an exception. From the 1970s onward, societal benefits of more generic strategic programmes were also assessed. Within these programmes basic science was carried out, with the expectation that it would lead to solutions for practical problems. The assessments were carried out by expert panels and evaluation professionals (Rip 2003.)

In recent years, there has been a trend of increasing evaluation of societal benefits. For example, the national research evaluation systems in the UK (Research Excellence Framework) (REF)) and the Netherlands (Standard Evaluation Protocol (SEP)) require all research units to present their realised societal benefits for ex-post evaluation (REF 2014; VSNU et al. 2014). Also, research councils in an increasing number of countries require researchers to address societal benefits in funding procedures. In some countries, it is even mandatory (Dance 2010). The evaluation of

societal benefits in national evaluations and by funding councils is usually done through peer review. However, most academics are inexperienced at evaluating societal benefits, and this development may have adverse effects (Martin 2011).

However, some promising evaluation methods are available. Best practices consist of narratives and additional relevant quantitative and qualitative indicators (Donovan 2011). Examples are the Payback Framework, which initiated and is mainly used in health research, but the scope of which has recently been expanded to also include the social sciences and humanities (Donovan & Hanney 2011; Klautzer et al. 2011) and the SIAMPI approach (Spaapen & Van Drooge 2011; Molas-Gallart & Tang 2011). Despite these practices, there are still numerous challenges to be tackled.

Challenges in evaluating societal actor involvement and societal benefits
Implementing poorly developed evaluation methods and procedures may have negative consequences (Dahler-Larsen 2011.) This warning is not stopping intermediaries in the science system to implement societal benefit evaluation on a large scale. What are the specific challenges related to the evaluation of societal actor involvement and societal benefits of academic research? In this sub-section I will discuss some of the methodological and more practical challenges. An overview of these challenges and related questions can be found in table 1.1. A concise description of current evaluation practices of societal actor involvement and societal benefits in the Netherlands is provided in box 4.

A first methodological challenge is selecting the right evaluation approach to assess societal actor involvement and societal benefits. Evaluations in the context of NPM and principal-agent relationships have a specific interest in assessing whether a task is performed as agreed upon. Such an evaluation in which the emphasis is on accountability is referred to as a summative evaluation. Its counterpart is a formative evaluation, in which the emphasis is on learning and improving (Scriven 1996). If accountability is the main objective, we have to deal with the issue of attribution (Spaapen & Van Drooge 2011). In many cases, multiple studies from multiple research collectives contribute to the ultimate societal benefit. On top of that, it is not only scientific contributions that matter, but also societal contributions and events. Some benefits would not have occurred without private investments, whereas other benefits may not have occurred because of a change in government. Acknowledging this, who should be given the credit for the benefits generated? And if benefits did not occur for reasons outside the span of control of researchers, can they be held accountable for that? If improving is the main objective, a focus on contribution instead of attribution may facilitate learning as it reveals the underlying processes (Spaapen & Van Drooge 2011; Molas-Gallart & Tang 2011)

A second methodological challenge is to define societal benefits. A definition will determine how societal benefits are assessed, but agreement has not yet been reached as to what this definition is (Grant et al 2009; Donovan 2011). Bornmann (2013) identifies three main strands of benefit definitions. The first considers societal benefit as knowledge with societal relevance embodied in a product, for example a book or software. A second strand considers impact as knowledge use by societal actors. This may be facilitated by products, for instance the use of a policy report by civil servants, or people, for instance researchers providing training for professionals. The third stream defines benefits as the positive results that actually occurred, in terms

of safety, health, business activity, culture etcetera. The difficulty of having multiple definitions of benefit is that this may distort the outcomes within an assessment and the comparability between assessments or research fields. Box 4 provides an overview of different terms and their definitions. Also, examples are provided to show how I use each term in this thesis.

Box 4: From societal relevance to societal benefits.

The rationale behind the definitions of the different terms related to societal benefits, is inspired by the basics of Logic Model development (W.K. Kellogg Foundation, 2001). A logic model visualizes the links between activities, outputs, outcomes and immediate, intermediate and ultimate impacts. As such, it shows the path from relevance to benefits.

Societal relevance is defined as the potential of research activities to result in societal benefits (Hessels 2010). It can be recognized in the topic of research, but for research to have societal benefits, additional efforts are required. For example, a study on bullying on schools' playgrounds may contribute to diminishing bullying, but the topic of research alone does not create a difference in bullying.

Societal output is defined as the products resulting from research that are used to communicate with societal actors. Although some studies (e.g. Boekholt et al. 2007) consider societal output as impact, I consider these outputs as a crucial step towards societal benefits, but not a benefit on its own. Building upon the example of bullying on schools' playgrounds, an intervention method that can be used by teachers to diminish bullying is an important step towards societal benefits. However, the mere publication and distribution of an intervention method is not enough to result in benefits.

Societal outcome is defined as the use of knowledge. Yet, in some studies use is considered as impact (e.g. Moffat et al. 2000; Roessner et al. 2006; Castro-Martinez et al. 2008). Again, I consider use as a crucial step towards benefits, but not as a benefit on its own. The use of an intervention method to diminish bullying on schools' playgrounds is required for the research to create societal benefits, but on itself does not guarantee societal benefits.

Societal impact is defined as the changes in the behavior or thinking of societal actors (Spaapen & Van Drooge 2011). In the case of the bullying example, this could be a difference in the way the teacher approaches bullying, a difference in the way children think about bullying and/or less bullying on schools' playgrounds.

Societal benefits is defined as the wider effect of research on society. This include specific societal impacts, such as less bullying, but also effects such as increased levels of happiness of school children and improved school grades.

A third methodological challenge is to develop a set of indicators that allows us to assess different types of benefits across different research disciplines without introducing undesired incentives. The emphasis of current indicators seems to be on technological and commercial impacts. For instance, patents represent a widely used indicator, but one that only assesses a potential in the earliest stages of impact (Donovan 2007). However, even in the natural and life sciences, only a minority of the researchers hold a patent (Balconi et al. 2004, Agrawal & Henderson 2002) and researchers in the social sciences and humanities are almost entirely excluded from using this indicator. As concerns all assessments, in assessing societal benefits, too, one has to be aware of the perverse effects indicators that may have (Rand, 2009). In the evaluation of scientific production, the 'number of publications' criterion directed some scientists towards strategies such as 'salami publishing' (publishing a study in multiple units to have more papers) (Broad 1981). This is a warning for the development of societal benefit indicators, for example to prevent irrelevant patenting or an overkill of courses for high school students. Also, valuing certain impacts more highly than others may stimulate these benefits more, whereas the less valued impacts may be neglected despite their importance for society.

A fourth challenge is to define the evaluand to which the benefits identified can be attributed or that can be said to have contributed to the benefits. The evaluand of societal benefit evaluations can be institutions, departments, groups, individuals, funding schemes, disciplines, programmes, projects or even single outputs. Examples of each can be found in the literature (e.g. Library House 2006; Hanney et al. 2004; DeLange & Muldur 2007; Simmonds et al. 2009; Walter et al. 2007; Boekholt et al. 2007; Burdorf et al. 2009; Prins 2008). The debate on what is the appropriate evaluand to evaluate societal benefits is still ongoing. Can individuals be expected to have an impact track record or is impact a group effort by nature? And should the results of every single project be assessed, risking the stimulation of disseminating knowledge to the societal domain that is not yet socially robust?

A fifth methodological challenge is how to define the appropriate instance of evaluation. Whereas outputs and possibly use can be evaluated after relatively short time frames, actual benefits may take time to occur and they may grow in size over time. However, waiting too long may introduce a hindsight bias (Sanna & Schwarz 2003) or create difficulties retrieving evidence and the individuals involved. This introduces the issue of temporality (Spaapen & Van Drooge 2011) and raises the question of what the appropriate time frames are to evaluate them. As researchers may have changed position within the applied time frame, a related question is to which institution the benefit can be attributed: the institution that employed the researcher at the time the research leading to the impact was conducted, the institution that employed the researcher when the impact occurred, or the institution that employs the researcher at the time of the evaluation?

A sixth methodological challenge is how to include the societal actor perspective in evaluations (Grant et al. 2009). Societal actors are not always easily identified as they may not necessarily be formal project partners (Olmos-Penuela et al 2014). Also, they may not be aware of all the benefits that occurred or of the contribution of the research to the benefits. And on what type of societal actors should the focus be placed? In the case of new technologies, is it about the commercial benefits for the company which adopted the technological knowledge, or is it about the impact these technologies have on patients, professional users or society at large?

The evaluation of societal actor involvement and societal benefits also has some practical challenges. The first is how to keep the burden related to collecting the relevant information as low as possible (Grant et al. 2009). To make a fair judgment, data is required on inputs (financial resources, time, involved individuals), the process (the ways societal actors were involved in the research), outputs (the products, such as workshops, reports, prototypes, used to communicate intermediate and final results with societal actors), outcomes (the application of knowledge), impacts (the resulting changes in thinking and/or behaviour) and benefits (the wider effects that occured) (W.K Kellog Foundation 2001). This requires an effort in determining which data are relevant and then collecting this data. Data might not be available for all indicators, as there is not yet a tradition in societal benefit evaluation. And even if collecting impact data were institutionalised, it may be difficult to collect all the relevant data. For example, government policies do not necessarily cite the reports they are inspired by.

The second practical challenge is how to scale the evaluation of societal actor involvement and societal benefits. Due to the broad scope of the proposals or reports submitted, reviewers already have difficulties assessing scientific quality (Van Arensbergen et al. forthcoming). Since the assessment of societal benefits is a relatively new phenomenon, one can expect that most academics are not experienced or trained in reviewing societal benefits. Because of the large scale of the assessments, even those peers who are experienced will lack the time to assess societal benefits using sophisticated methodologies. The development in which the assessment of societal benefits is transformed from a craft performed by experts to assembly work by lay-men could potentially do more harm than good (Martin 2011).

This overview of issues and accompanying questions is presumably far from complete. For example, across these issues there are questions concerning differences and similarities between the assessment of scientific disciplines (Donovan 2005), since there are differences in how fields organise their research and communicate with stakeholders (Whitley 2000). Already, the overview shows there is still a lot of work to be done before societal benefits can be evaluated in such a way that it fits the definition of evaluation (Donovan 2007; Martin 2011; Dahler-Larsen 2011). The aim of this dissertation is to contribute to the work that is to be done, acknowledging that it cannot solve, or even consider, all issues.

Table 1.1 Challenges related to the evaluation of societal actor involvement and societal benefits

Challenge	Prominent question(s)
Methodological	
Finding the right evaluation approach	Who should get the credits for the benefits generated? If benefits did not occur for reasons outside the span of control of researchers, can they be held accountable for that?
Defining societal benefits	Is it about products embodying knowledge, use of this knowledge or actual effects of the use of the knowledge??
Developing indicators	Which set of indicators can be used to assess a wide variety of involvement and benefits across disciplines? How can perverse side-effects of indicators be minimised or avoided?
Defining the unit of evaluation	Can individuals be expected to have an impact track record or is impact by nature a group effort? Should results of every single project be assessed, risking the stimulation of disseminating to the societal domain knowledge that is not yet socially robust?
Defining the right point in time of evaluation	When do benefits become visible? When are evidence and involved individuals still retrievable? When is the information given by individuals involved still reliable? To which individuals or organisations can benefits or contributions to these benefits be attributed?
Including the societal actor perspective	How can the social actors involved and/or affected be identified? Are societal actors aware of any or all the resulting benefits? Which societal actors should be included?
Practical	
Minimising the burden of evaluation	Which data are required? What is the best way to collect data?
Scaling evaluation	How can societal actor involvement and societal benefits be evaluated on a large scale?

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Box 5: Evaluation of societal actor involvement and societal benefits in the Netherlands

Traditionally, Dutch research evaluation has focused more on quality assurance and improvement than on accountability towards a funder (Van der Meulen & Rip 2000). A national ex-post evaluation system was announced in 1992 and introduced in 1994 by the Association of Dutch Universities (VSNU) to replace the system of conditional funding (Geuna & Martin 2003). Since 2003, the VSNU, The Netherlands Royal Academy of Arts and Sciences (KNAW) and research council NWO have jointly developed the protocol. Currently the evaluations are organised in a six-yearly schedule. The main elements of the procedure are a self-evaluation by the evaluand, a site visit by an international peer committee, a report by the peer committee and a formal response to the report by the university board (Van Drooge et al. 2013). The current indicators are scientific quality, relevance and viability, as in 2014, productivity was dropped as an

indicator (VSNU et al. 2014). Officially, one of the goals of the assessments is to inform the Ministry of Science. However, in practice the ministry is at large distance from the evaluations. Outcomes are mainly used by universities in internal policy-making and to show accountability in the media. In contrast to other countries, the outcomes of the evaluations are not used to allocate government funds (Van Drooge et al. 2013; Himanen et al. 2009; Geuna and Martin 2003).

In 2009, the Dutch research council introduced the knowledge utilisation paragraph as optional in some of its funding schemes. Since 2014 the paragraph has been mandatory in all funding schemes. It accounts for 20 per cent of the total review score of a proposal. In this paragraph, the research council invites applicants to reflect upon opportunities for knowledge utilisation. These opportunities may be identified within society, but also within other academic disciplines. Fundamental research without any knowledge utilisation opportunities is offered an opt-out (NWO 2013).

1.5 Methodology

In this section I will discuss the methodology of the study. First I will integrate the issues identified in sections 1.1-1.4 and use them to formulate research questions. Then I will explain how the data was collected. I will also introduce the cases. The link between the issues, research questions and cases is visualised in figure 1.1 at the end of section 1.5.2. Finally, I will discuss how I aimed to enhance the social robustness of the study.

1.5.1 Research questions

The first section of this introduction discussed the current situation concerning the valorisation policy in the Netherlands. Government introduced the valorisation policy in 2004, which fits within a trend of an increasing demand for societal benefits of science that emerged in the 1970s. In public debate, the academic community seems to consider valorisation as problematic or even undesirable. Clearly, the introduction of the valorisation policy is not without problems. This leads to the first main research questions of this thesis:

1 ***"How has the valorisation policy of Dutch government been translated to academic practice in the Netherlands between 2004 and 2014?"***

In the PAT section, it was explained that government delegates tasks to science. Valorisation can be understood as the delegation of a new task from government to science: producing benefits for society. For this task to be executed effectively, it is important that the task is comprehended and accepted by the academic community. Intermediaries play an important role in realising this by translating the policy from government to academic practice. Traditionally, Dutch intermediaries acted as a buffer between government and academic practice and protected the research community from too much government interference. However, the discussions concerning valorisation clearly indicate the research community is affected by government's valorisation policy. Therefore, it can be questioned whether the intermediary level still functions as a buffer between government and scientists. These theoretical and practical insights lead to the first sub research question of the first main research question, through which I aim to understand the perspective of academics:

1.1 "How do academic researchers respond to valorisation policies?"

The first section of this chapter also discussed the fact that academics struggle in integrating valorisation into their daily work. This inspired the second aim of this thesis: providing insights on how to improve valorisation of academic research. In the NPM section, the risk was identified that too much influence from society on scientific research will lead to an emphasis on research with short-term benefits. This relates to the balance scientists have to find between adhering to government's goals and pursuing their own goals, as identified in the PAT section. In the section on the generation of societal benefits, I concluded that although transdisciplinary research is believed to result in the societal benefits government aims to stimulate, it is unclear whether scientists opt for this research mode in large numbers and how this research mode leads to the desired benefits. To put it differently, it is unclear what behaviour can be defined as compliance to the valorisation policy. The second aim and the theoretical insights lead to the second sub-question of the first main research question:

1.2 "How do academic researchers include valorisation in academic practice?"

Valorisation is part of the performance agreements between government and universities; it is included in NWO granting procedures as the knowledge utilisation paragraph, and it is part of the national SEP for ex-ante evaluations. These developments fit in with the accountability trend associated with NPM. However, can academic researchers be held solely accountable for a process in which societal actors also take part and which they cannot fully control? PAT literature considers evaluation from a slightly different angle and conceptualises it as an instrument which government can use to secure compliance of scientists. How can evaluations be used to secure compliance with valorisation? Both questions focus on the design of the evaluation of valorisation. This leads to the second main research question:

2 "How can societal benefits of academic research be evaluated?"

Practical demands such as time frames used in evaluations and low administrative burdens will be taken into account when answering this research question. Societal benefits are defined as actual achievements, rather than potential relevance or the production of information carriers such as policy reports.

1.5.2 Research design

The overarching method to collect the data to answer the research questions of this thesis is the case study approach (Gerring 2007; George and Bennet 2005). The main reason to opt for this approach is that I study contemporary events on which behavioural control cannot be exerted. Yet, through interviews, surveys and documents there is the opportunity to study those individuals and organisations involved during or relatively shortly after events have occurred. An additional reason is that the research questions take the form of a 'how' question. In such cases, the case study approach is one of the obvious approaches (Yin 2003).

The focus of this thesis is on the effect of the Dutch government's valorisation policy on scientists. Doubtless, valorisation policies also have an effect on societal actors. They are increasingly expected to be involved in academic research and to invest in it. For valorisation policies to be successful, societal actors have to be willing and able to invest their resources in research and/or in adopting research results. Although societal actors have an active role in valorisation, this study will not specifically address their response to the policy.

One could also argue that in order to understand how valorisation was translated from policy to practice, the political and administrative processes preceding the policies have to be studied. Acknowledging that this will contribute to our understanding of policy dynamics concerning valorisation and the intentions of valorisation policies, this thesis puts the perspective of scientists at the centre. To understand this perspective, it is more important to study the documents in which policies are published than to study the preceding dynamics that, I assume, academics generally are not aware of. Besides this, academics react to the content of such documents in organised meetings or opinion pieces, as was recently the case when the Science Vision 2025 (Wetenschapsvisie 2025 (Ministry of Education, Culture and Science 2014) was published. This shows academics perceive these policy documents as potentially having an effect on their practice and that their content therefore is important to consider.

In terms of geography, the study is restricted to the Netherlands. The Dutch science system is one of the leading systems concerning valorisation. As discussed above, valorisation is expected across the full spectrum of academic research. Other leading systems in this respect include the UK (Kitagawa & Lightowler 2014), Australia (Donovan 2008) and Canada (Fisher et al. 2001). The importance of valorisation at European level can also be recognised in the Horizon 2020 framework[6,7].

The study entails four different cases[8]. Richard Whitley's (2000) typology of research fields has inspired the selection of cases. Whitley distinguishes seven types of research fields, based on their social and cognitive organisation. Within each field, researchers have a specific relation with their scientific and societal audiences. Some, such as the social sciences and humanities, have multiple types of audiences which have a more or less equal influence on research dynamics within the field. Other fields, like physics, have a limited range of audiences, of which one has a dominant influence on research dynamics. Concerning societal benefits, there is an abundance of studies focusing on the natural and life sciences (Hessels 2010). The emphasis of this study is therefore on other types of research fields.

In the first case (chapter 2), I include three types of research fields that cover the variety of research fields identified by Whitley (2000). These types roughly translate to the social sciences and humanities on the one hand and chemistry and physics on the other hand, with practice-oriented fields such as climate research and the biomedical sciences in between. I cast a wide net, to first get a science-wide view on academics' responses to the valorisation policies of government and intermediaries. This case concerns how academics understand the valorisation policy and the role of intermediaries in translating government policy to academic practices. Insights from this study serve as the main input to answer sub research question 1 of main research question 1.

6 Valorisation is a Dutch term. Comparable terms in other countries include for example social impact, third mission and knowledge exchange.

7 http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020, accessed 10-07-2014

8 All four studies have been performed in collaboration with co-authors. However, I take full responsibility for the positioning of the studies within the theoretical and methodological framework presented in this introductory chapter.

After obtaining a wide view, I focus on research fields in which I expect a broad variety of interactions with societal actors and on fields in which I expect the emphasis on valorisation to create additional difficulties compared to the natural and life sciences.

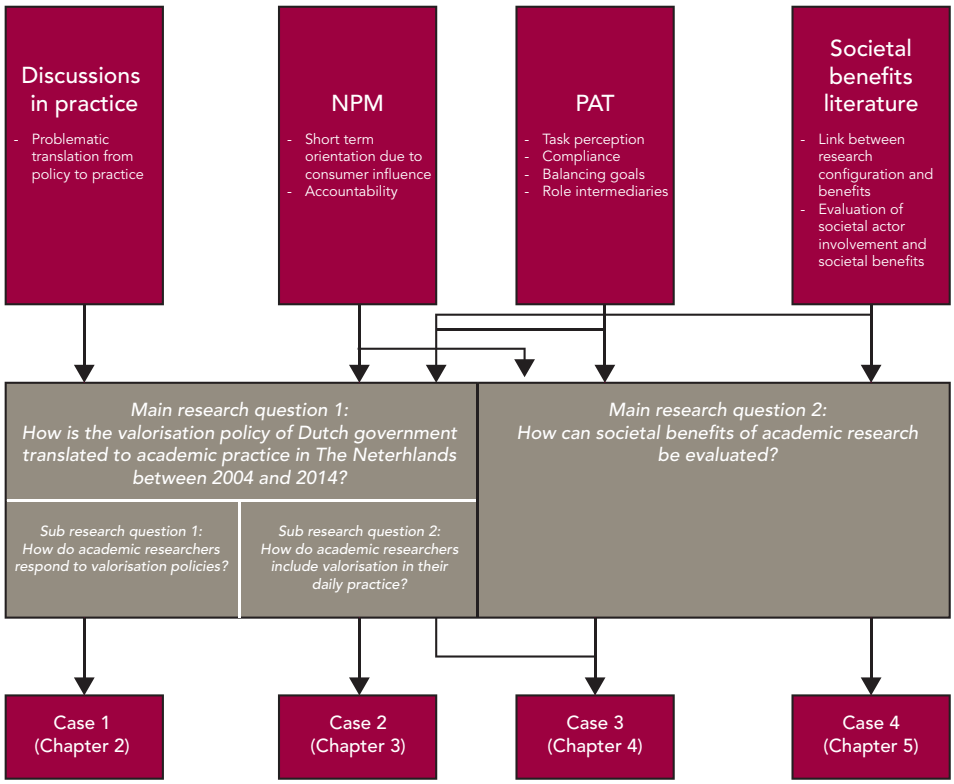
The second case (chapter 3) includes two research programmes in climate studies. This case is included in the study for two reasons. The first is that the two programmes are intermediaries in the science system, the two programmes are part of a larger policy scheme by government to coordinate research in a specific area with the explicit aim of generating societal benefits. The second reason is that within climate studies the focus is on solving a real-world problem: climate change. Moreover, within climate sciences, there is ample experience of interaction with societal actors. Therefore, by including this field I expect to find the research dynamics relevant for this study. I will explore the project dynamics using survey data and statistical analyses. Next, project dynamics are related to theory about transdisciplinarity and associated societal benefits. As such, this chapter is about how valorisation is integrated in academic practice, with a specific focus on transdisciplinarity and how this research mode leads to societal benefits. Together with the third case, this case serves as the main foundation to answer sub research question 2 of main research question 1.

The third case (chapter 4) focuses on ICT research. This field combines a research tradition in which methods are standardised, introducing a certain degree of scientific rigour, on the one hand, while interacting with a wide variety of societal actors on the other hand, which requires a certain degree of flexibility in the research process. This provides an opportunity to study how the task of generating societal benefits is integrated in scientific research. Within this study, I allow myself a minor diversion to the UK. The research system in the UK is comparable to the situation in Netherlands: NPM is influential in public policy-making (Boden et al, 2006), the UK has a productive science system of high quality; societal benefits is a criterion in funding procedures, and the UK has one of the most advanced national systems of research evaluation (Geuna and Martin, 2003), in which societal benefits is currently an important criterion. However, there is an important difference between the Netherlands and the UK. In the UK, the results of ex-ante evaluations have direct consequences for government funding for universities (Barker, 2007). This creates an important incentive for academics to aim for societal benefits. Although the countries are not systematically compared, including the UK brings in the perspective of a system in which academics already have an incentive to develop effective valorisation strategies. This case study concerns how valorisation takes shape in academic practice and how these insights can be used to design indicators, specifically to monitor societal actor involvement. Along with the second case, this case serves as the major source of empirical evidence to answer sub research question 2 of the main research question 1. Together with the fourth case, it is also the main input for the second research question.

The fourth case (chapter 5) deals with the evaluation of law and architecture research. These cases represent the types of research fields in which research priorities, methods and theories are manifold and in which the distinction between scientific and societal activities, achievements, audiences and impact is often difficult to make. In addition, evaluation of research within these fields is a challenge, as there is a tendency to evaluate their achievements using the same criteria applied to the natural and life sciences, whereas underlying research dynamics differ

greatly from these fields. It is suggested that, following scientific evaluations, societal benefits of these fields should now also be assessed using criteria that are less relevant in these fields, such as patents and spin-off companies. This case provides a setting to study how societal benefits come about in collaboration with societal actors and how indicators can be developed to assess societal actor involvement and societal benefits. This case is the second main data source to answer the main research question 2.

Figure 1.1 Link between discussion in practice, literature, research questions and cases



1.5.3 Social robustness

Apart from relying on scientific theories and methods to secure the academic quality of this thesis, I have interacted on multiple occasions with academics outside my peer community (non-peers) and science policymakers to enhance its social robustness. Characteristics of social robustness involve social actors testing research results outside the laboratory (which in my case is a desk with a laptop) and expanding and modifying knowledge based on interactions with societal actors (Nowotny 2003). Academics outside my own peer community and policy-makers have helped with identifying participants for focus groups and interviews, provided feedback on research designs (e.g. survey questions and selection of sub-cases) and reflected

upon outcomes. Results have been tested during multiple workshops and presentations for academics and policymakers and have even been used in preparing for a SEP evaluation (Van der Hoeven 2010). Interactions with academics and policymakers regularly resulted in new research questions, fine-tuning of interview and survey questions and rephrasing recommendations for practice.

1.6 Scientific relevance

In the sections above I have identified tensions in existing literature and practical discussions, I have formulated research questions and I have selected a methodology. In this section I summarize how these choices contribute to the scientific relevance of this thesis.
Previous studies have primarily focussed on how academics in the natural and life sciences deal with the increased demand for societal benefits voiced by government, intermediaries and society at large (e.g Hessels 2010). This thesis adds to existing literature by studying how academics in other research domains perceive this tension; how they practically deal with it and how their efforts can be evaluated by peers.

By taking the perspective of researchers concerning valorisation policies, the thesis also adds to the body of literature focusing on principal-agent relationships in the science system. This body of literature includes conceptual papers (e.g. Van der Meulen 1998; Guston 2000) and empirical studies on the role of intermediaries (e.g. Van der Meulen 2003; Shove 2003 and Wardenaar et al. 2014). However, the role of agents in this relation has received far less attention. An exception is the study of Morris (2004) on scientists' coping strategies with new policies.

The thesis further explores the value of process rather than output evaluations concerning societal benefits. It uses ICT research as test case for the SIAMPI approach. This approach was designed to solve the problem of benefit attribution by focussing on contributions (Spaapen & Van Drooge 2011). The value of the approach has already been tested in the social sciences and humanities (Molas-Gallart & Tang 2011). Also, the value of the concept of productive interactions, central to the SIAMPI approach, is further explored in the fields of law and architecture.
In the concluding chapter I further reflect on the contributions of the results of the thesis to the existing body of knowledge.

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2 Scientists' response to societal impact policies: a policy paradox[9]

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Abstract

Many countries have amended legislation and introduced policies to stimulate universities to transfer their knowledge to society. The effects of these policies on scientists are relatively unexplored. We employ principal-agent theory to increase our understanding of the relationship between impact policies and scientific practice. Our methodology includes the analysis of policy documents and of data gathered in focus groups. We conclude that there is a gap between policy on the one hand and how scientists perceive it on the other. Policy documents put forward a broad notion of impact, but scientists perceive them as focusing too narrowly on commercial impacts. Scientists are further puzzled by how societal impact is evaluated and organized, and their perceptions frame their behaviour. Our policy recommendations focus on improving the interaction between intermediaries, such as universities and research councils, and scientists so as to include the latter's perspective in policy-making.

2.1 Introduction

The Vannevar Bush (1945) report 'Science – the endless frontier' to president Roosevelt of the US lists some of the achievements of science at that time: a decrease in death rate for all diseases and the successful battle against the U-boat. Future benefits concerning health, security and welfare are promised if basic research is adequately funded. Bush recommended the establishment of a new agency to distribute funding for basic research. He advised the agency *'should have stability of funds so that long-range programs may be undertaken. It should recognize that freedom of inquiry must be preserved and should leave internal control of policy, personnel, and the method and scope of research to the institutions in which it is carried on. It should be fully responsible to the President and through him to the Congress for its program.'* (Bush 1945: pp 8-9).

Clearly, the autonomy of science advocated by Bush is no longer obvious. In recent decades, many countries have amended legislation and introduced policies to stimulate universities to transfer their knowledge to society. Since the 1970s, governments in the Western world have increasingly emphasized the benefits to society of their financial investment in science, using

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such labels as the third mission (UK) or valorisation (the Netherlands). Since the late 1990s, funding councils around the world have introduced the societal impact criterion in funding procedures (Dance 2013). Societal impact is also an important aim of the European framework programmes, for example the current Horizon 2020 programme (http://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020, accessed 10-07-2014), and it is further included as a criterion in research assessments (http://www.ref.ac.uk/panels/assessmentcriteriaandlevel-definitions/ accessed 10-07-2014; VSNU *et al.* 2014).

There is a rich body of literature studying the characteristics of those involved in impact processes by means of interviews, surveys or existing databases (D'Este *et al.* 2013; Lam 2011; Jensen *et al.* 2008). Another strand of literature provides insight into impact dynamics, based on interviews with academics as informants, in order to reconstruct impact pathways (e.g. Olmos-Peñuela *et al.* 2014; De Jong *et al.* 2014; Spaapen & Van Drooge 2011). A third collection of studies deals with methods and indicators for assessing societal impact (e.g. Donovan and Butler 2007; Meagher *et al.* 2008; De Jong *et al.* 2011). These studies involve academics and support staff testing and reflecting upon methods and indicators. Although these types of studies have resulted in valuable insights for improving and monitoring societal impact, the way scientists respond to impact policies appears to receive little attention.

The increasing emphasis on societal impact provides us with an interesting case that can contribute to our understanding of how scientists' perception of science policies frames their behaviour and thus the efficacy of these policies. The research question we aim to answer is: How do scientists cope with the increased policy emphasis on societal impact? Thus, we put the position of the agents at the centre and aim to explore their ideas and opinions by tapping into their realm of thought in a social setting. We will focus on their experience with societal impact activities to gain an idea of the issues that are relevant to them and the way they discuss them.

The structure of this paper is as follows. In the next section, we briefly discuss principal-agent theory as our theoretical framework. We then present our methodology, which combines document research with focus groups. In the third and fourth sections we discuss societal impact policies and the responses by the participants in the focus groups, respectively. In the conclusion and discussion, we answer the research question and reflect on the implications of our findings for principal-agent theory and societal impact literature and policy.

2.2 Theoretical framework

As Hessels *et al.* (2009) conclude, societal relevance nowadays is a central element of the 'contract' between governments and science (Guston 2000). This development can be described as a change in the principal-agent relationship between governments and science. In such a relationship, a principal and an agent exchange resources. In the case of science, government (the principal) has financial resources but lacks the skills to develop new knowledge, while scientists (the agents) have the skills but lack the financial resources. In exchange for financial resources from government, science develops new knowledge (Braun & Guston 2003).

However, the information asymmetry in this contractual relationship raises two concerns. The first is whether the principal is able to select the best agents to do the job ('adverse selection').

The second is whether the agent is pursuing the principal's goals ('moral hazard') (Guston 1996). Van der Meulen (1998) links principal-agent theory and game theory to explain how government and science strategically react to one another and both develop strategies to maximize their outcomes. Government can introduce monitoring systems, usually based on peer-review, to address adverse selection and moral hazard (Fernandez-Carro 2007). Leisyte (2007) describes the strategic options of the agent as compliance (adapting to new demands), symbolic compliance (successfully pretending to adapt to new demands without actually changing), and negotiation (trying to change the new demands). The costs involved in monitoring will reduce the resources for science's core tasks, which is neither in the interest of government, nor of science (Van der Meulen 1998.)

Intermediaries play a significant role in creating a balance between the principal's and agent's goals (Guston 2000). Important types of intermediaries are research councils (to address adverse selection (Caswill 2003; Van der Meulen 2003); research assessment systems (to address moral hazard) (e.g. Barker 2007) and research programmes (to address both adverse selection and moral hazard) (Shove 2003; Wardenaar *et al.* 2014). University departments are another type of intermediary. Morris (2002) finds that scientists perceive departments as an important mediator between them and government's research priorities, research councils and the national research assessment. She suggests that departments are able to broker between research practice and research policy because – despite their managerial function – they are close to researchers.

Literature suggests that scientists are able to cope with new policies by selectively complying or not complying and because of the existence of additional sets of professional rules. Morris (2004) addresses the relatively unexplored position of the agents by studying the strategies that scientists develop to cope with new or changed policies. She concludes that scientists comply as much as required, rather than fully, to cope with a new policy environment in which research funding and research freedom can no longer be taken for granted. De Boer (2003) studies the effects of a Dutch law meant to modernize governance at universities. He concludes that the new law is not very effective because a considerable number of full professors 1) ignore it and 2) indicate that informal rules provide leeway for professional autonomy.

Literature thus shows multiple relations should be concerned in order to understand the response of scientist's to new policies: government-agent, government-intermediary, intermediary-agent and relations between multiple agents.

2.3 Methodology

We have limited our empirical study to the changing relationship between government and science in the Netherlands. There, societal impact has been included as a core task of universities since the reform of the Higher Education and Research Act (WHW) in 1992. It is referred to in this Act as 'knowledge transfer for the benefit of society' (WHW, Article 1.3). Our analysis begins in 2004, the year in which the Minister of Science made societal impact a core issue in government science policy, using the label 'valorisation'. As valorisation currently appears to be the most commonly used term in impact discussions in the Netherlands, we will use valorisation rather than societal impact in sections 2.4 and 2.5 below.

In the implementation of the policy, two phases can be discerned. In the first phase, government and intermediaries negotiate about the meaning of valorisation and the way intermediaries should implement the policy in their agenda's. The (intermediate) results of this negotiation phase can be found in documents. Another reason to consider documents is that in response to questions by scientists, intermediaries refer to policy documents.

In the second phase, the policies are institutionalized within the academic community. This leads to responses within the research community. These responses are not systematically documented and have to be collected in interaction with academics. We opt for focus groups for two reasons. Since academic research is a collective and social activity and since theory suggests that agents develop strategies to cope with new policies, we expect that academics do not deal with the increasing demand for societal impact in isolation, but in discussion with peers. The other reason to opt for focus groups is that they make it possible to gather data on the attitudes and opinions of participants in a dynamic social context (Morgan 1988, cited by Sim 1998). Focus group participants have to explain themselves to and query other participants (Morgan 1996). We believe that this is a relevant strength of the focus group methodology, since we are studying a topic about which many scientists are still forming their own opinion.

2.3.1 Document research

Document research is used to summarize policy developments concerning the principal's impact goals and how the intermediaries articulate these goals. We identify government as the principal. Four intermediaries are identified: 1) the Dutch research council (NWO) as the intermediary that reduces adverse selection uncertainties, 2) the national research assessment as the intermediary that reduces moral hazard uncertainties, 3) the Association of Universities (VSNU) as the representative of the universities and 4) the Royal Netherlands Academy of Arts and Sciences (KNAW) as the 'the forum, conscience, and voice of the arts and sciences in the Netherlands'[10] (http://www.knaw.nl/en/about-us/taken accessed 23-07-2014). Documents published after the focus groups were held have not been included, since they could not have contributed to the responses of participants. An overview can be found in Table 2.1. In the result section, we have translated quotes from Dutch to English where relevant.

10 The Royal Academy (KNAW) has three functions by law: 1) a learned society 2) an advisory body to government and 3) a management body for national research institutes (http://www.knaw.nl/en/about-us/taken).

Table 2.1 Overview of policy documents studied

Title[11]	Year	Organizations involved
Focus on excellence and added value: Science Budget 2004	2004	Ministry of Education, Culture and Science
Valorisation of research as a task of the universities	2005	Ministry of Education, Culture and Science
Valorisation agenda: knowledge must circulate	2008	KNAW, NWO, VSNU, Association of Large Technological Institutes, Technology Foundation STW, Netherlands Organization for Applied Scientific Research TNO, Netherlands Association of Universities of Applied Sciences, Ministry of Economic Affairs, Ministry of Agriculture, Nature and Food Quality, Ministry of Health, Welfare and Sport, Ministry of Education, Culture and Science, Confederation of Netherlands Industry and Employers VNO-NCW, Royal Association MKB-Nederland.
From resolutions to taking the lead: knowledge must circulate	2009	idem
Standard evaluation protocol 2009-2015	2009	KNAW, NWO and VSNU
Evaluating the societal relevance of academic research: A guide	2010	KNAW, NWO, VSNU, Rathenau Institute and Netherlands Association of Universities of Applied Sciences
Response of Leiden University to the strategic agenda of the Ministry of Science	2012	Leiden University
A proposal for performance agreements	2012	Eindhoven University of Technology
A guide for knowledge utilization in the innovational research incentives scheme	2013	NWO
A framework of valorisation indicators	undated	VSNU Focus groups

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We used focus groups to gather data about how scientists and support staff, as the agents, respond to the policy environment. A focus group interview is 'a group interview – centred on a specific topic ('focus') and facilitated and coordinated by a moderator or facilitator – which seeks to generate primarily qualitative data, by capitalizing on the interaction that occurs within the group setting' (Sim & Snell, 1996 p.189). We follow the guidelines discussed in literature to prepare the focus groups, structure the discussions and analyse the results (Morgan 1996; Zeller 1993; Webb 2002; Stewart & Shamdasani 1990, cited by Sim 1998; Sim 1998; Kitzinger 1995; Barbour 2005; Kidd & Marshall 2000).

The overall population of participants was homogeneous in the sense they all have experience with societal impact, as defined by government and intermediaries. Furthermore, each focus group was assembled to be homogenous in terms of type of research field and academic rank, and heterogeneous in terms of sub-discipline, organizational affiliation and job (researcher or support staff). We included those with a supporting role, such as policy staff members, technology transfer officers and communication advisors, because they play a role in achieving societal impact too.

11 Where relevant translated from Dutch into English.

We selected four types of fields, covering the diversity of fields identified by Whitley (2000). In this way we aimed to capture a wide variety of opinions and experiences. The fields are the fragmented adhocracies (represented by the social sciences and humanities) at one extreme and technologically and conceptually integrated bureaucracies (represented by chemistry and physics) at the other. In the middle are professional adhocracies (represented by biomedical sciences, engineering, climate sciences and computer sciences). This gave us three series of focus groups. Within these fields, we aimed to maximize the number of sub-fields and universities represented.

Participants were invited by e-mail. In addition to the goal of the focus group, we mentioned some of their societal impact activities and explained that these were the reason to invite them. Table 2.2 lists the number of participants. The compositions of the group differ to final moment cancellations.

Table 2.2 Number of individuals per focus group

	Social Sciences and Humanities (November 2013)		Chemistry and Physics (April 2014)		Biomedical Sciences, Engineering, Computer Sciences and Climate Sciences (April 2014)		Total
	Senior group	Junior/ Intermediate group	Senior group	Junior/ Intermediate group	Senior group	Junior/ Intermediate group	
Researchers	8	6	6	6	7	7	40
Support Staff	1	2	4	1	2	3	13
Total number of Participants	9	8	10	7	9	10	53

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The focus groups began with an explanation of the goal of the focus group, after which participants briefly introduced themselves. Participants were also asked for permission to record the focus group. Finally, we told them how the research results would be disseminated to them and other audiences.

The core of each focus group consisted of three rounds of discussions. In the first round, each participant introduced a personal example of a societal impact activity or strategy and explained why he or she defined this is as 'valorisation', as well as described the elements of success. Other participants were invited to ask questions. In the second round, we divided the focus group into subgroups so that we could multiply the number of discussions and thus expand our data collection. Each subgroup designed, visualized and discussed a desirable future in which achieving societal impact was seen as a regular core task of universities. They were asked to think about the conditions and knowledge required in order to attain this future. Then, in a plenary setting, one member of each subgroup presented their future. Members of other subgroups were able to ask questions. In the final round, the knowledge needs were prioritized and discussed further.

Full transcripts were made of the recorded discussions. The transcripts were analysed using Atlas.ti. Only the issues discussed in the majority of the focus groups are presented in section 2.5 below. As our study is exploratory and we organized six focus groups, we will not be able to analyse differences per type of field or academic rank. However, by analysing six focus groups we will be able to capture overall dominant issues in the way scientists and support staff respond to impact policies.

For privacy reasons, in the result section, the focus group serves as the source of any quotes or narratives. Table 2.3 lists the captions. For example, JI-SSH refers to a quote or narrative provided by (a) participant(s) in the social sciences and humanities focus group consisting of junior and intermediate-level researchers. For readability reasons, the focus groups with participants from the biomedical sciences, computer sciences, climate sciences and engineering are referred to as Professional Adhocracies (PA).

Where narratives are presented, participants are coded 'P1', 'P2' etcetera in order of their contribution to the discussion. The codes are unique for each narrative in the sense that 'P1' generally does not represent the same individual across two different narratives. Contributions by the moderator are coded 'M'. Lastly, all quotes have been translated from Dutch to English.

Table 2.3 Overview of quote captions

Type of field	Level	Caption
Fragmented adhocracies (social sciences and humanities)	Junior and intermediate	JI-SSH
	Senior	S-SSH
Professional adhocracies (biomedical sciences, computer sciences, climate sciences and engineering)	Junior and intermediate	JI-PA
	Senior	S-PA
Technologically and conceptually integrated bureaucracies (chemistry and physics)	Junior and intermediate	JI-CPh
	Senior	S-CPh

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2.4 Valorisation in policy

In this section we describe the valorisation policies developed by government and the intermediaries as the background for interpreting the responses presented in the following section. Two steps can be discerned in policy development: the introduction of valorisation as an explicit goal in government policies and subsequent negotiation between government and the intermediaries.

In 2004, the Ministry of Science published a policy document in which it identified the utilization of research results as one of five priorities in science policy. The notion of 'valorisation' was introduced to emphasize the importance of universities collaborating with private organizations in order to close the 'knowledge gap' (Ministry of Education, Culture and Science 2004). One year later, in a letter to the boards of the universities, the Ministry broadened the meaning of

valorisation to include societal impact and dissemination in addition to economic impact. The Minister defined valorisation as science and technology communication, educating people, informal contacts, collaboration with public organizations and publishing research results (Ministry of Education, Culture and Science 2005).

The next step can be considered the negotiations between government and the intermediaries about the content of valorisation policies. In 2007, the government appointed a committee to improve the valorisation environment. In 2008, the committee presented the valorisation agenda that had resulted from the negotiations between the government, the intermediaries in the Dutch science and higher education system, and representatives of knowledge users (Nederland Ondernemend Innovatieland 2008). Among the 15 supporters of the agenda were the research council, the academy of arts and sciences and the association of universities. One year later, the committee published a more detailed agenda (Nederland Ondernemend Innovatieland 2009). It included a definition of valorisation: *'the process of creating value from knowledge by making knowledge suitable and/or available for economic and/or societal use and translating that knowledge into competitive products, services, processes and entrepreneurial activity'* (Nederland Ondernemend Innovatieland 2009, p. 8). The Government has used this definition up to the present day, although it omitted the word 'competitive'.

In the agenda, the organizations involved agreed on the development of additional policies to anchor valorisation in the Dutch science system. The agenda included follow-up steps for universities, the research council and the academy of arts and sciences. Universities agreed to develop valorisation strategies and to include valorisation achievements in their annual reports and research assessments. They also agreed to show appreciation for and reward employees active in valorisation and to include valorisation in employees' job profiles. The research council and academy agreed to develop policies to improve the valorisation awareness of researchers.

The result of the negotiation was reflected by policy documents published by intermediaries shortly after the valorisation agenda was released. In 2009, the Dutch research council introduced a 'knowledge utilization paragraph' in its funding applications. There, knowledge utilization is defined as *'a process that promotes the use of academic knowledge outside the academic domain and/or by other scientific fields. The process generally demands interaction between researchers and intended knowledge users, and this contact may appear in all phases of research: from developing research questions to disseminating results*' (NWO 2013, p. 2). Initially, the paragraph was optional, but from 2014 onward it became mandatory in all funding schemes. It now accounts for twenty per cent of the final score of a proposal. However, there is an opt-out for basic research. If an applicant convincingly argues that knowledge utilization is unlikely to be realized and if the review committee agrees, a full score is awarded for the paragraph.

The research council, the academy and the association of universities are jointly responsible for the Standard Evaluation Protocol (SEP). The SEP is used to guide the mandatory six-yearly assessment of each research institute. Central to the assessment is the site visit by an international peer review committee. Over the years, societal impact has gained importance under the label 'relevance.' According to the 2009 protocol, relevance *'covers the social, economic and*

cultural relevance of the research'. The committee is asked to consider one or more of the aspects 'societal quality', 'societal impact' and 'valorisation'. The first refers to policies and efforts to interact with societal partners, the second to actual achievements and the third to *'making research results available and suitable for application in products, processes and services'* (VSNU *et al*. 2009).[12]

Also by agreement, the VSNU association of universities included valorisation in the framework that provides job descriptions of academic ranks. Scientists are expected to *'create value* [of] *acknowledged scientific knowledge and insights for science, society and where possible for government and private parties.'* Although doctoral students in the Netherlands have the legal status of university employees, the description applies to all academic ranks except them.

In 2012, all universities concluded performance agreements with the national government in which valorisation was included as a priority. Examples of such agreements are: to adhere to the agreement in the valorisation agenda of spending 2.5 per cent of the university's financial resources on valorisation activities (Leiden University 2012) and encouraging science communication by means of *'demonstrations, exhibitions, lectures, popularizing publications, the university's website and social media'* (Eindhoven University of Technology, 2012).

Currently, the association of universities is developing a framework of indicators that defines valorisation largely the same as government does: *'the process of creating value from knowledge by making it suitable and/or available for economic and societal use and making it suitable for translation into competitive products, services, processes and entrepreneurial activities'* (VSNU undated). The development of the indicators is explicitly presented as a bottom-up process, to create wide support within universities. In 2015 there should be a long list of indicators from which universities can select those most appropriate for their research.

The academy of arts and sciences is involved in the development of the SEP and in the public debate about valorisation, but has not developed its own definition. Although it promotes valorisation in the institutes it manages, we have not found any related policy documents (VSNU 2014). The academy generally emphasizes the value of basic and autonomous research.[13] However, the academy is involved in developing methods to assess research on its full merits (e.g. KNAW 2010; 2011; 2013) and societal impact in specific (ERiC 2010).

12 In May 2014 an updated protocol was published. Research is assessed on three criteria: scientific quality, societal relevance and viability. A definition of societal relevance is absent, yet it is described as *'The committee assesses the quality, scale and relevance of contributions targeting specific economic, social or cultural target groups, of advisory reports for policy, of contributions to public debates, and so on. The point is to assess contributions in areas that the research unit has itself designated as target areas.'* Research groups are expected to make a case for their relevance with the committee using narratives (VSNU, KNAW & NWO 2014).

13 For example, members of the junior branch of the academy wrote an opinion letter in a national newspaper ('Munt slaan uit wetenschap is te kortzichtig'), *NRC* 7-06-2010.

In addition to the valorisation agenda, the government introduced the 'top sector policy' in 2011. The goal of this policy is to intensify collaboration between public research and industry in nine sectors (http://topsectoren.nl/home accessed 10-07-2014). Since then, a significant part the research council's budget has been earmarked for collaboration with private partners from these sectors. For example, the government earmarked 225 million euros of the research council's total 2013 budget of 628 million euros (http://www.nwo.nl/en/about-nwo/what+does+nwo+do/funding/budget accessed 10-07-2014).

Excluding the first task description by the government, there are major similarities between the descriptions used by government and the intermediary organizations (see Table 2.4), such as the process-like nature of valorisation, the variety of forms it takes and the specification of societal use in addition to economic. This suggests a certain consensus, although multiple terms and descriptions are used. In the next section we will see whether and how government policies and the outcomes of the negotiations between government and the intermediary organizations affect scientists and support staff involved in valorisation.

Table 2.4 Task descriptions used by government and intermediaries

Actor	Term	Task Description
Government	Valorisation	'The process of creating value from knowledge by making it suitable and/or available for economic and/or societal use and translating it into competitive products, services, processes and entrepreneurial activity' (Nederland Ondernemend Innovatieland 2009)
Research Council (NWO)	Knowledge utilization	'A process that promotes the use of academic knowledge outside the academic domain and/or by other scientific fields. The process generally demands interaction between researchers and intended knowledge users, and this contact may appear in all phases of research: from developing research questions to disseminating results' (*Handreiking kennisbenuttingsimpuls* 2014)
Association of Universities (VSNU)	Valorisation	'The process of creating value from knowledge by making it suitable and/or available for economic and societal use and making it suitable for translation into competitive products, services, processes and entrepreneurial activity' (*Raamwerk Valorisatie Indicatoren* undated)
Standard Evaluation Protocol (SEP)	Valorisation (as an aspect of relevance)	'The activities aimed at making research results available and suitable for application in products, processes and services. This includes activities regarding the availability of results and the interaction with public and private organizations, as well as direct contributions such as commercial or non-profit use of research results and expertise' (VSNU, NWO & KNAW 2009)

2.5 Valorisation in practice

In this section we present the three main issues that emerged during discussions between the participants of each of the six focus groups. These are the task description of valorisation, how it is appreciated, and how it is organized. We will explore how these issues are related in the responses of the participants.

2.5.1 Task Description

Although participants appeared to be familiar with the relevant policy terms, almost none of them found the definition of valorisation self-evident. This may explain why attempts to develop a task description were common in all focus groups. When discussing potential descriptions, some participants found to their surprise that they had excluded their own valorisation activities. Although consensus was generally reached, some activities were not readily considered valorisation by all participants.

In the focus groups' attempts to describe the valorisation task, two issues emerged. The first was whether valorisation is a separate task or whether it is part of the other core tasks of universities, namely research and education. A situation in which the three tasks are integrated was regularly presented as the ideal. The perfect research project was said to be in collaboration with a societal partner, to generate new scientific knowledge and to provide a practical context for educating students. This makes it difficult or even artificial to separate the three tasks. Below, two participants from the S-CPh group discuss this issue in one of the subgroups. They are clearly struggling to position valorisation in relation to education and research.

P1: '*That* [drawing a separate box for valorisation] *is a bit funny though, because the social responsibility is covered by these two* [pointing to research and education], *it does not stand on its own.*'
P2: '*Exactly, exactly. I fully agree with you. But it is also a matter of definition, right? Because you can define education as teaching your students…but of course it is already partially part of the university and it is also partially aimed at society. And in the latter case it is part of your social responsibility.*'

The second issue was the task description of valorisation as such, regardless of whether it is part of the other core tasks. Although task descriptions are provided by government and the intermediaries, this does not mean researchers are familiar with them. The moderator asked a participant from the JI-CPh group whether she had read the explanation provided by the research council. The participant could not remember the explanation in detail, but recalled that she had *'read it with scepticism, because I already knew…something is being imposed on us which did not originate from us. Without any motivation.*'

If it were up to the participants, what would the task description of valorisation be? First, participants describe valorisation as a process, not as products. For example, a patent was not considered valorisation, it was considered a means to achieving valorisation. Another recurring element used to describe valorisation was 'translating knowledge'. This included translating for the public, but also for other scientific disciplines. For instance, when a post-doctoral researcher from the JI-PA group explained that he used his (ICT) knowledge to solve problems in CERN's LHC reactor, other participants did not question whether or not this was valorisation. Third, commercial activities were almost always regarded as valorisation. Yet a widely shared view was that valorisation is about more than making money, although some participants seemed not to have considered this option before. The discussion below in one of the JI-PA subgroups illustrates this:

P1: *'And valorisation is not only about making money.'*
P2: *'No…'*
P3: '*That's a very interesting point you raise.*'

A potential explanation for participants emphasizing that valorisation is about more than commercial activities, is the perception that government and the intermediaries value science for its contributions to the economy instead of knowledge development. This is discussed in the JI-CPh group in the following way:

P1: *'I do see considerable hypes about which fields get money. Yes, that is influenced by the current political climate. So that is where you notice a large effect.'*
P2: *'Also, there are more programmes now that only allow you to submit a proposal if a company joins in and finances half. In cash.'*
P1: *'I think they are making a mistake about valorisation…that knowledge transfer…you easily get the feeling that only money…financial considerations matter instead of knowledge transfer.'*

Participants also get this message from their university departments. There is an emphasis on acquiring external funds. For example, a participant from the S-SSH group said his vice-chancellor recently set a target of acquiring sixty per cent of funds externally. The following quote by a participant in the S-CPh group illustrates that it is not only national politics which are perceived to focus on commercial valorisation: *'I think that is the direction of thought* [of the department's dean] *at the moment. Not: how can we valorize? But: how can we make money?'*

Still, even researchers who are engaged in commercial valorisation activities do not always recognize these activities as valorisation. This had already become clear when inviting participants. We had to convince one of the JI-SSH participants to accept the invitation. This researcher is the director of the commercial bureau of an archaeology department. In this role, the researcher was involved in multiple commissioned excavations and in reconstructing an historical building commissioned by a theme park. He did not identify these commissions as valorisation, and during the focus group he explained why:*'We decided to link it* [the commercial bureau] *to scientific research. That is why initially I did not think of it as valorisation. For us it is about collecting building blocks for scientific research.*'

Another SSH researcher is part of a research group whose members give public lectures and, based upon their scientific expertise, serves on the boards of several associations. He questioned whether he or his colleagues would be appropriate participants, because he felt they were not involved in valorisation. Due to other commitments, this researcher could not join the focus groups. Nevertheless, we will include part of his response because it is indicative of the confusion that reigns about the task description of valorisation: *'I looked at www.valorisatie.nl, but it did not help much. We are not really making money from our scientific results, but we do share our knowledge with society. However, isn't that just dissemination?'* Note that although his colleagues do not commercialize their findings, the activities he described fit the descriptions used by government and the intermediaries.

In the focus groups, a JI-PA participant involved in explaining results to lay audiences and a participant from the S-CPh group whose research is funded by a charity foundation and who collaborates with physicians and gives lectures to patients and their families reacted in comparable ways. They were unaware that these activities can be considered valorisation, for example by the research council. Also, when confronted with the official task descriptions, they remarked these were things that they had been doing for a long time.

In addition to participants who were unaware they were actively valorizing their research, there were also participants who questioned whether the activities mentioned by other participants were true examples of valorisation. Please note that all the participants were invited based on their having experience that fit the task descriptions used by government and the intermediaries. The following exchange was a discussion between two participants in the S-CPH group. Their descriptions of valorisation differed. The first participant initially considered valorisation include only activities aimed at applying research findings. The second participant used a broader description. Although the first participant seemed willing to revise his idea, he was not immediately convinced.

P1: *'So what do you consider valorisation?'*
P2: *'Valorisation is knowledge transfer. Making knowledge accessible for the world outside science.'*
M: *'The general audience?'*
P1: *'General audience?'*
P2: *'Yes...'*
M: *'It is nice to have the definition...'*
P1: *'Yes, because I never thought about valorisation in that way, to be honest.'*
P2: *'No?'*
P1: *'Telling people.'*
P2: *'Yeah, well, knowledge transfer. What I mean is…*[interrupted by P1]
P1: *'Whether or not they use it?'*

A participant in the S-SSH group questioned whether the examples given by two fellow participants could be considered valorisation. One of the examples was about work in collaboration with pharmaceutical companies and patient organizations; the other example concerned a consortium involving a number of public and private organizations. Notably, the consortium was funded by the research council and explicitly aimed at solving societal problems. *'I question whether this is valorisation. If you are doing commissioned work, isn't impact inherent to the research then? Someone is waiting for it, so in that case it isn't a problem at all, is it? Valorisation is effortless in that case.'*

The discussions concerning the task description of valorisation show that there is no widely shared description and that the participants were unaware of the task descriptions provided by government and the intermediaries. To resolve this situation, the participants in each of the focus groups expressed a need for examples. The lack of a widely shared task description has made it difficult for them to recognize their own and others' valorisation and achievements. Participants linked this to the topic of appreciation, as we will see in the next section.

2.5.2 Appreciation

The second topic that came up in all the focus groups was how to appreciate valorisation. We have chosen the term 'appreciation' rather than evaluation or assessment because it does more justice to the motivation of participants to engage in valorisation. Some felt a moral obligation to give something in return for tax payers' money, while others felt a need to fascinate, educate or help society, even if their efforts went unrewarded. The following narrative from the S-SSH group is illustrative for the motivation of scientists.

P1: *'Yes, it* [publishing a popular science book] *is like charity work. Like many tasks other than research and teaching. I'm also on the board of a foundation which awards a prize for the best translation from* [a specific European] *language. Translations create more exposure for* [that European culture and its language].'
M: *'What drives you do to those things?'*
P1: *'I am like a missionary. …There is a third task, being a knowledge broker.'*
M: *'Who else considers themselves a missionary or advocate? It may sound a bit theatrical. Many of you say it in one way or another.'* [many nodding heads and vocal agreements]

However, internal motivation is not sufficient to stimulate valorisation. Gaining recognition based on valorisation is perceived as problematic. Those who are evaluated face the challenge of presenting a convincing strategy without knowing what is expected of them, while those who evaluate face the challenge of assessing strategies they feel unequipped to assess. The following experience of a participant in the S-PA group illustrates the difficulties of evaluating valorisation strategies in research proposals. It also shows that the Dutch struggle is not restricted to the borders of the country, but also challenges foreign scientists involved in peer reviews.

'I also see that…paragraph in research proposals as a member of [a review committee of the Dutch research council] *and then we get a mathematical proposal with the most abstract mathematics imaginable and then suddenly there is…what should he fill in?! He can't say "I'm collaborating with a company" because I know for sure he won't be and he certainly shouldn't. So he says something like "I'm going to lecture to high school students." Yes, ok. In this case the committee will say "We accept it". And the international reviewer has no idea what we mean by it* [knowledge utilization], *absolutely no idea. They say "This is irrelevant". They won't fill it in.'*

Whereas the current policies of government and the intermediaries do not attribute different values to different types of valorisation, the quote above reveals the perception of an implicit hierarchy in valorisation activities. Collaboration with companies is perceived as more important than other activities. A participant from the JI-CPh group warned about this hierarchy:

'We have to make sure that there are no first-rank and second-rank third mission activities. So that…at least there is the perception…first rank of course is with industry, cash, patents, you name it. And second rank, well if that is not possible…then you can go for the pulpit, then we go fascinate high school students [sarcastic tone]. *Whereas if you acknowledge both are very valuable, perhaps of equal value…'*

Along with the difficulties inherent in evaluating valorisation in its own right, participants

experience a tension in the appreciation for scientific excellence and valorisation. The general perception is that valorisation is considered an extra at best. Scientific excellence is what reputations are predominantly based upon in evaluation settings, as an S-SSH participant explained. The quote shows that societal impact is ignored, although it is an explicit criterion in research assessments and job performance appraisals.

'We are dealing with the same issue. There is a tension. For the Dutch research council valorisation is important, but often the members of assessment committees are older hotshots. So, there is a generation gap. What I saw is this: the groups that are not involved in valorisation score very high. For all groups there is the heading "relevance", under which a number of researchers are given the score "reasonable", although their contribution to valorisation in some cases is very small. For other groups with high valorisation performance the scientific relevance is assessed lower. Another point: It should be an issue in job performance appraisals, but in practice this criterion does not play a serious role. However, it should be an issue in every job performance appraisal'

This implicit hierarchy also has questionable effects on the selection of researchers, according to the participants. They share the opinion that academic researchers are selected through incentives that stimulate scientific excellence, while they feel that additional skills relating to valorisation are required for a full professor, such as networking and acquiring funds from societal actors. Currently, they believe that these skills cannot be developed because they are not rewarded and indeed are even neglected in evaluation procedures. The following narrative originates from the JI-PA group and illustrates this view:

P1: *'I feel committees* [within the Dutch research council] *take a broad view of CVs, and also look at other activities* [i.e. other than scientific activities].'
P2: *'Only secondary I would say.'*
P1: *'Only secondary…ok…'*
P3: *'Let's look at the H-index… ok!'* [sarcastic tone]
P4: *… I just think you can train future professors much better and more efficiently by taking into account what they will have to do in the end in each step in their career.'*
P1: *'Are you saying it* [valorisation] *is not rewarded?'*
P4: *'Yes.'*
M: *'Or stimulated, because that is what you actually provide, an answer to* [P5's] *contribution, who does not see how you can develop the skills required to be a full professor within the university.'*
P4: *'Look, valorisation is just an extra skill that we expect of full professors. So how do you make them develop the skills that valorisation requires? In part by stimulating them to do so in their career. It should be included in reward systems.'*

Summarizing, the participants observe difficulties in how valorisation is appreciated. Because there is no clear task description, it is hard to prepare or perform evaluations and assessments. There is also a perception of implicit hierarchies. Scientific excellence is believed to have a higher status than valorisation and commercial valorisation is believed to have a higher status than other forms. Participants share the opinion that the lack of a reward for valorisation makes

it less likely to contribute to a scientific career. Many participants believed that improving the situation would require field-specific valorisation indicators. In the next section we will look more closely at the position of valorisation in the organization of scientific work.

2.5.3 Organization

The final topic that emerged was the division of labour concerning valorisation. It included issues such as additional workload and whether or not all individual scientists should be involved in valorisation.

Valorisation was perceived as an extra task, in addition to research, education and administrative work. Scientists and support staff members were aware of this issue. Adding extra working hours does not appear to be a viable strategy for coping with the additional task. Concerns were expressed in several of the focus groups:

'And the second, the second question is "Will there be enough time for teaching if we all start a third mission, in the sense of collaborating with companies and lecturing the public?"'- S-PA participant

And:

P1: *'Just like saying "You can clock hours for this* [valorisation]" *and then, perhaps, if there can't be additional costs, it will be at the expense of education, which nowadays takes up fewer hours because of developments in...'*
P2: *'Yeah, that's a good point, isn't it? How do you...education versus research versus the third mission. In terms of hours, there has to be a measure for that.'* – S-CPH participants

Also:

'It does not even fit into a 38-hour a week contract, what we ask of our employees. So if you want the opportunity to take a step back and interact with society then the world will say "That's a nice thing to do in your spare time!" All fine and well, but in that scenario you are asking people to constantly chase their own tails.' – JI-PA participant

However, nearly all the participants referred to valorisation as the third task of universities, suggesting that it should be done. Nevertheless, they acknowledge some researchers are better equipped to perform these activities than others. For those who are poorly equipped, valorisation is described as problematic. Nevertheless, these scientists still play a role in valorisation, as participants in the S-SSH group discussed:

P1 [explains a group visualization]: *'We would like to spare the goose that lays the golden eggs. We all know people, brilliant individuals in their field, who you should not bully about valorisation. You should not cause them sleepless nights. I'm dramatizing a bit.'*
M: *'Yet the goose is within the network.'*
P1: *'Yeah, with a certain degree of immunity.'*

M and P2: *'And the network has someone else who explains things on primetime television on behalf of the goose?'*
PI: *'That is the same differentiation issue that* [P3, presenter of another subgroup] *brought up.'*

Group members shared some specific examples of task division, although this is uncommon. In the S-PA group, one participant explained he is employed in an 'innovation track'. His job appraisals are based not on scientific achievement but on innovation achievement. A participant in the JI-CPh is employed in a dual track: *'Back then,* [a certain full professor] *supervised me during my PhD and he asked me to return for a job, which is part-time research and part-time outreach employee.'*

What these two examples have in common is that previous success creates the freedom to take the less conventional route. The previous achievements of the S-PA participant resulted in substantial royalties for the university. The JI-CPh participant's dual track was enabled by a prestigious national grant awarded to his full professor. Still, the question is what the effects of such constructs will be on the careers of these researchers in the long term, since scientific quality still dominates in most selection procedures.

It should also be noted that this division of labour was not to everyone's liking. One participant suggested a valorisation dean who can assign valorisation duties, just like educational duties, and apportion time over the three tasks. Others referred to their university's policy documents or to the research assessment protocol. These approaches were questioned by others:

P1: *'You are saying that one of the questions...for everyone employed by a university...do you really think so?'*
P2: *'That is what we are being told, this is the new core task. The evaluation protocol says in so many words "What are you doing about valorisation?" Education, research, valorisation.'* – S-PA

In short, participants believed that valorisation is a new and additional task, demanding extra time and skills. It is not clear how valorisation should be organized in relation to the other tasks of universities and in relation to personal strengths and preferences. These uncertainties have led to many questions concerning the way valorisation is organized, such as: How can valorisation be integrated on a practical level, alongside education and research? How should research groups be organized if valorisation becomes a goal? How can a change of culture be achieved in which valorisation (and teaching) is as important as research? Nevertheless, there seem to be modes for appointing specific valorisation researchers.

2.6 Conclusion and discussion

The aim of this paper is to help us understand the effects on scientists of government's increasing demand for science to have societal impact by tapping into their realm of thought. To this end, we have studied the introduction of impact policies by government and policy documents by intermediaries resulting from negotiations with government. We have also collected data on the responses of scientists and support staff members involved in the quest for impact. Our expectation was that if intermediaries successfully create a buffer between government and research, scientists will be able to cope with the policies that emphasize societal impact.

Looking at those policies, our impression is that of consensus between government and the intermediaries. This confirms the path dependency of 'mediating through' or consensus as a strategy in Dutch science policy (Van der Meulen 1998.) The first indication is that the intermediaries execute the agreements with government to include societal impact in their policies, and the second is that the task descriptions used by the intermediaries are largely similar to the description of government. Government and intermediaries all state that impact includes not only commercial activities but also activities aimed at public organizations or the general public. The research council even includes other research fields as potential beneficiaries and provides an opt-out for basic research. Impact criteria are included in funding procedures, research assessments and human resource management, and university job profiles include impact responsibilities.

In the focus groups, a picture emerged of a confused academic community. It is realized an additional formal task is introduced and academics are trying to fulfil this task or position their usual activities in terms of this task. The downside of the institutionalization is that symbiotic activities are artificially drawn apart, which results in confusion. Participants articulated the need for a clear task description. They quite often did not recognize either their own or their peers' activities as societal impact, even though these activities could be categorized as such according to the different policies. It requires little imagination to see that this will result in contra-productivity when societal impact is assessed in proposals submitted within socially relevant research programmes. Moreover, participants indicated that they had been involved in these types of activities for a long time, but never realized that they could be labelled as societal impact. In evaluation procedures, it was unclear to them how impact should be presented and assessed. There was the perception that scientific excellence is more important than impact and that commercial impacts are more important than other impacts. The organization of societal impact activities also puzzled the participants. Who should be involved? Where should the necessary time come from? How should the appropriate skills be developed?

Remarkably, the task descriptions used by government and the intermediaries are in line with the descriptions formulated by the participants of the focus groups. The response to policies seems like a paradox. Coming back to our research question, we have found little evidence of coping mechanisms, unlike De Boer (2003) and Morris and Rip (2006). In fact, we found overwhelming evidence of a struggle (Hessels 2010). Nevertheless our participants succeeded in fulfilling the impact task in accordance with the policies but without being aware of it. We believe that this cannot be considered as (symbolically) complying with policy, because the perception of the policies does not reflect the actual content of the policies. We have also found no evidence of organized negotiation between the agents and the intermediaries or government.

In addition to compliance, coping and negotiation, there seems to be another option: apathy. This is a response rooted in the conviction that behaviour theoretically should have an effect, whereas no effect is expected in practice. Tummers (2012) has described this as 'policy alienation'. Policy alienation is common among professionals and is defined as *'the general cognitive state of mind of a psychological disconnection with policy'* (Tummers 2012 p. 14). In our focus groups, we encountered multiple expressions of policy alienation. Participants seem to have

lost faith in university managers and government and intermediary policy-makers, and they read policy documents with scepticism.

Our findings have two implications for the application of principal-agent theory to the relationship between government and scientists. First, one has to be careful about assuming that scientists are familiar with the policies of government and the intermediaries. This supports Morris' (2003) conclusion that principal-agent theory provides a limited view of scientific practice because it fails to capture the agent's perception of the relationship. Second, we find that the agent's reactions to policies are more diverse than previously suggested in principal-agent theory. The relationship between government and science has been conceptualized as a game in which both rationally seek strategies to stabilize the situation (Van der Meulen 1998). We question whether apathy or policy alienation can be considered a rational strategy on the part of the agent. If agents do not understand the rules of the game, or even refuse to take notice of the rules of the game, it is difficult to maintain that they are using a strategy or are even playing a game.

This study has certain limitations. One is that our selection of participants is biased: to evoke experience-based discussions, we deliberately included only participants who were experienced in targeting societal impact. This means that we must be careful about generalizing our findings. A different picture could have emerged if we had studied those not experienced in societal impact or even those opposed to it. We can hypothesize two situations: 1) such scientists will find themselves in an even bigger struggle since they are faced with an increasing demand for something they are not doing, or 2) they will be able to develop coping strategies by focusing on academic excellence, since they are not internally motivated to be involved in societal impact activities,.

Also, our study is exploratory and concerns a limited number of focus groups. We are able to get an impression of important issues in the scientific community as a whole (Morgan 1996.) However, six focus groups does not allow us to compare between types of research fields nor between academic ranks. Stemerding and Nahuis'(2014) study within biotechnology suggests there are indeed disciplinary differences, even between sub fields. Further explorations per type of research field or academic rank and comparisons between them could be a direction for future research.

Furthermore, focus groups don't allow for analysis on the individual level. Nevertheless, our data suggests three responses to valorisation policies, that are not mutually exclusive: 1) the realization the policies entail activities that have been part of daily work for a long time, 2) the fear for tensions with academic excellence and 3) neglecting policies. In depth interviews could provide further insight of responses on the level of the individual academic (Morgan 1996).

Our study has an important implication for science policy too. From the principal-agent perspective, we learn that if scientists are puzzled by the intentions of government's policy, task fulfilment is problematic. After the negotiations between government and the intermediaries, the time has come for both to invest in their relationship with scientists concerning impact policies. On a positive note, the picture that emerges from our focus groups is of a community

that in general is very motivated to have an impact on society. We recommend engaging with them as soon as possible to improve the results of impact policies.

We have two further recommendations that require a joint effort by science policy-makers, science policy scholars and the academic community as a whole. First, during the focus groups participants indicated knowledge needs. Each of the focus groups expressed a need for examples of societal impact in order to get an idea of the meaning and to find inspiration. Approaches such as SIAMPI (Spaapen and Van Drooge 2011; Molas-Gallart &Tang 2011 and De Jong et al. 2014) have proven to be useful in providing examples and process insights. Although we had invited participants so that *we* could tap into their experiences and thoughts, many thanked us for the new insights *they* had gained during the focus groups. They planned to discuss societal impact with their colleagues and include it in research strategies. Indeed, focus groups are known for their empowering value (Morgan, 1996). The learning process concerning impact appears to benefit from a social setting and we recommend that debates should be organized, for example by the staff members of research councils or university departments. Science policy scholars are essential in translating policy into practice. Again, in our experience, there are generally scientists who like to be involved in organizing debates. In fact, they are needed to adapt the debate to the needs of a specific research community.

Second, participants expressed a need for impact indicators. It cannot be stressed enough that these should be research-context-specific indicators. Some participants suggested that scientists should be involved in developing these indicators. Indeed, this seems a fruitful approach, as we have discussed elsewhere (De Jong et al. 2011). However, before developing new indicators, policy-makers and science policy scholars should discuss the value of existing indicators with scientists, as they appear to be unaware of them.

Our final recommendation concerns our own peer community. The focus groups put forward a diverse range of questions related to the organization of societal impact. We believe these are important questions for the field of science policy studies and we know that there is already a huge body of knowledge available. Like the content of impact policies, we found that participants are also unaware of the knowledge developed in our field. We should realize that other scientists are among our most important stakeholders and work on improving our impact on them.

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3 Exploring the promises of transdisciplinary research: a quantitative study of two climate research programmes[14]

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Abstract

Scientists have long since become accustomed to explaining the future value of their work. Nowadays token statements are no longer sufficient. Societal impact must be embedded in the organisation of research. The call for societal impact is most explicitly expressed in and actively shaped by strategic research programmes that involve societal actors. We have examined two questions related to compliance in the principal-agent relation between a programme and its projects. The first question concerns the risk of moral hazard: is societal actor involvement a token activity or a substantial component of the research process? The second question relates to possible adverse selection: does societal actor involvement produce the expected benefits and, if so, under which conditions? We surveyed members and project leaders of 178 projects in two strategic research programmes in the Netherlands. There is no reason to suspect large-scale moral hazard. Projects formally labelled as transdisciplinary have characteristics typically associated with transdisciplinarity but academic projects share those characteristics. Neither is there reason to suspect adverse selection. The archetypical properties of transdisciplinary research are associated with the expected societal benefits. An important finding is that there are different types of benefit, each of which requires its own approach. Societal benefit is associated mainly with the characteristics of consulting transdisciplinarity rather than participatory transdisciplinarity. Benefit is achieved through informal involvement and a diversity of outputs, and much less by giving societal actors a prominent role or influence in the research process. Based on our conclusions we recommend customizing the design of research programmes and projects towards the needs of the specific societal benefits they aim to generate and reconsidering the emphasis on formal involvement of societal actors in funding procedures.

3.1 Introduction

Science is expected to produce benefits for society. This expectation is articulated in grant conditions of research funders, in research evaluation protocols, in government policy documents and public science budgets, and in various other government policies (Mowery, Nelson et al. 2001; Gulbrandsen et al. 2011; Lyall & Fletcher 2013). Scientists have long since become accustomed to explaining the future value of their work in grant applications, in reflections on

14 This chapter has been submitted for consideration for publication in Research Policy.

the possible implications of their results in the discussion section of papers, and in the dissemination sections of project funding proposals. Such token statements – sincere as they may be – are no longer considered sufficient. Societal impact must be embedded in the organisation of research.

Since Lewin first showed the potential of action research (Lewin 1946), a number of organisational modes has emerged that explicitly aim for science to produce societal change. They range from action research (Reason & Bradbury 2001) and participatory action research (Whyte 1991) to cooperative inquiry (Reason & Heron 1986), mode-2 research (Gibbons et al. 1994), transdisciplinary science (Rosenfield 1992; Pohl 2008), and knowledge co-production (Jasanoff 2006). These research modes have two significant commonalities: they aim to produce practical knowledge for a specific (social) context and they do so by engaging, involving, and empowering societal actors.

The call for societal impact is most explicitly expressed in and actively shaped by strategic research programmes. Societal actor involvement is a crucial part of the design of strategic research programmes (Hessels & Deuten 2013). By involving industry, local communities, regional governments, NGOs, and other societal actors in the research process, programmes aim to maximise societal impact, for example, by better adjusting knowledge to user needs, by creating commitment for contentious solutions, or by turning scientific inventions into new products and processes. Horizon 2020 is the most prominent recent example, allocating 31 billion euros to collaborative research into seven Grand Challenges. However, strategic research programmes have been growing in popularity as a public policy instrument for decades (Gray 2011; Kloet et al. 2013; Turpin et al. 2011). The rationale behind these programmes is that the urgency and complexity of the problems as well as their potential benefit for society warrant a "coordinated attack" (Bush 1945 p. 14). Strategic research programmes are expected to produce new knowledge and methods applicable in a specific socio-economic sector or problem area, share this knowledge with relevant actors to facilitate innovation, and bring about sustained improvement of the knowledge infrastructure (Van der Meulen and Rip 1998). Strategic research programmes with societal actor involvement as well as other inclusive research modes call for new evaluation criteria that reflect the interdisciplinary and transdisciplinary nature of research, the interests of the actors involved, and the variety of outputs and outcomes it produces (Carew & Wickson 2010; Wagner et al. 2009). There are two questions when it comes to identifying a particular mode and evaluating its impacts. The first question is if societal actor involvement is a token activity or a substantial component of the research process. The growing call to involve societal actors may tempt scientists to comply in name but not in fact. Weingart (1997) is concerned that although a research programme might have a transdisciplinary design, the research projects in the programme will still be organized along disciplinary lines. Weingart's concern may be warranted, as Pohl (2005) found that to many researchers transdisciplinarity is just another demand from the research programme.

The second question is whether and under which conditions societal actor involvement produces the expected benefits (Jolibert & Wesselink, 2012; Phillipson et al. 2012). The involvement of societal actors in scientific research has been the subject of many empirical studies (e.g. Cohen 1997; Roelofsen et al. 2011; Talwar et al. 2011; Olmos-Peñuela et al. 2014). It is generally

accepted that involving societal actors in research is conducive to generating societal impact. Yet, there remains a lack of systematic quantitative evidence on the effects of their involvement (Abreu et al. 2009).

In this paper, we use a principal-agent perspective to look for an answer to the two questions. Is societal actor involvement real or token? And does it fulfil its promises by producing the expected societal benefits?

A survey among participants and project leaders in two large-scale transdisciplinary research programmes on climate adaptation in the Netherlands, augmented with detailed information from the programmes' project databases, was used to compare projects designated as transdisciplinary ('hotspot projects') with projects designated as purely scientific ('thematic projects'). A comparison of the organisational properties of hotspot projects and thematic projects reveals no significant differences, which seems to suggest that transdisciplinarity is token. However, contrary to expectations societal actor involvement was also found in thematic projects, suggesting that societal actor involvement is most likely a substantial part of the research process, an effect that can be attributed to the design of the programme rather than that of the projects. We also find an association between specific ways of organising societal actor involvement and five types of societal impact, which shows that benefits were produced and reveals under which conditions that occurred.

The structure of this paper is as follows. In the next section we explain the context of our study. In the third section we present our theoretical framework. We discuss transdisciplinarity literature, conceptualize the relationship between government and science in terms of principal-agent theory and integrate these two strands of literature. In the fourth section we present our data and method. Our data consists of an administrative project database and a survey among project representatives. Data is analysed using non-parametric tests and regression models in section five. In section six we draw conclusions, discuss our findings and formulate policy recommendations.

3.2 Background

Until recently, strategic research programmes were an important component of the funding landscape of science and innovation in the Netherlands. Between 1995 and 2011 billions of euros of public revenues from natural gas extraction were invested in the Economic Structure Enhancing Fund (*Fonds Economische Structuurversterking*; FES) to strengthen the physical infrastructure and the knowledge infrastructure of the Dutch economy. The third of proposals aimed at strengthening the knowledge infrastructure (Decision Subsidies Investments Knowledge Infrastructuur; *Besluit subsidies investeringen kennisinfrastructuur*; *Bsik*) involved 37 programmes and investments of 802 million euros, supplemented with co-financing from European Structural Funds and the private and non-profit sectors. Programmes funded under *Bsik* were to represent collaborative networks of knowledge users and knowledge producers, do high-quality fundamental research, and translate the results into new products, processes, competences and services.[15]

15 Source: Erawatch (http://erawatch.jrc.ec.europa.eu/erawatch/opencms/index.html)

A number of Bsik programmes were eligible for additional funding in the FES 500 selective continuation (selectieve continuering) round, in which additional funding of 500 million euros was allocated (Ministry of Education, Culture and Science and Ministry of Economic Affairs 2009; Ministry of Economic Affairs 2010.)

There is a difference between proposals and actual projects. Hessels et al. (2014) have examined user involvement in the 37 programmes funded by Bsik. They conclude that there is a close association between how users were involved in proposals and how they were involved in the eventual programmes, although users may fall short when it comes to contributing financially. This indicates formal compliance with design requirements, but is not sufficient to assess the nature of the involvement of societal actors in the research process or the production of expected societal benefits.

In this paper, we make an in-depth analysis of two FES programmes that focus on climate adaptation. Climate research is a good example of problem-oriented research with close involvement of societal actors (Wardenaar 2013; Hegger 2012; Pohl et al. 2005; Funtowicz & Ravetz, 1993). Climate changes Spatial Planning (CcSP) is part of the Bsik round and ran from 2004 until 2011 and had a total budget of 80 million euros; it was succeeded in the FES 500 round by Knowledge for Climate (KfC), which ran from 2008 until 2014 and had a total budget of 100 million euros. The two programmes are transdisciplinary in design: they involve a substantial number of public and private societal actors and aim to produce practical solutions for a complex societal problem in a specific context, based in part on high-quality fundamental science.[16]

The projects in the two programmes are similar with respect to the research field, the type of funding source, and the societal actors that were involved. These similarities as well as the institutional integration of the programmes allow us to treat the projects as a single set. There is, however, a significant difference between the programmes in how they organise transdisciplinary research. CcSP organized research in scientific projects along research themes, the results of which were integrated and disseminated through so-called communication projects in the second phase of the programme. KfC organized its research from the outset in clusters of so-called hotspot projects –regional projects working on societal problems– and thematic projects that develop more fundamental knowledge to support the research in the hotspots (Merkx et al. 2011). The communication projects and hotspot projects are transdisciplinary in design, while the thematic projects have an academic focus and will serve as our control group.

3.3 Theoretical framework

The literature provides a range of concepts and labels to describe modes of research that involve societal actors and aim to produce practical knowledge for societal problems. We position our paper in the context of transdisciplinary research. However, the results are equally relevant for mode-2 research, knowledge co-production, or any of the other modes.

16 For a more detailed description of the programmes we refer to Wardenaar et al. (2014) and Wardenaar et al. (under review).

3.3.1 Involving societal actors in transdisciplinary research

The origin of the notion of transdisciplinarity can be traced back to Jantsch (1972) who envisioned a new way of problem solving, moving beyond the disciplinary organisation of academic knowledge development. His vision encompasses the integral coordination of science, education and innovation, aimed at contributing to a certain societal issue.
The understanding of Jantsch's notion has evolved. Numerous definitions of transdisciplinarity have been proposed – in addition the various alternative labels and theories on inclusive and collaborative modes of research – but there is as yet no consensus definition (Pohl 2011). Many authors do use Rosenfield's description (1992) that emphasises the integration of knowledge by researchers from different disciplines and societal actors from different fields, working on a common problem over an extended period of time, and developing shared conceptual frameworks, skills, and goals (see also Choi & Pak 2006). Recurring elements of what is considered transdisciplinarity are 'collaboration between academics and societal actors', 'integrating knowledge' and 'real world problem oriented' (Carew & Wickson 2010; Walter et al. 2007; Wagner et al. 2009; Wickson, Carew & Russel 2006).

Scientists operating in a transdisciplinary research setting are expected to engage actively in collaborating with societal actors (Lawrence & Després 2004). Societal actors can be included as official project partners, but their contributions can also be organized more loosely. Olmos-Peñuela et al. (2014) emphasize that relations with societal actors regularly remain non-formalized, involving no legal or other traceable documents. The involvement of societal actors changes the focus of the research process. Societal actors tend to focus on practice and on products that can be applied in specific contexts and not on the future rewards from the scientific community (Podestá 2013). In many studies societal actor involvement has been positively associated with the development of societally relevant knowledge (e.g. Walter et al. 2007; Raftery 2009; Meagher 2008; Rogers 1995; Clark & Holmes 2010; Jolibert & Wesselink, 2012) and with the social robustness of that knowledge (Gibbons et al. 1994; Lawrence & Després 2004)

Societal actors can be involved in different roles. Mobjörk (2010) distinguishes two types of transdisciplinary research: consulting and participatory. In consulting transdisciplinary research, societal actors provide input and feedback but they do not do research. In participatory transdisciplinary research scientists and societal actors are equal partners, making it easier for societal actors to contribute to the research process. Ideally, societal actors should have a role in each phase of the process, as impact has been shown to increase with the number of phases in which they have a role (Pohl & Hirsh Hadorn 2008; Voinov & Brown Gaddis 2008; Peer & Stoeglehner 2013). In setting goals and defining questions, societal actors have a preference for research questions that are more relevant to their own context (Rietchel et al. 2009, Brousselle et al. 2009; Molas-Gallart & Tang 2007; Philipson et al. 2012) and for practice-oriented research (Jolibert & Wesselink, 2012). In research design, they can make valuable contributions to the selection of cases and data sources, based on their practical and local knowledge (Siegel et al. 2003). In executing the research, they contribute data that would otherwise be difficult to obtain (Voinov & Brown Gaddis 2013) and provide access to facilities and study sites (Molas-Gallart & Tang 2007; Phillipson et al. 2012). In communicating research results, their involvement helps to take into account local contexts and to communicate research results in understandable terms (O'Fallon & Deary, 2002; Weichselgartner & Kasperson 2010).

3.3.2 Research programmes as intermediaries between government and science

The relationship between government and science can be conceptualized as a principal-agent relationship. Central to the relationship is the exchange of resources. Guston (2000) described this relationship using the notion of a contract in which science supplies new knowledge in exchange for financial support by government. Government is uncertain about two aspects of the compliance of science, both resulting from information asymmetries, specifically the government's lack of specific knowledge. The first uncertainty concerns the possibility of adverse selection: are the most capable scientists funded? The second uncertainty involves the risk of moral hazard: are scientists performing as agreed upon? (Guston 1996).

Government can manage these uncertainties by delegating control to intermediary organisations (Guston 2000) that use the expertise of other scientists to select those scientists (most) capable of performing the required tasks and to assess whether they actually did what was required (Fernandez-Carro 2007). Morris (2002) studied the mediating role of university departments that function as brokers between scientists and governmental policy and form a buffer between governmental research priorities, research councils and national research assessments. Research programmes are also a type of intermediary organisation between government and science (Rip & Van der Meulen 1996). They combine the roles of funding councils, by allocating research funds, and university departments, by brokering between the goals of government and science. Research programmes develop coordination measures to secure compliance (Wardenaar et al. 2014). For example, they organize the evaluation of research proposals by scientific and societal peers and monitor project progress.

A number of studies examines compliance in science. For example, in an analysis of the use of contracts in the relation between research councils and scientists, Caswill (2003) found that, although compliance with contracts is seldom verified, shirking is rare. Van der Meulen (1998) models the behaviour of scientists in reaction to policy as a game of developing strategies to maximize outcomes. Scientists can follow three strategies: (1) compliance, which involves adapting to policy demands, (2) symbolic compliance, which involves pretending to adapt to policy demands, and (3) negotiating in an effort to alter policy demands (Leisyte 2007). Principal-agent theory can help in understanding the organisation of transdisciplinary research. Research programmes are a means to direct the research efforts of a collection of agents (Wardenaar et al. 2014). For example, Stemerding & Nahuis (2014) describe how the impact definition used by a research programme directs the efforts of scientists within the programme.

Programmes that provide funding for research that meets specific transdisciplinary requirements, will also attract projects that involve societal actors as window dressing, assigning them a role while not necessarily giving them influence. Mobjörk's (2010) distinction between consulting and participatory transdisciplinary research is comparable to the distinction between symbolic compliance and actual compliance in principal-agent theory. Elzinga's (2008) observation that societal actors can be involved in more symbolic roles, also suggests that scientists can comply symbolically with demands for societal actor involvement.
Compliance with transdisciplinary requirements has two dimensions, each of which comprises from two characteristics. The first dimension relates to roles and functions. Are societal actors included as official project partners as well as informally? Have societal actors been given a role

in taking decisions concerning the research? The second dimension concerns their influence and information on the results. Do societal actors actually have influence on the research? Are efforts being made to communicate (preliminary) results to societal actors? When a project only performs on the first dimension, this may indicate symbolic compliance with transdisciplinary requirements. Societal actors are included in the project's design but inclusion may not involve influence. When a project also performs on the second dimension, this may indicate actual compliance. Such a project takes into account the contexts of application from the outset and gives societal actors influence throughout the research.

We explore the relation between the two dimensions of compliance with transdisciplinary requirements and the main goals of the programme, that is, producing societal impact and contributing to the knowledge infrastructure. Societal impacts are defined as changes in thinking or behaviour of societal actors (Spaapen & Van Drooge 2011; De Jong et al. 2014). Examples of societal impacts of climate research are influence on the debate about climate change in local communities; raising awareness among regional watershed councils regarding climate change effects; or contributions to the implementation of climate adaptation measures, such as water storage below greenhouses (Ford et al. 2013; Verhoeven et al. 2011). Is transdisciplinary research the right approach to achieve these goals?

3.4 Methods and data

This section describes the methods and data that were used to find an answer to our questions. Our results are based on two complementary data sources. The first source is the combined project database that was created after the two programmes CcSP and KfC were integrated. The project database was maintained by the programme management office, which gave full access to our team. The second source is a survey among researchers who participated in the various projects of CcSP and KfC. A paper based on these data sources has been presented at the 2013 Atlanta Conference on Science and Innovation Policy (De Jong et al 2013).

3.4.1 Project database

The project database contains information on all projects funded by CcSP and KfC. There are two types of projects. Thematic projects have an academic focus and develop new academic knowledge on climate adaptation. Hotspot projects and communication projects have an explicit transdisciplinary focus, working on practical problems in collaboration with societal actors in a local context. Thematic projects are the traditional academic research projects that serve as the control group that is necessary for this type of study (Walter et al. 2007).

The database contains information on team size and composition. Participants were classified as scientists or societal actors based on their organisational affiliation. Universities and public research institutes are considered scientific, while governments, firms, knowledge platforms, and NGOs are considered societal. There are two caveats to this strict separation of sectors. First, we ignore the fact that some societal organisations, such as firms and consultancies, do in-house research. Second, some people have a dual affiliation with an academic and a societal organisation. For each project, we have calculated the percentage of participants that is affiliated to a societal organisation, including those who have a dual societal-academic affiliation. This percentage reflects the formal involvement of societal actors.

The project database also produces information on three control variables: project team size, project budget, and programme. Project team size and project budget may have an effect on impact independent of societal actor involvement (e.g. larger teams may have access to larger social networks). We will also control for programme, because the programmes use somewhat different strategies to achieve their societal aims.

3.4.2 Survey

Data on societal actor involvement and societal benefits were collected using a survey among 1,382 participants from 316 projects. Questions and answer categories were constructed based on 23 exploratory interviews with programme management, scientists and societal actors involved at the level of programmes and projects (Merkx et al. 2011).

The involvement of societal actors was measured using four groups of questions:

1. *The number of types of societal actors that were informally involved* was measured by asking respondents to identify which of 22 categories of societal actors were not part of the project team but were involved in the project in some other way, leaving room for open answers.
2. *The role of societal actors in the research process* was measured by asking respondents about the involvement of societal actors in four tasks: (a) formulating research questions, (b) developing the research design, (c) conducting research, and (d) disseminating results.
3. *The actual influence of societal actors* was measured by asking respondents to what extent the interaction between scientists and societal actors resulted in (a) changes in research questions, (b) changes in research subjects, (c) improved insight into societal actors' knowledge needs, (d) acquisition of relevant knowledge from practice, (e) and improved capacity to translate research results into practice.
4. *Efforts to communicate results to societal actors* were measured by asking respondents to identify which of 13 non-scientific research outputs were used to communicate about the project with societal actors. These include publications, lectures, advisory work, climate adaptation and mitigation strategies, several types of models and decision tools, databases and cost-benefit analyses.

The programmes are expected to produce two types of societal benefit: impact on the problem and an improvement of the knowledge infrastructure.

1. *Societal impact* was measured by asking respondents to indicate to what degree project results were used to achieve five specific types of societal impact that were identified in the preparatory interviews and that together reflect the societal impact of a project. These five types of impact are that project results (a) were used in societal debates, (b) contributed to including climate change knowledge in investment decisions, (c) created political support for climate adaptation measures, (d) helped to postpone or cancel climate adaptation measures, and (e) produced climate adaptation measures and strategies that were implemented.
2. *Contribution to the knowledge infrastructure* concerns the creation of new contacts and the improvement of existing contacts resulting from a project. Respondents were asked to

indicate whether new or improved contacts were achieved for 22 categories of societal actors as well as an open category.

The survey was pretested to ensure that respondents would understand the questionnaire as unambiguously as possible. A number of questions was rephrased, additional response categories were added, and the order of questions was changed.

The survey measures self-reported impact from the perspective of scientists participating in the projects of CcSP and KfC. It was distributed in January 2013 to 1,382 participants with a scientific affiliation. These are the agents who are expected to do most of the work and whose behaviour is a prime target of the FES policy scheme. Although it is common to query self-reported impact, we did consider extending the survey to include participating societal actors.

However, where scientists take part on an individual or group basis, many societal actors represent participating organisations. Their responses would consequently be different in nature from those of scientists and including them would have lowered the consistency of responses. Representatives changed during the programmes' duration and a random check of the background of individual participants from societal organisations (using LinkedIn) produced a fair number of secretaries.

Not all projects were finished at the time, but we expected most benefits to have occurred or to have become clear to project participants. Also, we had to take into account that a number of CcSP projects finished a few years earlier. Postponing the survey until all KfC projects had finished could increase hindsight bias (Sanna & Schwarz 2003).

Many respondents were involved in multiple projects. To minimize their workload, projects were specifically assigned to respondents to ensure that no one had to respond to more than one questionnaire and that there was at least one respondent per project, preferably the project leader. The survey produced 440 partly and fully completed questionnaires, corresponding to a response rate of 32 per cent for the survey as a whole, with different response rates per question. Individual responses were transformed to average scores per project.[17]

Where multiple survey items were used to measure an aspect of transdisciplinary research or societal benefit, factor analysis was used to test whether they measure the same phenomenon. The four items on the role of societal actors in the research process load on a single component. Their average score represents the construct *prominence of societal actors in the research process* (standardized Cronbach's α=.808). The five items for the actual influence of societal actors load on two factors, but the internal consistency of the resulting constructs is poor. The average score of the five items represents the construct *influence of societal actors on the research process* (standardized Cronbach's α=.801). *Societal impact* is a construct comprising the average score of four of the five types of societal impact (standardized Cronbach's α=.862).

17 Where a project was represented by a single respondent per project, that respondent's response reflects the project score.

There were not enough responses to the question whether a project helped to postpone or cancel climate adaptation measures and variation in responses was low, so this type of impact was excluded. The items measuring the project's contribution to the knowledge infrastructure were averaged, resulting in a construct labelled *contribution to knowledge infrastructure* (standardized Cronbach's α=.787). Constructs were created by calculating an unweighted average of available scores, also when an individual item was missing. The variables *informally involved societal actors* and *societally aimed output* were constructed by counting the number of categories selected by respondents.

3.4.3 Data description

The resulting variables and their descriptives are listed in Table 3.1. In total, we have (partial) data for 178 out of 316 projects (56%), 52 (29%) from CcSP and 126 (71%) from KfC. According to the project database, 53 projects have a transdisciplinary label (hotspot and communication projects). The average project team is dominated by scientists, although there are projects without any scientific team member. Typical projects involve three societal actor types that are not part of the project team. On average, societal actors have considerable influence on the research process. Projects produce three to four publication types aimed at society. The average project had moderate societal impact and resulted in improved or new relationships with five types of organisations.

3.5 Results

In this section we present the statistical results in two parts. First, we test if societal actor involvement is a token activity or a substantial component of the research process. Then, we examine whether and under which conditions societal actor involvement produces the expected benefits.[18]

The correlations in Table 3.2 provide some initial insights into the relationships between design, impact, and project size. There is a modest association between the participation, prominence and influence of societal actors. Participation is a precondition for prominence and influence, while influence requires that societal actors have a specific role or function (prominence). As expected, there are significant correlations between societal impact and informal involvement, prominence, influence and diversity of output. However, a counterintuitive result is that societal impact is negatively associated with the share of societal actors in project teams. The impact of projects on the knowledge infrastructure (new or improved contacts) matches our expectations: a strong, positive association with the influence of societal actors in project teams, the number of societal actors that is informally involved, and the diversity of output.

The share of societal actors in project teams is positively related to the number of project members. Larger teams may provide better opportunities for organising the involvement of societal actors, but this result can also be read as an indication that such involvement is a mere add-on. Larger projects also produce a lower diversity of outputs, while diversity and the number

18 Sensitivity analysis was done to verify the results. The models were constructed from scratch by another researcher on the team, using different approaches and testing alternative definitions of the dependent variables. The results were confirmed.

of informally involved societal actors are positively related. This association can work in two directions: projects that produce a larger variety of outputs can reach a wider range of societal actors and the wider involvement of societal actors may elicit a more diverse set of outputs. Finally, the strong correlation between project budget and the number of project members originates in the fact that salaries account for the bigger part of project costs. In our statistical analyses we only use the number of members to measure project size.

Table 3.1 Variables and their descriptive statistics

Variable	Definition and scale	N	Mean	Median	St. dev.	Min.	Max.
Design variables							
SHARE_SOCIETAL	Share of societal actors in project members	171	0.167	0.056	0.235	0	0.913
INFORMAL_INVOLVE	Number of societal actor types informally involved (out of 22 categories)	94	3.649	3	2.850	0	13
PROMINENCE	Prominence of societal actors in research process (construct; from 1=scientists only to 5=societal actors only)	98	7.198	1.75	15.392	1	75
INFLUENCE	Influence of societal actors on research process (construct; 1=hardly any influence to 10=very strong influence)	76	8.708	7.1	8.253	1.8	44.2
DIVERSITY_OUTPUT	Number of publication types aimed at non-scientific audience used (out of 13 types)	69	3.435	4	1.440	1	7
Societal benefit variables							
SOCIETAL_IMPACT	Societal impact (construct; scale of 1 to 10; average of available responses)	60	5.767	6	2.308	1	10
CONTACTS	New or improved contacts as contribution to the knowledge infrastructure (construct; up to 23 categories)	67	5.507	5	3.249	1	14
Control variables							
PROJECT_BUDGET	Budget in euros	151	681578	351766	948886	58843	5657927
PROJECT_MEMBERS	Number of project members	171	18.409	7	24.978	1	142
Specific benefits							
IMPACT_1	Results were used in societal debates	55	6.509	7	2.705	1	10

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Variable	Definition and scale	N	Mean	Median	St. dev.	Min.	Max.
IMPACT_2	Results contributed to including climate change knowledge in investment decisions	53	5.358	6	2.440	1	10
IMPACT_3	Results created political support for climate adaptation measures	49	5.745	6	2.775	1	10
IMPACT_4	Results were used to support a decision to postpone climate adaptation measures	43	3.209	3	2.426	1	10
IMPACT_5	Project resulted in climate adaptation measures and strategies that were implemented	45	5.011	5	2.946	1	10
CONTACTS_NEW	New contacts were made	68	5.081	4	3.264	0	14
CONTACTS_IMPROVED	Existing contacts were improved	68	3.370	3	2.589	0	11

Table 3.2 Correlations between design variables, impact variables, and control variables (Spearman's rho)

	SHARE_ SOCIETAL	INFORMAL_ INVOLVE	PROMINENCE	INFLUENCE	DIVERSITY_ OUTPUT	SOCIETAL_ IMPACT	CONTACTS	PROJECT_ BUDGET	PROJECT_ MEMBERS
SHARE_SOCIETAL	1 (171)	.164 (94)	.180* (103)	.249** (76)	.034 (69)	0.117 (62)	-.026 (67)	.167** (151)	.547*** (171)
INFORMAL_INVOLVE	.164 (94)	1 (94)	-.073 (92)	.147 (73)	.414*** (66)	.379*** (59)	.562*** (65)	-.066 (88)	-.072 (94)
PROMINENCE	.180* (103)	-.073 (92)	1 (98)	.397*** (76)	.187 (69)	.482*** (62)	.150 (67)	-.033 (92)	.065 (98)
INFLUENCE	.249** (76)	.147 (73)	.397*** (76)	1 (76)	.227* (64)	.500*** (59)	.407*** (62)	.062 (71)	.115 (76)
DIVERSITY_OUTPUT	.034 (69)	.414*** (66)	.187 (69)	.227* (64)	1 (69)	.314** (60)	.552*** (64)	-.309** (65)	-.356*** (69)
SOCIETAL_IMPACT	0.117 (62)	.379*** (59)	.482*** (62)	.500*** (59)	.314** (60)	1 (62)	.465*** (59)	-0.007 (58)	0.016 (62)
CONTACTS	-.026 (67)	.562*** (65)	.150 (67)	.407*** (62)	.552*** (64)	.465*** (59)	1 (67)	-.144 (64)	-.176 (67)
PROJECT_BUDGET	.167** (151)	-.066 (88)	-.033 (92)	.062 (71)	-.309** (65)	-0.007 (58)	-.144 (64)	1 (151)	.590*** (151)
PROJECT_MEMBERS	.547*** (171)	-.072 (94)	.065 (98)	.115 (76)	-.356*** (69)	0.016 (62)	-.176 (67)	.590*** (151)	1 (171)

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* =p<.1 **=p<.05 ***<.01
Note: The shaded areas indicate correlations within the three categories of design, impact, and control.

3.5.1 Is transdisciplinarity real or token?

If hotspot projects are really transdisciplinary, we expect to find a difference between projects that were labelled as thematic and those labelled as hotspots. We first statistically compare the characteristics of the two types of projects. Since the data are not normally distributed, we use non-parametric independent samples tests (Mann-Whitney) to evaluate differences.[19] The results are presented in Table 3.3.

Societal actors are better represented, more involved (prominence), and have slightly more influence in hotspot projects than in thematic projects. This matches our expectation of transdisciplinary projects. However, the programme also required thematic projects to involve societal actors. As a result, societal actors had considerable influence in thematic projects. There is also no difference in the number of societal actors that were informally involved, in the diversity of output, or in the impacts on the knowledge infrastructure.

Surprisingly, there is no difference between hotspot projects and thematic projects in overall societal impact (averaged across five different types) or in their overall contribution to the knowledge infrastructure (averaged across two different types). When we examine the specific types of societal impact, the differences that remain relate to IMPACT_2 (results contributed to including climate change knowledge in investment decisions) and IMPACT_3 (results created political support for climate adaptation measures) where hotspot projects report higher impact. Hotspot projects also report a stronger improvement in contacts than thematic projects. The differences are, however, relatively small.

This comparison shows that there are clear differences in the design and size of academic and transdisciplinary projects, but few differences in their societal benefits. How well can we predict if a project has an academic or a transdisciplinary label in CcSP or KfC just by looking at design and size? We use forward binary logistic regression to test whether and, if so, with which variables we can predict if a project is transdisciplinary or academic. The model does not predict project labels very well. It has an initial accuracy of 76.2 per cent (assuming all projects are academic) and a final accuracy of 81 per cent. Out of 63 projects (48 thematic and 15 hotspots), 7 of the 15 hotspots (46.7%) were accurately classified, whereas 4 thematic projects (8.3%) were mistakenly classified as hotspots.[20] Control variables had no effect.

The only variable that seems to matter is the share of societal actors. Projects differentiate only by the most basic characteristic of transdisciplinary science (participation of societal actors) and not their role or influence, their informal involvement, or the diversity of output and size of projects. In short, we cannot predict based on design or size whether a project in our sample has an academic or a transdisciplinary label. In Mobjörk's (2010) terminology, this suggests that

19 Effect size is defined as small when $r \leq 0.1$, medium when $r \leq 0.3$, large when $r \leq 0.5$, and very large when $r \leq 0.7$ (Rosenthal, 1996). Please note the term 'effect' refers to a relationship, which may not necessarily be a causal relationship.

20 Dependent variable is PROJECT_TYPE and independent variables are SHARE_SOCIETAL, INFORMAL_INVOLVE, PROMINENCE, INFLUENCE, DIVERSITY_OUTPUT, PROJECT_MEMBERS. Results: N=61, model χ^2=111.698 (p=.001), Nagelkerke R^2 .270, Hosmer & Lemeshow p=.071.

societal actors within the programmes mainly have a consultancy role and do not really participate in research. This indicates symbolic involvement (Elzinga 2008) or symbolic compliance in terms of principal-agent theory (Leisyte 2007). The large share of projects with an intentionally academic focus appears to confirm Weingart's (1997) concern.

Table 3.3 Comparison of medians per variable for academic and transdisciplinary projects

	Thematic projects (academic)	Hotspot projects (transdisciplinary)	Results of Mann-Whitney test
SHARE_SOCIETAL	0 (118)	.2668 (53)	.000***
INFORMAL_INVOLVE	3 (75)	4 (19)	.397
PROMINENCE	1.75 (77)	2.25 (21)	.014***
INFLUENCE	6.8 (59)	7.6 (17)	.026**
DIVERSITY_OUTPUT	3.5 (54)	4 (15)	.288
PROJECT_BUDGET	392083.3333 (116)	293855 (35)	.027**
PROJECT_MEMBERS	4 (118)	18 (53)	.000***
SOCIETAL_IMPACT	5.375 (47)	6 (15)	.130
IMPACT_1	7 (43)	6.25 (12)	.934
IMPACT_2	5 (41)	6.75 (12)	.068*
IMPACT_3	6 (36)	7 (13)	.086*
IMPACT_5	5 (35)	6 (10)	.457
CONTACTS	4 (54)	6 (13)	.522
CONTACTS_NEW	4 (55)	5.67 (13)	.546
CONTACTS_IMPROVED	3 (55)	4.67 (13)	.093*

* =p<.1 **=p<.05 ***<.01

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From an inverse point of view, symbolic compliance may in fact be actual compliance. The academic projects in the two transdisciplinary research programmes also have characteristics associated with transdisciplinarity. They informally involve societal actors, they report considerable influence of societal actors on the research process, and produce about as many output

types aimed at societal actors as transdisciplinary projects. Academics working in the environment created by CcSP and KfC, in close (institutional) proximity to hotspot projects, may have been infected with transdisciplinarity.

3.5.2 Do transdisciplinary projects produce the expected benefits?

The projects in CcSP and KfC can consequently be considered as a single group of similar projects in terms of societal actor involvement. What is the relationship between the design characteristics of transdisciplinary science and the expected benefits? The purpose of involving societal actors in the two programmes is to achieve a number of societal impacts and to contribute to the development of a knowledge infrastructure.

We have used backward linear regression to examine this relationship for the entire sample of projects. The results are presented in table 3.4. The model for societal impact shows that the number of societal actors informally involved and their prominence have fairly strong effects on societal impact. What is remarkable is that the share of societal actors has a significant negative effect. The model for the contribution to the knowledge infrastructure shows that this particular benefit requires a different strategy. New and improved contacts are associated with the number of societal actors informally involved and the number of publication types aimed at non-scientific audiences. Controlling for budget, number of project members, and project type had no effect on the results. Respondents from the KfC programme report lower societal impact than those of the CcSP project, but this effect may be due to a time lag: KfC was still running, while CcSP projects are largely finished and have had more time to accumulate impact.

Table 3.4 Results of backward linear regression analysis at construct level (standardised coefficients)

Variables	SOCIETAL_IMPACT	CONTACTS
SHARE_SOCIETAL	-.244* (-1.774)	
INFORMAL_INVOLVE	.344* (2.741)	.313*** (2.843)
PROMINENCE	.449*** (3.369)	
DIVERSITY_OUTPUT		.454*** (4.117)
R^2	.268	.383
Adjusted R^2	.224	.360
F (p)	6.096 (.001)	17.041 (.000)
N	54	58

Note: t-values between brackets. p<.000. * =p<.1 **=p<.05 ***<.01.
The variables PROJECT_MEMBERS, PROGRAMME, and PROJECT_TYPE had no effect.

Societal impact and the contribution to the knowledge infrastructure are constructs based on items in the survey. Impact consists of four different items and contributions to the knowledge infrastructure of two. Table 3.5 shows that the impact variables are highly correlated, but also that the correlations are by no means perfect. Although one impact may contribute to another, they measure different dimensions of impact and are worthwhile studying separately (Martin 1996).

Table 3.5 Correlation between societal impact items (Spearman's rho)

	IMPACT_1	IMPACT_2	IMPACT_3	IMPACT_5	CONTACTS_ NEW	CONTACTS_ IMPROVED
IMPACT_1 (Results were used in societal debates)	1 (55)	.550*** (50)	.664*** (47)	.393** (40)	.537*** (53)	.531*** (53)
IMPACT_2 (Results contributed to including climate change knowledge in investment decisions)		1 (53)	.810*** (45)	.474*** (41)	.332** (51)	.326** (51)
IMPACT_3 (Results created political support for climate adaptation measures)			1 (49)	.612*** (39)	.621*** (47)	.325** (47)
IMPACT_5 (Project resulted in climate adaptation measures and strategies that were implemented)				1 (45)	.479*** (44)	.292** (44)
CONTACTS_NEW (New contacts were made)					1 (68)	.649*** (68)
CONTACTS_IMPROVED (Existing contacts were improved)						1 (68)

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* =p<.1 **=p<.05 ***<.01

Will an analysis at item level reveal the same patterns between the design variables and benefits as were found on the construct level? We repeated the backward linear regressions for each of the societal impact items and knowledge infrastructure items. Each benefit is associated with a different set of variables (Table 3.6), which suggests that each requires a special strategy.

Implementation of results profits (1) from a lower percentage share of societal actors who are, however, prominent involved in the project, and (2) from a larger number of informally involved societal actors. The first may relate to the effectiveness of translating project results into practical solutions; in complex problem areas with many societal actors, it is a challenge to turn available knowledge into actions (Nelson 1974; 2011). The second may relate to broader support for the solution in its context. This negative effect of the share of societal actors is only found for the implementation of project results.

Informal involvement and output diversity are the most pervasive design variables, affecting all but one or two impacts. These two variables are particularly associated with new or improved contacts and contributions to societal debates. Since informal involvement and output diversity are the most outward-oriented variables, this association seems logical.

Table 3.6 Results of backward linear regression analysis at item level (standardised coefficients)

	Societal debate	Investment decisions	Political support	Implement-ation	Improved contacts	New contacts
SHARE_SOCIETAL				-.439*** (-2.866)		
INFORMAL_INVOLVE	.381*** (3.162)			.427*** (3.068)	.215* (1.859)	.313*** (2.873)
PROMINENCE		.281* (1.992)	.264* (1.836)	.608*** (4.203)		
INFLUENCE	.286** (2.570)					
DIVERSITY_OUTPUT	.444*** (3.652)	.324** (2.296)	.386** (2.685)		.461*** (3.993)	.456*** (4.182)
R^2	.488	.236	.287	.409	.316	.389
Adjusted R^2	.452	.200	.250	.358	.291	.367
F (p)	13.634 (.000)	6.497 (.003)	7.834 (.001)	8.065 (.000)	12.922 (.000)	17.833 (.000)
N	47	45	42	39	59	59

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Note: t-values between brackets. p<.000. * =p<.1 **=p<.05 ***<.01.
The variables INFLUENCE, PROMINENCE, PROJECT_MEMBERS, PROGRAMME, and PROJECT_TYPE had no effect.

Giving societal actors a role in the research process (prominence) supports investment decisions and especially the implementation of results. At the construct level, there was no association between the two benefits and the influence of societal actors. However, this association does emerge when we distinguish very specific types of impact: giving societal actors influence is beneficial for using the results in societal debates. This tempers the suggestion that societal actors should be influential in all research phases and that the context of application should be taken into account from the outset to generate socially robust results (Gibbons *et al.* 1994; Pohl & Hirsh Hadorn 2008).

In short, there is an association between the archetypical properties of transdisciplinary research and the expected societal benefits. Explained variance of the models ranges from 20 per cent(investment decisions) to well over 40 per cent (societal debate). Controlling for number of project members, project type, or programme had no effect on the results. Roughly 55 per cent to 80 per cent remains to be explained.

In contrast to earlier findings (Walter *et al.* 2007), our results suggest that societal benefit is associated mainly with the characteristics of consulting transdisciplinarity rather than participa-

tory transdisciplinarity. Benefit is achieved through informal involvement and a diversity of outputs, and much less by giving societal actors a prominent role or influence in the research process.

3.6 Conclusion and discussion

Scientists are expected to produce benefits for society and, in evaluations and grant proposals, prove that they did. They need to take this expectation seriously: token compliance is no longer sufficient. Realising societal benefits requires a custom design: it must be embedded in the organisation of research, particularly by involving societal actors in the research process. Societal actor involvement is considered an effective approach to achieving societal impact.

In this paper, we have examined two strategic research programmes in the Netherlands, Climate changes Spatial Planning (2004-2011) and Knowledge for Climate (2008-2014). These programmes take a transdisciplinary approach to climate adaptation research. With a combined budget of 180 milion euros, scientists may have been tempted to comply de jure rather than de facto with requirements to involve societal actors. Using a survey among members and project leaders of 178 projects, we have examined two questions related to compliance in the principal-agent relation between a programme and its projects. The first question concerns the risk of moral hazard: is societal actor involvement a token activity or a substantial component of the research process? The second question relates to possible adverse selection: does societal actor involvement produce the expected benefits and, if so, under which conditions?

There is no reason to suspect large-scale moral hazard (Guston 1996). A comparison of projects formally labelled as transdisciplinary and academic reveals that the former have characteristics typically associated with transdisciplinarity but also shows that academic projects share those characteristics. One reason for this similarity is that these particular academic projects were also required to involve societal actors. In fact, some of the academic projects are managed by societal actors. This supports the argument that research evaluations should consider the context of a project (De Jong et al. 2011). A mere focus on goals and outcomes may result in an inconclusive assessment. Another possibility is that elements of transdisciplinary research may have spilled over into the academic projects through the project members they share. A large proportion of the academics involved in the programmes is engaged in multiple projects, both academic and transdisciplinary.

There is also no reason to suspect adverse selection (Guston 1996). As expected, transdisciplinary research was found to have a positive effect on societal benefits. The design and organisation of projects in two climate adaptation programmes is associated with various types of societal benefit. They can be considered an appropriate approach to generating the societal benefits government expect of research programmes: share knowledge with relevant societal actors to facilitate innovation, and sustainably improve the knowledge infrastructure (Van der Meulen & Rip 1998).

Evaluating the societal impacts of research remains challenging. We have explored this relationship using quantitative analysis. Three limitations must be discussed. First, researchers in successful projects may have been more inclined to answer the survey than researchers in less successful projects. Non-response analysis in a comparable survey among participants in the

same two programmes in 2010 suggests that this did not occur (Merkx *et al.* 2011). Second, some of the main variables are based on self-reporting by researchers. Societal impact is actually impact as perceived by scientists who participated in projects. We did not include societal actors in our survey, primarily because their responses are inherently different (they tend to provide the organisation's view rather than their own) and because representatives changed as the programmes progressed. A pragmatic argument is that self-reporting is a common approach (e.g. Pohl 2005; Landry *et al.* 2007; Masse et *al.* 2008; Pohl 2008; Van der Weijden *et al.* 2012; Olmos-Peñula *et al.* 2014). And third, self-reporting might guide the results: if the project was designed to produce an impact, then that impact must have been produced. However, projects and project members were queried individually, which means that respondents had no opportunity to scale or coordinate their responses.

Our discussion of the limitations suggests that a contribution to the literature which includes the societal actor perspective on the research process and the achieved benefits is urgently needed. In addition, our findings may be of value to many other fields – ranging from sociology to biotechnology – in which researchers are working to solve problems that involve a variety of affected actors (Whitley 2000). Future research should investigate how researchers in other fields and problem areas produce societal impact. Comparative studies are needed because the sectoral background of societal actors matters (Bekkers & Bodas Freitas, 2008). Finally, our models leave a substantial part of variance unexplained (between 6 per cent and 80 per cent). Even though this high percentage is quite common in social science studies, it begs the question what factors and circumstances account for the remainder. Possible answers are funding sources, research group size, and group leader experience (Van der Weijden *et al.* 2012), cultural barriers (Siegel *et al.* 2003), the quality of the scientific research (Hewitt-Dundass 2012), individual characteristics of researchers, such as previous experience in interacting with societal actors (D'Este & Patel 2007), and political and economic conditions. And even if all such variables had been included, a degree of variance would remain, because benefits can be generated by accident or serendipitously (Molas-Gallart *et al.* 2002).

Our results have implications that deserve consideration by policymakers. Firstly, the design of research programmes and projects must be customized towards the needs of the specific societal benefits they aim to generate. Societal benefit is a multidimensional concept. Each impact requires its own approach and what works for one type of benefit (e.g. informing societal debate) may not work for another (e.g. new contacts). Secondly, our advice is to reconsider the emphasis on formal involvement of societal actors in funding procedures. Formally involving societal actors is a common criterion in research funding science. Also, societal actors are regularly required to co-fund research. Our results suggest this may not have the expected result. It is important to be aware of and facilitate informal interactions (Olmos-Peñuela *et al.* 2014) as well as to assess strategies to informally involve societal actors, as this may be a source of additional gains.

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4 Understanding societal impact through productive interactions: ICT research as a case[21]

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Abstract

Universities are increasingly expected to fulfill a third mission in addition to those of research and education. Universities must demonstrate engagement with society through the application and exploitation of knowledge. As societal impact of research is uncertain, long term and always dependent on other factors, we argue here that evaluation should focus on the conditions under which societal impact is generated rather than on the impact itself. Here we focus on a specific set of those conditions: the interactions between academic researchers and societal actors. Instead of speculating about potential impacts of research, we argue that current productive interactions of researchers with societal stakeholders improve the probability that future societal impact will occur. This article supports this idea by examining in detail several, mainly retrospective examples. As productive interactions are field specific, we restrict ourselves to 'professional adhocracy fields', especially to information and communication technologies (ICT) research. We address the patterns of productive interactions that result in societal impact within this field and we discuss whether differences are observed in contrast to other fields, such as social sciences and humanities (fragmented adhocracies). We end by discussing the implications that these patterns have for societal impact assessment. Shifting the focus to interactions allows assessment of short-term knowledge transfer and other collaborative efforts with stakeholders that contribute to long-term societal impact.

4.1 Introduction

Beyond education and research, universities are increasingly expected to realize their 'third mission'. These 'third mission' activities of universities are meant to stimulate the application and exploitation of knowledge for the benefit of the social, cultural, and economic development of society. They shape the interaction between universities and academic research with the wider society (Pålsson et al. 2009; Tran 2009). Several concepts have been suggested for

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this interaction in the academic literature including 'Mode 2 knowledge production' and the 'Triple Helix of university-industry-government relations' (Gibbons et al. 1994; Etzkowitz & Leydesdorff 1998; Hessels & Van Lente 2008). However, these remain at a rather general level and do not help to assess societal impact at the level of individual research projects and programs. For this, a range of methods have been proposed, developed and sometimes tested (Davies et al. 2005; Bozeman & Sarewitz 2011; De Jong et al. 2011; Donovan & Hanney 2011; Spaapen & Van Drooge 2011). Inspired by these concepts and methods, science policy makers and funding agencies have introduced a variety of instruments to stimulate relationships between science and society, including European Framework Programs, the Dutch Bsik-FES programs, and the UK Economic and Social Research Council's Science in Society Program.

Simultaneously, (experimental) indicators for societal impact are increasingly included in national research evaluation exercises. The swift conversion of societal impact assessment from craftsmanship to standard and routinized activity in research evaluation and by funding agencies leads Ben Martin (2011) to fear that *'. . . we may be in danger of creating a Frankenstein monster'* as it remains unclear what impact exactly is and how it can be stringently and soundly evaluated. A wide range of definitions exist for the concept of societal impact. Bornmann (2013) identifies three main strands of societal impact definitions that have been developed in research evaluations since the 1990s. These strands seem to represent three subsequent stages in the process of research having impact:

1. Societal impact as a *product*: Knowledge with a potential societal value is embodied in a product that may or may not be used by societal audiences (Boekholt et al. 2007). Among these products, one may distinguish between information, products, tools and instruments, methods, and models. An example is the summary for policy makers of the report 'Managing the risks of extreme events and disasters to advance climate change adaption' issued by the IPCC (2012);
2. Societal impact as *knowledge use*: Interaction processes between researchers and societal stakeholders may result in the adoption of knowledge by the latter (Moffat et al. 2000; Roessner et al. 2006; Castro Martinez et al. 2008). Knowledge use may be facilitated by a product (the use of a policy report by civil servants) or a person (researchers as consultants);
3. Societal impact as *societal benefits*: The effects of the use of research results is the meaning here. Within this category, many notions of societal impact can be found. The focus can be on policy, professional practice, business or on wider impacts, such as the impact on culture, media and community. Impact can have the form of jobs and education (Library House 2006), or network building, trust, and community formation (Walter et al. 2007)[22].

There is no clear consensus yet on how to evaluate social impact. In research evaluation differences between fields create challenges for comparison (Donovan 2007; Lane 2010; Martin

22 The things that are regarded as benefits very much depend on the perspective of the relevant actor, for example creating new jobs may be the objective of a politician, but the reduction in the number of jobs may be the aim of an entrepreneur who deploys new knowledge to rationalize work processes.

et al. 2010); the same holds true for the evaluation of societal impact (De Jong et al. 2011). Furthermore, many proposed societal impact indicators shed light mainly on economic impact (for example, Health Economics Research Group et al. 2008) and health impacts (Bensing et al. 2004), and therefore there is a need for a broader set of societal impact indicators able to capture other kinds of societal effects.

Scholarly output indicators can at most suggest a picture of potential societal impact, and it is well-known that the links between scholarly output and societal use and benefits are generally indirect and time-lagged. These problems are related to temporality and attribution; it often takes a long time for societal impact to come about and impact often is mediated and moderated by a variety of actors and events, both scientifically and societally. This would imply that evaluating societal impact can only be done through in-depth case studies—a rather time and resource consuming procedure as currently adopted by e.g. the UK *Research Excellence Framework (REF).*

Process indicators can overcome the problems of temporality and attribution, and at the same time solve the problem of resource intensive research assessment. If we know what process characteristics correlate with (often only long-term) impact in terms of use and benefits, these process characteristics can be used as a proxy for societal impact. They actually show the smart efforts made by researchers to contribute to societal impact. For example, the type and intensity of interactions between researchers and stakeholders may be a reliable predictor of societal outcomes in the long run.

To date, however, process indicators are less well researched. Societal impact process indicators should be based on an improved understanding of the complex interactions between academic researchers and societal stakeholders. What is known about which interactions are important, or even required, for research to have impact?

- Two types of interactions can be distinguished in the literature: direct and indirect interactions. Direct interactions are established by academic researchers with stakeholders during and after the research process. These interactions may generate relevant research questions, may improve access to financial and material resources, and may support knowledge diffusion (Bozeman & Coker 1992; Molas-Gallart et al. 2000; Cowan & Patel 2002; Molas-Gallart & Tang 2007; Academy of Finland 2009). In the process of stakeholder involvement, personal interaction between researchers and stakeholders may accelerate research uptake (Meagher et al. 2008; Brousselle et al. 2009). The involvement of key persons, such as high level civil servants, have been found to increase success chances (Molas-Gallart & Tang 2007; Kennedy et al. 2009; Krücken et al. 2009). Alternatively, malfunctioning personal interaction hampers research achieving societal impact (Kingsley et al. 1996). Indirect interactions are mediated through information carriers. For instance, this can be in the form of texts (Molas-Gallart et al. 2000; Molas-Gallart & Tang 2007; Health Economics Research Group et al. 2008; Prins 2008) and of technological artifacts (Kingsley et al. 1996; Kingsley & Farmer 1997).
- Interaction processes with stakeholders are subject to field specific dynamics. Different fields are characterized by different research dynamics, based on internal factors as well as

on contextual factors. Research dynamics are fundamentally related to the organizational characteristics of a field. For example, if in a certain field researchers depend less on peer recognition for careers and funding, they have more freedom to address a large variety of audiences. If there is no clear hierarchy between these audiences and if they have different objectives, the dependence of scientists upon any single audience is lower than in the case of a strict hierarchy. In cancer research, for instance, the objective of patients and scientific peers are different. For instance, funding by patient organizations in addition to research councils, facilitates the introduction of practices and aims that go beyond the purely scientific (Whitley 2000). Verbree et al. (2013) indeed found that medical research groups have a wide variety of funding sources, indicating a wider variety of audiences.

– Interactions can be rather complex. The network configuration, the actors (researchers, intermediaries and stakeholders), research fields, and societal sectors involved may all influence societal impact and the way it is, or isn't, generated (Molas-Gallart et al. 2000; Krücken et al. 2009). There is an urgent need for more in-depth study of these interaction processes. Cozzens et al. (2002) suggest the challenge in measuring societal impact is due to a paucity of well-developed models explaining the processes leading from innovation to impact. In a report about the value of medical research, the Health Economics Research Group et al. (2008) stated that there is consensus in the academic literature about the existence of societal impact of academic research, but that it is less clear how different processes of knowledge transfer contribute to it. In their study of the impact of a German university on its geographic region, Krücken et al. (2009) argue that there is a need for additional studies to completely grasp the fundamental dynamics of knowledge transfer. Jensen et al. (2008) pleaded for more qualitative research on the interaction mechanisms deployed by academic researchers.

To summarize, (i) previous research has resulted in limited knowledge on how field specific interactions between academic researchers and societal actors relate to the societal impact of academic research, and (ii) evaluation methods generally have neglected these interactions so far. In the SIAMPI project[23] we investigated how information about interaction processes between academic researchers and their stakeholders can be made productive for evaluation purposes. Molas-Gallart & Tang (2011) applied the approach to social sciences and humanities (SSH) cases. Their conclusion is that it offers a way to deal with attribution problems that are widespread in the evaluation of these fields, as SSH research dynamics are intertwined with social and political developments. Moreover, mapping productive interactions helped researchers to reflect on their engagement with users and society.

In this article we extend the SIAMPI approach to other fields than social sciences and humanities (De Jong et al. 2011; Molas & Tang 2011). We focus on the class of fields labeled 'professional adhocracies' (Whitley 2000), which include engineering, artificial intelligence, and biomedical sciences. These fields are different as they combine standardized research methods with a wide variety of audiences. Other fields either have highly varied audiences but low

23 Social Impact Assessment Methods for research and funding instruments through the study of 'Productive Interactions' (SIAMPI), a European FP7 project grant number 230330.

standardization of research procedures, for example the social sciences (fragmented adhocracies) and humanities (polycentric oligarchies), or have highly standardized research procedures but a small variation in audiences (technologically integrated bureaucracies), such as chemistry.

Despite the variety of audiences, in professional adhocracies performance standards are mainly set within the peer community. Other audiences have less influence on evaluation criteria (Whitley 2000). Consequently, on the one hand serving highly varied audiences is intrinsic to these fields, while in evaluations emphasis is on the academic audience. This creates a tension in adhering to standards set by the peer community on the one hand and being relevant to varied audiences on the other hand. Furthermore, professional adhocracies display a high variation of research topics within each field. If commercial applications exist, the variety increases even more (Whitley 2000). Mapping productive interactions in one of these fields has to take into account a wide variety of research dynamics and thereby serves as a serious test for the method. By so doing, we hope to contribute to a better understanding of how societal impact is produced in a variety of research fields and also contribute to improving research evaluation of these fields. The questions we will answer about 'professional adhocracy' fields are: (1) Can we relate societal impact to (past) productive interactions? (2) If so, what are the implications for societal impact assessment of these fields? To answer these questions, we will present four examples of information and communication technologies (ICT) research that were analyzed using the SIAMPI method.

The following section explains the method, data, and discusses the selection of the cases. The subsequent section describes four examples in terms of the observed productive interactions and the observed societal impact. The fourth section presents a comparative analysis of the examples, leading to impact indicators presented in section five. The concluding section reflects on the value of the SIAMPI approach for the evaluation of societal impact.

4.2 Method and cases

To answer our research questions, we co-developed the SIAMPI approach (Spaapen & Van Drooge 2011), which is based on the earlier Evaluation Research in Context (ERiC) project (De Jong et al. 2011). At the core of the approach is the notion of productive interactions. Productive interactions are defined as encounters between researchers and stakeholders in which both academically sound and socially valuable knowledge is developed and used. The method distinguishes direct interactions from indirect interactions, as described above. Within these interactions, different carriers may be distinguished, like, for instance, funding. Knowledge production and transfer are considered interactions rather than impacts. Interactions are also characterized by their duration and the resources involved. Examples of resources are intellectual property rights (IPR) agreements, financial contributions, and societal or economic use of research equipment (Horlings et al. 2012). Research impact occurs when stakeholders change their attitudes, opinions, and behavior based on the research outcomes. Stakeholders are broadly defined as all the actors involved in the process that leads to societal impact. This includes societal actors such as governments, NGOs, industry and consultancy firms and also researchers from other fields that take up knowledge and further develop it. In order to identify the interactions that relate to (later) impact, we adopted an exploratory case study approach. At the same time the study had to show how it might be used in evaluation

procedures and therefore it had to be restricted in terms of resources used and time. In other words, the function of the case studies is a proof of (impact evaluation) concept. In the concluding section we discuss additional research that is needed to further underpin the evaluation approach.

From the professional adhocracies fields we selected ICT research because we expected to find a large variety of productive interactions in this field. ICT has a wide range of applications that permeate society throughout various sectors including the commercial sector, applications within government and in research and education. We selected two cases in two different evaluation contexts—a research program and a university department. The first is a society-oriented multi-university research program with multiple stakeholders involved from the outset; the second is a single university research department with no pre-determined stakeholder audiences.

The UK digital economies research program[24] is funded by four UK Research Councils, and has a broad societal aim: to bring about the transformational impact of ICT for all aspects of business, society, and government. Within the program, we selected a project in which two universities cooperate with a variety of societal stakeholders. These are multinationals in the ICT and electronics sector, local organizations including patient and government organizations and some 3000 volunteers from the region, including people from a range of age groups and with a variety of disabilities. Under these circumstances, we expected to find many productive interactions between ICT researchers and their stakeholders. The university department is a computer science department located in a Netherlands university. It has an excellent scientific reputation, in a broad range of areas including both theoretical and applied computer science. Research undertaken by the group is heavily funded through EU and national research programs. In addition there is evidence of interdisciplinary collaboration by computer science staff with economists and social science researchers. Within the department we have selected one basic and two more applied research groups.

Data collection is mainly based on in-depth interviewing, since interactions often are not recorded in documents (Spaapen & Van Drooge 2011). Separate interview protocols were developed for researchers and stakeholders. The researcher protocol includes the following item categories: interviewee profile; research context in terms of users; mechanisms of interaction and outcomes/ impacts. The stakeholder interview includes items on: interviewee profile; knowledge context in terms of use of academic knowledge; mechanisms of interaction with the academic researchers on the one hand and their own stakeholders on the other hand and outcomes/impacts for/on their organization.[25]

From a wide variety of examples resulting from the interviews in the two cases, we selected four to illustrate the diversity of interaction patterns and impacts we found in ICT research. Three

24 http://www.rcuk.ac.uk/research/xrcprogrammes/Digital/Pages/home.aspx accessed 5 May 2012.

25 In this study, stakeholders are broadly defined as beneficiaries of the ICT researchers that have been interviewed. NGO's, funding agencies, governments and private companies, other scientific researchers, such as biologists and medical scientists are included.

examples were taken from the department and one from the program. The examples differ in several dimensions: type of research (basic versus applied); stakeholders known from outset or not; inclusion of stakeholders in research or not; and whether impact was achieved or not (yet). In the first project, it took 10 years from basic academic knowledge to societal impact. Here, a potential audience was not identified at the outset of the project. The second project also involves basic research, but a potential audience was identified and targeted from the onset. However, at the time the case study was undertaken there was no societal impact yet identified. The third project is again about basic knowledge, but in this instance there is a chain of academic researchers from different fields who have all contributed to the current impact. The fourth project deals with applied research in which a target audience was not only identified from the outside of the project, but was also included in the project from the beginning. An additional reason to select these four projects is that they could be reconstructed into sufficient detail to allow analysis.

Data were primarily obtained through 1–2 h semi structured interviews, following the SIAMPI interview protocols, which we adapted to the ICT field. In the case of the computer science department, we interviewed four researchers, the leaders of the selected projects and the head of department, and five dominant stakeholders. For the UK research program, we conducted 18 researcher interviews and 3 stakeholder interviews. They were selected because of the breadth of activity undertaken in the case study.

The interviews were recorded and fully transcribed. The interviews protocols were color coded, in order to identify the various types of productive interactions, as well as the outcomes and social impacts. Alongside the interviews, texts such as websites, annual reports, policy documents, and evaluation reports were used to obtain contextual information. The second interviewer checked the transcripts and the coding. The interviewed researchers and stakeholders checked the descriptions of the projects, and they gave feedback to correct factual mistakes. Researchers and stakeholders draw their own pictures, but they proved to be consistent with each other. The overall analysis of the department case was presented to and discussed with the head of the department.

The program is a multi-activity example and for the purpose of this article one activity was selected on which to focus our analysis. The SIAMPI team interviewed four researchers and three stakeholders involved in the Ambient Kitchen project, next to a large number of researchers and stakeholders active in other activities of the program. The project website and publicly available outputs were consulted. Feedback from the relevant departmental head highlighted the early stage of the productive interactions, and the ambitions of the project at that time. A more detailed analysis at the current time could identify a broader range of interactions that took place during the project and beyond.

4.3 Findings

This section presents our findings on the selected four projects. For each case, productive interactions and impacts are described, together with factors that influenced the interactions and impacts of the research.

4.3.1 Project 1: Applying semantic technologies in the development of forensic software

A professor of a Dutch research group in knowledge representation and reasoning was involved in a 10 year research effort during the 1990s that resulted in a standard language for ontologies for the World Wide Web. The language developed facilitates software applications *'that need to process the content of information instead of just presenting information to humans'*[26]. The research undertaken resulted in new standards for the semantic web and in one of the best-cited (and awarded) papers in the field. The impact on the development of the semantic web is also an obvious societal outcome of the research.

Furthermore, the research resulted in a spin-off company, which is the focus of the first case. Over the years the company employed many former Masters and Doctoral students of the group. In 2009 after 10 years of research and development, the company launched a software product for forensic research, which allows intelligent investigation of large numbers of e-mails and data files. The product became a success. Four phases of interactions can be distinguished in the process from academic research to product launch.

I. Between 1998 and 2001 academic knowledge was being developed into technology. The leader of the academic research project took part-time leave from the university in order to be involved in the new spin-off company, which was founded by a former classmate and personal friend of his. Engineers were hired from a polytechnic where the owner of the company had been employed. In this phase, his most important role was demonstrating the potential value of the technology. The professor and the company signed an IPR agreement stating that all IPR would rest with the company. In this phase, the professor and employees of the company co-authored a number of scientific papers, which were presented at academic conferences.
II. From 2001 to 2005 the company was involved in projects to demonstrate the viability of the technology. The goal was to translate the academically developed technology into a practical tool for use outside the university. The owner of the company financed the R&D. Pilot projects were undertaken in the building industry and in the education sector amongst others. The company also participated in EC funded projects with various academic institutes and large firms, large telecom and insurance companies. Every 3 months meetings were held with the professor, in which he had two main roles. First, he served as the company's antenna in academia, for example by highlighting upcoming new standards and formats to take into account. Second, he brought in his network. The university based research group provided the company with skilled employees and interns, who served as an additional interaction mechanism between himself and the company.
III. The phase of product development began in 2006 and ended in 2008. In this phase the goal was to slim down the tool to its essential core. The role of novel academic knowledge became less prominent and meetings with the professor were held only twice a year. His role shifted towards providing complementary knowledge rather than providing state of the art advice. The company shifted its focus towards the market. *'We [the company] said: 'we will make it a success', so we could not stay in our ivory development tower, we had to*

26 http://www.w3.org/TR/owl-features/ accessed 5 May 2012.

go into the field and talk to police departments, we had to give presentations . . .' In this phase, the need for knowledge on marketing and software engineering grew. Knowledge on licensing and financial investments was obtained externally.

IV. From 2009 onwards the focus has been completely on marketing. The relation between the university and the company now is maintained through the scientific board of the company, of which the professor became a member. A joint venture with a software vendor with market knowledge was created to enter the market. Within 9 months a worldwide sales organization was established to distribute the software. The product is marketed in combination with training on how to use it and has already been sold to police departments in the Netherlands, China, and the USA, and to international accountancy companies. It is used to investigate digital information in the fight against crime and fraud.

In terms of the three approaches to impact, this case is an example of impact as a societal benefit. More specific, the research resulted in economic and safety impacts.

4.3.2 Project 2: Using knowledge representation for analyzing the consistency of medical protocols

When asked for his best recent paper, a Dutch researcher in knowledge representation and reasoning mentioned a paper in which he and his colleagues demonstrated that medical knowledge could be represented using reasoning tools based on mathematical logics. They were the first researchers to achieve this. The project was funded by the European Commission through a FET-open grant; a grant for blue-sky research in future and emerging technologies in ICT[27]. The test case in this project was a medical protocol for breast cancer treatment. Initially, medical researchers thought that it would be impossible to capture medical knowledge into logics because it would be too complicated. Experts from logics, on the other hand, thought that it would be impossible because medical knowledge would not be precise enough to do so. After a few years of research in an international consortium, the approach was successfully applied on the case of a protocol for the treatment of breast cancer. The stakeholder involved in this project is an institute responsible for improvement of quality in health care, including medical protocols. The researchers collaborated intensively with the institute but not with medical researchers themselves. One of the results of the project was that existing treatment recommendations proved to be inconsistent.

Regardless of the success of the method and its obvious potential value for medical practice, the societal impact of this research has remained only limited to present date. The researcher explained that apart from financial investments outweighing quality improvement, the method was too far ahead of its time to have been already incorporated into medical practice. Applying the method requires skills, which are hardly available, and the deployment of formal reasoning in medical practice would require substantial changes in existing routines and culture. Absorptive capacity to deploy the method is lacking at the level of the every-day medical practice. Therefore, IPR agreements have never been made, since from the beginning it was clear the project would not result in a marketable tool. Nevertheless, because of the study, an

27 http://cordis.europa.eu/fp7/ict/programme/fet_en.html accessed 21 Mar 2013.

institute responsible for improvement of quality in health care realized it should improve its internal quality procedures.

Unlike the previous case, the principle investigator is not investing any additional effort into stimulating societal application for the method as he does not consider it to be his responsibility and there is a lack of incentive to be involved in third mission activities. *'Do we try to keep it in the spotlight so . . . no . . . that is unrealistic. Knowledge transfer . . . to say it bluntly . . . I'm neither paid nor rewarded for knowledge transfer or directed towards it . . . to be honest . . . I did not become a scientist to do those things.'*

This does not mean the efforts invested into developing the method were not of any use. The research is being taken further by the same principal investigator in a new project that aims to integrate static data in personal health records into the dynamic data of the protocols. Integrating static and dynamic data is a scientific challenge in computer sciences, with potential societal benefits. Knowledge on formalizing dynamic data gathered in the previous project is used in this project. In terms of the interaction types, the uptake of the method by other societal relevant projects may lead to indirect societal benefits.

To summarize in terms of the impact concepts distinguished in the introduction, the knowledge developed in the project described here clearly resulted in a product whose value was clearly acknowledged by societal stakeholders. However, the sectors' absorptive capacity is simply not large enough to use this type of innovation at this moment and turn it into a societal benefit, as it is not compatible with existing practice and skills. The approach developed in this project may turn out to be a necessary contribution to changes in practice but in isolation it is not sufficient for change.

4.3.3 Project 3: Using imaging technology to increase diagnostic efficiency

In 2003 the Dutch government funded nearly 40 new research programs at a total cost of 802 million euro The overarching goal of these 4–8 year programs was to strengthen the future national knowledge base[28]. One of the aims of the programs was the translation of basic knowledge into new products, processes or societal concepts. Consequently, the program leaders had a responsibility for knowledge transfer and dissemination.

One of the programs was the Virtual Laboratory e-science program (VL-e), which aimed to improve e-sciences by developing facilities and methodologies. VL-e had a Medical Subprogram, and within it a Medical Diagnosis and Imaging Project focused on recognition of digital images. This project resulted in a software tool that is now widely used within a university medical center. The tool is expected to contribute to finding a cure for Alzheimer's disease at a much faster rate than had the tool not been developed.

28 http://www.agentschapnl.nl/programmasregelingen/besluit-subsidies-investeringenkennisinfrastructuur-bsik (6-12-2011) accessed 6 Dec 2011.

The software tool is based upon the work of a research group on high-performance distributed computing. The group develops methods for digital image recognition and had generated a generic software platform for distributed computing. This software platform was further developed within the VL-e program. There, collaboration emerged between researchers from the ICT research group and a senior researcher in medical informatics at a university medical center. The goal of the latter was to improve the ICT environment within the center. After a few meetings the senior researcher started to adapt the generic software to the environment of the center. He needed a test case to develop the software further. At the medical center he approached a radiologist who was studying brain images to identify biomarkers of Alzheimer's disease. Pharmaceutical companies used these markers in clinical trials. The software he used to study the images was rather slow and it took half a year to analyze the thousands of images resulting from his research. The radiologist, however, was reluctant to use the newly developed software tool, since he was not able to see its value. By coincidence, the radiologist happened to play field hockey with an employee of an ICT support organization who had supported the senior researcher in his research. *'But also it turns out that the medical doctor, the radiologist, who doesn't know much about computers but is a very good radiologist, understands shrinking brains, happens to play field hockey with the ICT support person at [. . .] that I was dealing with. So they talked.'*

The ICT support person convinced the radiologist to try the software tool. From that moment on, the radiologist and the senior researcher had many conversations about what ICT had to offer and about the radiologists' needs.

Despite the fact that the distributed computing researchers had to continue working at the forefront of their own field, they remained involved in the development of the software. The senior researcher in medical informatics served as a translator between the distributed computing group and the radiologist. The computer researchers preferred to provide academic support through e-mail and over 700 e-mails in total were sent back and forth. Ultimately, a software tool was developed to study brain images 300 times faster than before. An analysis that previously took half a year to complete could now be done overnight. In terms of impact definition, in this case there is a clear change in practice because of knowledge use by stakeholders. The change in practice has resulted in a societal benefit of ICT research, if medical researchers are considered stakeholders of ICT researchers.

In spite of the cooperation in the project, disciplinary boundaries made it impossible for the computer scientists and the researchers in the medical center to produce joint publications. What is frontier research in the medical imaging field is considered applied research in ICT research. Therefore, the ICT researchers did not invest in a joint research paper, as they expected publication in the core journals of their field to be problematic.

4.3.4 Project 4: Developing technologies to assist domestic living

The Digital Economy Program[29] is a nationally focused cross-research council program from the UK. It is aimed at providing capability in the early adoption of information technologies by business, government, and society and focuses on the transformational effect that these technologies can have. One of three UK research hubs funded through the Digital Economy program is the Social Inclusion through Digital Economy (SiDE) hub, a collaboration between two universities who have worked together on previous projects on ageing, assisted living, and associated technologies. The hub addresses some key strategic and applied research questions, which aim to yield innovations across the fields of technology, social science, business, and user engagement in research.

One of the projects in the hub is the Ambient Kitchen. This is a lab-based project through which the research team explored the use of pervasive computing for assisted living. In brief, The Ambient Kitchen embeds sensors in the kitchen environment, for example in the floor, cupboards, kettles and food containers that allow the kitchen to be aware of how food and utensils are being used. Tags integrated in food items and appliances, together with sensors integrated into the bench and cupboards, allow the location and changes in location of objects to be monitored and a pressure sensitive floor allows people in the kitchen to be tracked[30]. The project team are particularly interested in supporting the elderly and those with dementia.

The Ambient Kitchen is a research platform and the software is in a constant stage of development and redevelopment. The Ambient Kitchen is a collaborative, university- led research project involving significant numbers of users in several different 'groups'. Interactions between researchers, volunteers, and stakeholders are structured from the outset into the Digital Hub project. It includes researchers offering regular demonstrations for a variety of groups such as university students, representatives from other universities, members of the public, city council members, company visitors, and the media of the technologies developed by the project. The concept of delivering demonstrations to a variety of groups was planned but the type of audience is subject to opportunities emerging during the timescale of the project.

The project aims to work with volunteers, including people from a range of age groups and with a variety of disabilities. Recruiting to the volunteer pool has been carried out through local governmental departments and local charities including Years Ahead, the Regional Forum on Ageing and The Alzheimer Society. The panel of volunteers is contributing to the formulation of research strategy and the evaluation of the research outputs, as well as being engaged in participatory design, co-design, and evaluation activities to ensure that the outputs of the research program are both meaningful and usable.

Other interactions factored into the planning of the project included membership by the Digital Hub researchers of various charities which were engaged in the research to help recruit users. Being involved with the charities helps the research teams to maintain strong links with the user

29 http://www.rcuk.ac.uk/research/xrcprogrammes/Digital/Pages/home.aspx accessed 19 Jan 2012.
30 http://culturelab.ncl.ac.uk/ambientkitchen/ accessed 19 Jan 2012.

community and to develop the applications. The involvement of researchers may be personal but provides a link that can be exploited for the benefit of the research activity and the charity's community.

As the project is ongoing at the time of writing, the full impact has not been realized yet. It is however clear that work on the Ambient Kitchen includes many different productive interactions between scientists and societal actors in the form of publications, awareness raising and liaising with stakeholder groups. The latter will help in articulating user needs and in generating feedback on new products and services.

In terms of the types of impact, and the interaction types, this case is an example of societal impact as knowledge use: Interaction processes between researchers and societal stakeholders results in adoption of knowledge by the latter.

4.4 Comparative analysis

The previous section described four different examples of research projects (within a department and within a program) with their specific audiences, productive interactions, and types of impacts—as summarized in Table 4.1. This section aims to analyze the cases and collect the building blocks for indicators to assess professional adhocracies based on an understanding of their research dynamics. ICT research, as expected, has a wide variety of stakeholder audiences (Table 4.1). In some cases, such as the Ambient Kitchen, quite a few direct stakeholders are involved, such as volunteer groups, charities, and city council members. In other cases, such as the forensic software, only one stakeholder was involved. In the knowledge representation example, one direct stakeholder was involved and a large set of indirect stakeholders.

We have found a variety of productive interactions between ICT researchers and their stakeholders (Table 4.1). There are direct interactions, including demonstrations in the Ambient Kitchen, indirect interactions such as the software in the medical imaging project where hundreds of emails were exchanged and financial interactions, for example the investments in the forensic software project. In some instances interactions are straightforward, as in the forensic software project, or complex as in the medical imaging and the medical guidelines cases.

What does seem to be important for the creation of social impact are interactions that take place after the research has been completed, as a comparison between the forensic software case with impact and the medical protocol case without impact demonstrate. Both technologies were promising and in the medical protocol case stakeholders acknowledged the value of the research. In the first case the investigator was committed to further development of the knowledge, since the owner of the company was a personal friend and many employees were his former masters and doctoral students. It is not (mainly) the incentives of the research system, but the social network of the involved researcher that seems to be an important factor. In the latter case, without such network relations, the researcher was not committed to further development of the technology.

Comparing the cases, productive interactions can occur in basic research as well as in applied research. There does, however, seem to be an important difference between basic and applied

research configuration. In basic research projects, it is not clear from the outset what end-users might benefit from the research, which makes it difficult to include them directly. As a result the impact of basic research is often dependent on more or less complex 'knowledge production chains' with many interactions in each link. A stakeholder in one link can be the researcher in the next. This type of configuration may yield generic basic research results with a wide range of potential applications. The knowledge production chain can have different branches resulting in different applications of the same generic research results. An example is the medical imaging project. In applied projects the end-user is more likely to be known and therefore can be included in the project from the start, as we have seen in the Ambient Kitchen case. In that case, research is conducted in a 'beehive' configuration, where researchers from multiple fields and stakeholders from different backgrounds can interact simultaneously to achieve a common goal. This type of research configuration leads to more specific application oriented outcomes.

Table 4.1 Overview of the findings

Case	*Impact*		*Stakeholders of researcher*		*Productive Interaction types*		*Interaction characteristics*	
	Scholarly	**Societal***	**Direct**	**Indirect**	**Direct**	**Indirect**	**Resources (Human, financial, technical, legal)**	**Time lag between outcome and impact**
1 Basic	Highly cited paper	SOCIETAL BENEFIT Spinoff-company. Successful product. New standards for the semantic web.	Spin-off company	Building industry. Education sector. Police departments. Accountancy firms.	Professor participated in company in different roles over time. Coauthoring papers. Presentations at scientific conferences. Advice by PI. Hiring employees with additional skills.	Internships. Graduates of involved group. Scientific papers.	IPR Agreement. Company funding. EC funding. Joint venture. Sales contracts.	Long, from knowledge development to product introduction (1998-present)
2 Basic	Proof that representing knowledge in logics is possible	OUTCOME Potential impact on medical treatment guidelines (project showed inconsistency of current guideline	Organization for improvement of quality in health care	Health care sector (medical doctors, nurses, hospitals) and patients	Face to face meetings with stakeholder. Formal project meetings with research consortium.	Take up of results by other research project – which may have societal impact.	EC funding through FET-open; medical protocols	Not relevant (no use or societal outcomes)
3 Basic	Generic software tool for distributed computing	SOCIETAL BENEFIT Software tool for medical imaging resulting in 300 times faster image analyses	Senior researcher medical informatics	Radiologist and other medical researchers the university medical centre	Formal meetings Informal meetings	Software tool E-mail Intermediary person	Government funding through VL-e	Long period of knowledge development, development of tool (2003-present)

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Case	*Impact*		*Stakeholders of researcher*		*Productive Interaction types*		*Interaction characteristics*	
	Scholarly	**Societal***	**Direct**	**Indirect**	**Direct**	**Indirect**	**Resources (Human, financial, technical, legal)**	**Time lag between outcome and impact**
4 Applied	Academic conference articles and position papers	USE OF KNOWLEDGE Ambient kitchen incorporating prototype system	Charities, City Council, volunteers in user groups, people with dementia, carers, University Students, representatives from other universities, members of the Public, company visitors, media.	Broader Community. This project promotes community cohesion	Volunteer panel Conference disseminations Demonstrations membership of Charities	On-line forums Prototypes feedback forms newsletters, project website newspaper/ magazine articles	Commercial company Council and Charity representatives working within the project	Long period of knowledge co-development, (2007-present)

*Type of impact as distinguished in the introduction

Apart from the issue of not (yet) known end-users there is also the issue of the complexity of the (potential) stakeholder network. In the case of the medical protocols, the potential users were well known (the doctors in the field) and therefore, this is a basic research project with known potential users. However, the development from the prototype into usable and used tools requires many different additional innovations and organizational changes in the health care system, in order to have the technology implemented. The stakeholder environment is in this case large, diverse, and highly institutionalized. The researcher did not have the position, instruments, or intention to influence this system. In the imaging analysis case, the users were not yet known and potentially there are many. Nevertheless, a relatively simple chain of actors enabled the development into a specific application for a specific user type. In project 2, the context was much more complex than in projects 1 and 3 and the involved researchers and the organization for quality improvement in health care were not connected to the main players. This may explain the different outcomes in terms of use. To have a tool adopted by a group of medical researchers is much easier and requires less socio-technical systems innovation than to have a tool used by the medical profession, which is strongly institutionalized, regulated, and dominated by established interests. Basic research often leads to specific (essential) inventions and the development into an innovation requires a follow up trajectory that depends on the complexity of the stakeholder context. Applied research, in contrast, often includes from the onset an analysis and development of the whole sociotechnical system in which innovations would be used and not only one (albeit crucial) component (Table 4.2).

Table 4.2 Type of research, complexity of the stakeholder community, and obtained impact

Research type	Project	Complexity	Impact Strategy	Impact
Basic	2	High	No	Outcome with potential impact
Basic	1, 3	Low	Yes	Societal Benefits
Applied	4	High	Yes	Use of Knowledge

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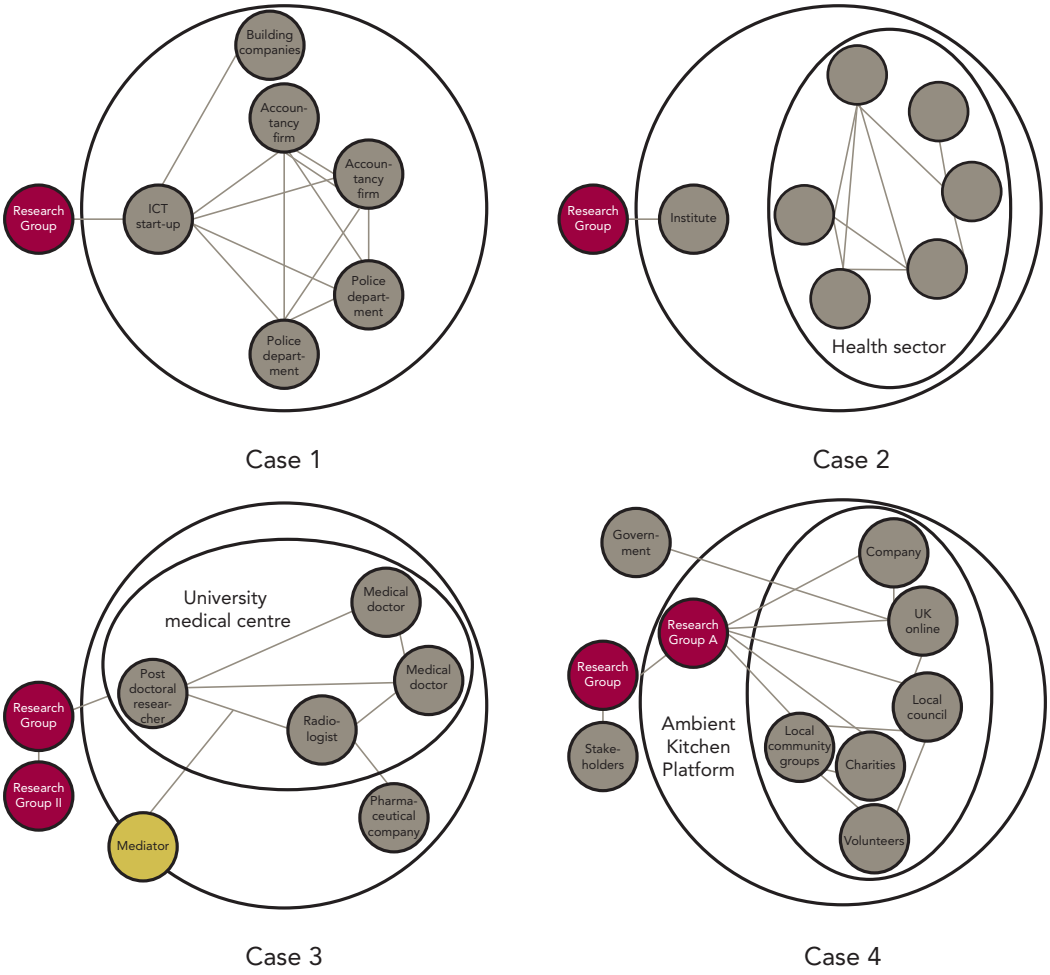
Figure 4.1 illustrates in brief the interaction networks. Where the researcher collaborates with a stakeholder who is well integrated in the user environment and has a significant interest in 'selling the product', societal relevance changes into deployment of the innovation in society.

By tracing productive interactions, we found a number of impact types of ICT research (Figure 4.1). We found health and safety impacts, exemplified by the potential improvement of medical protocols, commercial impacts, such as the forensic software (which could also be considered a safety impact), and impacts on the quality of life, as the Ambient Kitchen and medical imaging cases show. In all cases, ICT research was one of the contributors to the impact. The knowledge it produced had to be further developed, as in the forensic software case, or it facilitates the advancement and impact of other disciplines. ICT research contributed to the resulting impacts,

rather than bringing them about by itself. Two consequences of this facilitating role can be seen in the cases. First, it takes time for ICT research to have impact; it took 10 years from an academic web language to a commercial forensic software tool. Second, impact also depends on the stakeholder. If a stakeholder acknowledges societal relevance of research outcomes, but lacks, for example, resources or absorptive capacity, societal impact will, at least, be delayed. The medical protocol case is a clear example of such a situation.

Figure 4.1 Network diagrams of the cases



4.5 Discussion

4.5.1 The SIAMPI approach

Our study aimed to test the value of the concept of productive interactions for ICT research, which is a representative case of professional adhocracies. We have shown a variety of interactions that were beneficial for the generation of impact, suggesting that process characteristics can be used as a proxy for future impact in the 'professional adhocracy' fields. Molas-Gallart & Tang (2011) applied the SIAMPI approach in the social sciences (fragmented adhocracies) and also found that productive interactions are crucial for impact. Similarly to our project 3, they explained that by focusing on the interactions and processes, impacts previously unknown could be identified. They found that the approach helped social scientists to legitimize their significant efforts in engaging with society. We did not find this for ICT researchers, as esteem resulting from societal impact seemed to be less important to them. Obviously, fragmented adhocracies are more dependent on reputation gained in non-scholarly audiences than professional adhocracies, who are more dependent on peer recognition (Whitley 2000).

The SIAMPI approach might seem to be labor intensive because of the case study style approach involving document analysis and interviews. A similar criticism has been raised against the use of case stories to assess social impact in the UK Research Excellence Framework. We believe this is not necessarily the case, as data collection can be guided by just two questions: (1) with whom, and how do you interact during your research and afterward for the exploitation of the research results, and (2) what has your contribution been to their opinions and activities? Answering these questions facilitates self-reflection in preparing research evaluations. Our examples show that few interviews are required to obtain consistent answers to these questions.

4.5.2 Lessons for research evaluation

This study shows that using process indicators does help anticipating societal impacts that may not yet have occurred at the moment of evaluating. This finding is consistent with other studies showing that interactions with practice are an important predictor of impact (Bercovitz & Feldman 2011; Lövbrand 2011; De Jong et al. in preparation).

In this way, the classical problem of time lags in evaluation can be solved. It is well known, as some of our cases also demonstrate, that there is a considerable time lag between research and impact. By shifting focus to the quality of interactions and knowledge transfer efforts, the likelihood of future contributions to societal impact can be assessed.

Our approach also helps solve the second classical problem of attribution. Attributing impacts to individual researchers or single research groups is problematic because usually more parties, scholarly as well as societal, are involved in knowledge production and application. The focus on interactions in the network of researchers and societal stakeholders, and on the mechanisms that moderate and modulate societal impact, clarifies how knowledge contributed, directly or indirectly, to observed impact. The advantage of the approach is that it may reveal impacts the researchers were unaware of, as became clear in several of the SIAMPI cases (Molas- Gallart & Tang 2011).

Evaluating through tracing productive interactions should not be mistaken for a linear model. Interaction networks may be complex, changing over time, with information and influence disseminating in many directions (e.g. Molas-Gallart & Tang 2007), as our examples show. It is exactly these interactive processes that are captured by the SIAMPI approach. Four aspects are especially relevant.

First, our cases illustrate that it is insufficient to focus only on direct contacts that researchers have with societal stakeholders when evaluating their societal impact. In addition to having its own direct societal impacts, ICT research also contributes to societal impact of other research fields (Khan et al. 2013) through the tools it develops. In other words, when assessing societal impact, researchers in other research fields may be the relevant direct stakeholders, who may then interact with societal stakeholders. Sometimes these indirect relations can be detected through co-authorships, citations, or acknowledgements. In other instances, it may require interview based studies as in this article. Not only can the knowledge production network be complex, the same may hold for the stakeholder network in which knowledge is received and used. That societal relevant knowledge may not generate societal benefits, may depend on characteristics of the use-networks that are far beyond the influence of researchers (e.g. project two). In other words, one should always look at the position of the research in the larger interaction network between research and its often complex audiences.

Second, not only did we find various successful interaction configurations but also differences in types of output. Both interaction patterns and relevant outputs differ between fields (Martinelli et al. 2008; De Jong et al. 2011; Mutz 2013). This implies that we cannot generalize our findings, since they are based on just four examples. In follow-up research we will investigate the production of societal impact in other fields, such as climate science. This may lead to a more complete picture of how societal impact is generated and should be evaluated in different fields. In the end this should lead to general (theoretical) understanding about the mechanisms behind the production of societal impact.

Third, post-research support—ranging from support through e-mail conversations to being employed by a spin-off company—to stakeholders seems to have promoted societal impact in our cases. Murray (2004) also found that the involvement of academic inventors in entrepreneurial firms beyond academic invention were beneficial to the firms. This leads to an additional societal impact indicator for evaluating research institutes or programs: are incentives present for post-research support to societal stakeholders? Incentives should cover more than financial rewards, as researchers differ in their motivations for research commercialization (Lam 2011).

Finally, we feel that our approach also may inform ex-ante assessment of research proposals. Increasingly research funders require applicants to explain how they plan to realize societal impact. Reviewers of proposals may assess these plans in terms of (i) how well applicants are able to describe the network of required productive interactions, and (ii) how adequate their plans are to create and exploit these relations.

This article explored some of the interactions that relate to impact. Although we cover only ICT research, the following preliminary implications for research evaluation can be formulated that

should be subjected to further research. When assessing societal impacts, emphasis should be on (i) contributions of research to societal impact instead of attributing societal impact to specific research, and (ii) efforts instead of results. The latter does not exclude acknowledging short-term results, but reflects recognition that rapid, successful innovation is not the standard outcome of research activities. Here post-research support plays a role. Furthermore, (iii) it should be taken into account how well the efforts are embedded in an understanding of the knowledge production and knowledge use in the networks of the research group, project of program. Through such an approach we may avoid Martin's Frankenstein's evaluation monster that may do more harm than good to the science system and to the societal benefits it brings.

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5 Evaluation of research in context: an approach and two cases[31]

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Abstract

Science is increasingly heterogeneous, posing new questions for research evaluation. How can we evaluate the scientific and societal quality of research, taking into account differences between research fields and between research groups? In this paper we present the findings of two case studies in fields where societal and scholarly output of research are highly intertwined (architecture and law). We analyze the nature of the two fields in terms of research areas and specific aspects of knowledge dynamics. This results in an approach and indicators for contextual research evaluation.

5.1 Introduction

For a long time, societal and economic relevance of scientific research was taken for granted. In recent decades, however, changes in the societal role and position of science have ensured a more direct demand for relevant knowledge, which has been theorized in concepts such as mode- 2 knowledge production, or the triple helix (Gibbons et al, 1994; Etzkowitz & Leydesdorff 1998; Hessels & Van Lente 2009). The audit society (Power 1997) and new public management (Lane 2000; Schubert 2009) do not take societal relevance of research for granted; it has to be shown in grant applications and in evaluation of research programs and institutes. However, measuring the scientific and societal impact of research requires appropriate concepts and indicators.

First, with respect to the scientific impact, the role of publications and citations in high-impact journals has become dominant, especially in the natural and life sciences. This resulted in an abundance of citation- based indicators (Moed 2005; Bornmann et al. 2009; Durieux & Gevenois 2010), which are heavily debated even in these fields (Opthof & Leydesdorff 2010; Van Raan et al. 2010; Bornmann & Mutz 2011; Leydesdorff & Bornmann in press; Waltman et al. 2011). Second, research evaluation has a methodological bias towards the natural sciences (Nature,

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2010), but the same methods are increasingly applied to technical sciences, social sciences, humanities and creative arts (Donovan, 2007; Martin et al, 2010). However, research output here is much more varied than scientific journal articles only, and also consists of books, proceedings, computer programs, designs and prototypes, etc. In these fields, the usefulness of citation-based indicators is even more questioned (Butler 2007; Franceschet 2010; KNAW 2005; Nederhof 2006; Nederhof et al. 2010; Van Leeuwen 2006; TU Delft 2009).

Third, the emphasis on societal impact adds a new dimension to research evaluation (Goransson et al. 2009; Gregersej et al. 2009; Krucken et al. 2009; Pålsson et al. 2009; Ca 2009), which is still poorly addressed in evaluation practice (Nightingale & Scott 2007). Several indicators for societal relevance have been proposed recently (Danish Council 2006; Donovan 2008; Grant et al. 2009), generally focusing on economic impact (Health Economics Research Group et al. 2008) or health impact (Bensing et al. 2004).

Fourth, evaluating societal quality suffers from methodological problems, as it is difficult to attribute impact to specific inputs: The relation between knowledge and impact is complex and innovations are based on a variety of (knowledge) sources. Furthermore, it may take years before knowledge is applied and has impact. The mechanisms generating societal impact have hardly been studied (De Jong et al forthcoming), therefore we do not understand how societal relevance and impact are generated and should be measured.

Nevertheless, some progress is visible. Based on the laboratory activity profiles approach (Callon et al. 1992; Larédo & Mustar 2000), positioning indicators were proposed to relate performance of research groups[32] to their mission (Lepori 2006; Lepori et al. 2008; Merkx & Van den Besselaar 2008). Research groups have an (explicit or implicit) mission, specifying what kind of research and research outcomes are aimed at, and for which audiences. This can be narrow, for example, frontier research with top publications for peers and PhDs in the field as the only two output categories. It can also be broad when a research group also aims at contributing to innovation, professional work, policy development and public debate. Output will be much more varied and may include publications for professionals, policy reports, patents, and newspaper articles. In other words, research groups can have different (combinations of) audiences: the scholarly community, professionals, policy, companies, and the general public. For these audiences different types of research output are produced and should be taken into account in research evaluation. The evaluation of the quality of this heterogeneous output should be done against criteria defined by the respective audiences. In the scholarly domain, peers define quality and relevance of research output, and citations may be one indicator. In a similar way, the various societal audiences should assess quality and we need indicators for this too.

Consequently, evaluating research in context focuses on the interactions, that is communication and collaboration, between researchers and their scholarly and societal audiences (Spaapen et al. 2007; ERiC 2010)[33]. Research quality refers to all dimensions of this interaction and not only

32 Where we use 'research group', one may also read 'institute'or 'program'.

33 We focus on evaluation for organizational learning and not for (anyhow not useful for) ranking exercises.

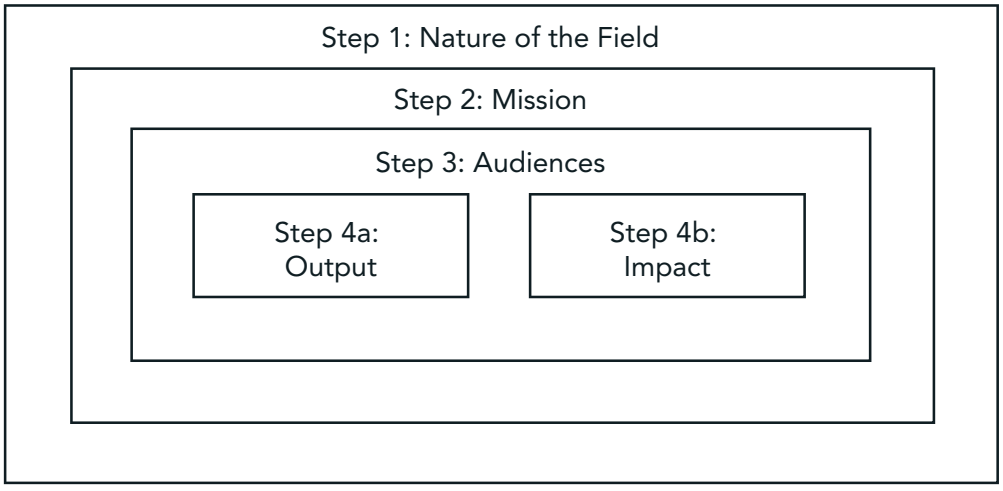
to 'impact' which may not yet be visible. Productive interactions also take place in agenda-setting, in collaborative research, in communication and disseminating of research outcomes, and in the use of knowledge. Productive interactions between researchers and the various audiences can be seen as 'proxy' for (future) impact[34].

In this paper we test an approach for evaluating research in context, using the framework of productive interactions. In two case studies, we analyse agenda-setting, research collaboration, knowledge dissemination, and knowledge use (impact) which are field-specific and group-specific. This leads to the identification of the intended audiences and types of output, and to a set of indicators for scholarly and societal output and quality. The four steps are visualized in Figure 5.1.

Research evaluations should not be based on indicators that a priori cover the entire science system, as this has become too heterogeneous to be served by a 'one size fits all' approach. In this paper we will show how a contextualized approach can be translated into indicators. More specifically, we will answer the following questions:

- What are the main characteristics of the research field under evaluation?
- What is the local context in which academic research groups are embedded, and how does this influence knowledge dynamics?
- What are the intended audiences and related types of output?
- What indicators for scholarly and societal output and impact can be derived from this?
- Finally, are the resulting evaluation approach and indicators useful?

Figure 5.1 Approach to evaluation of research in context



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34 Increasingly framed in terms of the role of user engagement in research collaboration and agenda setting (Donovan and Butler, 2007).

5.2 Data and methods

Two fields (architecture within engineering and law within the social sciences) were selected as they combine several of the problems discussed above:

1. Large heterogeneity;
2. Long-lasting and unsettled difficulties in determining indicators for scholarly output and quality (Van der Voordt 1999; De Jong & Van der Voordt 2000; Herweijer 2003; Stolker 2003; VSNU 2005, 2007; Buruma 2007; Franken 2008; QANU 2002, 2007);
3. Poor coverage in the Web of Science;
4. Strong orientation on societal relevance; and
5. A large overlap in scholarly output and societal output.

Moreover, both fields were to be evaluated soon, and our studies could be instrumental in the preparation of these evaluations. We aimed to include all subfields, as this would enable us to develop an approach that could be applied across the field. Based on these criteria, we selected one faculty of architecture (out of two) and seven faculties of law (out of nine). As the selected faculty of architecture is by far the largest, we have for both fields the majority of research included in this study.

Data were obtained from annual reports, websites, research proposals, self-assessment reports, evaluation reports, and studies reflecting on the specific knowledge dynamics in these fields. Data sources per case are summarized in Table 5.1.

Table 5.1 Data

	Architecture (1 faculty out of 2)	**Law (7 faculties out of 9)**
Annual Reports	√	√
External Evaluations	√	√
Self-evaluations	√	√
Research programme proposals	√	√
Websites of faculty and research groups	√	√
Interviews with tenured staff	15	23
Interviews with stakeholders	14	20
Workshops with researchers and stakeholders	2	2

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Based on the findings of the document analysis, we conducted a first round of expert interviews with researchers and stakeholders to gain more insight into the nature and knowledge dynamics of the two fields. After the interviews, workshops with prominent researchers, faculty management and stakeholders were organized for both fields to present and test our findings about the nature of the field and the various types of audiences. In the workshops we started

the discussion about output and quality indicators, related to the typology of audiences. The results were summarized and reported back to the participants for validation. In a second round of expert interviews with research leaders the indicators were refined, and then tested again through feedback and comments from the specialists.

Finally, stakeholders of the research groups were interviewed to gain more in-depth knowledge about the use and impact of different types of research output, the collaboration between researchers, and to gather input for a further test of the indicators. Throughout the process, we regularly had informal meetings with research directors of the faculties to receive feedback.

5.3 The architecture case

5.3.1 Research field context

The first element of the research context is the heterogeneity of the field. The faculty of architecture distinguishes four main subject areas, related to different disciplines: the design of buildings related to art; social study of urban and regional processes and structures; building technologies; economics and management of building processes and the existing stock of real estate. These areas are rather heterogeneous themselves, as they deploy different research approaches. First, evaluation research, the empirical study of how buildings, cities and regions function. Second, research about the historical development of design ideas and practices. Third, conceptual (exploratory and experimental) research aiming at innovative and revolutionary concepts, manifestos, visions and materials for the architecture, urban planning and building. Finally design research for professional practice, collecting knowledge needed to find optimal solutions for a specific building assignment (Table 5.2).

Table 5.2 Research in architecture: two typologies

Typology 1: Research area based			
Architecture research	**Urbanism**	**Building technology**	**Real estate and housing**
Related to art studies concerning its research approach. It studies buildings and the built environment as well as the theory of architectural design. The creative component is most prominent in this type of research	Related to sociological research. It studies existing or determined objects, like spatial development patterns, urban areas, cities or building blocks, and the study of undetermined objects that regard future possibilities	Related to the natural and technical sciences. This research theme focuses on the technical details of buildings	Related to management studies. The theme focuses on the management aspects of the building process. This includes research into the 'product side' of real estate: the development and management of real estate. In addition, this theme pays attention to the process of initiation, preparation, development, design and construction of real estate, the so-called 'process side'

Vervolg op de volgende pagina ›

Typology 2: Research approach based			
Evaluative research	**Historical research**	**Conceptual research**	**Practical design research**
The empirical study of existing objects and processes. It analyses societal effects and consequences which become manifest once architectural objects or processes have been realized	The interpretation, understanding and explanation of the historical development of designs and designing, while paying attention to site characteristics	Exploratory and experimental research, aiming at innovative, revolutionary concepts, manifestos and visions on the built environment	Research done for educational purposes and for professional practices. It refers to the research architects need to do to find optimum solutions for a certain building assignment

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Second, much stronger than other technical sciences, artistic, cultural and normative perspectives play an important role in architecture, especially within conceptual research. These specific characteristics of architecture and building research are covered under the label 'research by design': research during and by designing, covering the four approaches distinguished above. It is often discussed whether 'research by design' meets a level of scientific rigor comparable to the natural sciences. In architecture, however, the concept of scientific rigor itself has to be balanced with specific contextual demands of a normative nature, such as reflection and creativity in the design process, and the normative appreciation of problems in the built environment. Consequently, a tension exists between traditional criteria used by funding agencies and in research evaluation, which seem not to grasp the necessary normativity of architecture research.

Third, architecture research has a strong relation with practice, since practices and practitioners are not only an important audience, but also the object of study. The object of research is man-made and in many instances even research-made. For example, the study of problems within an urban environment may result in theories influencing architectural and urban planning practices — which in turn can be studied. The object of research, and the way it is approached, change as a result of knowledge development. We can recognize the intertwining of research and practice in all the four types of research: studies derive objects and processes from practice and aim at contributing to improving practice.

Intertwining with practice is also reflected by a large number of full professors who are very actively involved in architectural practice. Top architects are offered part-time positions as professors. By doing so, knowledge flows from practice to science and vice versa through a single person. The faculty currently employs 26 part-time professors[35] who also hold positions at well-known national and international architectural offices (Van der Hoeven. 2010).
The heterogeneous, normative and practice orientated nature of architectural research points at a variety of audiences of architectural research. Briefly, four types of audiences can be distinguished in this case: peers, professionals (architects, urban planners), companies (e.g. contractors and housing corporations) and government agencies (Table 5.3).

35 At the full–professor level.

Table 5.3 Stakeholders in architecture research

Evaluative Research	Historical Research	Conceptual Research	Practical Research
Peers (researchers) Professionals: - Architects - Urban Designers Companies - Spatial Planners - Contractors - Real estate developers Governments - Municipalities - Provinces - National Government	Peers (researchers) Professionals: - Architects - Urban Designers Companies - Spatial Planners - Contractors - Real estate developers Governments - Municipalities - Provinces - National Government	Peers (researchers)	Client who commissioned the work

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5.3.2 Aspects of knowledge dynamics

What do these characteristics mean for the four dimensions of knowledge dynamics: agenda-setting, research collaboration, knowledge dissemination, and impact?

Agenda-setting

A tension exists between orientation on practice and academic freedom. Researchers emphasize that societal stakeholders (such as companies or government) may have specific interests, and therefore should not determine research agendas. Furthermore, problems from practice cannot always be translated into scholarly research and therefore should not always automatically be incorporated in research agendas. In other words, research and practice should interact but this does not imply that researchers are kept on a short leash by stakeholders.

Nevertheless, researchers do interact with stakeholders when establishing research agendas. So, given this tension, how is the research agenda determined? On the one hand, important issues and questions arising in practice (the object of research) influence the research agenda. Some researchers are inspired by societal concerns and take into account governmental policy and societal trends (such as sustainability) when formulating a research program. Others more directly involve their stakeholders when formulating the research agenda. This is often done through recruiting part-time professors who remain (or were in the past) actively involved in architectural and building practice. In other cases it is done through workshops, symposia or annual meetings with stakeholders to discuss the research agenda and keep in touch with what is considered topical and important by practice. It should be emphasized that researchers also seek to influence stakeholders' policy agenda . Many interviewees explicitly mentioned their role in shaping agendas of societal actors. The research groups consider it to be an important societal responsibility to make societal questions explicit, bring actors from society together to formulate agendas, and critically reflect on agendas of societal actors.

Research collaboration

We have identified three types of collaboration with stakeholders in architecture research. They differ in their degree of involvement and consequently in the degree to which knowledge is exchanged. In commissioned research, a research group aims at solving a problem posed by for instance a government agency or a housing corporation. The research question generally is jointly elaborated but during the research process, collaboration is limited. In the majority of cases, it is an exchange of knowledge for money. A second form of collaboration is the long-term funding of targeted research. A societal actor may acknowledge the long-term importance of a research theme and support it financially. Although the actor is interested in the content of the program, it is not involved in the research itself. Influence is exerted from a distance. The third most extensive form of collaboration is joint research. This type of collaboration is characterized by a two-way stream of knowledge between researchers and societal partners. The most common form is attracting professors from practice. Another form is a long-term partnership between a research group and a societal organization or company.

Knowledge dissemination

Dissemination of architecture research uses a large variety of output types for different audiences (see Table 5.4 for a summary). Our study indicates that texts are the main form of output. Publications in peer-reviewed journals as well as in professional magazines are considered important, as are policy reports and books. Most research groups prefer professional journals or books, because these types of output are more suited to reach their societal and scholarly audiences. This is confirmed by an analysis of architectural publications in WoS-indexed journals. Nine well-known departments[36] of architecture together have had 462 publications (78% articles) between 1987 and 2009, which is only six papers per year — although there has been a rise in recent years. Clearly, this kind of research output is only marginally important in the field of architecture. Our study also showed the role of non-textual output, such as software tools, drawings, computer animations, scale models, and prototypes of buildings as well as constructions. Visualizations in turn can be discussed in exhibitions, lectures, debates, colloquia, seminars and conferences. Some of these events do result in publications such as exhibition catalogues or conference proceedings. Last but not least is the dissemination of research results by people. As mentioned before, part-time professors serve as an important link between practice and science. They not only suggest relevant research subjects, but also communicate research results to practice. Furthermore, researchers' advisory and consultancy activities serve to disseminate knowledge to governments, companies, nongovernmental organizations and to society at large. As a consequence of the strong orientation on practice, communication with local stakeholders highly matters to research groups. Researchers therefore prefer national (Dutch language) professional journals to communicate with stakeholders, as stakeholders are not expected to read international scientific journals. Additionally, researchers feel that papers about local problems can hardly be published in international journals.

36 MIT, ETH Zurich, University of Cambridge; Technical University Delft; Technical University Eindhoven; University of Sheffield; University of Reading; Ghent University.

Table 5.4 Classes of output by types of architecture research

Evaluative Research	Historical Research	Conceptual Research	Practical Research
ISI Publications Professional publications Policy Reports Tools	Books Exhibitions (and catalogues)	Conference proceedings Exhibitions (and catalogues) Designs - Drawings - Computer Animations - Scale Models Prototypes - Buildings - Constructions	Exhibitions (&catalogues) Designs - Drawings - Computer Animations - Scale Models Prototypes - Buildings - Constructions

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Impact

Based on the dominant role of societal audiences, one would expect to easily find examples of research output with impact in society. Interviewed researchers, however, could hardly give an overview of the impact of their research. And the direct (first order) stakeholders do not always provide feedback about the use of research results. In other cases, impact is generated through indirect (second- or third order) stakeholders, which makes keeping track of impact even more difficult. Nevertheless, stakeholders proved capable of informing us about the different forms of impact of architectural research. For instance, a housing corporation introduced a new management model that came out of a research project, changing its everyday managerial practice. Results of another research project were referred to in a letter to parliament by the Minister of Housing. A third example of impact is the use of new building typologies by a Dutch municipality for city expansion, which changed the way urban areas and buildings are designed and constructed.

5.3.3 Quality indicators

In Table 5.4, we listed types of research output that can be measured. What indicators for the quality of the output might be useful? As argued in the introduction to the paper, the audiences (stakeholders) play a crucial role in defining quality. In the interviews and workshops we therefore tried to find out what the various intended audiences of the research output consider as quality. And, quality indicators should not be restricted to impact, but should cover all phases of the knowledge production process. Table 5.5 summarizes the quality indicators that we found in this case. Some of them can be easily quantified, for others this is much more difficult and less appropriate. However, as we focus on positioning indicators that compare quantity and quality of the research with the mission of the evaluated research group, this is not a problem. The aim of our approach is research evaluation in context, and not a ranking of research groups or programs. As Section 5.3 will demonstrate, similar quality indicators could be formulated for the law case.

Table 5.5 Indicators for evaluating societal quality of architecture research

Agenda Setting	Collaboration	Dissemination	Impact
1. Societal issues are explicitly addressed in research 2. Occasional/structural interaction with stakeholders to establish relevance 3. Relevant experience of researchers as practitioner in societal domain 4. Positive evaluations or external funding related to societal/commercial issues	1. Commissioned research by societal actors 2. Earmarked/structural funding related to societal theme 3. Actual collaboration in research, testing and evaluation with stakeholders	1. Scholarly and professional publications, including in local language 2. Technologies, artefacts, standards, designs, exhibitions 3. Advisory/consultancy roles 4. Popularization, contribution to societal debate 5. Education, training of professionals, graduates	1. Convincing examples of use of outcomes of research 2. Satisfaction/recognition of alumni and stakeholders 3. Substantial returns or economic value of outputs of research 4. Visibility in the public debate/ media rankings

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5.4 The law case

5.4.1 Research field context

As in architecture, law is a heterogeneous research field, which results in a variety of field classifications. Textbooks distinguish four areas of law: private law, constitutional law, administrative law and criminal law (Janssen et al. 1999; Cliteur 2000). A closer look at the research programs of law faculties, however, shows that law research does not neatly fit into this classification. The organization of departments and research groups follows different logics. Moreover, the four areas of law do not cover the so-called 'metajuridical' studies in which law is being studied from the perspective of other fields, like sociology or philosophy. For classifying research programs, it is more useful to distinguish between private law; constitutional and administrative law; criminal law and criminology; international and European law; and metajuridical studies.

Independently from this, two major types of research should be distinguished: doctrinal research and empirical research. Doctrinal (humanities oriented) research consists of descriptions and analyses of legal sources, and aims at uncovering the internal structure of law, such as the underlying (philosophical) assumptions, its internal coherence and the lack of it, and the way it is interpreted in jurisdiction. Empirical research, on the other hand, focuses on the way law and legal institutions function in society. This type of (social science) research is based on systematic empirical observations (Table 5.6).

Table 5.6 Research in law: two typologies

Typology 1. Research area-based				
Private law	**Constitutional and administrative law**	**Criminal law and criminology**	**International and European law**	**Meta-juridical studies**
Studies legal relations between individuals (e.g. contract law, property law, family law, commercial law, and inheritance law)	Studies relationships between the state and individuals, and between different branches of the state Studies agencies' roles and power	Studies criminal behaviour, its causes, prevention and sanctioning from a legal perspective (criminal law) and from a psychological or sociological perspective (criminology)	Studies the European and international aspects of law, including the legal relations between countries Also comparative study of national legal systems	Studies the legal system from a sociological, economic, and philosophical perspective

Typology 2. Research approach-based	
Doctrinal research	**Empirical research**
Descriptions and analyses of legal sources (e.g. legislation, jurisprudence) from the perspective of the legal system. The aim is to structure law, indicate inconsistencies, and to add, adjust and improve where needed.	Empirical studies of the functioning of the legal system. The focus is on societal dynamics, functioning and effects of law and legal institutions.

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Second, doctrinal law research has a strong normative character. The researcher's opinions often resonate in the research, which aims at normative judgments. In jurisprudence the primary question is: 'Should it be like this?' instead of: 'Is it really like this?' (Stolker 2003; Kwakman 2005). Consequently, many scholars tend to be more concerned with 'ought' than with 'is', more with improving law than with explanation. Improvement is pursued mainly by ordering, comparing and interpreting current law and legislation.

Third, the object of legal research is law and the legal system. The object is 'man-made' and subject to change caused by human action: 'Law is what people agreed on to be law.' It is not a static or secluded research object; law is studied and practiced simultaneously. This reflects a main characteristic of law research, which some people consider as strength, others as pitfall: the strong intertwining with legal practice (e.g. Stolker 2003). The legal system and its legal norms and rules constitute the primary research object. These are ordered, described, compared, interpreted and commented upon, in order to ensure better jurisdiction. According to many researchers, the most important task of academic law research is to inform (and improve) practice. This strong orientation towards practice is reflected in the large number of professional publications compared to scientific publications. The first mainly aim at explaining and clarifying for legal practice, while the latter particularly focus on communicating new insights. However, a lot of professionals also use scientific publications.

Another indication of the strong intertwining of research and practice is that a large share of the researchers in law schools, particularly professors, occupies positions in the legal practice, next to their position at the university, which is considered necessary within the field of law research.

In order to conduct relevant good-quality research, researchers need to maintain feeling with practice. For example, besides being a professor they hold a position as a lawyer, deputy judge or legal counsellor. This is similar to architecture research, but in sharp contrast to many other fields, where this is regarded as undesirable. Because of this strong interdependence, it is often difficult and even considered irrelevant to distinguish between scientific and professional research output and stakeholders. It is hard to disentangle the different domains and evaluate the scholarly part of research output independently from it societal quality.

Fourth, and also similar to architecture, legal research has a rather strong national orientation — a worldwide phenomenon. For legal scholars in the Netherlands, Dutch jurisprudence and legislation constitute the key context in which they conduct research. International and comparative law research constitutes only a small part of the discipline. The Dutch legal professionals make up the main audience, resulting in Dutch as the main language of publication. Although the importance of publishing in English is generally acknowledged, it is claimed that an important part of Dutch legal research can simply not be published in English, as the Dutch language has its own specific legal concepts which would lose their meaning when translated (VSNU 2007). Furthermore, international publications would require much more contextual information (about the Dutch legal system) to make a publication understandable.

Finally, despite the typical Dutch inclination towards programming of research, the study of law is, and has traditionally been, a field in which mainly individual and small-scale research is conducted. As no expensive instruments or laboratories are required for this type of research, researchers are not forced to cooperate — mutual dependency is low (Whitley 2000). In contrast to architecture, law research is highly disciplinary, reinforcing its individualistic character. Although multidisciplinary research is increasingly considered to be valuable, it only evolves slowly. Legal scholars mainly stay within their own (sub)field and therein they all have their own specialism.

This analysis leads to a distinction between the domains or audiences in which law research is relevant (Table 5.7). Within the field, three domains are distinguished: the (inter)national scientific domain (peers); the domain of the public and private legal practice (professionals); and the political and societal domain (policy-makers and the general public).

Table 5.7 Stakeholders in law research

(Inter)national Science	(Public & Private) Legal professionals	Politics & Society
Peers (also scientists from non-legal disciplines) Students	Investigation services (e.g. police) Advocacy Public prosecutor Jurisdiction Council of State (Part of) public administration Notaries Insurers Mediators	Government Ministries Policy-makers Governmental advisory bodies (e.g. Council of State) European Committee N-government organizations Non-governmental advisory bodies

5.4.2 Aspects of knowledge dynamics law research

Agenda-setting
Academic researchers determine the research agenda. However, because many researchers are also involved in legal practice, the relation between research and practice is strong. Researchers are perfectly aware of what is taking place in practice, where the knowledge gaps are, and which important issues need to be investigated. Research questions often involve problems professionals encounter in their daily work, for instance when they are asked to provide legal advice in new or uncommon situations, where existing legal rules cannot directly be applied. Current societal problems also play an important role in research programs. Mission statements of the different law research programs describe the importance of studying societal problems and they reflect the high value ascribed to societal relevance. Furthermore, to some extent research questions are influenced by external parties (from the political and business world) through commissioned research. According to our interviewees, external parties' impact on the research agenda remains small, as researchers generally have the freedom to elaborate research questions to make them better relate to existing research programs.

Research collaboration
Although the actual conducting of research lies primarily in the hands of researchers, important stakeholders are involved in law research. For example, stakeholders may provide input for setting up the research project, and for the formulation of research questions, for example whenever the Ministry of Justice requires an analysis of legislation. The most important form of research practice collaboration is researchers often conducting research 'in the field'. Many researchers not only study law; they work with it at the same time. As in architecture, this means individuals carry knowledge flows from research to practice and vice versa. A second form of collaboration is at the institutional level: research centres based on partnerships between universities and private parties such as law firms, notary offices, pension funds, legal departments of large enterprises and financial institutions. These private partners enable scholars to conduct research in the companies' practices. These companies also offer internships to students, which enables them to observe legal knowledge in practice. In return private partners have the opportunity to 'scout' future juridical talent and access relevant and useful scientific knowledge. To elaborate on this last point, there seems to be a need for more scientification of legal practice. For example, jurisdiction established several chairs at Dutch universities in order to fulfil the need for scientific deepening of jurisdiction.

Knowledge dissemination
Legal research focuses on different audiences such as peers, professionals, politicians and the public (Table 5.7). Researchers do interact with these audiences in terms of a varied research output (Table 5.8). The large variety of types, audiences and functions of publications requires a subdivision. The most important part consists of scientific and professional publications. We take them together as it is often difficult to differentiate between these two types. The majority of the (Dutch language) law journals are being read by both the scientific and professional community. Other categories of publications are monographs (highly valued within law research), dissertations (mainly in the form of a monograph, rarely as a compilation of articles), conference proceedings, preliminary advices, inaugural lectures, (advisory and policy) reports and popular-

izing articles. The boundary between scholarly and professional publications is fuzzy and disputed. For example, the annotation is a concise commentary on a judicial verdict and is directed to both legal professionals and researchers. Although they are regarded as very valuable output by legal practitioners, annotations are not always considered scholarly output. Another form of textual output are tools, manuals and codes of conduct, which can be utilized in legal practice and elsewhere in society. Examples of these types of output are guidelines for the impartiality of judges and the code of conduct for the treatment of injury claims. Many of these tools are published on the internet, making them accessible to a wide audience. Furthermore, contributions to national and international conferences, symposia, lectures and expert meetings are also considered to be important types of research output. The audiences may vary: scholars, policy-makers and members of parliament, professional lawyers, or the general public. Another important way to disseminate research results is via the mobility of people. Part-time researchers can directly disseminate and implement academic knowledge into practice. Therefore, sidelines in legal practice are considered research output as well. Dissemination can also be realized via membership of (inter)national scientific committees, networks and editorial staff of journals and membership of political and societal advisory and policy committees. The latter affiliation enables academic knowledge to flow directly into professional practice and society. Finally, post-academic education is an important way of disseminating academic knowledge via people. Researchers provide postgraduate education for jurists in favor of their legal practice. By organizing interactive seminars, researchers are both disseminating academic knowledge and being informed by practice.

Table 5.8 Classes of output categories in law research by audience

(Inter)national Science	(Public & Private) Legal professionals	Politics & Society
Scientific & professional publications Membership of scientific committees, networks & editorial staff Contribution to conferences & symposia	Scientific & professional publications, reports, manuals External function in legal practice, advisory body Membership of editorial staff Contribution to conferences & symposia Post academic education	Professional & popularizing publications Membership of political & societal committees Contribution to conferences & symposia

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Impact

The variety of research output described above can be considered as the instruments used by researchers and research groups to translate their mission into scholarly and societal impact. As in architecture, legal researchers too found it difficult to indicate the impact of their research and link signs of impact to specific research projects despite the fact that legal research and practice are strongly intertwined, and impact may be realized rather directly. Nevertheless, researchers are sometimes aware of the practical use and influence of their research. Research regularly leads to parliamentary questions, and to changes in rules and legislation. For instance the Council of State biweekly discusses the latest journal papers and annotations, and determines whether this coincides with the current jurisprudence or whether adjustments have to be made. However, use is also often unnoticed, as legal pleas and judgments lack references.

Nonetheless, many researchers are actively involved in legal practice and in advisory committees, where they can implement knowledge and directly observe impact.

5.4.3 Quality indicators

In a similar way as for architecture, output indicators were developed. Based on the interviews and workshops with researches and societal stakeholders, we determined what different audiences consider to be 'quality'. These quality criteria relate to the several phases of the knowledge production process, and not only to impact. It is relevant to emphasize that the bibliometric databases do not play a role in law, for instance because the WoS is heavily biased towards US law journals and US research, and therefore cannot be used in research evaluations of law research elsewhere (Moed 2005). The indicators are listed in Table 5.9. Again, some indicators can be easily quantified, while other indicators are qualitative.

Table 5.9 Indicators for evaluating societal quality of law research

Agenda Setting	Collaboration	Dissemination	Impact
1. Societal concerns and issues explicitly addressed in research 2. Occasional/structural interaction with stakeholders to establish relevance, 3. Relevant recent experience of researchers as a practitioner in societal domain	1. Commissioned research by societal actors 2. Partnerships between universities and external parties/stakeholders 3. Academic researchers enabled to conduct research 'in the field' by working in practice concurrently	1. Scholarly and professional publications, including local language 2. Books, monographs, preadvices, annotations 3. Guidelines, tools, manuals, codes of conduct 4. Contributions to national conferences/symposia/ expert meetings 5. Advisory and consultancy roles 6. Training of professionals	1. Convincing examples of use of outcomes of research 2. 2nd Editions of books 3. Pre-advices 4. Commissioned research 5. Visibility in the public debate / public media

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5.5 Evaluation research in context: conclusion and discussion

In this paper we introduced an approach for evaluating research groups in their disciplinary and local context. Frame of reference is the mission of the research group, as this defines what the group is expected to accomplish. First, the different scholarly and societal audiences (or stakeholders) of a research group are identified.

Second, in interaction with researchers and their audiences, the specific types of output for these audiences, and the interactions between researchers and audiences are identified.
Third, indicators for research output, quality, and impact were developed.
Fourth, in contrast to what is done usually, we do not restrict quality to visible impact. A more general quality concept was introduced that takes into account the quality of communication and collaboration between researchers and their audiences: productive interactions that may result in impact at some future moment.

Finally, stakeholders are needed to assess societal impacts, comparable to scientific peers who are able to evaluate scientific impact. Carefully selected local stakeholders can be valuable in determining societal impact. Stakeholders were able to indicate in what way research is relevant for them, how they productively communicate with researchers, and how they use the results in their daily work — even if this cannot always be measured through formal and explicit references to research output.

In order to develop the approach, we started with two practice-oriented research fields, architecture and law, as these have very heterogeneous audiences and research output. Our two case studies showed the practical usability. Although the information required was not always easily available, the cases illustrate that it can be collected[37]. And this does not lead to huge amounts of paperwork and excessive workload, as is sometimes suggested (Grant et al 2009). The main result, however, was in the architecture case. There, the recent formal research evaluation report was based on the approach presented in this article (Avermaete et al 2010). The same holds for recent proposals for evaluating engineering research (KNAW 2010).

Interactions with non-academic stakeholders are an important way of circulating knowledge between science and society. The intensity of the collaboration informs us about the type and amount of knowledge that is circulated. On top of that, collaborations are an indication of societal quality. In both fields, collaboration with stakeholders can be considered a significant way to circulate knowledge between the different domains of science, professional practice, politics and society. Although stakeholders do not play a substantial role in research practice itself, they do enable researchers to conduct research 'in the field' and remain in close contact with practice.

In the two case studies, researchers are at the same time practitioners, and research is often individual and small-scale. These characteristics influence the nature of the researchers–stakeholder interactions, the dynamics of agenda-setting, collaboration, and use of knowledge. The concept of productive interactions needs to be studied more systematically. We are currently studying other fields, where research is large scale and more integrated. This leads to different types of interaction, often more indirect and 'networked'. Consequently, other quality and impact indicators will be required for these fields.

We end with two general issues. First, evaluation is often aiming at the ranking of research groups. In contrast, the proposed approach is meant for the evaluation of the performance of a research group against its own mission. As missions differ, the result of evaluations may not be easy to compare. Only where missions and research fields are sufficiently similar is comparison meaningful. However, given the large number of goals, audiences, and types of output, every reduction of performance to a single figure would be meaningless. Researchers themselves play a significant role in the dissemination of their output. Since many of them are practitioners at the same time, new knowledge can immediately be applied in practice. Additionally, researchers

37 Evaluation requires skills and guidelines alongside the evaluated researchers. To support learning, a guideline was developed to be used in the regular research evaluation (ERiC, 2010).

are often members of scientific, professional, societal, and policy advisory committees and they provide post-academic education. This also creates the possibility of implementing research results directly into the different domains.

Second, our study has shown a large variety of stakeholders, types of collaboration, and forms of dissemination within both architecture and law, illustrating the complexity and heterogeneity of the contemporary science system. Classifications of research into two 'modes' (Gibbons et al 1994), or into four 'quadrants' (Stokes 1997), seems too general for analysing the dynamics of the science system and particularly for research evaluation. The frequently discussed change of 'the relations between science and society' has resulted in a large variety of types and contexts of scholarly research, and appropriate evaluation approaches are needed that reflect this heterogeneity. This paper is an empirical contribution. Current (and future) work focuses on refinement of the approach and on testing it in other contexts and disciplines.

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6 Concluding chapter

6.1 Introduction

In this thesis I have studied the translation of valorisation policy as a core component of Dutch science policy since it was introduced as such by government in 2004. Valorisation is officially defined as *'The process of creating value from knowledge by making it suitable and/or available for economic and/or societal use and translating it into products, services, processes and entrepreneurial activity'* (Nederland Ondernemend Innovatieland 2009).'

The aim of this thesis is twofold. The first aim is to contribute to the understanding of how science policy translates to academic practice. The second is aim is to provide insights on how to improve valorisation of academic research. The introduction of the valorisation policy in the Netherlands provided both a case of a policy introduction on a national system scale as well as a case in which emerging valorisation practices could be found.

To answer the main research questions '*How has the valorisation policy of Dutch government been translated to academic practice in the Netherlands between 2004 and 2014?*' and '*How can valorisation of academic research be evaluated?'*, I have studied valorisation is four different contexts[38]. The first case (chapter 2) focused on the role of valorisation in the everyday work of individual academic researchers and valorisation policy staff members. The second case (chapter 3) dealt with the organisation of valorisation in research programmes with the explicit aim of developing and transferring knowledge for the benefit of society. The third case (chapter 4) explored valorisation in the everyday work environment of the university department. The fourth case (chapter 5) explored how valorisation can be included in existing research evaluation practices.

In this concluding chapter, the insights from these studies will be used to answer the research questions. After answering the research questions, I will discuss the effects the selected methodology may have had on the results. Finally, I will reflect upon theoretical and practical implications following from this study.

6.2 Conclusions

In this section I answer the research questions. The first main research question is *'How has the valorisation policy of Dutch government been translated to academic practice in the Netherlands between 2004 and 2014?'*. To collect the building blocks to answer this question, I will first answer two sub research questions: *'How do academic researchers respond to valorisation policies?'* and *'How do academic researchers include valorisation in academic practice?'* After answering the first main research question, I will answer the second main research question: '*How can valorisation of academic research be evaluated?'* I will draw on results from all four empirical chapters to answer each question and refer to the specific chapters that support my arguments.

38 All four studies have been performed in collaboration with co-authors. However, I take full responsibility for the analysis, reflections and recommendations presented in the concluding chapter of this dissertation.

6.2.1 How has the valorisation policy of Dutch government been translated to academic practice in the Netherlands between 2004 and 2014?

How do academic researchers respond to valorisation policies?
Insight into the response of academic researchers to government's valorisation policy and the resulting valorisation policies of intermediaries helps to improve the understanding of the relationship between scientists and government concerning the introduction of a new policy.

The intentions of valorisation policies are unclear to the academics that participated in the focus groups in the second chapter. They perceive policymakers at government and university level as only interested in or primarily emphasising the economic value of academic research through valorisation policies. The top sector policy[39] of government as well as university administrators setting targets for acquiring external funds contribute to this perception. In addition to collaboration with companies, the participating academics consider activities such as contributing to policy-making, societal debates and scientific literacy and sharing insights with other scientific fields as valorisation. However, they believe policymakers at best consider these activities as second-rank valorisation. In reality, the policies describe a wide range of valorisation practices, without any formal distinction. Basic research without any valorisation opportunities is even offered an opt out by Dutch research council NWO: if it can be substantiated that there are no valorisation opportunities, the maximum score is awarded for the knowledge utilisation paragraph. Yet, the exact content of the policies appears to be hardly known among academics and some of them do not even want to learn about their content as they have lost their trust in government and intermediaries.

The academics included in the study believe valorisation policies create an artificial difference between the society-oriented activities the policies aim to address, and research and teaching. Three activities that ideally go hand in hand are believed to be separated to make them manageable. As such, valorisation is also a new label for activities that many academics were already involved in and that traditionally are integrated with scientific and teaching activities. Consequently, it is not uncommon for academics to be unaware of their valorisation activities. This can be observed across the entire spectrum of research domains, from the humanities to physics. For example, one of the participants from the SSH domain did not recognise his commercial and consultancy activities for a local government and theme park as valorisation, because they were integrated with scientific research.

From the focus groups, the insight emerges that there is no shared perspective on valorisation within the larger academic community or within individual research fields. There are different understandings of valorisation among academics: what some consider as valorisation is rejected or not recognised as such by others, even if the specific form of valorisation is the result of funding requirements by research council NWO. Furthermore, there are different

39 The goal of the top sector policy is to intensify collaboration between public research and industry in nine sectors (http://topsectoren.nl/home accessed 10-07-2014). Since 2011, a significant share of the research council's annual budget has been earmarked for collaboration with private partners from one of these nine sectors.

visions on the organisation of valorisation. Some participants believe all researchers have a valorisation responsibility. Others believe it should be organised at group level, with some researchers only working on brilliant scientific discoveries in the lab and others also discussing the findings of the group, for instance with policymakers or companies. The lack of a shared vision also makes it difficult to evaluate valorisation in ex ante and ex post assessments, as evaluands have no clear idea how to present their valorisation strategy or achievements and evaluators have no shared assessment frame. This creates difficulties in assessing valorisation, and prevents valorisation from having an effect on academic careers. As a result, the resources academics are willing to invest in valorisation activities are limited as the rewards for these investments are uncertain.

How do academic researchers include valorisation in academic practice?
To understand how academics aim to include valorisation in academic practice, I explored valorisation practices within different fields and organisational settings. Although I found many academics personally motivated to be engaged in valorisation, and a multitude of valorisation efforts, I found little evidence of well-developed general valorisation practices.

Personal motivation is an important driver behind valorisation (chapter 2). Some academics in this study indicate that the funding of their research with tax-payers' money brings a moral obligation to contribute to providing society with relevant knowledge. Others feel an urge to contribute to societal debates or practices with the latest scientific facts and insights. In doing so, they aim to improve the quality of the debate and new policies or of legal or medical practices, for example. Another group has a drive to fascinate society for science through sharing their most recent findings. Apart from such explicitly voiced motivations, the specific research context may determine whether or not researchers make an effort to promote societal benefits of their findings (chapter 4).

The valorisation activities of the academics included in the four cases aim at a variety of audiences, ranging from supplying other academics with new research tools to helping societal actors solving their problems and educating the general audience. Although it is common for researchers to share their results with their peers, there is a difference between sharing knowledge within a disciplinary community and sharing new knowledge with academics who are not part of that community. Research results are not necessarily directly applied to solving societal problems, but can also be applied indirectly, through solving scientific problems in other research fields. Such a solution then may facilitate or boost valorisation of research within this specific field (chapter 4).

Nonetheless, the majority of valorisation activities I encountered involve societal actors, in a variety of roles. The general audience is mostly addressed as being composed of rather passive knowledge absorbers. More specific audiences, such as companies, NGOs, governments and interest groups can also be addressed in such a way, but can be offered an active role in research as well. There are multiple axes along which societal actor involvement in academic research can be organised. The involvement of societal actors can be informal, leaving no official administrative traces (for example by inviting them to a meeting to provide their input to a project) or it can be formal, using contracts or agreements (e.g. as the result of funding

schemes that require matching by societal actors). Societal actors can have a reflecting role from a certain distance or an influencing role as fully-fledged participants, having actual effects on research direction and performance (chapter 3).

There also seems to be a difference between basic and applied research in the way societal actor involvement is organised (chapter 4). In applied research, the development of knowledge is geared towards a specific application. To take into account all the required features, a wide variety of societal actors may be involved from the outset, as in the Ambient Kitchen project discussed in chapter 4. The result is a tailor-made solution to a specific problem. However, in basic research the direction and context of application are less clear. In that case, a long-term approach building a long-term relation with a single societal actor might be fruitful to explore the most promising direction. This is more likely to result in rather generic knowledge, which can then be adapted to specific local contexts. The forensic software case described in chapter 4 is an example of this approach.

In this study, I have come across a variety of outputs through which results are shared with societal actors. Although patents, spin-off companies and licences can be easily counted and are therefore often used as valorisation indicators, these are the outputs that are encountered the least. The list of outputs used to communicate about results specifically with societal actors is lengthy and includes, for example, software, consultancy and advisory work, post-graduate training courses, exhibitions, books, workshops, demonstrations, presentations and media appearances (see chapter 5 for lists of outputs commonly used in architecture and law research). It is not possible to draw conclusions about which outputs contribute most to societal benefits (chapter 4). Effectivity seems to depend on the types of societal actors that are interacted with and on the type of research. However, it seems to be the case that if a large number of different output types are used to disseminate results this increases the size of societal benefits (chapter 3).

All in all, the personal motivation of researchers is an important driver behind the accomplishment of an enormous diversity of valorisation activities. These are aimed at academic researchers in other fields, specific societal audiences and society at large. In some instances there is an official collaboration whereas in other instances interaction remains informal. Some collaborations are initiated with a clear application in mind, whereas other collaborations focus on solving more general problems. Knowledge exchange between academics and their audiences is facilitated by a wide range of research outputs. A golden standard for valorisation was not found.

The translation of valorisation policy to academic practice

The previous two sections collected the building blocks to answer the first main research question of this thesis: '*How has the valorisation policy of Dutch government been translated to academic practice in the Netherlands between 2004 and 2014?*'

The picture emerges of a system in transition. Government has added a formal task to scientists' responsibilities, and intermediaries have included valorisation in their own policies. However, it can be questioned whether the policies have also been successfully translated by government and intermediaries to academic practice. On the one hand, the personal motiva-

tions of academics to be involved in valorisation, the wide range of stakeholders addressed and the variety of outputs to communicate results to society suggest that valorisation is coming about naturally, without any effort or questions from the academic community. On the other hand, academics are poorly informed about the content and the aim of the policy. They have many questions concerning the organisation and evaluation of valorisation. Individually they do everything according to their ability to organise a diversity of interactions with a wide range of stakeholders and evaluate these efforts. Yet, deliberate valorisation strategies and robust evaluation procedures seem to be the exception. One could say that a significant share of academics are involved in valorisation despite the policy, rather than because of it. Taking a negative view, one can conclude that the valorisation policy has been poorly translated to academic practice. A more positive view leads to the conclusion that the Dutch science system is in a transition of which some phases may have been completed, whereas other phases are still in progress. The motivation of academics to contribute to society and the many interactions they have with societal actors can be seen as a promising base for the future of valorisation.

6.2.2 How can valorisation of academic research be evaluated?

Internationally, the evaluation of valorisation is still a puzzle. Although many methods and indicators to evaluate valorisation have been proposed in recent decades, there still is no single, generally accepted approach. Given this, the answer to the second main research question should primarily be considered as a contribution to improving existing methodologies, an extension to the available toolkit and an addition to the available critical reflections on the evaluation of valorisation.

This thesis supports the claim that it is problematic to hold academics accountable for the actual occurrence of societal benefits resulting from their valorisation efforts. Apart from the quality of their knowledge and efforts, many other factors outside their span of control determine whether knowledge generates societal benefits (chapters 3 and 4). Nevertheless, academics can be held accountable for their valorisation efforts. This shift from result focus to process focus means a shift from attributing specific benefits to specific research or researchers to considering the contribution of specific research or researchers to specific benefits. This shift may also contribute to solving the issue of the right timeframe to evaluate societal benefits. Whereas benefits may take more than a decade to occur, efforts can be evaluated within the current six-year time frame in Dutch ex-post evaluations.

If evaluations were to focus on the process instead of results, there would still be a need for a benchmark for comparison purposes. Whether the aim of the evaluation is learning and improving or accounting, one needs to know what valorisation efforts will most likely lead to the desired societal benefits. This would change our view on valorisation activities from a random collection of actions to a deliberate and coordinated strategy. In other words, if the focus were on the process, the object of evaluation would be valorisation strategies (chapter 5). This approach can be used in ex-ante evaluations (what strategy is proposed?) and ex-post evaluations (what strategy has been followed?).

The next question is how to determine what a good strategy is. The starting point for determining what a good strategy is, is the mission of the evaluand. The mission reflects the societal practice that one is aiming to influence.

The mission determines which societal actors should be interacted with. In some cases these might be academics in other disciplines. An important insight from this study is the significant relation between societal benefits and the interaction with societal actors who are not formally participating in research. Instead, they may have participated in a workshop or attended a lecture. Involving societal actors in such a way requires additional efforts after the research has been designed. This indicates the evaluation of societal benefits should have a wide view and not only concern how interactions with formal project partners are or have been set up, but also how other societal actors are or were interacted with.

The type of societal actors that are interacted with determines the selection of communication channels. As stakeholders differ in their knowledge-uptake behaviour, communication with them should be adjusted to their needs. Across disciplines, communication with societal actors may be institutionalised in different manners. In some fields interaction is organised mainly through e-mail, seminars and prototypes, whereas in other fields personal interactions occur in advisory bodies, post-academic education, part-time positions in practice, opinion pieces and articles in professional magazines.

To put it in another way, there are no golden strategies. Different missions require interactions with different types of societal actors, and different societal actors require different interaction channels. On top of that appropriate strategies also are discipline dependent (chapters 3 and 5.) Therefore, managing valorisation should not focus on ticking boxes of certain research outputs, but on the presence of a well-thought-out strategy. To be able to evaluate the proposed or followed strategy, an evaluator should be well-informed about the research context. Evaluators of valorisation strategies may be academic peers, but also knowledgeable societal actors.

However, while a focus on mission and strategy may contribute to solving some of the issues listed in the introduction (e.g. temporality, broadening the set of indicators, decreasing the burden of data collection by focusing on data relevant to the selected strategy, and the aim of the evaluation), there is the pitfall of a too narrow focus. For example, it may fail to recognise contributions to societal benefits not included in the initial mission.

Also, there are some hurdles to be taken before societal missions and valorisation strategies can be evaluated using a methodological approach. First, there is no agreement within the academic community about what valorisation entails (chapter 2). This creates difficulties for evaluators and those who are evaluated. For example, if an evaluator considers valorisation to be commercial activities only, this creates a problem for the researcher being evaluated who also includes outreach to the general audience as valorisation. Research councils may provide definitions, but in practice academics follow their own ideas. Second, valorisation data are not yet systematically collected by most academic researchers and administrative staff (chapter 5). Third, there is a tension with research. Academics perceive valorisation in evaluations as being at best considered second rank in relation to excellence (chapters 2 and 5).

Nevertheless, focusing on the process helps to increase awareness about valorisation. It provides a label for processes that are part of everyday work and thereby facilitates communication and learning about valorisation. As such, it would help academics to understand what is expected of them, while simultaneously contributing to government's goal of stimulating the societal use of academic knowledge by offering academics an opportunity to learn and improve.

In conclusion, the best approach to evaluating valorisation seems to be to focus on the strategy that has been proposed or followed. On the one hand this solves the issues of attribution and temporality and on the other hand it facilitates learning.

6.3 Reflection

In this section I reflect upon the methodology and bodies of literature that have guided this study. Also, I reflect upon issues that deserve further study. The selection of methods and cases may have influenced my findings. As such, the reflection on the method serves as a frame to consider the reflection on the theory. In the reflection on theory, I discuss which of the results support the literature introduced in the introductory chapter and which results offer new insights. The reflections on the methodology and theory lead to questions for future research. These are summarised in box 1 at the end of this section.

6.3.1 Reflecting on the methodology

This thesis aims to increase the understanding of how policy is translated to academic practice and how the practice of valorisation can be improved. The delineations in space and time have strengthened the focus of this dissertation, but also have resulted in some limitations and remaining questions. In this section I reflect on these strengths and limitations and on the remaining questions that are in my opinion most important.

The primary focus of my study on the Netherlands provides an in-depth understanding of the current situation concerning valorisation policies in this specific country. A broad view on the academic landscape has been obtained by including a wide range of research fields, from the humanities to physics, and a variety of perspectives, from the research programme and university department to the individual project and individual researcher. The combination of qualitative and quantitative studies resulted in complementary data that allowed both for quantitatively testing generalizability of qualitative findings as well understanding the underlying qualitative dynamics of quantitative results.

The trade-off of an in-depth study focusing on a single country is that it is potentially less easily generalised to other countries. Van der Meulen (1998) showed that national relationships between government and science are embedded in national path dependencies and are therefore inherently different. For example, the Dutch science system is characterised by a dense layer of intermediate organisations to facilitate consensus building. I have found this to be the case concerning valorisation policies as well. At the end of the 2000s government, intermediary organisations and lobby groups negotiated on the valorisation agenda (Nederland Ondernemend Innovatieland 2009). In other countries, for instance Germany, this layer of intermediate organisations is absent. Another difference related to national contexts is the link between research assessments and funding. In the UK, research funds provided by government

are directly related to REF outcomes, whereas in the Netherlands the outcomes of SEP evaluations are not (Barker 2007; Van Drooge et al. 2013). Such national differences may result in different effects of valorisation policies on the research community. The effect on funding of assessment outcomes in the UK creates a greater necessity for individual academics and academic communities to have an answer to the UK's social impact policies, as the REF also considers societal benefits. Nevertheless, the influence of valorisation policies on academic practice increases worldwide (Dance 2013) and I believe this study provides lessons for other countries concerning the response of academics to these policies and the dynamics and evaluation of valorisation processes.

The focus of this study was on the perspective of researchers. No policy makers at key ministries or at intermediaries responsible for valorisation policies were interviewed. As a result of that decision, limited attention has been paid to the political and administrative dynamics that resulted in the valorisation policies that confronted the academic community. However, these dynamics may offer insights that help to understand why the policies were publicly framed in a specific way and thereby may help to understand the perception of the policies by academics. A suggestion for future research is to take into account the perspective of ministries and intermediaries to understand their role and the effect of the negotiations between these organisations on the translation of valorisation policy to academic practice.

The four cases only included researchers experienced in and motivated towards valorisation, whether they use the term or not. Even within this group, valorisation policy is misunderstood and causes many questions. Also, the practical aspects related to organising valorisation are considered a challenge within this group. Those not experienced in and motived towards valorisation were not included and consequently their position towards the policy could not be systematically analysed. However, the policy alienation and problems in organising and assessing valorisation can be expected to be even bigger among academic researchers within this second group. Addressing them might even be more cumbersome than addressing the academics involved in this study. Increasing our understanding of their motives and the barriers they experience might help to include them in the valorisation discussion.

6.3.2 Reflecting on theory

New Public Management

Literature about NPM was used to position the introduction of Dutch valorisation policy into a broader context of contemporary policy-making. It helped us understand that this specific policy roots in a trend of increasing the efficiency and market orientation of the public sector, including science. Also, it made clear that the focus on outputs and valorisation in assessments is not specific to scientific evaluations, but fits in a larger picture of emphasising public sector outputs and including consumer or societal actor satisfaction.

However, some deviations from this trend have recently been recognised. First of all, the NPM culture is opposed from within academia, in the Netherlands (Science in Transition and Platform H.Nu) and abroad (Council for the Defence of British Universities in the UK, Actiegroep Hoger Onderwijs in Flanders (Hosch-Dayican & Leisyte 2014), and The San Francisco Declaration on

Research Assessment internationally[40]) academics call for a change in the emphasis on numbers, such as the number of scientific papers produced or journal impact factors, and the power of university managers.

Perhaps more surprisingly, deviations from the NPM trend of focusing on finances and numbers can also be observed at the level of intermediaries and even government. As from 2014, the SEP protocol for national research assessments abolished productivity as an independent criterion. Moreover, it explicitly invites research groups to present a narrative or case study for certain impact indicators (VSNU et al. 2014). This development can be seen as a move away from simply counting outputs to regarding the process using qualitative inputs. The development is not limited to the Netherlands, as the same can be observed in the UK's REF 2014. Also the knowledge utilisation paragraph of NWO is qualitative in nature and calls for a vision on valorisation to be presented for the project that is submitted for funding consideration. Furthermore, the Ministry of Science abolished the phrase *'knowledge, competence, cash'* ('kennis, kunde, kassa'), which emphasised the economic motive of valorisation policies, as it proved to be counter-effective. During a speech at Leiden University in September 2014 the Dutch Junior Minister of Science questioned whether scientific papers should be the only indicator used to understand the value of science. He also praised non-commercial activities of researchers, such as media appearances and including local people in archaeological excavations[41].

Whereas previous studies largely focused on the natural and life sciences (e.g. Hessels 2010), to understand what the increasing demand for societal relevance means for research, this thesis also concerned other research domains and emphasised actual benefits rather than potential relevance. The struggle seems to be comparable, yet there is an important difference. Although individual researchers in the natural and life sciences may have difficulties explaining the societal benefits of their work, they do not perceive the societal benefit of their field to be questioned. This contrasts with the situation in the humanities, where researchers also perceive the societal benefit of their field or even of the entire domain to be questioned.

A suggestion for future research is to study these signs that science policy is moving away from the classic NPM characteristics of emphasising output over process, using countable and therefore easily comparable indicators and emphasising financial value. Is this a temporary movement or the beginning of a new policy trend? Can it be observed in more countries? Can it also be recognised in other science policies than valorisation policies, as current public discussions concerning healthcare[42] and education[43] show? And if the influence of NPM is

40 http://am.ascb.org/dora/

41 http://www.rijksoverheid.nl/documenten-en-publicaties/toespraken/2014/09/01/opening-academisch-jaar-leiden.html (last accessed 10-11-2014)

42 See for example De Volkskrant, (7-11-2014, p4) where a representative of the Association of Nurses and Caretakers in the Netherlands states that nursing homes that focus on production targets, time measurement and bureaucratic procedures often have difficulties meeting the norms of health care quality.

43 See for example De Volkskrant (6-11-2014, p5), about a bill by members of the Dutch parliament which proposed to decrease the surveillance by the Dutch Inspectorate of Education and provide more freedom to teachers in deciding on the number of tests and the ways of teaching. The newspaper calls the bill a turning point in education politics.

declining, what policy paradigm is replacing it and what effects can be expected of this new paradigm?

Principal-agent theory

PAT allowed me to conceptualise the relationship between government and science and the role of valorisation policy within this relationship. I focused on how the policy, among other means through intermediaries, was translated to academic practice, and on the response of the academic community to the policy. My results have implications for the theory and its operationalization within the context of science policy.

The available principal-agent literature focusing on the science system seems to have a limitation in describing the behavioural strategies of scientists towards intermediaries and government. The literature conceptualises the relationship as a game and distinguishes compliance, symbolic compliance, shirking and negotiation as the range of deliberate strategies adopted by scientists (Van der Meulen 1998; Leisyte 1997). This study found that scientists also can distance themselves from intermediaries and government by leaving the strategic game entering a state of mind resembling apathy. I argue that this behaviour cannot be considered as a strategy or a form of shirking, as scientists displaying this specific behaviour have left the game and did not seem to have opted for this behaviour to maximise their outcome of the game. Their behaviour is rather rooted in a general loss of faith in government's and intermediaries' intentions. This suggests that academics perceive intermediaries as being too closely associated with government (Van der Meulen 2003.) A similar response has been described for health care professionals. Tummers (2012) labels this behaviour 'policy alienation.' It could be argued that this makes it even more difficult to incentivise the behaviour of academics or negotiate the content of policies, as these professionals no longer concern the content of policies.

When using PAT to analyse relationships between government, intermediaries and science, it should be realised there are also principal-agent relationships within organisations. Within universities, there is the strategic level of the university board and department boards and the operational level of research groups and individual researchers. For example, following performance agreements made with government, the strategic level sets valorisation targets for the operational layer. However, the operational layer feels poorly equipped to meet the targets. The way researchers speak about the strategic level indicates that this level is not regarded as representing the academic community (also see Halffman & Radder 2013). In fact, the strategic level more and more resembles the characteristics of an intermediary or even a principal. An illustration is the case of the SEP evaluations. In that specific context, there is a situation in which research groups are in practice no longer accountable to government, but instead are accountable to their own board. Government does not consider the reports of individual evaluation committees and does not allocate funds based on the results of the evaluation. Instead, it is the university board or department board which may decide to terminate the relationship with a poorly performing group by cutting its funds (Van Drooge et al. 2013). As such, the strategic level within the university can be regarded as an intermediary or even a principal. The implication for future research on science policy is to regard the university and the academic community within a university as two distinctive levels when operationalising PAT theory. The realisation that there are principal-agent relationships within academic institutions

also raises the question of how policy is translated from university boards to middle management, research leaders and individual academics. Understanding these micro-level principal-agent relationships is not only important for valorisation policy, but could also provide valuable insights to tackle such issues as gender and diversity (Van Arensbergen et al. 2012).

Within the execution of ex post and ex ante evaluations, a similar task differentiation can be observed. The management and policy employees of the research council and the organisations responsible for the SEP (KNAW, NWO and VSNU) can be considered as the strategic level developing the peer review procedures. The actual evaluation is delegated to an operational level of academics. Evaluations increasingly include valorisation, but academics feel poorly equipped to perform this specific evaluation task. This implies that when studying intermediary organisations within the science system, the policymakers and the academics implementing the policies should also be treated as two distinct analytical levels.

Finally, a limitation of PAT is that it treats government as a single actor. However, in the case of Dutch science policy, multiple ministries are involved, each with its own agenda. For example, the Ministry of Economic Affairs is involved in science policy making as it considers knowledge essential for economic growth. In the case of valorisation, this ministry has a narrower view on valorisation than the Ministry of Science, focusing primarily on the economic benefits of academic research (e.g. Ministry of Economic Affairs 2015). Although the academics in this study do not make a distinction between ministries, often do not distinguish government from politics and sometimes even refer to 'The Hague' (the seat of Dutch government and parliament) when voicing their disapproval of the valorisation policy, we should be wary of treating the government as a single actor if we want to understand how valorisation policy is translated to academic practice. A more fine-grained view of the origin of policy documents and catch phrases will help in understanding the rationale behind the messages that are directed to scientists and as such will help in comprehending what is expected by individual ministries and political parties and why.

The findings of my study provide several leads for future research. For general-principal agent theory my suggestion is to further study and understand the apathy or policy alienation I identified, as well as the effects of this behaviour on the fulfilment of the delegated task. For the application of principal-agent theory in science policy-making, the role of universities and university departments as intermediaries deserves further attention as my study suggests they can no longer be operationalised as agents. Specifically regarding the valorisation policy, the translation of government policy by and within intermediaries and the way they have developed their own valorisation policies warrants further attention. Their role is crucial in understanding the translation of policy to academic practice. The same accounts for the interaction of different ministries involved in science policy making. A better understanding of these steps and interests may help to identify how the translation of future science policies can be improved at an earlier stage

Societal benefits literature

Societal benefit literature was used as a heuristic to analyse how research dynamics relate to societal benefits and how both can be evaluated. In the introduction, questions and challenges

were identified regarding societal actor involvement and societal benefits. This dissertation addresses some of these questions and challenges.

Transdisciplinary research is generally believed to induce societal benefits (Pohl & Hirsh Hadorn 2008; Voinov & Brown Gaddis 2008; Peer & Stoeglehner 2013), but the link between the two as well as the actual occurrence of transdisciplinary research is still questionable (Jolibert & Wesselink 2012; Phillipson et al. 2012; Weingart 1997). The findings of this study suggest a link between the characteristics of transdisciplinary research and societal benefits, but also suggest transdisciplinary research in its ideal form may not be required to generate benefits. I found evidence for a positive link between consultancy transdisciplinary research (Möbjork 2010) and societal benefits, in which societal actors have an advisory role to academic researchers, but I did not find this link between participatory transdisciplinary research ((Möbjork 2010), in which societal actors have an equal role to scientific researchers, and societal benefits. However, additional research is required to confirm this finding. More academic projects were found to display consultancy transdisciplinary research characteristics as well. These findings temper the weight attached to Weingart's (1997) fear that transdisciplinarity is not as widespread as suggested and that not all research in transdisciplinary research programmes is organised in a transdisciplinary fashion.

Concerning the challenge of including the societal actor perspective, this study suggests that not only should the perspective of formal project partners be included, but also of informally involved partners. More specifically, I found convincing evidence that informal involvement has a positive link to societal benefits. This supports the findings of Olmos-Peñuela et al. (2013), who stress the importance of informal links between academics and societal actors concerning societal benefits. Olmos-Peñuela et al. find that some informal links remain informal for longer periods of time, whereas others are formalised through legal agreements. Although there is some insight into the conditions under which informal collaborations remain informal (too high additional costs of formalisation, for instance, a decrease in flexibility or trust; coverage of the investment of academics in the relationship by funding other sources), the specific mechanisms behind the relationship between these collaborations and the benefits that result from them deserve further investigation as the effects were found to be considerable.

A possible explanation for the identified abundance of interactions between scientists and societal actors may be offered by generation effects (Verbree et al. 2013). Since Weingart expressed his concern, a new generation of researchers has been trained, for whom valorisation may be a more self-evident part of academic practice, although women seem to have a more positive opinion towards valorisation than men (Van der Weijden et al. 2012; Van der Weijden et al. 2014). This raises the questions of what effect the increased emphasis on valorisation will have on future generations of academics and on gender differences in science.

Finally, this study shows that the distinction between research domains concerning their interaction with society is not as black and white as is generally believed. Often, the social sciences and humanities (SSH) are treated as a special - perhaps even problematic - case, whereas the benefits of chemistry and physics are considered as a given (e.g. Van Langenhove 2012; Ochsner et al. 2013; Olmos-Peñuela et al. 2014). In fact, I found large similarities between

such fields as string theory, astronomy and high energy physics on the one hand and such fields as theology and anthropology on the other hand. Researchers in these fields indicate that their findings have little direct value for industry or policy-making. Therefore, these fields fulfil their valorisation task by educating and fascinating the general audience. Researchers in these fields feel vulnerable because of their lack of direct economic value. Treating SSH as a special case neglects the challenges researchers with similar research dynamics in other fields are faced with. Future research may help to identify these other fields and address their challenges.

Box 6: Research agenda

- Understanding the motives of valorisation opponents as well as the barriers they experience
- Analysing whether the influence of the NPM paradigm on policy, including science policy, is declining and what paradigm may be already replacing it
- Understanding the effects of policy alienation in the principal-agent relationship between government and scientists
- Understanding the effects of principal-agent relationships within universities on policy translation
- Understanding the translation of valorisation policies to academic practice from the perspective of government and intermediaries
- Verifying whether consultancy transdisciplinary research may be sufficient to generate societal benefits
- Understanding how the informal involvement of societal actors leads to societal benefits
- Identifying which research disciplines experience difficulties concerning developing valorisation practices.

6.4 Recommendations for practice

A number of recommendations to improve the practice of valorisation follow from this study. Although the recommendations are based on the empirical research and the resulting conclusion of this study, I allow myself to take a step back and also include insights based on the numerous discussions about the topic I had with policymakers, support staff and last but not least academic researchers outside my own peer community. The papers included in this thesis include only a selection of the insights gathered during this study. Additionally, attending national conferences and university department symposia, organising valorisation workshops for support staff and academics and bilateral meetings with policymakers were equally valuable in understanding the issue of valorisation as the four empirical chapters included in this dissertation. In the following sections, I address government, intermediary organisations and academics outside my own peer community. An impression of the situation that may result from implementing the following recommendations is sketched in box 7. A list of action items is included at the end of the recommendations section in box 8. The aim of my recommendations is not to contribute to managerialising valorisation by making it a box-ticking exercise, but to contribute to professionalising its organisation. If anything should be managed or, perhaps

more appropriately, be supported and facilitated, it is the development of context specific valorisation strategies. In that case, management is not about specific societal actors and outputs, but about the quality of the strategy proposed or followed.

Box 7: 2020: A retrospective on the rise of the third mission[44]

'My first wish is that every academic can explain the use of his knowledge. That would be my wish, you should be able to explain this' – full professor in physics (2014)

Along education and research, the third mission has become a formal task of universities. Many academics perceive the third mission as a challenge or even a burden. What would the university in 2020 look like if the third mission is just as self-evident as education and research? This is exactly what we asked 39 academics and 14 supportive staff members, who all have experience with aiming for societal impact, in six focus groups. The next three fictive narratives summarise the views of these experience experts on a future in which the third mission is a full-fledged task, integrated in the university system.

Jane, a Roman archaeology expert, is the first to share her story. She has supervised numerous excavations commissioned by local governments. Also, she has rebuilt Roman constructions to show the public what a Roman villa looked like.

'Five years ago I did not realise my commissioned works and reconstructions were considered as third mission activities in research assessments. I noticed many of my colleagues were also unaware about their societal impact, so I organised meetings within the humanities department to discuss the topic. We also published a book with examples, to inspire other researchers. I learned we were not the only ones struggling with the third mission. My sister is a biophysicist. She collaborates with the Alzheimer foundation as well as physicians and gives lectures for patients and their families. However, she never knew what to write in her grant applications under the impact heading. After I told her about my experience, she convinced her peers to organise a thorough third mission discussion in the physics community. My sister recently received a prestigious grant, because apart from scientific excellence, she could also convincingly demonstrate an impact strategy .'

Albert, an influential chemist, has another tale to tell. He holds several patents, is the founder of three spin-off companies and directs a research lab fully funded by industry. Also, he regularly chairs evaluation committees at the research council.
'Since 2014 the Dutch research council requires evaluation committees to assess third mission strategies in proposals. In the beginning, we had no clue how to assess these

44 The content of box 7 was published as 'Back from the future: a look at the rise of the third mission'. Invited contribution to EU-SPRI 2014 conference weblog http://euspri2014.blogspot.co.uk/#!/2014/06/back-from-future-look-at-rise-of-third.html . June 11, 2014 (in collaboration with J. Smit and L.H.A.van Drooge, , L.H.A.)

strategies. There was no vision on societal impact. I used to consider it simply as commercialising research findings. A few years ago I met Marc. Marc is an astrochemist and his research is light-years (haha!) away from application. He is actively involved in giving public lectures and develops educational methods for high school students. I never thought of these activities as part of the third mission, but when he told me about them I realised they are. It is an excellent way to show society what we are doing and to share our excitement! Nowadays, these activities are considered just as important as commercialisation of research findings.'

James can provide a different perspective, as head of the human resource department of a university. He has chaired a national committee of university human resource managers. The challenging task of the committee was to develop a plan to include third mission activities in career tracks.

'It was a difficult job but we I believe we managed. What we recommended is that the third mission should be a responsibility on the level of a research group, not on the individual level. Some researchers have excellent track records in scientific journals, but it would be a VERY bad idea to let them explain their findings on national television. While others are excellent in doing these things. To allow the required diversification in personnel, we also recommended a diversification in their assessment. Of course your research should meet quality standards, but if you publish fewer papers because you are actively involved in the third mission, that is okay. We need these people! Last year we appointed the first full professor whose appointment was mainly based on his third mission activities, which of course are based on sound research. An important development in realising this was the inclusion of the third mission, as well as education, in promotion criteria. Just a decade ago the dominant criterion to move up the academic ladder was individual academic excellence. Only at the rank of full professor academics were suddenly expected to collaborate with societal partners. This simply did not work. Besides the new promotion criteria, doctoral students are now also required to take courses in third mission strategies.'

Whether it sounds like heaven or hell to you, this represents the outcome of the focus groups in the Netherlands. The participants believe that in such a future third mission activities will be facilitated. Do they expect this future to come naturally? Not at all. How can science policy and science policy studies help them in their third mission activities? We identified three major needs: 1) A broad set of examples of third mission activities and policies to inspire and stimulate debate. 2) Third mission indicators for use in both ex-ante and ex-post research assessments and human resource management. The indicators are primarily needed to create a reward system. It cannot be stressed enough these indicators should be field specific. 3) A change of academic culture and management in order to create conditions that support the third mission. An example is an innovation track, in which researchers are primarily assessed on their innovation activities instead of publications.

Some of the answers might already be available in the science policy studies community. Our contribution to the third mission could be understanding and meeting the needs of an important group of our stakeholders: other academic researchers. Otherwise, what is the use of our knowledge?

6.4.1 Government

This thesis shows that although the term valorisation may cause confusion and sometimes even irritation, the underlying thought of scientific research contributing to societal benefits receives support in the academic community. It was shown that there is considerable overlap between the content of the policies and the visions of academics. Yet, the perception of the policies by academics is different from what can be read in policy documents. Currently, government and some intermediaries are considering introducing a new term. My recommendation for government would be to maintain the term valorisation and invest in rectifying the perception of the policy.

Introducing a new term would lead to a similar situation as identified in this thesis in ten years' time. It will take time to develop a new term, negotiations have to be conducted between government and intermediaries as to what the term precisely entails and then it has to be made generally known among academics. Currently, the term valorisation seems to have trickled down to academic practice, although there are still many researchers who are unfamiliar with the term as such or with the rationale behind it. Yet, the official definitions used by government and intermediaries capture all the elements considered important by academics.

Therefore, a better option may be to invest in rectifying the perception of the policy by actively carrying out what is understood as valorisation, emphasising that it is about more than short-term economic benefits. The distinction identified between strategic and operational levels in universities suggest government can no longer consider university boards as representing the academic community concerning the negotiation and implementation of science policy. If government aims to communicate with the academic community, it should think about ways to do so in a direct manner. It cannot be assumed that academics read lengthy policy documents. They base their opinion on public appearances by ministers, public debate and hearsay. Ministers and high level civil servants could contribute to a better understanding of the policy by academics by emphasising the broad meaning of valorisation in interviews and speeches. Applauding the few brilliant individuals who managed to found successful spin-off companies is great, but the same should be done for researchers who made career-long investments in fascinating high school students for their discipline or those who had a major impact on public policy. This and comparable messages would include many who currently feel left out of the discussion.

Furthermore, government should further encourage intermediary organisations to support valorisation as agreed in the valorisation agenda, not only in words, also in actions. In the valorisation agenda (Nederland Innovatieland 2009), it was agreed that valorisation would be included in quality care systems. Under the heading of societal relevance it is addressed in the Standard Evaluation Protocol (SEP), and NWO uses the label knowledge utilisation. However,

the mere inclusion of a criterion is not sufficient if researchers do not know what is expected of them. Additional effort is required by the administrators of the SEP (KNAW, NWO and VSNU) and NWO to raise the awareness of valorisation. At the moment, this is not done at all, or is scarcely done. Anecdotal evidence includes that the owners of the SEP believe that their job is done after writing the new SEP and that NWO believes it should not tell academics how to write a knowledge utilisation paragraph. Also, it was agreed that universities would include valorisation in academic job profiles. It has been included in the UFO, but in practice research is still dominant. Acknowledging that academic research should be of excellent quality, universities should be stimulated to consider job diversification. I have come across isolated valorisation tracks, where researchers are mainly judged on their valorisation activities. The more such tracks are available, the more appealing the option to pursue a scientific valorisation career.

6.4.2 Intermediaries

SEP and NWO

As agreed in the valorisation agenda, valorisation is included as a criterion in the Standard Evaluation Protocol (SEP) under the label of societal relevance. NWO has included it as knowledge utilisation in the assessment of project proposals. Both SEP and NWO use a broad notion of valorisation. These are necessary first steps. The next steps include further raising awareness of valorisation in evaluation procedures, as this will contribute to improving quality care and valorisation practices.

SEP and NWO should consider publishing best practices of societal relevance sections of self-evaluations and knowledge utilisation paragraphs, and/or sharing them in workshops. The best practices should be accompanied by an explanation of what elements make it a best practice. Academics in this study have clearly voiced a need for examples, in order to better understand what valorisation is, to be able to develop a vision and to become inspired. For example, some academics perceive valorisation as traditionally being part of academic research. They might be actively fulfilling the task without even knowing it. Ask them to mention their achievements in an assessment and the page will remain blank. Academics should understand what valorisation is about. The better prepared academics are in evaluations, the more they can learn about valorisation processes.

Not only should the awareness of those who are evaluated be increased, academics who evaluate and policymakers who supervise and organise the evaluation should also be addressed. The confusion about what valorisation is can also be found in evaluation committees and among policymakers. Some specific examples have been discussed in chapter two. There are researchers who believe only application is valorisation, whereas others do not consider collaboration as valorisation. Also those with extensive experience in evaluation committees explicitly mention the struggles they encounter in these contexts when assessing valorisation. At the level of the UK's REF 2014, Derrick (2014) finds that some evaluators disregard valorisation, while others assess valorisation by considering more traditional criteria such as 'originality of research questions.' Even if valorisation is accepted as an independent criterion, there is the risk of a narrow assessment. As Van Arensbergen et al. (2014) show, committees will fall back on the quality elements they all agree upon. As far as valorisation is concerned, this means economic

benefits. An analysis by Derrick et al. (2014) shows policymakers may have an elaborate idea about the organisational aspects of the evaluation process; like researchers they have no uniform idea of what valorisation is. It would be advisable to clearly instruct evaluators and policymakers what valorisation is and to let them share their definitions before the evaluation is performed, possibly during a special course or workshop.

Also, continue the recently selected route of focusing on the process instead of on output. Focusing on strategies solves the problem of attribution by focusing on contribution. A strategy requires a deliberate decision about with whom to interact and how and when to interact. This facilitates learning and improving future strategies. A focus on process instead of result may not fit within the NPM paradigm, but the observed recent deviations from NPM (e.g. the inclusion of narratives in SEP and case studies in the UK's REF) could pave the way to realise the future of qualitative indicators as envisioned by Donovan (2007).

Going back to a focus on outputs may result in conceptual difficulties in evaluations. Outputs and benefits are difficult to compare. Is a patent more valuable than an advisory report to a ministry? Are 50 jobs more valuable than saving 2 lives? Also, their achievement is subject to influences outside the scope of researchers.

A focus on output may also result in undesired behaviour within the science system. It may result in simplified valorisation rankings based on the outputs resulting from the process. This will incentivise university administrators and researchers to focus on products, causing a growth in the number of workshops, policy reports and opinion pieces without thinking about the actual contributions resulting from these products. As such, a focus on products will assess symbolic compliance rather than actual compliance. A focus on products may also result in a narrow selection of easily measurable and comparable outputs, which may not necessarily be the best selection of interaction channels between societal actors and academics in every research field. These practical problems are similar to the current discussion on the ever-growing number of journal articles at the expense of, for example, books and ignoring the question of whether journal articles are the best way to reach science's goals (Science in Transition 2013.)

Research organisations (Universities, KNAW and NWO)
Following the valorisation agenda, steps have been taken by research organisations[45] to professionalise their valorisation tasks; for example, valorisation is now formally included in academic job profiles (UFO profiles). Further steps can be taken to facilitate the fulfilment of valorisation in the broad sense of the term. Important additional reasons to take these steps are that many academics are motivated to contribute to society, that they enjoy the interaction with societal actors and that these interactions regularly result in innovative research questions. A first necessity is the organisation of a debate about valorisation within research institutions. Exchange of experiences and examples is much desired by academics, as even those who have a track record in valorisation feel they are poorly equipped to valorise their research.

45 KNAW and NWO are also considered as research organizations, as they manage 16 and 8 research institutes respectively

There are some successful examples of valorisation symposia at university department level, where academics and sometimes also university managers collectively determine what valorisation means to that specific academic community, and where experiences are shared. There is a tendency to put the achievements of established researchers at the centre of attention. However, smaller achievements by researchers less experienced with valorisation should also be applauded. This will demonstrate that success in valorisation is achievable for all who want to achieve it. The debate is also facilitated by translating policy documents by government, NWO and SEP into understandable terms and comprehensible formats for researchers. As I established in this study, academics do not necessarily read these policy documents.

Another important step is realising valorisation is an opportunity to create society's support for public research and not just an opportunity to increase research funds. This may involve a mentality shift, as over the past 30 years NPM has created an environment in which a positive and independent financial status was considered of great importance. Valorisation policy, especially as initially introduced, offered universities a manner to tap into additional sources of money. However, economic impacts are about contributions to the economy as a whole, not just to the financial balance of the university. Additional attention for social, cultural and democratic aspects of valorisation (AWT 2007) may contribute to increasing society's support for public research as well. The Science Vision 2025 (Wetenschapsvisie 2025) of the Dutch Minister of Science (Ministry of Education, Culture and Science 2014) also emphasises the broad meaning of valorisation. To this end, universities may consider transforming Technology Transfer Offices into offices that provide different forms of valorisation support. In that way, they become offices for all academics involved in – or aspiring to be involved in - valorisation, not only for those collaborating with companies or working on patentable research, for example academics who collaborate with governments or who are involved in sensitive societal debates may also benefit from professional support.

Further, valorisation should be made a part of academic human resource management (HRM) policies. Currently, the emphasis in academic HRM is on scientific excellence (Van Arensbergen et al. 2013). Additionally, other competences, including valorisation, should be included and evaluated (ACUMEN 2014), as without formal acknowledgement there is little incentive for academics, in particular young academics, to invest in engaging with society, as the quote from an assistant professor in biomedical sciences shows:

'Why don't I read the NRC Handelsblad [a Dutch quality newspaper]*? Because on a Saturday morning I'm reading a scientific paper. So up to the moment I need the newspaper to continue my research career, I will never read it. Of course I would rather read the scientific paper.'*

If valorisation is considered as a task in its own right, it should be encouraged by making it a part of doctoral training, as the League of European Research Universities suggests (LERU 2014) as well as a part of further academic training, such as academic leadership courses. Universities could, for example, facilitate academics temporarily working as researchers-in-residence in industry or a public organisation. It should also be included in selection processes, such as making it a formal criterion in tenure track procedures. Valorisation tracks could be considered to employ academics who focus on valorisation and who are therefore not able to meet current

publication requirements, although what they publish meets academic standards of quality. In this way, valuable individuals who act as a bridge between scientific research and innovation can be maintained for academia. Nevertheless, it should be realised that deliberately distinguishing specific tasks of academics for managerial purposes only may be counterproductive. It may lead to confusion about what valorisation is, as many academics experience it as integrated with research and teaching.

6.4.3 Academics

I found many academic researchers who were highly motivated to contribute to society. However, the majority seem to work on this aim in relative isolation. Sharing valorisation strategies is not part of daily routine within research groups, in the same way as sharing of methodologies or publishing strategies, for example. If valorisation is to be taken seriously by the academic community, it should become a collective endeavour.

Academics could start by making sure they are informed about valorisation policies. My study showed that the average academic is knowledgeable about the content of valorisation policies only to a limited extent, and that his or her perception of these policies is different from the actual content. An understanding of the policies may result in a valorisation discussion based on facts instead of hearsay, and may thereby take away many of the concerns.

Such a discussion could be organised within research communities, within a research group, a university department or (sub-)discipline. As this study shows, there is no single golden strategy to generate societal benefits; researchers have to develop their own context-specific strategies. Important questions to discuss when developing a valorisation strategy are: what is the societal aim of our research? What contribution do we want to make? Which societal partners and perhaps other academic fields do we need to achieve our aim? What are the best ways to interact with them? An off-site day or symposium to answer these questions and exchange experiences could be a start to initiate such a discussion. It should become as much common practice to discuss these questions as it is to discuss the selection of a research method or the strategy to publish in a distinguished journal. Having a clear mission and strategy in mind will help to mobilise knowledgeable actors in society that can make relevant contributions to research, as the Science Vision 2025 (Wetenschapsvisie 2025) (Ministry of Education, Culture and Science 2014) demands. As such, it contributes to preventing unfocused input from a random selection of societal actors.

Another important topic of discussion for academic communities is the role of valorisation in talent selection and careers. As we know that the doctoral phase of an academic's career shapes future behaviour (Verbree et al. 2013), it is a responsibility of supervisors to train their doctoral students in valorisation and a responsibility of doctoral students to include valorisation activities in their personal education plan. Acquiring valorisation skills is important for pursuing an academic career, albeit only for getting access to funding. Valorisation skills will also help academics who leave science and have to pursue a career in other public sectors or the private sector, as is the case for the majority of doctoral students (De Goede et al. 2013). Although many junior and senior scientists would like to develop valorisation skills, they tend to believe the majority of their peers still consider excellence more important than valorisation. If indivi-

duals do not discuss this perception, the status quo will remain. Discussing as a community how excellence, valorisation and teaching can be balanced may help to improve evaluation procedures at NWO, for example in the 'Vernieuwingsimpuls' and selection procedures within universities and thereby maintain valuable researchers for academia.

Box 8: Action items

Government
- Invest in rectifying the perception of the valorisation policy
- Emphasise that valorisation is about more than economic benefits
- Encourage intermediaries to support academics in including valorisation in academic practice

Intermediaries
- Publish best practices of societal relevance sections and knowledge utilisation paragraphs
- Train evaluators and involved policy makers in the evaluation of valorisation
- Focus on the strategy instead of the outcomes when evaluating valorisation
- Organise debates about valorisation within universities and public research institutes
- Reconsider whether valorisation is above all about increasing financial means
- Include valorisation in human resource management

Academics
- Become informed about the content of valorisation policies
- Organise a discussion about valorisation within research communities
- Discuss and include valorisation in talent selection and career development

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Epilogue

The origin of this thesis can be traced back to the question I asked as a student: *'What can we use this knowledge for?'* Clearly, this question contains a normative element. It implies that the results of academic research should be useful. It is only now that I realise I have not asked this particular question in recent years when I was studying valorisation. In these years, I've had the opportunity to talk to many academics about what they love best: conducting research. Over time, it became increasingly easy to comprehend the importance and potential societal benefits of their knowledge, sometimes even before the academics realised it themselves. So, the need to ask them the question became obsolete.

Through this study, I learned that societal benefits are inherent to scientific research, regardless of its discipline or whether it is basic or applied science. However, these societal benefits are not necessarily generated spontaneously. It may require some thought, time and action to release their potential. I believe that every academic has an obligation to develop and implement a strategy of contributing towards societal benefits. This is where valorisation comes in, as it is about the process of generating these benefits. My study shows that valorisation may take multiple forms, applicable to different personalities, types of research and academic disciplines. For some academics, contributing to societal benefits may mean deliberately sharing their knowledge with that one colleague who is known for being well embedded in, for example, policy circles or industrial networks, whereas for others it may mean being involved with these circles and networks themselves. In the end, it is all about creating a knowledge development chain.

Interacting with policy makers, university staff members and academics outside my peer community also made me realise the potential benefits of the academic discipline of science studies. Many of the people that I spoke with regarding valorisation had never previously heard of this discipline, even though they have the potential to benefit greatly from its achievements. Concerning valorisation, policy makers, university staff members and academics have voiced a clear need for: 1) methodologies to assess valorisation, specifically on the individual level, 2) approaches to include valorisation in academic work and academic careers, and 3) the organisation of a cultural and managerial transformation in academia that results in more equality between the three tasks of universities (education, research and valorisation) on the one hand and less red tape on the other. As I often heard at conferences, there is a danger of such practical questions leading to pleas for *'a better conceptualisation'* or *'a clear definition.'* Although a better understanding of the subject may be required to answer the above-mentioned and other questions, we should not forget the potential of the knowledge already available. Yet, the question of how the results of a study could be used to support other academics is asked only rarely at conferences. Sometimes, the question *'What can we use this knowledge for'?* may not be as negative as it sounds. It is not a normative question per se; it can also be a sincere question aiming to reveal the inherent value of academic research as a collaborative start to generate societal benefits.

Nederlandse samenvatting

Engaging Scientists: Organization of valorization in the Netherlands

Valorisatie in wetenschapsbeleid en wetenschapspraktijk

Dit proefschrift gaat over valorisatie. *'Kennisvalorisatie is het proces van waardecreatie uit kennis, door kennis geschikt en/of beschikbaar te maken voor economische en/of maatschappelijke benutting en te vertalen in concurrerende producten, diensten, processen en nieuwe bedrijvigheid.'*[46] In 2004 benoemt voormalig minister Van der Hoeven van Onderwijs, Cultuur en Wetenschap (OCW) valorisatie tot een kernpunt van het wetenschapsbeleid. De minister geeft zo nader invulling aan de derde wettelijke taak van universiteiten: het overdragen van kennis ten behoeve van de maatschappij.

Ruim tien jaar later zorgt het begrip valorisatie voor de nodige weerstand en verwarring op de academische werkvloer. Wetenschappers voeren een verhit debat over de bemoeienis van overheid en maatschappij met de inhoud van hun werk. Het valorisatiebeleid is dus niet enkel positief ontvangen. Het is daardoor de vraag of de overheid haar doel bereikt.

Dit proefschrift heeft twee doelen. Het eerste doel is het vergroten van het begrip van de vertaling van wetenschapsbeleid van de Nederlandse overheid naar de wetenschappelijke gemeenschap. Het tweede doel is bijdragen aan het verbeteren van de valorisatiepraktijk.

Twee onderzoeksvragen staan centraal in dit proefschrift. De eerste vraag is: 'Hoe is het valorisatiebeleid van de Nederlandse overheid tussen 2004 en 2014 vertaald naar de academische praktijk?' Om deze vraag te beantwoorden is in het bijzonder gekeken naar hoe wetenschappers reageren op valorisatiebeleid (deelvraag 1a), en hoe zij de valorisatietaak opnemen in hun dagelijks werk (deelvraag 1b). De tweede vraag is: 'Hoe kunnen maatschappelijke opbrengsten van wetenschappelijk onderzoek geëvalueerd worden?' Het proefschrift gaat niet in op de normatieve vraag of valorisatie als taak van de wetenschap goed of slecht is.

46 Nederland Ondernemend Innovatieland. (2009). Van voornemens naar voorsprong: kennis moet circuleren. Den Haag: Inderdepartmentale Programmadirectie Kennis en Innovatie. P 8.

Publiek beleid

Het begrip valorisatie past in een grotere stroming van publiek beleid: New Public Management. Deze stroming ontstaat in de jaren tachtig van de vorige eeuw onder premier Margaret Thatcher in het Verenigd Koninkrijk. Het idee achter New Public Management is dat marktwerking leidt tot een efficiënte en resultaatgerichte publieke sector. De wetenschap is een voorbeeld van een publieke sector. De zorg, het openbaar vervoer en het onderwijs zijn andere voorbeelden. Efficiëntie zou volgen uit concurrentie tussen publieke organisaties. Resultaatgerichtheid zou volgen uit contracten tussen de overheid en de publieke sector. In deze contracten maken overheid en publieke sector afspraken over doelen, evaluaties en consequenties. Een bekend voorbeeld daarvan is de boete die de Nederlandse Spoorwegen krijgt opgelegd als te veel treinen niet op tijd rijden.

Het eerste belangrijke effect van New Public Management op wetenschapsbeleid, is de introductie van de maatschappij als consument van wetenschap. Zo krijgen niet-wetenschappers toegang tot de colleges van bestuur, en gaan bedrijven deelnemen aan onderzoek. Het tweede belangrijke effect is het veranderende doel van onderzoeksevaluaties. In het verleden hadden onderzoeksevaluaties tot doel om op lokale schaal vakgenoten over wetenschappelijke kwaliteit te informeren. Sinds de opkomst van New Public Management zijn ze vooral bedoeld om de overheid en andere belanghebbenden van wetenschap te informeren over de voortgang van het onderzoek. Aan bestaande evaluatiecriteria, zoals wetenschappelijke kwaliteit, worden criteria als levensvatbaarheid van de onderzoeksgroep en maatschappelijke relevantie van het onderzoek toegevoegd.

De invloed van de maatschappij en de nadruk op resultaten kunnen spanningen veroorzaken binnen de bestaande wetenschapspraktijk. Zo kan de invloed van de maatschappij leiden tot een grotere aandacht voor toegepast onderzoek, omdat dat resultaten oplevert die op de korte termijn van belang zijn. Dat kan ten koste gaan van fundamenteel onderzoek, waarvan de resultaten vaak niet direct tot toepassingen leiden. En de nadruk op resultaten roept de vraag op, of onderzoekers volledig afgerekend kunnen worden op de maatschappelijke opbrengsten die uit hun onderzoek voortkomen. De ontwikkeling van wetenschappelijke kennis tot maatschappelijke toepassingen is immers een proces waar veel verschillende partijen bij betrokken zijn. En waar veel factoren, zoals politiek of economisch klimaat, invloed op hebben.

De relatie tussen overheid en wetenschap

De *principaal-agenttheorie* helpt om de vertaling van het valorisatiebeleid van de overheid naar de wetenschappelijke praktijk te begrijpen. Deze theorie stelt de interactie tussen overheid en wetenschap voor als een relatie tussen opdrachtgever en opdrachtnemer. De opdrachtgever is de overheid. Zij heeft kennis nodig en heeft geld beschikbaar voor de ontwikkeling daarvan. Maar zij mist de inhoudelijke capaciteit om het zelf te doen. De opdrachtnemer is de wetenschap. De wetenschap wil kennis ontwikkelen en heeft de inhoudelijke capaciteit om dat te doen, maar mist het daarvoor benodigde geld. De overheid geeft de wetenschap geld in ruil voor het ontwikkelen van kennis.

De Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO), de Koninklijke Nederlandse Akademie van Wetenschappen (KNAW) en ook universiteiten als organisatorische

eenheden van onderzoek, hebben in de principaal-agentrelatie een functie als intermediairs. Ze vertalen het beleid van de overheid naar de wetenschapspraktijk. Ook kunnen zij de belangen van de praktijk behartigen bij de overheid. Intermediairs moeten daarbij zoeken naar een balans. Als zij teveel lijken te handelen in het belang van de overheid, wekt dat argwaan bij de wetenschapspraktijk: de autonomie van de wetenschap is in het geding. En in het omgekeerde geval verliest de overheid de zekerheid dat intermediairs haar belang dienen.

Valorisatie kan gezien worden als één van de voorwaarden die de overheid heeft gesteld aan het financieren van wetenschap in ruil voor de ontwikkeling van kennis. Met deze ruil krijgt de overheid het recht om te controleren of de wetenschap handelt in overeenstemming met de doelen van de overheid. De overheid gebruikt daartoe evaluaties. Voorafgaand aan onderzoek, bijvoorbeeld via wetenschapsfinanciers als NWO, om de beste onderzoekers te selecteren. Maar ook achteraf, bijvoorbeeld via het Standaard Evaluatie Protocol, om na te gaan of beloften zijn nagekomen.

Het beschouwen van de relatie tussen overheid en wetenschap als die van principaal en agent maakt duidelijk waar de spanningen in de vertaling van het valorisatiebeleid vandaan kunnen komen. Het laat zien dat de voorwaarden die de overheid stelt aan de financiering van wetenschap, duidelijk moeten zijn voor wetenschappers. Anders kunnen zij er geen zinnige invulling aan geven. Daarnaast vraagt het recht op controle van de overheid om een balans te vinden tussen de autonomie die wetenschap nodig heeft om nieuwe kennis te ontwikkelen, en het geven van sturing in de door de overheid gewenste richting van kennisontwikkeling. Tot slot vraagt de nieuwe voorwaarde, (in dit geval valorisatie), van onderzoekers om hun strategie om kennis te ontwikkelen, opnieuw te bepalen. Hoe kunnen de doelen van de overheid verenigd worden met het verkennen van voor de wetenschap veelbelovende onderzoeksrichtingen?

Aanpak van het onderzoek in dit proefschrift

De *case study* methode is gebruikt om de twee onderzoeksvragen[47] te beantwoorden. Deze methode maakt het mogelijk om door middel van interviews, vragenlijsten en bronnenonderzoek, grip te krijgen op hedendaagse gebeurtenissen. De nadruk in dit onderzoek ligt op onderzoekers in Nederland.

Het proefschrift bestaat uit vier deelstudies. Er komen veel wetenschappelijke disciplines aan bod, maar de nadruk ligt op de sociale en geesteswetenschappen, klimaatwetenschappen en computerwetenschappen. De reden daarvoor is dat er al veelvuldig onderzoek is gedaan naar maatschappelijke opbrengsten van onderzoek in de levenswetenschappen en natuurwetenschappen.

In de eerste studie is gebruik gemaakt van focusgroepen. In zes bijeenkomsten is met 53 onderzoekers en ondersteuners van diverse vakgebieden gesproken over valorisatiebeleid, valorisatiepraktijk en de wisselwerking daartussen. In de tweede studie zijn ruim honderdzeventig

47 1) Hoe is het valorisatiebeleid van de Nederlandse overheid vertaald naar de academische praktijk tussen 2004 en 2014? 2) Hoe kunnen maatschappelijke opbrengsten van wetenschappelijk onderzoek geëvalueerd worden?

projecten in twee grote klimaatonderzoeksprogramma's bestudeerd. De nadruk ligt op de organisatie van deze projecten: zijn zij zo georganiseerd dat maatschappelijke opbrengsten mogelijk worden? En welke projectkenmerken laten een relatie zien met maatschappelijke opbrengsten? De derde studie bestudeert in detail vier projecten in de computerwetenschappen om te kunnen begrijpen hoe valorisatie in de praktijk verloopt. De vierde studie heeft bijzondere aandacht voor de evaluatie van maatschappelijke opbrengsten. Er is daarvoor een methode ontwikkeld en getest in de bouwkunde en de rechtsgeleerdheid.

Om de maatschappelijke betrouwbaarheid van de resultaten van dit proefschrift tussentijds te toetsen, is bovendien gebruik gemaakt van talloze gesprekken, presentaties, workshops en op het publieke debat gerichte publicaties. Er is contact geweest met onderzoekers, maatschappelijk belanghebbenden van onderzoek en beleidsmakers en-ondersteuners op verschillende niveaus: van ministerie en wetenschapsfinancier, tot faculteit en onderzoeksgroep. Dat leverde regelmatig nieuwe vragen, nieuwe inzichten en een nieuwe oriëntatie van het onderzoek op.

Conclusies

De conclusies gaan over de bevindingen die de vier deelstudies gezamenlijk opleveren. De onderzoeksvragen zijn daarbij leidend.

De reactie van onderzoekers op valorisatiebeleid

Onderzoekers in Nederland zijn op de hoogte van het bestaan van valorisatiebeleid, maar zijn slecht geïnformeerd over de inhoud ervan. Wantrouwen in het beleid is het gevolg. Onderzoekers hebben het idee dat valorisatiebeleid vooral gericht is op het stimuleren van korte termijn en economische opbrengsten van wetenschap. Over andere vormen van valorisatie, zoals bijdragen aan beleidsontwikkeling of maatschappelijk debat, bestaat het idee dat de overheid ze minder belangrijk vindt dan economische opbrengsten. De paradox is dat noch het beleid, noch de wetenschappelijke gemeenschap onderscheid maakt tussen het belang van verschillende vormen van valorisatie.

De beperkte kennis van onderzoekers over het beleid zorgt voor onduidelijkheid en vragen. Onderzoekers herkennen de maatschappelijke bijdragen van zichzelf en andere onderzoekers regelmatig niet als valorisatie. Dat bemoeilijkt het ontwikkelen van zowel een individuele als een collectieve visie op valorisatie. Het gemis aan visie levert problemen op bij het organiseren van valorisatie: in de relatie met onderwijs en onderzoek, bij het verdelen van taken in onderzoeksgroepen, en bij het evalueren van onderzoeksvoorstellen aan de ene, en uitgevoerde activiteiten en behaalde resultaten aan de andere kant.

Valorisatie in de wetenschappelijke praktijk

Onderzoekers blijken veelal persoonlijk gemotiveerd om op basis van hun onderzoek een bijdrage te leveren aan de maatschappij. Die motivatie kan voortkomen uit het gevoel van verplichting omdat onderzoek met belastinggeld betaald is, uit de wil om een bijdrage te leveren aan de verbetering van een maatschappelijke discussie of praktijk, of uit de wens om de maatschappij te fascineren voor het proces en de uitkomsten van wetenschappelijk onderzoek.

Deze persoonlijke motivatie is de basis voor het contact met een veelheid aan belanghebbenden van het onderzoek. In sommige gevallen zijn dat wetenschappers in andere vakgebieden. Zo kan een computerwetenschapper zijn kennis over beeldanalyses inzetten om het onderzoek van medische disciplines te versnellen. In de meeste gevallen zijn het maatschappelijke organisaties en personen. Onderzoekers benaderen het algemeen publiek vooral als ontvangers van kennis. Zo benaderen onderzoekers specifiekere doelgroepen, zoals bedrijven, overheden en belangenorganisaties, in sommige gevallen ook. Maar specifieke doelgroepen kunnen ook een actievere rol krijgen in het onderzoek. Door te reflecteren op onderzoeksvragen en resultaten. Of door deel te nemen aan het onderzoek.

Onderzoekers gebruiken veel kanalen om kennis met belanghebbenden van hun onderzoek te delen. Veelgebruikte valorisatie-indicatoren, zoals patenten, spin-off bedrijven en licenties, maken daar deel van uit. Wel vormen ze een duidelijke minderheid. De lijst van gebruikte kanalen is lang, en bevat onder andere software, advieswerk, trainingen, post-academisch onderwijs, tentoonstellingen, websites, boeken, demonstraties, presentaties en media-optredens. Welk kanaal het meest effectief is, hangt af van het onderzoek, de onderzoeker en de belanghebbenden.

Van valorisatiebeleid naar wetenschapspraktijk

De overheid verbindt in 2004 een nieuwe voorwaarde, valorisatie, aan de financiering van wetenschappelijk onderzoek. In de daaropvolgende jaren nemen intermediaire organisaties deze voorwaarde over. Wetenschappers blijken gemotiveerd om een bijdrage aan de maatschappij te leveren. Wetenschappers werken met veel soorten belanghebbenden samen. En wetenschappers delen kennis met belanghebbenden via veel kanalen. Het lijkt er dus op dat het valorisatiebeleid geslaagd is. Maar wetenschappers weten eigenlijk niet goed wat het beleid van hen vraagt. Weloverwogen valorisatiestrategieën zijn zeldzaam en wetenschappers voelen zich niet bekwaam om de valorisatietaak uit te voeren. De motivatie van wetenschappers en de veelheid aan valorisatieactiviteiten zijn een belangrijke basis om valorisatie te ontwikkelen tot een volwaardige derde taak naast onderwijs en onderzoek. Er ontstaat dus het beeld van een systeem in een overgangssituatie. Een systeem dat naar een nieuwe balans zoekt.

De evaluatie van valorisatie

Er spelen in valorisatie veel factoren een rol die buiten de invloed van onderzoekers liggen. Daarom moeten niet alleen onderzoekers verantwoordelijk gehouden worden voor maatschappelijke opbrengsten van wetenschappelijk onderzoek. Maar zij kunnen wel verantwoordelijk gehouden worden voor de inspanningen die zij leveren om hun resultaten tot maatschappelijke waarde te laten komen. Dat betekent dat de evaluatie van valorisatie zich moet richten op het proces in plaats van de uitkomsten: welke inspanningen zijn er geleverd?

Als evaluaties van valorisatie zich op het proces zouden richten in plaats van uitkomsten, dan is er nog steeds een evaluatie-object nodig. Zowel bij evaluaties die zich richten op beoordelen, als bij evaluaties die zich richten op leren. Dat is de valorisatiestrategie. Maar wat is een goede valorisatiestrategie? Dat hangt af van het maatschappelijk doel van het onderzoek. Oftewel, de praktijk waar het onderzoek aan probeert bij te dragen. Uit het maatschappelijk doel volgen despecifieke belanghebbenden met wie de onderzoekers moeten samenwerken. En met wie zij

over het onderzoek en de onderzoeksresultaten moeten communiceren. Daaruit volgt welke communicatiekanalen onderzoekers het beste kunnen inzetten. Belanghebbenden hebben verschillende voorkeuren om samen te werken, te communiceren en resultaten tot zich te nemen. Er is dus geen gouden standaard om valorisatie te evalueren.

Om valorisatie goed te kunnen evalueren, moeten enkele hindernissen overwonnen worden. De eerste is het gebrek aan een gezamenlijke visie op valorisatie. Als geëvalueerden niet weten wat evaluatoren van hen verwachten, en als evaluatoren niet goed weten wat zij moeten beoordelen, levert dit problemen op bij evaluaties. De tweede is dat onderzoekers en ondersteunend personeel de informatie die nodig is voor de evaluatie van valorisatie, vaak nog niet systematisch verzamelen. De derde is dat onderzoekers in de praktijk ervaren dat in evaluaties excellentie belangrijker wordt gevonden dan valorisatie.

Een belangrijk voordeel van het evalueren van het proces in plaats van de resultaten, is dat het valorisatie herkenbaar en bespreekbaar maakt voor onderzoekers. Dat maakt het mogelijk om te leren en te verbeteren. En dat draagt weer bij aan het doel van de overheid. Het overdragen van kennis ten behoeve van de maatschappij kan zo verbeterd worden.

Aanbevelingen

Het onderzoek in dit proefschrift leidt tot aanbevelingen voor de overheid, intermediaire organisaties in het wetenschapssysteem en de onderzoeksgemeenschap.

Overheid

De overheid moet de term valorisatie behouden en investeren in een beter begrip van het beleid. De term valorisatie is inmiddels bij veel onderzoekers bekend. Bovendien komen de visies op valorisatie van de overheid en onderzoekers in grote lijnen overeen. De introductie van een nieuwe term betekent vooral nieuwe onduidelijkheid. Investeer daarom in een beter begrip van het beleid in de onderzoeksgemeenschap. Benadruk dat valorisatie breder is dan onderzoek vertalen in economisch gewin. Niet alleen in documenten, maar ook in optredens van bewindspersonen. Dat betrekt veel onderzoekers weer bij de discussie. Stimuleer tot slot intermediaire organisaties om onderzoekers bekend te maken met de daadwerkelijke bedoeling van het valorisatiebeleid, en hen te ondersteunen in de praktijk van valorisatie.

Intermediaire organisaties

Intermediairs in het wetenschapssysteem, zoals NWO, KNAW en universiteiten, hebben een verantwoordelijkheid om valorisatie bij onderzoekers onder de aandacht te brengen en te stimuleren. Er is een grote behoefte aan voorbeelden van wat valorisatie is. En van goede beschrijvingen van valorisatie in financieringsaanvragen en zelfevaluaties. Intermediaire organisaties kunnen deze voorbeelden verzamelen en verspreiden. Ook kunnen zij discussies binnen vakgebieden, universiteiten en faculteiten organiseren over de betekenis van valorisatie voor de betreffende onderzoeksgemeenschappen. Dat draagt bij aan de ontwikkeling van een gezamenlijke visie op valorisatie. Daarnaast is het van belang dat valorisatie niet alleen op papier, maar ook in de praktijk deel uitmaakt van personeelsbeleid. Alleen als onderzoekers getraind worden in en beloond worden voor valorisatie, kan het een volwaardige taak zijn naast onderwijs en onderzoek.

Onderzoeksgemeenschap

Onderzoekers kunnen zelf ook proberen om onbegrip en onduidelijkheid te voorkomen. In de eerste plaats door kennis te nemen van de inhoud van valorisatiebeleid. Daardoor wordt een discussie over valorisatie mogelijk op basis van feiten in plaats van anekdotes en onderbuikgevoelens. Een andere belangrijke stap is het organiseren van en deelnemen aan discussies over valorisatie in onderzoeksgemeenschappen. Wat betekent valorisatie voor ons, en hoe geven we er invulling aan? Bespreek ook de rol van valorisatie in talentselectie en -ontwikkeling. Investeren in valorisatie moet betekenen: investeren in een wetenschappelijke carrière.

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Curriculum Vitae

Stefan de Jong was born in Utrecht on 11 May 1983. He attended secondary education at Mondriaan College in Oss, graduating in 2001. From 2001 to 2005 Stefan studied biology at Wageningen University (BSc). From 2006-2008 he studied innovation studies at Utrecht University. After graduating, Stefan worked as a researcher for the Science System Department of Rathenau Instituut in The Hague. from 2009-2015. Stefan's research focuses on the social impact and evaluation of academic research. Stefan was involved in the national ERiC Project, the European SIAMPI Project, Comparative Monitoring of Knowledge for Climate and Valorisation in the Social Sciences and Humanities. During his research, he was actively engaged in national debates about these topics. Stefan organised training courses, gave presentations and published advisory reports and opinion pieces. In 2014 he joined the Centre for Science and Technology Studies in Leiden as an external doctorate candidate. In February 2015 Stefan joined the Knowledge Partnering Team of Luris as a knowledge broker for the social sciences and humanities. Luris represents all scientists from Leiden University, Leiden University Medical Center (LUMC) and associated science clusters with the aim of applying knowledge in society

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Who was Rathenau?

The Rathenau Instituut is named after Professor G.W. Rathenau (1911-1989), who was successively professor of experimental physics at the University of Amsterdam, director of the Philips Physics Laboratory in Eindhoven, and a member of the Scientific Advisory Council on Government Policy. He achieved national fame as chairman of the commission formed in 1978 to investigate the societal implications of micro-electronics. One of the commission's recommendations was that there should be ongoing and systematic monitoring of the societal significance of all technological advances. Rathenau's activities led to the foundation of the Netherlands Organization for Technology Assessment (NOTA) in 1986. On 2 June 1994, this organization was renamed 'the Rathenau Instituut'.

Globally, the call for impact of science on society is louder than ever. The Netherlands is no exception. In 2004, valorisation was introduced as a core element of Dutch science policy, aiming to increase the societal benefits of academic research. In scientific practice, the introduction of valorisation meant scientists got a new task, in addition to teaching and education.

This thesis studies the valorisation policy from a principal-agent perspective. It aims to answer two questions. 1) How has the valorisation policy of Dutch government been translated to academic practice in the Netherlands between 2004 and 2014? And 2) How can societal benefits of academic research be evaluated? Scientists from a multitude of disciplines, as well as societal actors, have been interviewed and surveyed and policy documents have been studied.

The first key result of the study is that the Dutch science system is in a transition. Scientists are motivated to engage with society and do so in many different ways. However, they have a limited understanding of valorisation policies and feel poorly equipped for the task. The second key result is that valorisation should be evaluated as a process. This facilitates learning among scientists and as such allows for improving valorisation practices.

The study ends with policy recommendations, addressing government, intermediaries, such as research council NWO and universities, and the academic community.

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