Productive interactions: societal impact of academic research in the knowledge society

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PUSHING
THE FRONTIERS
OF INNOVATIVE
RESEARCH

Table of contents

Main authors

Executive summary

Part 1 Introduction

In October 2016, Carlos Moedas, the European Commissioner for Research and Innovation, stated that research impact should be one of three "core values" for Europe's research funding programmes, next to excellence and openness, and that his hope was to develop a "more sophisticated approach" to impact.

Over the last decade and more, the discussion of universities' impact on society, and the impact of research in particular, has gained importance. It is, to a varying extent, embedded in policies referring to universities' contributions to the knowledge society, solving global, societal challenges, building an open and inclusive European Research Area, and more. LERU expects this trend to intensify even more in the near future.

In this paper, LERU reflects on the consequences of these societal developments on research and research impact, and how and why the concept of impact has changed in recent times. It analyses the current context in which societal impact is discussed at LERU universities and beyond, how this impact is pursued as a high-level strategy at LERU universities, and how the current understanding of impact and its explicit recognition inside and outside of the university has significant consequences for the entire research ecosystem, including universities, researchers, funders, governments, private and public stakeholders, the public at large etc.

Part 2 Universities' Triple Mission

Since the 19th century universities' *raison d'être* has been to achieve societal impact through high quality education and research. The combination of the latter two is unique for universities and guarantees a fertile environment for creating new knowledge and educating tomorrow's problem solvers.

Universities' societal impact has come to the forefront of higher education and research policy due to dramatic changes related to globalisation, intensifying global competition and related socio-economic developments. The world has

become so dependent on new and reliable knowledge and a highly educated workforce, that governments have intensified their explicit demands for societal impact from universities in general, and from research in particular.

European universities find themselves now at the crossroads of international academic competition and local, national or European policy demands. Regarding research, it is expected that it is academically excellent, globally competitive, and at the same time relevant for societal challenges. For current evaluation systems, the challenge is to find ways to assess and value both aspects.

Part 3 Societal Impact

With the recognition of academic research being part of a wider process of innovation (both social and technological), policies based on a sharp distinction between 'academic' and 'applied' research are no longer adequate. This has been recognised in the scientific literature from the 1990s onward and has become increasingly apparent in research policies at the national and European level. To induce changes in, for example, health, climate change and the migration challenge, academic research from a wide range of disciplines is needed, but solutions require a wider societal input, for which researchers need to collaborate with other experts and work in inter-, multi- or transdisciplinary contexts – which is frequently referred to as the co-production of knowledge.

In such open, non-linear and networked systems, academic knowledge should be seen as a dynamic part of a wider process of knowledge production in which stakeholders bring in their own expertise, knowledge and insight. Societal impact is thus the outcome of the creative encounter of these stakeholders and their contributions to a common goal. The collaboration should start right from the design phase of a research project and last throughout its course. The traditional prevalence of uniform, linear models of knowledge production and impact assessment, focusing on easily quantifiable output and direct economic benefit, is a tide that has started to turn, albeit perhaps too slowly or unevenly. It

is reassuring to LERU that governments and policy makers (begin to) realise that these models do not suffice to capture the very societal impact they want, and that, at worst, they may jeopardise fundamental scientific characteristics, such as unpredictability, experimentation, sufficient time-span and even failure.

Part 4 Comprehensive Assessment

LERU universities are pro-active in developing more meaningful and robust approaches to impact, recognising that there are multiple pathways to impact, that one-size approaches will not fit all circumstances and different sorts of research will generate different sorts of impact. Evidence of this change can be found in universities' new strategic plans, in their support for research projects in which, in line with the productive interactions model, societal stakeholders are involved from the start and throughout the process, in the way in which they recruit and promote researchers, and more. They do this in response to, and/or to actively help shape policies by governments and funders, who are developing or revamping their own approaches to impact (cf. REF in the UK, SEP in the Netherlands, etc.).

To determine research impact in this new context, a new approach for evaluation is necessary, one which more adequately reviews the direct and indirect interactions between researchers and stakeholders. Consequently, traditional mechanisms will come under (even) more scrutiny. Two such mechanisms, bibliometrics and peer review (each with their own pros and cons), will need changes to remain fit-for-purpose and meaningful in the research ecosystem. In a number of countries, we see the emergence of evaluative systems allowing for a wider form of evaluation that takes societal impact into account. Also in the literature, new qualitative and quantitative measurements are being developed, for example regarding the use of social media, or wider forms of peer review.

New evaluation procedures need to have the capacity to assess quality and relevance in a non-linear, and often serendipitous environment. Procedures need to be flexible, process-oriented and able to review the different contributions of partners and the productive interactions between them. These new evaluative arrangements will differ per discipline, accounting for variation in production, communication and context. In this paper we refer specifically to the SIAMPI approach of productive interactions and the impact pathways developed in the UK and French contexts.

Part 5 Conclusions

LERU universities are committed to demonstrating the vital role of universities in contributing to society, in terms of education and training, the production and dissemination of new knowledge, and the sustained engagement with societal stakeholders within the national and international challenges they face. To demonstrate societal impact, therefore, is an integral part of what LERU universities do and what they are about.

Societal impact always has been a core task of LERU universities (and universities in general), and it will remain so in the future, because ultimately it is what universities are for, even when the context and framework in which impact is understood may change over time.

The principal tenets of this paper are that (1) knowledge production is not a linear process starting with basic research and ending up with applications, but instead progresses in increasingly open and collaborative ways, and that (2) innovation in society is not only the result of scientific and/or technological progress, but to a large extent the outcome of an iterative process of interaction between scientific and other social domains and its stakeholders. In this process, research and innovation are recognised to take place in a network in which different partners with diverse expertise and knowledge collaborate on the basis of a joint agenda.

As a result, we argue, competition or comparison should no longer be seen as the main (or only) drivers in the production of knowledge, and should make way for productive interaction between stakeholders and the formulation of common goals and joint achievement of results.

The LERU universities are committed to this agenda and keen to engage with others in a debate on impact at the EU and international level. It is vital for all of us, for the sake of science and for the sake of society.

Part 6 Recommendations

Recommendations for universities:

-   Universities should fully embrace the societal impact agenda, safe in the knowledge that it is fully compatible with their historical fundamental missions of knowledge creation and transmission.

- Universities should continuously seek to support and promote societal impact as a dynamic, open and networked process in a culture of sustained engagement and co-production of knowledge.

- Universities should engage with others across the broad spectrum of the research ecosystem, including governments, research funders, the private sector, civil society and society at large, so as to foster a better understanding of impact, to develop future-oriented policies and implement innovative practices based on the concept of impact described in this paper.

- Universities should, as a consequence, develop open, explicit and transparent reward systems that include the value of all kinds of impact, reward it and take it into account for individual promotion. They should avoid (inadvertently) creating or following perverse incentive systems.

LERU and the LERU universities are committed to this agenda and keen to engage with others in a debate on impact at the EU and international level.

Recommendations for others:

LERU urges governments, policy makers and funders, at the EU, national and other levels, to:

- recognise and endorse the view of impact as a dynamic, open and networked process in a culture of sustained engagement and co-production of knowledge,

- temper their expectations when it comes to the question of predicting the outcome(s) of grant applications, since the production of knowledge is non-linear and full of unpredictabilities,

- support and incentivise universities in their endeavours to embrace this broad impact agenda,

- engage with universities in a dialogue to develop sensible impact policies, and

- translate the ideas and recommendations put forward in this paper into innovative approaches and initiatives.

Introduction

Impact also suffers from a standard misconception. We tend to shy away from this word. We do not want to appear to have a utilitarian vision for science. We fear being characterized as philistines, who fail to see that science is a good in itself. Again, I fear we are falling into false dichotomies. [...] So, we can have a culture that, on the one hand, promotes the measurement of the impact of research, while on the other hand, understanding, intellectually, that not all research will have a concrete and immediate impact. I hope that in the next Framework Programme we can have a more sophisticated approach to this issue of impact. We can do more to capture and measure different kinds of outputs – including the unexpected ones. Because sometimes results that we don't think have impact can have a huge impact in other disciplines. We have to work on cross-impact between disciplines. We have an obligation and an incentive to be much better at understanding and communicating the impact of what we do. Not only to ministers of finance, but to the general public!
(Carlos Moedas, 10 October 2016)

1. Societal impact is high on the agenda of universities and will be even higher in the years to come. Governments are increasingly asking higher education institutions to show how public money spent on research improves society.

2. The challenges of our time are undoubtedly enormous, ranging from global issues (climate change, renewable energy, sustainable agricultural production), to more regional concerns (inequality, migration and democratic systems). And while universities - from their establishment in the Middle Ages onwards - have always played a significant role in their communities, this role has changed over time, especially when modern technology became an important factor in the economy. Over the last two decades, however, societal impact seems to have been narrowed down to more or less direct economic profit. Most policymakers and funders adhere to a linear concept of knowledge production: universities provide for new, fundamental knowledge that can or should be directly applied and then brought to the market.

3. It is now high time to resolutely give up this linear line of reasoning (if not done already), because (1) today's challenges require inter-, multi- and transdisciplinary approaches in which natural and technical sciences are combined with social sciences and humanities (Federation: 2014) and in which universities (have to) collaborate with all relevant societal stakeholders and (2) fundamental, independent research does not work in a linear way. It is one thing to gather scientific data on climate change, it is quite another to combine these with the perspectives and interests of socio-political stakeholders and work together on solutions. Research is a dynamic and non-linear process (especially in the larger context of innovation) and societal impact should therefore be regarded in a similar manner, that is, as the result of the productive interactions within a network of researchers and societal stakeholders, which develop in space over (shorter or longer) periods of time.

4. When assessing impact in this broader sense of the word, universities, stakeholders and funding agencies will have to rethink their core missions and roles vis-à-vis each other in order to develop a common ground for new sorts of evaluation procedures (which of course entails a change of culture as well).

5. Clearly, societal impact is already an integral part of most universities' wide array of activities, but there are many new questions that need to be addressed, for example how universities balance fierce international competition on the one hand against the orientation towards societal problems, or how they maintain fundamental values such as academic freedom in the face of increasing dependency on funding from big industry. These questions also touch upon one of research universities' fundamental characteristics: the deep connection between performing research and educating inquisitive people and independent thinkers. It is thus essential that universities express and define how they engage with society - and how that engagement will be evaluated - in ways that on the one hand preserve and foster their role as creators and purveyors of new knowledge, and on the other hand, how they manage this role in a context with many other stakeholders and interests in society.

6. Leading figures at LERU universities realise that research and innovation are very much taking place in a *network* society in which different partners with diverse expertise and knowledge collaborate on the basis of joint agendas addressing the pressing issues of our time. LERU universities, as important generators of excellent research, are willing and able to take a leading role in demonstrating societal impact and in considering the most sensible ways to assess it.

Universities' Triple Mission

2.1 A Rising Demand for Societal Impact

7. Since their emergence universities have survived much social, economic and political turmoil and have proven to be powerful and resilient institutions. After the 18th century their *raison d'être* always has been to be relevant to society through high quality education and research. The combination of the two is unique for universities and guarantees a fertile environment for knowledge creation and for the education of tomorrow's problem solvers[1]. Over the last decades the demand from policy and society for universities to have broad impact on all kinds of societal challenges has become even stronger, due to dramatic changes in the context in which universities operate. Because of globalisation (economically speaking, but also in terms of global societal challenges including climate change, sustainability, food security, intensifying competition world-wide and related socio-economic developments such as the migration crisis and political insecurity), the world has become so dependent on new and reliable knowledge and a highly educated workforce, that policy makers have intensified their demands for impact. As a result, societal impact has come to be formulated as a third mission of universities next to education and research, the importance of which can be found in most if not all university mission statements.

8. Looking at the LERU universities' mission statements and strategic plans, references to the importance of impact are abundant. For example, the title of the University of Edinburgh's new strategic plan is *Delivering Impact for Society*. The University of Cambridge wants to contribute "to society through the pursuit, dissemination, and application of knowledge" and Heidelberg University's goal is to "make research results available to society and encourage their utilisation in all sectors of public life." Lund University has a Strategic Plan in the making for 2017-2026 which states that "collaboration and external engagement is to permeate our University" and that the University will take "greater social responsibility, promote interaction and the benefits of our education and research […] by utilising our ability to meet future societal challenges". KU Leuven aims to actively participate "in the advancement of a knowledge-based society. It puts its expertise to the service of society, with particular consideration for its most vulnerable members".

9. It is fair to say that the combination of the three missions now and in the foreseeable future defines the university. Consequently, these institutions are uniquely placed to play a central role in the development of the knowledge society and have an impact that is hard to underestimate (LERU: 2008).

10. The rising demand for universities to explicitly demonstrate (consideration of) societal impact is strongly connected with the dynamics of the concept of the knowledge society in a neo-liberal context, where economic growth and job creation have priority[2]. All relevant entities in society are expected to contribute to these goals, including universities. Policy schemes now demand not only the best in all three mission areas, but also a focus on the vital, economic goals set by governments (e.g. the Dutch 'Top Sector' policy[3]). This puts a new kind of pressure on academia because the emphasis in funding schemes is much more on societal impact than before (cf. the Societal Challenges pillar of Horizon 2020).

11. Regarding education, universities are expected to produce a highly educated future workforce that is also flexible enough to address various societal questions. It entails universities have to recognise the importance of training students not exclusively in one, specific discipline, but in more interdisciplinary ways (LERU: 2016a). For example, the problem of sustainable and clean energy sources is not only a matter of technical

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1   See also *What Are Universities For* (LERU: 2008).
2   On the website of EU Commissioner for Research, Science and Innovation, Carlos Moedas, the first of his main responsibilities mentioned is "making sure that research funding programmes, notably Horizon 2020, contribute to the Commission's jobs, growth and investment package" (http://ec.eur-opa.eu/commission/2014-2019/moedas_en). Perhaps even more telling is the list of 10 top priorities for EU policy. Despite the rhetoric about the 'knowledge society', the words 'knowledge', 'research' or 'innovation' are not in the list (which contains Jobs, Growth and Investment; Digital Single Market; Energy Union and Climate; Internal Market; Economic and Monetary Union; EU-US Free Trade; Justice and Fundamental Rights; Migration; EU as a Global Actor; Democratic Change).
3   Moreover, it is expected that research is conducted in a responsible way. Conditions for funding are adapted to this both at the European level and in some national contexts. For the EC, Responsible Research and Innovation (RRI) is an action in the 'Science with and for Society' programme of Horizon 2020, including such aspects as public engagement, access to research results, gender equality, ethics, and science education, and cutting across to other objectives of H2020 (LERU: 2016c; Strand a.o.: 2015).

disciplines, but has also to do with changes in human behaviour, and therefore need the social sciences and humanities (LERU: 2013a). Regarding research, they have to be excellent in a growing competitive and international environment and at the same time focus their attention on economic and socio-cultural issues in society, in which they also have to collaborate with non-academic stakeholders (HEFCE: 2014). During the past decades the tension between the missions of education and research has become more intense. The latter still seems to have a higher importance, certainly in terms of the academic reward systems that are dominated by journal output measures (which became the currency of the international scientific community) and the amount of extra budget a researcher or research group is able to generate. The tension is also caused by the fact that mass access to higher education and high-quality research have appeared to be driven by, and to address, different value systems (Nowotny a.o.: 2003, p.188). According to LERU, these different pressures may not be aligned very well (Science in Transition: 2013).

2.2 Universities and Governmental Policy

12. Universities have always played significant but varying roles in the development of societies. Historically, they did so mainly by training the next generation of university graduates who could take up important positions in society. From the moment they became research universities (beginning in the 18th and continuing in the 19th century after the scientific and industrial revolution, in a period when numerous new universities were founded (Kranzberg: 1967)) their focus on technology, agriculture and health developed, all to improve the well-being of the economy and the population (see also Clark: 2006). More recently, answering explicit demands through large governmental funding programmes, research universities support the economy and society in the broadest sense. Private parties, as well as big and small industries, are expected to contribute more and more to the funding of knowledge development, in kind and cash. Universities have become part of large networks in society that target innovation in many sectors.

13. After the Second World War we can distinguish three periods with different characteristics when it comes to the relationship between academic research and national governments.

14. In the wake of America's war effort for science, Vannevar Bush presented his famous report to the government (Science, the Endless Frontier, 1945), in which he combined the value of academic research with benefits for society: investments in science would always pay off for the public cause. It led to the widespread conviction of policymakers that excellent science would ultimately lead to practical applications. Most governmental policies were directed towards providing the best conditions for science to thrive within the universities or in specialised institutes (defence, health, agriculture).

15. In the beginning of the 1970s, after the first major post-war economic crisis, governments started to expect more impact from academic science than the 'blue sky research' of the Vannevar Bush philosophy, in terms of accountability and economic value. Specialised institutes and large research programmes were established (biotechnology, ICT, micro-electronics). In the universities the research function started to become more important, and so did the demand from society to be 'more relevant'.

16. Evaluation mechanisms were introduced by governments in the 1980s, and the balance in the relation between education and research started to move in the direction of the latter: academic systems predominantly rewarded publications in high ranking journals, which led scholars to realise that doing research and publishing in international circuits were better for their career than teaching (Blume and Spaapen: 1988).

17. As a consequence, the research function of universities kept gaining significance under the influence of two arguably contradictory developments. Globalisation accelerated international competition of research, but at the same time governments felt a growing need for research to have more local economic impact. Budgets for research started to grow (the European framework programmes tripled in a few decades) and finances for academic research became a multi-stakeholder occurrence. Next to governments also industry started to invest in academic research. Public organisations and even the public at large – cf. crowd sourcing - are now among research investors.

2.3 Universities and the Knowledge Society

18. Universities are fundamental to the success of knowledge societies. They play a vital role in terms of education, production of new knowledge and taking responsibility as publicly funded institutions to demonstrate their societal contributions, expressed today in terms like 'societal

impact', 'broader impact', 'relevance', 'valorisation', etc. These terms all point to the same phenomenon, but may have different connotations depending on the local or regional policy context. Many funding programmes nowadays expect research proposals to include clear statements on societal impact, and moreover, focus on building coalitions between the academic world and societal stakeholders. This growing emphasis on impact has a clear political background, as described in section 2.1. LERU universities have embraced this notion of impact as part of their core mission, and also have established mechanisms or pathways for impact (see, for example, the Heldig ecosystem initiated by the University of Helsinki, the Barcelona Citizen Science Office founded by the OpenSystems research group of the University of Barcelona, Scientifica of the University of Zurich, or the Impact Pathways developed by Imperial College (see this paper, box B on p.22)[4].

19. At the same time, the orientation of universities to societal challenges can be (perceived to be) at odds with academic autonomy and the independence needed for unfettered research. However, LERU does not consider them to be contradictory. In fact there is evidence that they strengthen each other (Jensen a.o.: 2008), although in practice there can be complications, for example when funding decisions have to be made. Also, the development of new knowledge is often a more uncertain process than mission-oriented research is expected to be, and its practical implications often only become clear in the long term. But since there are many currently pressing or emerging global societal challenges that need intellectual input from academic research, universities have to find ways to combine the two and to make explicit the broader values of the pursuit of new knowledge.

20. Many individual academics have become uncertain how to attune their various roles within the missions of their institution. As teachers, they want their students to be imbued with the highest levels of knowledge, skills and experience to face major societal challenges in their future careers. As scholars, they want their research to be excellent and to contribute to the global reservoir of knowledge, and at the same time their research should address and help solving societal problems and issues. LERU universities are keenly aware of these sometimes conflicting agendas and actively strive to ensure that institutional practices are optimally aligned with them. Universities should and do champion this

as the generic way in which a culture of teaching and research generates both world-class academic research as well as broad and specific societal impacts (see also Wissenschaftsrat: 2016).

21. Academics are currently also faced with an environment in which competition for research and teaching funds is severe, due to an ever growing global context and the budgetary restraints most governments introduced in the aftermath of the financial crisis of 2008. Therefore, the ways in which funds are allocated have become more important and subject to scrutiny at different levels of aggregation (within universities, nationally, at the European level). In this process, many LERU (and other) universities are (re-)evaluating their position and profile, focusing on a limited number of key areas, for example, as a result.

22. In this, universities face the difficult task of attuning different interests and demands both inside and outside their institutions. They have to (1) balance the forces of international research and student competition with the forces of societal impact demanded by their local environment, (2) rethink differences between faculties with many students and little research time, and those with fewer students and more research time, (3) discuss their internal reward systems and design allocation mechanisms that will better fit in the new context, (4) create knowledge exchange mechanisms and other relations with stakeholders in society, some of whom are big funders and thus are bound to influence the direction of research.

23. Educating and training the next generation of highly qualified, independent professionals is perhaps the most important impact dimension of academic institutions, both for the public and private sector. In the second half of the previous century, the research function in universities started to take over the central position of teaching, up to a point that students and teachers in many places began to question this development in the wake of other transitions (professionalisation of management, intensifying collaboration with industry). Furthermore, during the past decade most western countries have adopted the concept of the 'Knowledge-Based Society' or 'Knowledge Economy' as a prime motivation for their higher education and innovation policies, and have taken measures to strengthen these sectors in the light of growing international competition with the emergence of

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4 For a discussion of the necessary changes in institutional culture see Benedictus and Miedema: 2016; Sarewitz: 2016.

**Box A. Future Scenarios for Universities
(based on Rathenau: 2014)**

1) National solidarity

In this scenario, if the future of a higher education institution is based on national solidarity and if society places more emphasis on the public value of education and research in a stable (European) environment with little competition, then maybe there is going to be one large European research budget, while higher education will remain more of a national issue, with focus on *Bildung* rather than on vocational training.

2) Regional power

In this scenario, where regional power gains more momentum, knowledge may be seen as a private commodity in a more fragmented Europe, where universities link their research programmes with their regional economic and cultural challenges, while in the meantime the number of courses offered proliferates because students compose their own curricular paths according to their expected careers or interests.

3) International selection

This scenario, based on international competition and selection, would see rankings gain ever more importance for research, which could mean that only top universities would get the largest chunk of (governmental) budgets, since the latter are mainly based on research performance. Education then also becomes very competitive, since only these high-ranked universities would attract the best students from all over the world and (must) have rigorous selection processes.

4) European variety

In this scenario, European integration has become a success and the mass demand for education will result in a more stratified structure of various types of universities. For the top 10 percent of the most excellent students there will be small colleges where they are educated by personal tutoring and training. The 'lowest' levels will have to do with MOOCs, while there are other types of higher education in between, where students encounter various levels of blended learning or are offered 'live' lectures at the 'higher' levels. As for research, the success of European integration could enlarge European research funding, while at the same time private and semi-private funds would grow.

other economic powers (China in particular, but also the other BRIC countries, and a number of Arab countries).

24. In all scientific disciplines boundaries are blurring, as a consequence of internal scientific developments and in response to societal demands (Thompson Klein: 1990; LERU: 2016a). Universities are designing more curricula in terms of interdisciplinary courses around grand societal themes such as healthy aging, sustainable cities, global citizenship, cultural participation. For instance, this may include an increasingly known and practiced phenomenon such as citizen science, which, when embedded in university-based research, LERU sees as an integral part of the open science movement and an important development for its ability to shape a "productive relationship between science and society" (LERU: 2016b, p. 2).

25. To be sure, this is not an overnight process. The Dutch association of universities (VSNU) and the Rathenau Institute recently produced an interesting report - based on a series of expert meetings with researchers, policy makers and stakeholders - in which the future of universities was discussed along four different scenarios, depending on their outside orientation: (1) National Solidarity, (2) Regional Power, (3) International Selection and/or (4) European Variety (see box A). The discussions centred around two uncertainties underlying all four scenarios. Firstly, for whom is the university, to whom should it belong? Do we see the university as public property, with the goal to advance society? Or is it in fact an enterprise with contractual partners, who can make demands on education and research in exchange for their investments? What is the dominant 'value network' within which the university operates: who are the most important stakeholders and what value do they attach to the university's performance? Secondly, the degree of competition was reviewed, as well as the scale on which this competition takes place. Will universities have to compete more and more to recruit (particularly the best) staff and students? Will competition for scarce research funding become fiercer and more international (see also Münch: 2014)? Or will universities choose collaboration and take on a regional role? Will direct governmental research funding still allow the university to determine its own research priorities? (For some possible consequences see box A.) LERU universities view these questions as highly relevant, particularly as they seek to develop institutional policies and practices that are compatible with internally or externally driven impact agendas (see also Zwaan: 2016.)

2.4 The Policy Gap

26. Some academic fields are very competitive in an international context, others are less so. Some fields focus on innovation in terms of breakthroughs, others see innovation in terms of better understanding and then solving (parts of) complex social, cultural or economic problems. Many researchers these days are involved in large projects or programmes with a long-term perspective and many stakeholders, in which competition is not the prime motivation, but solving complex, social or technical problems is, or a mixture of both (for example global warming, healthy aging, cultural identity, renewable energy). When we put all the above in the perspective of research policy, perhaps the main question is: do we see research policy in terms of academic competition or in terms of collaboration? If it is the first, impact within the academic community seems to be the main driver (see also Benedictus and Miedema: 2016). If it is the second, mutual learning and improving research collaboration are arguably the main goals. Improvement in this context does not mean striving for a higher place in one of the international rankings, but being more effective in reaching the intended scientific and societal goals. This is more complex because societal goals are sometimes not undisputed and have to deal with different stakeholders such as policy makers, NGOs, industry and/or consumer organisations.

27. It is therefore both timely and necessary that we take a closer look at the necessary strategies that enable universities to adapt to and flourish in this new policy context. Focussing on the encouragement of connections between parts of the research and innovation system that already have a stake in the transition of 'science for its own sake' to 'science for society', may lead to innovative new networks in which the broader perspective is taken seriously.

28. The main question then becomes: how to develop an adequate network-oriented research policy? At LERU universities and elsewhere policies have been developed or are being developed to promote and support the impact of research in this new context, although much work still remains to be done. A main reason for this is that there is still a wide gap between what most of the academic research on innovation concludes and the policies implemented by universities (Cozzens and Snoek: 2010; Wissenschaftsrat: 2016). Both inside and outside the university linear and competitive notions of the research process tend to persist, even though the academic literature analyses developments in the research and innovation system in terms of stakeholders operating in more or less stable networks. In those networks, the main drivers for advancement are collaborations between partners with different expertise and contributions, and the focus is on establishing a common agenda on the basis of common goals. As a rule, these goals need input from different partners, with different expertise.

29. Many universities, however, are still oriented towards the individual performance of researchers, competing with the rest of the world, and most common indicators are derived from the ways researchers communicate with their scientific colleagues, especially in the STEMM fields[5]. The main driver behind these systems is the desire to be visible in the (international) competition between researchers and between institutions. Consequently, it is not rewarding for researchers to concentrate on activities other than those resulting in publications. And that is a hindrance for developing societally relevant research. As long as academic culture keeps valuing journal publications above everything else, this obstacle will remain. Some years ago, in a qualitative survey of the Royal Society, several researchers highlighted that public engagement activity was seen by peers as bad for their careers. Another message coming through was that public engagement was done by those who were "not good enough" for an academic career (Royal Society: 2006). Such notions still persist, even though the contrary seems to be the case: "scientists who engage with society perform better academically", to quote the title of an article by Pablo Jensen and others about their findings within the CNRS (Jensen a.o.: 2008).

30. Fortunately, there are also many signs of a changing culture. For example, at UCL knowledge transfer is recognised and awarded in its criteria for (individual) promotion. The introduction of impact case studies in REF[6] (because of their weighting in assessment and significant driving of funding allocations) has brought about real change in terms of what activity is seen as rewarding.

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5   STEMM stands for Science, Technology, Engineering, Mathematics and Medicine.
6   REF or Research Excellence Framework is the UK's system for "assessing the quality of research in UK higher education institutions" (see www.ref.ac.uk)

31. In Figure A we show a graphic representation of what most policy makers see (top) and what the situation is according to the most recent academic literature about research (bottom). The top image illustrates the weak connections between the different stakeholders with regard to a common societal problem, where each operates in its own sphere of interest. The bottom image represents a situation where the various stakeholders create common ground to define a societal problem in a common research agenda and where ultimately consensus has to be reached about how to evaluate the goals decided upon. This is what happens in most of the Horizon 2020 programmes, and more and more in local and regional arrangements between universities and stakeholders in the close environment of the universities.
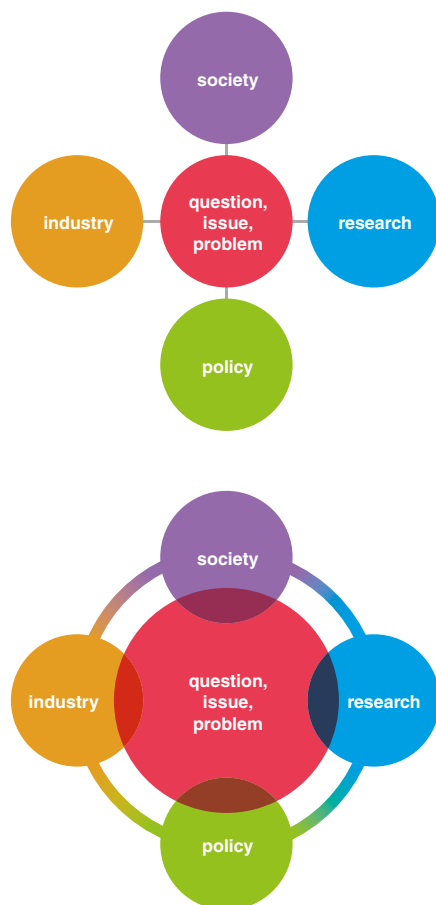
Figure A: Changing connections between stakeholders

Societal Impact

32. It is difficult to dispute that universities should (and should wish to) be able to demonstrate the impact they achieve in society, be it on specific questions or in parts of society, or in more general ways. And when research is anchored in society, assessment of its quality and impact should be a basic element of academic life. But, as we have seen above, there are frictions around the concept of impact.

3.1 Knowledge Production and the Economy: the Linear Model

33. For quite some time, impact has been - and in many ways still is – understood as mainly economic impact, especially in political discussions and debates. Often politicians think in terms of a direct return of investment and therefore see the production of knowledge in a highly linear way. In its most simple form: universities produce new knowledge that has to be made suitable for concrete services or products, preferably as quickly as possible in order to stimulate the economy. Over the last decades national and international governments have tried to link their public budgets to research projects which have a clear outcome, preferably right from the beginning, be it in the form of marketable products for companies or in the form of direct, short-term solutions for practical problems. A clear "shift of funding towards commercialization" can be observed (EARTO: 2014, p. 6).

34. In this model knowledge production is based on a linear concept with one-way traffic from (fundamental) research to applications, where Technology Readiness Levels (TRLs) play an important role. The TRL model, originally designed by NASA, is based on nine levels of 'readiness', ranging from basic principles observed to actual systems proven in an operational environment. This may be a model to successfully launch a rocket, but it does not correspond to the way in which knowledge at universities is generally produced. Nonetheless, the idea of TRLs is still alive, for example in some pillars of Horizon 2020[7]. However, one has to realise that for many knowledge domains – for example theoretical physics, mathematics,

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7   The success of the linear model is explained by Godin: 2006 in terms of its simplicity and because it allows for relatively easy use of statistics.

social sciences and humanities - this model is impossible to use, simply because the production of knowledge does not work that way at all. So it comes as no surprise that there is a growing resistance against the TRLs and the linear concept behind them (LERU: 2016d).

35. Things tend to go wrong if governmental bodies transfer these models to academic research in general and especially if they link them to *direct* economic profit, since this is not the primary goal for universities. Of course research contributes to the economy, especially when the collaboration between academics and entrepreneurs is viewed in the wider perspective of the economic development of society in general and not in terms of exclusive arrangements. Universities are part of a global knowledge society. This view recognises that the economic chain is long and complex, and that there is a global market for research in which it is often hard to predict which company or even which country is best equipped to advance certain discoveries or innovations[8].

36. While some universities like to call themselves 'entrepreneurial', a pure business model cannot and should not be transferred to research universities, since their primary goal is not producing marketable products, but educating people and producing new knowledge and insights, a view compellingly expressed by the Vice-Chancellor of the University of Cambridge: "What is less obvious - indeed counter-intuitive - is that universities' contribution to the economy is so effective precisely because it is not our primary objective. Economic productivity is a by-product of the teaching and research that we perform for other reasons. If it were turned into a primary objective - if universities became the Research and Development branch of Big Industry - then our distinctive contribution would be lost. […] One reason for this is that the discoveries that make the biggest contribution economically tend to result from blue-skies, fundamental research, not applied, 'near-market' research" (Borysiewicz: 2012).

37. The attention that policymakers and governments have given to the linear model of impact also has led to a suspicion in academic communities that academic freedom is under threat, since the model does not take factors such as unpredictability, experimentation and even (repeated) failure into account. As Carlos Moedas put it: "Impact also suffers from a standard misconception. We tend to shy away from this word. We do not want to appear to have a utilitarian vision for science. We fear being characterized as philistines, who fail to see that science is a good in itself. Again, I fear we are falling into false dichotomies" (Moedas: 2016).

3.2 The 'New Production of Knowledge'

38. Often 'curiosity driven' research is spoken of as diametrically opposed to 'applied' (or 'directed') research. But in many cases there is no real opposition between these two. Knowledge grows "through a richly interwoven system of scientific and technological research in which there is no clear hierarchy of importance and no straightforward linear trajectory. […] All knowledge should be valued. Some production of knowledge is oriented towards improving our understanding of the world through the process of *discovery*; some is focused on the creation of new useful techniques and devices through the process of *invention*" (Narayanamurti a.o.: 2013, p.10).

39. With the recognition of innovation being an iterative process, it becomes clear that policies based on a sharp border between a 'pure' form of free exploration and an 'applied' form of utility - with an (implicit) value judgement that the former is of a higher order - are inadequate. Most researchers go back and forward between these two forms, and everything that lies in between, and are prepared to collaborate with other stakeholders interested in the same topic.

40. In The *new production of knowledge* Michael Gibbons, Helga Nowotny and others claim that the production of knowledge and the process of research are in a radical process of transformation (Gibbons a.o.: 1994). In their view the traditional way of academic knowledge production (referred to as 'mode 1') yields to a new way in which knowledge is transdisciplinary, allowing for other than academic expertise to come in, and subject to multiple accountabilities (referred to as 'mode 2').

41. One of the consequences of 'mode 2' is that distinctions in types of research, such as 'fundamental' versus 'applied', are becoming less adequate, since many researchers work in inter-, multi- or transdisciplinary contexts in which these conceptual distinctions are less relevant than the

8   In a recent study commissioned by LERU universities, it was shown that the LERU universities make a considerable contribution to the economy: in 2014 alone they generated a total economic value of €71.2 billion in Gross Value Added to the economy and 900,000 jobs across Europe (BiGGAR: 2015, p. 1).

EXAMPLES OF PROJECTS DEMONSTRATING PRODUCTIVE INTERACTIONS AT LERU UNIVERSITIES

UNIVERSITY OF HELSINKI – COMHIS

Academic progress is made through cooperation and issues studied together from the very beginning. This is the starting point for 'Opening up research data: digital humanism and open science'. The research project COMHIS (Computational History and the Transformation of Public Discourse in Finland, 1640–1910) is a study of the development of public discourse and early modern information production in Europe. The project is based on an open international ecosystem, without any cooperation agreements. A central contribution for various stakeholders (businesses, organisations) is that the project cleans up a great number of data which others can reliably use as the basis for their digital services. Important for the success of the research project is that it works together with memory institutions (such as the National Library of Finland). (https://www.helsinki.fi/en/researchgroups/helsinki-digital-humanities)

UNIVERSITY OF BARCELONA - FLOWERED

The project's objective is to contribute to the development of a sustainable water management system in areas affected by fluoride contamination in water, soils and food in the African Rift Valley countries, thus to improve living standards (environmental, health and food security) of its population. The project mainly operates at small village scale to develop an integrated, sustainable and participative water and agriculture management at a cross-boundary catchment scale. It takes into account local experiences, aiming to enable local communities to manage water resources. The integrated approaches improve knowledge for EU partners, local researchers, farmers and decision makers. Through the involvement of SMEs, the project seeks to strengthen the development of co-innovative demonstration processes as well as new market opportunities. (http://www.ub.edu/web/ub/ca/recerca_innovacio/recerca_a_la_UB/projectes/fitxa/D/PE001625/index.html)

UNIVERSITY OF OXFORD – FLOOD MANAGEMENT

Flooding is a major issue for the UK, with substantial impacts and costs incurred for communities. North Yorkshire residents and Oxford University researchers work together, challenging flood management assumptions, paving the way for new ideas and a new way of working with communities affected by flooding. It has challenged the standard models of flood defence by pooling local knowledge and academic expertise, which resulted in a new methodology called Environmental Competency Groups (ECG, see http://www.environmentalcompetencygroups.org/). The methodology is designed to combine scientific and local expertise in the simulation of the causes of flooding in the locality and the potential effects of different management interventions in order to identify the most effective and affordable defence option. The group was made up of community members, flood modellers and social scientists. The first-hand knowledge of the local members of the project provided important inputs to the production of a more bespoke flood model for the town and, as a result, a more viable flood management proposition. (https://www.socsci.ox.ac.uk/research/current-iaa-projects/bringing-academics-and-communities-together-to-reduce-UK-flooding)

LEIDEN UNIVERSITY – ENGAGING WITH THE PAST

One of the main challenges in Caribbean heritage management is raising local awareness and understanding of the importance of protection of heritage resources. With some notable exceptions, current multi-ethnic culture and society considers the pre-colonial Amerindian populations as fundamentally different. In order to develop long-lasting and successful heritage preservation policies this project aims to engage the public by focussing on more general connections, stressing the continuity of the complex, dynamic and multivocal character of social processes in the region. In this way the indigenous Amerindian past (and its relationship with present-day indigenous peoples) can be positively incorporated in an inclusive and creative Caribbean cultural memory. There are two approaches: (1) public education, and (2) active community participation and collaboration. (http://www.nexus1492.eu/?page_id=1827)

UNIVERSITY OF ZÜRICH – DYNAMICS OF HEALTHY AGING

Productive interactions between researchers and different stakeholders (older adults, adult children, caretakers) have been underway for some time in this programme. Within the Participatory Research Laboratory, key ingredients and processes required for the successful collaboration between professional scientists and those from the general public (citizen scientists) are systematically defined and evaluated with regard to different types of outcomes (scientific productivity, third-party funding, stakeholder interest, competences). Citizens can become fully engaged in each step of the research process (from developing research questions to the interpretation and write-up of the results), sharing the same rights as the professional researchers. (http://www.dynage.uzh.ch/de/partizipativ.html)

question how their academic knowledge can solve a societal problem (Narayanamurti a.o.: 2013).

42. To induce change in any given situation - health, poverty, sustainable energy, cultural exclusion – academic research is needed, but the challenges involved primarily need an approach that is broader than a purely 'scientific' one. Researchers need to partner with other experts (policymakers, NGOs, companies, the public at large) and design strategies for a common understanding and ways to address the problem, a process commonly referred to as 'co-creation of knowledge' (Hegger a.o.: 2013).

43. Some academics strongly defend complete academic freedom - no outside interference and no questions about societal impact whatsoever – and argue that this is the only way scientific discoveries can be made, calling (mostly) upon the role of serendipity or the fact that progress in research may take a (very) long time and sometimes many failures before anything valuable comes out. Others take a different view, and merely see this as a problem of organising tasks and interacting with others in an innovation network. Both kinds of arguments can be found in all disciplines, and in all age groups.

44. To be clear: the result of (fundamental) research is often not predictable, and the impact is difficult to define from the outset (LERU: 2016d). But that does not mean that fundamental research does not give rise to unforeseen but highly valuable impacts nor that it cannot be done with applications in mind (Arnold and Giarracca: 2012, p. 4).

45. For most innovation processes the road from a fundamental idea to something useful in society involves teamwork of (many) participants going back and forth with ideas, temporary results, experiments, half products, formal and informal get-togethers, funding decisions, disappointments and successes.

3.3 Knowledge Production and Societal Impact: The Dynamic Model of Productive Interactions

46. Since research is a many splendored phenomenon, it can have impact in many different societal contexts and in ever so many different social domains. For some time the impact of research on society was rather narrowly defined as technological or economic impact and the methods used to assess this were relatively simple (numbers of patents, economic statistics). But things change if we take into consideration new approaches such as open science, citizen science, etc.[9] One of the real game changers of how universities can and do disseminate ideas more widely is open access. In this respect universities are playing a new role both in the academy and in the wider world in terms of increasingly publishing their outputs in institutional open access presses[10]. As a consequence the definitions of research impact on society are now broader, thanks to the rising awareness that on the one hand there are indeed many types of impact and that on the other hand the societal challenges nowadays are so complex that they need input from many academic fields.

47. One of the more comprehensive definitions of such a broad concept of impact is provided by the UK's 2014 Research Excellence Framework (REF: 2011):
Impact includes, but is not limited to, an effect on, change or benefit to:
- *the activity, attitude, awareness, behaviour, capacity, opportunity, performance, policy, practice, process or understanding*
- *of an audience, beneficiary, community, constituency, organization or individuals*
- *in any geographic location whether locally, regionally, nationally, or internationally.*
Impact includes the reduction or prevention of harm, risk, cost or other negative effects.

48. This definition includes many activities and potential beneficiaries, which and who all have different interests and may be all over the world at different aggregation levels. Unlike the relative clarity that exists within a purely academic context, this concept of societal impact has to deal with a much broader and more variegated environment, which can take on different forms depending on the stakeholders involved, both from within and outside academia.

49. Societal impact of academic work depends on multi-faceted contexts in which different interests and power relations exist. Furthermore, when looking more closely, one can distinguish that the networks of stakeholders in these contexts are *dynamic* and thus not always stable: they can develop over time and take on different constellations. Stakeholders who were interested at some

point in time might have backed out, and others might have come in later. This also is a consequence of the different interests that stakeholders may have: impacts may be assessed positive by one stakeholder and negative by another ('grimpacts').

50. For example, to prevent the devastating effects of malaria, many stakeholders have to work together. Researchers are necessary to produce fundamental knowledge about malaria parasites interacting with the human host and the mosquito vectors that transmit them. But to prevent malaria from spreading in areas where the disease is common, knowledge from other disciplines, e.g. about human behaviour, sanitary conditions, local economy, is absolutely necessary. Furthermore, to introduce

programmes that help put fundamental knowledge into practice, collaboration with local authorities and local people (indigenous knowledge) is essential. And the pharmaceutical industry has to be willing to produce vaccines at acceptable costs for malaria stricken areas.

51. The networks that are formed around such a societal challenge develop both in space and in time. To say anything of importance about relevance or societal impact, it is necessary to have insight in the dynamics of such networks and in the kind of interactions that take place between stakeholders. Figure B makes this clear.

52. Figure B shows a graphic representation of the relations
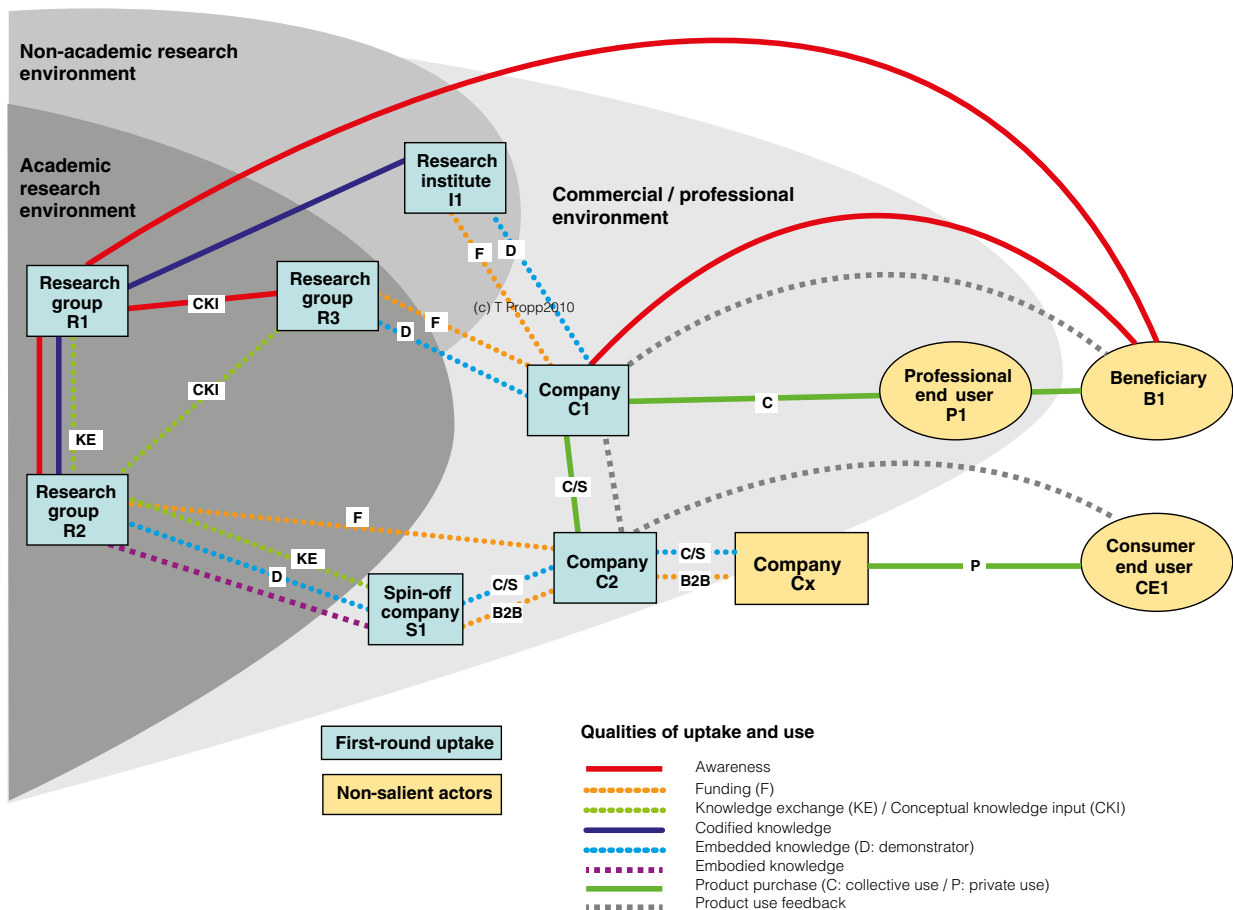

Figure B. Interaction between scientific and societal stakeholders. Down stream knowledge uptake in nanoscience and technology. Most knowledge relations are with stakeholders with a strong R&D profile. Relations with end users, beneficiaries and consumers in the lighter areas are only indirect and outside the realm of the researchers. SIAMPI project © Tilo Propp

to be found around nanoresearch programmes in the Netherlands and France (Spaapen a.o.: 2011[11]). It represents the multi-faceted interactions in a network of different stakeholders in a particular innovation process. There are various kinds of knowledge exchange: communications about product development, feedback loops from users to fundamental researchers and others, funding decisions, etc. The graph illustrates that academic researchers interact with all other stakeholders in the network and thus shows the dynamic, changing position of university researchers (left in the picture) in the societal context. It is important to realise that sustained 'engagement' of academics in these networks arguably improves the impact they can have and also will most likely enhance ideas within universities how to best engage with their communities and external stakeholders.

53. In a follow-up of the *The New Production of Knowledge* book, the authors talk about the co-evolution of science and society, a process in which innovation in society is not the result of scientific and technological progress alone, but the result of a wider, iterative process of interaction between scientific and other social domains, such as technical experts, professional organisations, industry, government and the public at large (Nowotny a.o.: 2001; see also Spaapen a.o.: 2011 and Smits and Kuhlmann: 2004). The outcome of such a process is what Nowotny and colleagues refer to as *socially robust knowledge* (Nowotny a.o.: 2001, chapter 11): science needs to move beyond the mere production of reliable knowledge and engage into active negotiation with society, not so much about the knowledge itself, but about the implementation of knowledge in the societal context. Innovation is more than a technological phenomenon and/or new products, *it is social too*. According to some, the main component of successful innovation is not R&D or new technology, accounting for only 25%, but social change (new ways of organising things, new relations between economic sectors and consumers, re-thinking institutional frameworks), accounting for 75% (Volberda a.o.: 2011).

54. Thus, it is not competition or comparison that are the main drivers in this process, but collaboration, the formulation of common goals and the joint achievement of results. To gain successful impact, it is necessary to have insight into these networks and in the variegated interactions and communications among the diverse sets of stakeholders that are part of the network *right from the design* of the research project.

55. Central in this process is the concept of *productive interactions* that has been developed in the EU FP7 project SIAMPI and is based on studies in a wide variety of fields in the social sciences and humanities, health and health policy, nano research and ICT. Productive interactions are defined as the mechanisms through which research (and other) activities lead to societal relevant applications. An *interaction* entails a contact between a researcher and a stakeholder. Interactions are distinguished in three categories, *direct (between people), indirect (via media) or material (financial or other forms of support)*. The interaction is productive when it leads to efforts by stakeholders to apply research results to societal goals, i.e. when it induces behavioural change. The idea of the use of productive interactions as driving forces for societal impact is that academic knowledge is not a simple package that can be handed over, but develops in interaction with a relevant context of stakeholders and that impact is the result of the various contributions of these stakeholders (Spaapen and Van Drooge: 2011).

56. The essence of this approach is that it is not competitive but collaborative by nature. Its premise is that to achieve societal impact it is most fruitful if various relevant stakeholders work together, combining different kinds of knowledge and expertise, designing a joint research and innovation agenda, and being open and inclusive because one never knows in advance where things are going. In this approach there also is a joint responsibility for every actor to evaluate the project and learn from it (see also Wissenschaftsrat: 2016). This is a fundamentally different approach, in that it puts the control of the process in the hands of researchers and stakeholders *together*, because they know best what is happening, certainly in the short and medium term.

57. Both researchers and different societal stakeholders relate far better to this dynamic model of knowledge production than to the linear model. It matches their practice and thus their 'reality' in the sense that it also takes into account factors such as time, unpredictability, chance and unforeseen consequences. It also encompasses and even blurs the boundaries of all types of research, from fundamental, translational to applied, within the same projects or evolved over different projects.

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11   The picture is constructed on the basis of interviews with researchers and stakeholders about the kind of productive interactions they had.

EXAMPLES OF PROJECTS DEMONSTRATING PRODUCTIVE INTERACTIONS AT LERU UNIVERSITIES

UNIVERSITY OF MILAN – MOVECARE

The project develops an innovative multi-actor platform that supports the independent living of the elderly at home by monitoring, assisting and promoting activities to counteract decline and social exclusion. It comprises a service layer for monitoring and intervention, a context-aware Virtual Caregiver (a 'service robot') and the users' community, to strongly promote socialisation as a bridge towards the elders' ecosystem: other elders, clinicians, caregivers and family. Gamification glues together monitoring, lifestyle, activities and assistance inside a motivating and rewarding experience. Among the stakeholders involved in the design and dissemination activities of the project is the KORIAN group, the first and largest European assistance provider for long-term care to elderly people living in nursing homes and at home. (http://www.movecare-project.eu)

UTRECHT UNIVERSITY – CHILD HEALTH PROGRAMME ON CYSTIC FIBROSIS

Cystsic Fibrosis (CF), the most prevalent rare disease in western countries, is a focus area of the *Child Health Programme* of the University Medical Center Utrecht (UMCU). Treatment requires a multidisciplinary approach and the UMCU collaborates with the *Dutch Cystic Fibrosis Foundation* (DCFF): patients actively engage in setting the research agenda and in regular research evaluation. The CF-Center delivers patient care, from early diagnosis to lung transplantation; performs innovative research leading to improvement of prognosis; is a key player in education to professionals and families. The societal impact is manifold: pilot trials that have enabled a governmental decision to initiate a national Heel Prick Screening programme on CF, selectively contracting health insurance companies, investing in high quality CF-care to the community, stimulating public engagement by documentaries on TV and in newspapers, collaborating from the design of the project onwards with the DCFF, increasing public and patient awareness. (http://mobile.journals.lww.com/co-pulmonarymedicine/_layouts/15/oaks.journals.mobile/articleviewer.aspx?year=2016&issue=11000&article=00013)

UCL – MUSEUMS ON PRESCRIPTION

Hospitals and care homes are known to be depressing environments and many people find it difficult to work through their own feelings about their situation. Using objects such as museum artefacts as prompts for reminiscence or conversation can help reduce stress and improve general wellbeing. Very little robust research has been done on this subject. The '*impact of museums on health and wellbeing*' project investigated how museum activities contribute to health/wellbeing in hospitals and care homes and has led to the development of a new wellbeing measure in partnership with museums and other partners. As the first rigorous study of therapeutic benefits of museum activities, this research has made an invaluable contribution to policy debates on arts and health, raised awareness of the role culture plays in society, led to the development of a volunteer programme, and offered a compelling argument for supporting arts and humanities funding in this area. (http://www.ucl.ac.uk/museums/research/museumsonprescription)

UNIVERSITY OF EDINBURGH – STAMP OUT SLEEPING SICKNESS

Thousands of lives in Africa have been saved by an initiative to help eradicate sleeping sickness. Cases of acute sleeping sickness among people in rural Uganda fell by 90 percent after Edinburgh researchers, led by Professor Sue Welburn, working with colleagues from Makerere University prevented transmission to humans by eliminating the parasite from cattle. Researchers aim to extend the project to all of the districts in Uganda that are affected by acute sleeping sickness. The condition, which is a parasitic infection affecting the nervous system, is always fatal if not treated. Many sufferers are in the poorest rural areas with no access to treatment and are unaware of the risk to their health posed by infected livestock. Researchers eliminated the trypanosome parasite that carries the disease by injecting livestock with trypanocide and by carrying out regular insecticide spraying to prevent re-infection. The results were achieved as part of the Stamp Out Sleeping Sickness campaign, created in 2006 by the University of Edinburgh, Makerere University, Industri Kapital Aid & Relief Enterprise, Ceva Sante Animale and the government of Uganda. (http://www.ed.ac.uk/files/atoms/files/strategic_plan_2016.pdf)

COMPREHENSIVE ASSESSMENT

4.1 Transition from Old to New Methods of Assessment

58. Research impact in the traditional meaning of influence on and in the scientific community refers to questions like: what do scientific colleagues think of my research and are the results I produce a useful addition to the existing body of knowledge? Academic impact measurements have been developed especially in the field of bibliometrics, where as a rule these questions are evaluated via references to articles in scientific journals. Although one can trace their origins back to 1926 ('Lotka's Law'), metrics have become a major factor in assessing research at almost all universities since the 1990s (Wilsdon a.o.: 2015, p.13). After initial resistance in the scientific community these measurements conquered a steady position in the higher education system worldwide. Nowadays researchers, funders and managers "face an ever-expanding menu of indicators, metrics and assessment methods in operation" (ibid., p. 4). As a consequence the "evaluation hype" has moved the indicators "from the niches of academia into a strategic position in policy making" (Weingart: 2005, p. 130).

59. Critique on this method of assessment remains an equally steady part of the discussion, and has even become stronger in recent years within the research communities. See for example the San Francisco Declaration on Research Assessment (DORA: 2013), which has also been signed by LERU. Criticism can be found on a number of topics. The system can stimulate researchers and managers of higher education institutions to put quantity above quality, especially if the data are not presented in the right context and are not accompanied by interpretation (Wilsdon a.o.: 2015, p. 82). Bibliometrics often tend to have a bias against results from interdisciplinary projects (ibid., pp. 84-85). There is the possibility and reality of 'gaming' the system (self-citation and 'citation clubs') (ibid., pp. 32, 83, 119). As the number of authors responsible for one and the same article keeps increasing, it becomes increasingly difficult to attribute the real production of knowledge to a real person: who has written what? (ibid., pp. 32-33). For a number of fields, for instance, books are one of the most important ways of publicising results of research. Impact of this kind of output is much more difficult to measure through bibliometric methods and this means that parts of the social sciences and especially the humanities are left out (ibid.: 2015, p. 48). Last but not least metrics have a negative effect on equality (gender) and diversity (ibid, pp. 90-95; LERU: 2012b, p. 3). Initiatives like DORA "will eventually shift the culture and identify multivariate metrics that are more appropriate to 21st Century science" (Eisen a.o.: 2013, p. 2). The negative effects of bibliometrics, and in particular the misuse of these instruments have been criticised in the Leiden Manifesto, which aims at creating a set of rules for responsible use (Hicks a.o.: 2015)[12].

60. As Frank Miedema, a leading epidemiologist on HIV and Dean of the medical faculty at Utrecht University puts it in *The Guardian*: the "tsunami of papers would suggest a vastly expanding reservoir of knowledge with enormous societal impact. Unfortunately, this is not the case. Many papers are never cited and probably never read. Even worse, many supposedly high-quality papers in the life sciences, describing breakthroughs or possible therapeutic targets, cannot be reproduced. […] Assessing 'scientific quality' has been reduced to bean counting. Scientists are judged by the number of papers they publish and by the impact factors of the journals in which papers are published. This has led to major goal displacement. Publishing scientific papers originally was meant as a form of communication with peers and perhaps a first step towards the application of new findings. Increasingly since the late 1980s, publishing papers has become a goal in itself" (Miedema: 2016; see also Sarewitz: 2016).

61. Although there are many diverging views about peer review, most people agree that it is a necessary component when assessing results of academic research. This is especially the case as an antidote against quantification, since there is a fair chance that universities become – or have become - obsessed with measurement and monitoring, which may result in a culture "detracting from the real quality of research and the boundless search for knowledge" (LERU: 2012a, p. 3). This means that bibliometrics and similar indicators "should only be applied in connection with qualitative peer review" (Weingart: 2005, p. 130). But peer review in the new

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12   See also Benedictus and Miedema: 2016 and Ferguson: 2016.

context of societal questions also needs to be revised and extended. Firstly because peers are not necessarily fit to judge research that is inter-, multi- or transdisciplinary, and secondly, because other expertise is also necessary should societal questions be at stake. Innovation in peer review procedures has been suggested in several studies (KNAW: 2011). Therefore the expert panels in the REF UK 2014 were to some extent joined by external stakeholders and interdisciplinary research was cross-referred between assessment panels. Also, research 'users' were included in the assessment of impact case studies.

4.2 Assessment of the Dynamics of Research and Innovation

62. In a world used to assess research impact via publications in Web of Science journals, where impact factors and H-indexes play a predominant role, especially in the natural and biomedical sciences, it will not be easy to see impact in a broader way, let alone to balance this evaluation against the more traditional evaluation of scientific quality[13]. Yet, this is what has to be done. LERU's view is that "university assessment or evaluation is an important and integral part of the university enterprise" (LERU: 2012a, p. 4) and that LERU "will continue to inform, support and where appropriate, lead this debate" (ibid., p. 14). It is clear that traditional evaluation mechanisms do not work in these new contexts with multiple dimensions of time and space.

63. The assessment of the impact of scientific research on society has to take at least three factors into account: (1) contextuality, (2) temporality and (3) contribution (see Spaapen and Van Drooge: 2011).

64. *Contextuality* refers to the fact that processes in which new scientific knowledge is turned into practical applications, differ from sector to sector, and are dependent on different interactions between variegated stakeholders. Medical fields have to deal with hospitals, legislators, the pharmaceutical industry and patient organisations, whereas language fields have to deal with school boards, teacher organisations, publishers, parents, pupils and the general public. All these processes are non-linear.

65. *Temporality*: it takes time between the emergence of a fundamental scientific question and the practical application in society. In some cases this might be a few years, in others it even can be fifteen to twenty years, or longer. In the meantime, many changes may occur in the network in which the particular innovation takes place: theoretical and conceptual approaches may change, new technological options might become available, etc.

66. *Contribution:* in such a network, it is difficult to assess the specific contribution of stakeholders, since most steps forward (and backward) are the result of collaboration. Also, a particular contribution might be valuable in year x but discarded in year z, for good reasons.

67. There are two additional problems that have to be faced. Firstly, the necessary data are often not readily available, because they were not previously collected. Secondly, there is resistance from the side of policy makers who favour simple evaluations with concrete numbers over qualitative, often more complex approaches to impact evaluation.

68. Looking at both the research on and practice of impact evaluation, we can distinguish at least three main new evaluation models: (1) ones that aim at emulating quantitative measurements; a new offshoot being Altmetrics, which focuses to a large extent on output via social media (Facebook and Twitter for example)[14] and other web-based media such as reference managers like Zotero and Mendelay[15]; (2) ones that develop alternative and often qualitative measurements (case studies or narratives), as has been done in the UK REF 2014; (3) ones that focus on interaction and communication patterns between research and societal context. The latter recognise best that research is part of a broader innovation process, a network involving many parties that together form a flexible environment and share a common societal goal. Knowledge and expertise are exchanged and tested between stakeholders in a more or less continuous process, circulating between parties. The research that is produced in these networks has to be scientifically robust and at the same time societally relevant. Evaluation in other words becomes 'contextual', a distributed and ongoing process, and a joint responsibility.

13 An interesting and promising development in this respect is the exponential growth in the use and sharing of research data that enhances transparency, facilitates reproducibility and the exchange and transfer of knowledge. (See LERU: 2013b)
14 On the use of social media by scientists and its impact, there is a growing literature, see for example McClain a.o.: 2015.
15 Altmetrics (http://altmetrics.org/manifesto/) is a young and promising field for evaluation, which aims at tracking down communications outside the regular journals, using public search engines like Google or Bing, and having special attention for social media used by researchers. At the second Altmetrics conference held in October 2015 in Amsterdam, it was concluded however that results so far are not developed enough to be used in societal impact evaluation.

4.3 National Systems

69. The rising awareness about the changing context for university research has led to many different answers in Europe and beyond. Governments change their policies from rather distant to more demanding, both in terms of conditions for financing (collaboration with industry and society is now often a requirement) and in terms of evaluation. Many of the new evaluation systems are too recent to be analysed here, but it is interesting to take a quick look at some systems in terms of societal impact[16].

70. Many national systems are set up in order to (re) allocate money, but most do not yet take societal impact indicators into account, for example, the Australian *Excellence in Research for Australia* (ERA), New Zealand's Performance-Based Research Fund, the Danish *BFI*, the French *Initiatives d'Excellence*, the Italian *Evaluation of the Quality of Research* (VQR) (Wilsdon: 2015, p. 22-26) or the German *Excellenzinitiative*.

4.3.1 The Netherlands: SEP

71. In the Netherlands, all academic research is evaluated through *the Standard Evaluation Protocol* (SEP), a system running since 2003. Every six years a new version is published, and the current one runs from 2015 till 2021. The SEP is self-organised by the universities and the prime goal is quality control and a judgment of the societal impact of research. Re-allocation of budgets is not a goal of the SEP. There are three main criteria, scientific quality, societal impact and viability of the research unit. Productivity, which used to be a separate criterion, is left out in the current version as a reaction to the growing critique that too much focus on producing articles has perverse effects on both the quality and relevance of scientific research (see for example Science in Transition)[17]. Review committees are asked to value scientific quality and societal impact on an equal basis. Much like the REF in the UK, research units can present case studies or narratives to underpin their cause. The first results are coming in now, but it is too early to draw conclusions yet. One interesting effect is that all the Dutch humanities faculties gathered into a joint project to find an adequate structure for narratives, and the evidence to support them.

4.3.2 UK: REF

72. In the 2014 Research Excellence Framework exercise (REF), UK higher education institutions were asked to submit impact case studies demonstrating changes and benefits to the economy and society at large. Similar to the SEP, the main criteria of the REF are the quality of research outputs, the vitality of the research environment and the wider economic and social impact of research. Unlike in SEP, there was a precise weighting of the three main criteria, respectively 65% for the research output, 20% for the impact, and 15% for the vitality criterion. Impact case studies were short four-page documents and were assessed by two criteria: (1) *Reach* – "the spread or breadth of influence or effect on the relevant constituencies"; and (2) *Significance* – "the intensity or the influence or effect". Also unlike in SEP, a relatively large amount of money, approximately £1.6 billion over the next five years, will be determined by impact case studies. Synthetic analysis of the REF impact case studies found that much of the research was multi- and interdisciplinary, that the societal effects were diverse and wide-ranging, with over 60 unique 'impact topics' identified, and more than 3,700 unique pathways leading from research to impact (King's College: 2015). The same effects were found to a large extent also outside the UK.

73. The analysis has also produced the REF impact case study database, a searchable tool enabling analysis and automated text mining of the case studies (http://www.ref.ac.uk/). One strength of the impact case studies (and somewhat comparable to the SEP) is that authors were allowed to select the most appropriate and highly specific data to evidence the specific types of impact claimed. In other words, in both the Dutch and UK system the research community is taking on a role in the development of evaluation mechanisms for societal impact assessment. A less positive aspect, however, has been that in many cases it is difficult to attribute particular contributions to a specific actor (a researcher, a group or a programme) precisely because innovations are the result of many contributions that develop over time. The REF impact case studies still generally assume a linear model of research impact, rather than a network model[18].

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16 For a more comprehensive discussion on national systems see LERU: 2012a, p. 6-8 and Wilsdon a.o.: 2015.
17 See http://www.scienceintransition.nl/english
18 Lord Stern, in an independent review of the REF in July 2016, looked forward to the next REF in 2021 and suggested that the assessment of research impacts should be broadened, to include links to a larger body of work, or to the wider impacts of teaching and public engagement (Stern: 2016; see also Wilsdon: 2016).

Box B: Pathways to Societal Impact

A recent report from Imperial College (Gann et al.: 2016) introduces a systems approach to wider impact evaluation. While recognising that such broader approaches are being introduced in other institutions in the higher education sector, the report states that Imperial is willing to take the lead in developing a policy regarding the increase of relevance and impact of research on society. Technology Transfer Offices were introduced in the 1980s with quite some success in the external application of research results. However, it is now acknowledged that TTOs are only 'part of the system': "emphasising a few select commercialisation 'pathways' neglects a myriad of other routes by which research and education interact with and can have beneficial impact for society" (p.13). The model they propose "encapsulates application of research and experiential education across the private sector, public sector, third sector (charities, foundations, trusts and NGOs) and broader community. This is a dynamic system in which exchange of ideas occurs through interactions and flows of people, knowledge and technology. We call these the pathways to societal impact" (ibidem).

The report distinguishes three 'pathways to societal impact', which resemble the trio of interaction channels of the SIAMPI model:
(1) People: developing, educating and engaging talented people is the largest direct impact that the College has on society, perhaps followed by treating patients at our hospitals; including full-time and part-time students, permanent and temporary staff (professional services and academic), as well as internships, Adjunct Professorships, those in further education, alumni, partners, clients (e.g. of executive education), donors, advisers, and friends;
(2) Knowledge: dominant through scientific publishing, although this may have less direct or immediate impact on society; includes pathways such as consulting and problem solving, data sharing, conferences, influencing policy, outreach, and defining new research domains, and
(3) Technology: the core mission of the College's TTO includes pathways such as patent filing, licensing, entrepreneurial start-ups and spin-outs, as well as less common routes of standards setting.

The report aims at a comprehensive policy for "developing, encouraging, measuring and rewarding participation in these pathways". Rather than an isolated policy, it "should be inherent in everything that we do, in the same way that research and education are fundamental to the College's mission" (ibidem).

4.3 New Approaches: Available and Tested

74. While there are frictions and confusion about how to assess societal impact, there are also promising approaches from which to learn (Bornmann: 2013). One such example is the report by Imperial College on P*athways to Societal Impact* described in box B. A methodological approach for comprehensive assessment was developed in the above mentioned EU FP7 *SIAMPI* project. This method analyses the societal network around academic research in a wide variety of fields and presents three different indicator categories that work for all these fields and that are characteristic for the interaction between science and society (Spaapen and Van Drooge: 2011). At INRA, the French institute for agricultural research which has a main focus on food, nutrition, agriculture and the environment, concepts of impact pathways have been developed that resemble ideas developed in the SIAMPI project (INRA: 2014). Both approaches (1) recognise the networked character of research and innovation, (2) acknowledge the importance of stakeholder participation, and (3) combine quantitative and qualitative indicators. The appendix to this paper contains a more elaborate description of both approaches.

75. In reviewing their evaluation procedures, universities have to reconsider much more than just the procedures. For example, they have to rethink their role in the knowledge society vis-à-vis the other stakeholders (policy makers, industry, public organisations, the public at large), and also the way in which they train students to be able to operate in the new context (if only for the practical reason to teach them how to be successful in grant applications).

76. In brief, LERU universities realise that innovative ways to evaluate research in a wider context exist; they support the critical review and eventual implementation of such methods in their policies[19]. These new methods are far less unilinear than more traditional assessment approaches, and look forward instead of backward. They do not focus on impact as an end result, but as a multi-faceted series of transitional effects and results, as steps in a larger iterative innovation process.

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19   Good reviews can be found in: Greenhalgh a.o.: 2016 and Guthrie a.o.: 2013.

CONCLUSIONS

77. LERU universities are committed to demonstrating the vital role of universities in contributing to society, in terms of education and training, the production and dissemination of new knowledge, and the sustained engagement with societal stakeholders within the national and international challenges they face. To demonstrate societal impact, therefore, is an integral part of what universities do and what they are about.

78. Societal impact always has been a core task of universities, and it will remain so in the foreseeable future because, ultimately, it is what universities are for, even when the context and framework in which impact is understood may change over time.

79. In this paper we have analysed the current context in which societal impact is discussed at LERU universities and beyond, how this impact is pursued as a high-level strategy at LERU universities, and how the current understanding of impact and its explicit recognition inside and outside of the university has significant consequences for the entire research ecosystem, including universities, researchers, funders, governments, private and public stakeholders, the public at large etc.

80. The premises of this paper have been that (1) knowledge production is not a linear process starting with basic research and ending up with applications, but instead progresses in dynamic and increasingly open and collaborative ways, and that (2) innovation in society is not only the result of scientific and/or technological progress, but to a large extent the outcome of an iterative process of interaction between scientific and other social domains and its stakeholders. In this process, research and innovation are recognised to take place in a network in which different partners with diverse expertise and knowledge collaborate on the basis of a joint agenda.

81. When research and innovation are regarded as a dynamic, open and networked process, then competition or comparison are no longer the main or only drivers in the production of knowledge, but successful interaction between stakeholders and the formulation of common goals and joint achievement of results become paramount.

82. This way of looking at the research process requires a similarly dynamic, open and networked way of looking at impact. When academic knowledge is not seen as a simple package that can be handed over, but as a dynamic part of a wider process which develops in interaction with a relevant context of stakeholders, each with their own expertise, knowledge and insight, then societal impact should be regarded as the outcome of the creative encounter of these stakeholders and their contributions.

83. To be successful in creating societal impact thus requires insight into the relevant networks of stakeholders and the variegated interactions and communications that are part of those networks, and this insight should as much as possible start *right from the design* of the research project. Central to this is the concept of *productive interactions*: the mechanisms through which research and other activities lead to socially robust knowledge and relevant applications.

84. To determine research impact in this new context, old mechanisms are under scrutiny. The two traditional cornerstones of research assessment (bibliometrics and peer review) have both been shown to have flaws and to need substantial changes to be fit-for-purpose in a dynamic, open and networked research ecology. Many initiatives and innovative approaches are starting to take ground, following critique coming from inside the academic community (cf. DORA and Science in Transition). A number of qualitative and quantitative measurements have been developed, other new methods cover the growing use of social media (e.g. Altmetrics), and peer review is being opened up and extended with other expertise.

85. It is crucial that new approaches are network- and stakeholder-oriented, looking for the productive interactions that are central to this concept. This also means that qualitative methods (such as the use of case studies and narratives) may be more informative than quantitative methods (such as bibliometrics, sociometrics, econometrics etc.).

86. Recognition of the changed way of looking at the research process and societal impact is leading to changed thinking at universities about what types of activity are recognised and rewarded, not least for promotion. Universities increasingly take into account their scholars' efforts in considering the impact of their research in society at large, but more can and needs to be done if universities want to maintain a leading role in the knowledge society.

RECOMMENDATIONS

87. This paper has included a selection of examples from LERU universities to show how they have taken on board the impact agenda in their strategies, policies, initiatives and practices. On the basis of the analysis of this paper and the insights received from LERU universities, we have formulated the following recommendations for universities and other stakeholders:

Recommendations for universities:
- Universities should fully embrace the societal impact agenda, safe in the knowledge that it is fully compatible with their historical fundamental missions of knowledge creation and transmission.
- Universities should continuously seek to support and promote societal impact as a dynamic, open and networked process in a culture of sustained engagement and co-production of knowledge.
- Universities should engage with others across the broad spectrum of the research ecosystem, including governments, research funders, the private sector, civil society and society at large, so as to foster a better understanding of impact, to develop future-oriented policies and implement innovative practices based on the concept of impact as a dynamic, open and networked process.
- Universities should, as a consequence, develop open, explicit and transparent reward systems that include the value of all kinds of impact, reward it and take it into account for individual promotion. They should avoid (inadvertently) creating or following perverse incentive systems.

88. LERU and the LERU universities are committed to this agenda and keen to engage with others in a debate on impact at the EU and international level.

Recommendations for others:
LERU urges governments, policy makers and funders, at the EU, national and other levels, to:
- recognise and endorse the view of impact as a dynamic, open and networked process in a culture of sustained engagement and co-production of knowledge,
- temper their expectations when it comes to the question of predicting the outcome(s) of grant applications, since the production of knowledge is dynamic and thus full of unpredictabilities,
- support and incentivise universities in their endeavours to embrace this broad impact agenda,
- engage with universities in a dialogue to develop sensible impact policies, and
- translate the ideas and recommendations put forward in this paper into innovative approaches and initiatives.

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APPENDIX: INNOVATIONS IN ASSESSMENT

1. Productive Interactions: the SIAMPI Method

The EU FP7 project SIAMPI - Social Impact Assessment Methods through Productive Interactions - delivered an innovative evaluation approach in 2011 based on the analysis of the productive interactions between researchers and stakeholders in society[20]. The project looked at the formal and informal networks of stakeholders surrounding research in various fields, both in STEM and SSH areas, in four European countries (Spain, France, the UK and the Netherlands). The main goals of the project were to understand how these interactions were organised, what kind of contributions different stakeholders produced, and what the similarities and differences between different fields and different countries were. They were particularly interested in the consequences these patterns of communication and interaction would have for societal impact evaluation. The SIAMPI approach is inspired by the so-called fourth generation evaluation approach that focused on the involvement of stakeholders (Guba and Lincoln: 1989) and based on ideas of *the New Production of Knowledge* developed by Gibbons a.o. (1994). The latter group of researchers characterised academic research in the new context of societal demand as 'research in the context of application' and as transdisciplinary, socially distributed, and subject to multiple accountabilities. The SIAMPI project combined (qualitative) network analysis through case studies with the development of indicators in three sorts of interactions: (1) direct (through people), (2) indirect (through media) and (3) material (through funding or other material support). The indicators are informative about different phases of the innovation process. They are process indicators that give information about how advances are realised on cooperation between stakeholders in the network. They aim at giving policy information to adjust the direction of research, or the collaboration with stakeholders.

The indicators identified by the project were very diverse: research publications, policy reports, hybrid articles, prototypes, guidelines, websites, designs, protocols, exhibitions, films, memberships, shared use of facilities, double functions, financial contributions. Central in the analytical framework of SIAMPI is the concept of *productive interactions*: the mechanisms through which research activities contribute to a socially relevant topic. An interaction entails a contact between a researcher and a stakeholder. The contacts are mediated through various means, as diverse as a research publication, a policy report, a prototype, a guideline, a website, a design, a protocol, a membership of a committee, shared use of facilities or financial contributions by a stakeholder. The interaction is *productive* when it leads to efforts by stakeholders to apply research results to societal goals, i.e. when it induces behavioural change.

To discover the multitude of societal impacts, exploratory case studies were conducted in four different fields (two older ones and two relatively young ones) and in four different European countries: (1) Nanoscience and -technology (the Netherlands and France), (2) ICT (the Netherlands and the UK), (3) Health and health care research (the Netherlands), (4) Social Sciences and Humanities (Spain, the UK which in one case accidentally branched out to Argentina). There were also different research organisations involved, both inside and outside academia. The different fields that were studied represented to a large extent the broad scope of scientific research thus showing that the SIAMPI approach is applicable in variegated fields and contexts. Short characteristics of the four fields also show that engagement with society can be manifold, quite similar to the REF experience.

Nanoscience and -technology is a relatively new emerging field that receives major research funding from existing and new funding bodies. Funding in the field is legitimised by both scientific and socio-economic arguments. Promises for societal impacts are manifold and include higher environmental sustainability through increase of the effectiveness and efficiency of production processes and better health services through improvement of drug development and drug delivery. The range of spheres where research in this field has impact on society is multiple and varied.

ICT, needless to say, is so important for our present society that without it, we could not imagine continuing the lives we live. And yet this area, as we know it today, is no more than a few decades old. Our dependency on the technology, which seems to grow at the same exponential pace as the chip capacity itself, raises all kinds of legal and ethical questions, from personal privacy to quality of working life, and includes many kinds of risks in the event of failure or dependency on other global regions' technology. Here, publicly funded research ranges from fundamental research to applications of real ICT systems in domains of business and social activity.

Health and health care is a longer existing area than the previous two, and of vital importance in every society. It is an area that mixes the generation and deployment of advanced technological practices with the development of fundamental knowledge and a variety of social and ethical issues. Research develops in a variegated user and stakeholder context, from patient organisations to the general public, to the pharmaceutical industry, and from government and regulatory bodies to start-up companies.

The fourth area is a combination of two fields with a long tradition, social sciences and humanities. Both areas cover a wide range of disciplines, ranging from the very theoretical (some fields in sociology, philosophy, linguistics and economics), to hermeneutical (history) to applied disciplines (business studies). The areas are not endowed with large sums of money in the EU Framework Programmes or in national initiatives. Nevertheless, it is of vital importance to address many significant societal problems such as for example migration and integration, the economy, or the development and implementation of health care systems. Further, research in these fields can have considerable impact in the development of social institutions and on cultural change processes.

As expected, the range of impacts encountered in these four areas was indeed extremely diverse. The SIAMPI project found that this range was larger in some fields than in others, depending on the level of coordination. Some fields have a high degree of coordination and consultation (health care research, for example), which means that stakeholders in that field are used to operate in a collaborative environment in which it is common to negotiate about societal or policy goals and the research needed. In short, people are used to design a common research agenda. In the case of the social sciences (business studies), the study found quite the opposite in terms of organisation, i.e. a far more unpredictable, 'serendipitous' pattern when it comes to the interaction with stakeholders. Interestingly enough, this led to an unexpected impact: a sustainability model regarding the prevention of grass fires for the Welsh Assembly was successfully applied through a series of change encounters in an Argentinian mining community for conflict resolution (Spaapen and Van Drooge: 2011, p. 215).

The conclusion of the SIAMPI project is that a designated research policy can further the achievement of societal impact, but also that evaluation models need to be open to serendipity, to chance events that cannot be caught in quantitative numbers and can sometimes only be traced by following the interactions of individual researchers and stakeholders via case studies. More of these unpredictable, serendipitous patterns were discovered, in ICT for example, where it is not uncommon for researchers to actively move between the academic and the private sector (start-ups for example), which enhances the chance that impact occurs in unexpected places. To end with an unusual case of societal impact, the discovery, 'translation' and publication of Spanish sixteenth century music was seen as a valuable contribution to the preservation of Spain's cultural heritage. This reflects the diversity in relationships that researchers have with stakeholders.

The study's main thrust is that despite differences in contextualisation, the SIAMPI approach is applicable in all these cases, precisely because the focus is on interactions and on the contributions of the various stakeholders. Therefore, it is important to involve the stakeholders not only in the design of the research agenda, but also in the evaluation of the network activities. SIAMPI does this through organising focus groups in which both the research agenda and the criteria and indicators for evaluation are discussed. These focus groups reviewed the relevant steps in the innovation process (written contributions, exchanges of expertise, artefacts, discussions, collaborations, products), and from there on learning and improving collaboration between stakeholders instead of

Direct, personal interactions	Indirect interactions through media	Material interactions
- face-to-face meetings - double functions, other mobility arrangements - phone conferences - email - social media - videoconferencing - public debate - radio, tv, internet	- academic journals - professional journals - non-academic journals - popular media - exhibitions - artefacts, models - films - master theses, graduate projects - standards, protocols - social media	- research contracts - facility, instruments sharing - start-ups - contribution "in kind" (people) - IPR arrangements, patents, licenses - professional training - other stakeholder interest

judging, comparing and accounting. By way of example, a table with possible indicator categories is given below.

As a final remark, the network that evolves around academic researchers is not always characterised by consensus about what to research and how to evaluate it. In fact some fields and issues are heavily contested. But it is only by addressing these different views and discussing them with all relevant stakeholders that solutions can be found through socially robust research.

There are also methods for how to do that, for example the PIPA method. Participatory Impact Pathways Analysis (PIPA) is a project planning and monitoring and evaluation (M&E) approach. It is a relatively young and experimental approach that draws from programme theory evaluation, social network analysis and research to understand and foster innovation. It is designed to help the people involved in a project, programme or organisation to make their theories of change explicit, in other words how they see themselves achieving their goals and having impact. Living labs are stakeholder-oriented environments where several elements needed to make a change come together in a creative setting: diversity of expertise, knowledge and perspectives. In these settings scenarios for future solutions of societal issues can be discussed among stakeholders. Evaluation can be directed towards processes of change, of social and technical innovation. (Sauer: 2013).

2. INRA

The INRA (*Institut National de la Recherche Agronomique*) policy was inspired by the ASIRPA project[21], which was launched by INRA's general directors in January 2011. At that time, a number of the researchers in the ASIRPA project were also involved in the SIAMPI project. One of the findings of the ASIRPA project was – not surprisingly - that the pathways between academia and society are often long and seldom straight, but sometimes rather circuitous. One of the leaders of the ASIRPA project, Pierre-Benoit Joly, explains on the INRA website why they are developing the impact pathway methodology: "There are two general methods for evaluating the applied importance of research. The first focuses on the economic impacts of the research in a given sector, by estimating the returns achieved for the research funds invested. This method is quite useful, and it shows that rates of return are usually very high. However, this technique remains myopic because it only focuses on the economic benefits of the research. Furthermore, it cannot be used to uncover the mechanisms that are generating impacts. The second method uses case studies. It can be utilised to flesh out the details of the paths that lead to impacts (i.e. impact pathways). However, its disadvantage is that it relies on the analysis of a collection of different research 'stories', which can make it difficult to draw more general lessons. We have developed an approach that uses standardised case studies, making cross-case comparisons and broader conclusions possible" (INRA: 2014)[22].

Joly's co-leader, Laurence Colinet, explains further why impact pathways through case studies are a valuable approach for evaluating the societal impact of research, and are much better than quantitative methods: "Our research has allowed us to scientifically confirm some ideas that were already more or less accepted or that seemed intuitive. First, impact pathways for agricultural research are long: on average, 19 years elapse between the beginning of a project and the manifestation of its impacts. That is why we need to proceed with caution: asking for rapid returns is sure to be counterproductive. Indeed, economists realised early on that the government should provide research funding because it takes such a long time for research to yield impacts. Our results also underscore the importance of research infrastructure, such as experimental facilities, collections of genetic material, livestock, and databases, as well as partnership schemes. Most of the case studies we examined involved interdisciplinary collaborations" (ibid.).

The method has been tested by some of INRA's research divisions and the feedback was so positive that they plan to roll it out during the institute's next five-year evaluation. They are convinced that this methodology can be applied in other research institutes as well.

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21 The ASIRPA (*Analyse Socio-économique des Impacts de la Recherche Publique Agronomique*) project analysed the impacts of publicly funded agri-cultural research. It was launched in 2011 and carried out by INRA scientists from two research units, the Sciences and Society Unit (SENS) and the Joint Research Laboratory for Applied Economics (GAEL) in Grenoble, as well as by collaborators at the French Institute for Research and Innovation in Society (IFRIS).
22 See http://www.inra.fr/en/Scientists-Students/Economics-and-social-sciences/All-the-news/Translating-research-into-impacts-30-case-studies.

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