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Knowledge as Public Property: The Societal Relevance of Scientific Research

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KNOWLEDGE AS PUBLIC PROPERTY: THE SOCIETAL RELEVANCE OF SCIENTIFIC RESEARCH

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Universities are funded by public means to a large extend. It's reasonable to expect that society benefits from the results. For scientific research this means that it should at least have a potential societal impact. Universities and individual investigators must explicitly consider the societal relevance of their research activities. And also report on it explicitly. Core questions are: 'Do we do the right things?' and 'Do we do them right?' This implies that next to indicators of scientific quality, attention should be given to indicators of societal relevance. This dual aim is placed in the context of current evaluation practices of academical research. A proposal for 12 indicators of societal relevance is formulated, focussing on both social-cultural value and economic value. Examples given mainly concern the health and life sciences. The paper ends by discussing the central challenges in evaluating the societal relevance of scientific research.

One of my heroes is the British statistician Austin Bradford Hill (Bouter, 1993; Hill, 1952, 1965). In 1948 he introduced the randomized clinical trial to determine the effectiveness of medical treatments through randomized treatment allocation and blinded outcome assessment. At the time, this approach gave rise to heated debate, and was criticized as unscientific and unethical. Sixty years later, Hill's position is no longer controversial. Today there is a consensus that, in cases where there is reasonable doubt, it is actually unethical not to conduct a clinical trial. The doctrine of evidence-based medicine is founded on this very principle. It centres on the notion that, while theory and fundamental research are essential, they nevertheless provide an insufficient basis for the application of scientific knowledge. This requires applied research in the relevant setting. Hill formulated four questions that authors and readers of scientific articles should ask.

Why did you start?
What did you do?
What answer did you get?
And what does it mean anyway?

It is this last question that I would like to discuss. There are two key elements in my central message. The first is that researchers should reflect on the societal relevance of their work. The second is that universities should report on the work of their researchers in terms of concrete indicators of societal relevance.

First, I will consider the relationship between scientific quality and relevance to society. I will then proceed to show the importance of focusing on societal relevance and its place within the tradition of VU University Amsterdam. Lastly, I will identify a number of indicators of societal relevance and I will put forward a proposal for working with them.

Quality and relevance

The dream of every modern-day university manager is a cockpit with a dashboard full of performance indicators. If we're honest, we all wanted to be pilots when we grew up. I am such a manager and I know that my steering ability depends on the quality of those indicators. And, of course, vision and wisdom are important when it comes to interpreting the readings

on those displays and dials. We can make two demands of research: that it is of high scientific quality and that it is relevant to society. The first demand is incontrovertible and is central both to the assessment of research proposals and the evaluation of academic research. The demand of societal relevance is less self-evident and gives rise to a great deal of discussion.

To begin with, relevance often depends to a large extent on the outcomes of the research, in addition to all kinds of circumstances beyond the control of researchers and universities. A good example of external circumstances turning out favourably is a study on the use of back support belts to prevent injuries among the baggage handlers who load the aircraft at Amsterdam's Schiphol Airport (Van Poppel et al. 1998). This kind of work can cause back problems. Our study showed that the back support was not effective in preventing these problems. "Negative" findings like this often make a study difficult to publish. But we were fortunate. Our findings came out just as legislation to make back support belts compulsory was being drawn up in the United States. In record time, our study was printed in a leading journal and became the topic of heated debate in the media and during sessions at the US House of Representatives.

It would not be reasonable to expect every research project to have such a clearly identifiable social impact. But this example does show how scientific quality and societal relevance can go hand in hand. On the whole, I think there is at least a moderately positive correlation between quality and relevance. Of course, it should also be noted that bad research is never relevant. There should be no misunderstandings about that. In my view, quality and relevance are not interchangeable. I have no sympathy for attempts to boost societal relevance by making concessions on scientific quality.

Since universities are publicly funded, it is reasonable that society expects something in return for this investment. First and foremost, this means training professionals who can make a difference. This is surely the best way to make our societal relevance clear to all. But it is research, not education that I want to discuss here. At the very least, we should be entitled to demand that research has the potential to be relevant and can lead to results which can be implemented. While this can be seen most clearly in applied research, I believe it applies also to fundamental research, although the relevance of the latter is much more difficult to predict and can sometimes take decades to emerge. In many cases the waiting will be in vain, but that should not undermine the good intentions in the first place.

Universities have to achieve transparency when it comes to the scientific quality and societal relevance of their research. In other words, are we doing the right things and are we doing them right? (Bensing et al. 2003). The first question has to do with taking up the challenge of society's problems. The second concerns both the quality of the research and the relevance of the findings. Society has the right to receive a clear answer to these questions. Besides, it is becoming increasingly difficult to make an impression by simply referring to the intrinsic importance of fundamental research.

Scientific quality

In many countries, the quality of scientific research is evaluated at fixed intervals and often the primary significance of such an evaluation is for the policy of the university in question (Meta Evaluatie Commissie, 2007; Standard Evaluation Protocol, 2003). This is certainly true of the Netherlands. But there are cases where this evaluation process has far-reaching consequences for the budget allocated by the government. The United Kingdom is a good example of this, with its Research Assessment Exercises (RAE) which are held every

four years (www.rae.ac.uk). That approach is still the subject of much discussion, since the method used appears to work to the distinct disadvantage of interdisciplinary and applied research (Banatvala et al. 2005; Shewan and Coats, 2006).

The RAE also give rise to strategic behaviour, such as the temporary transfer of foreign colleagues who have an impressive list of publications to their name. This is not the way forward. However, I do believe that it is important to reward good behaviour and I therefore add my voice to the call of those who advocate more dynamism in the funding of research (Commissie Dynamisering, 2006a, 2006b; Raad voor Medische Wetenschappen, 2005; Zuijdam, 2006). I also think that, within the university as well, there are good reasons for linking budget allocation to performance, to some extent at least. But any such allocation needs to be based on performance indicators which are simple to measure and difficult to manipulate.

Publications and citations are countable aspects of scientific quality. Subsidies obtained also make a statement about the quality of the researcher and the research group. However, there are important cultural differences between disciplines as regards subsidies, publication and citations (Wouters, 1999). Citations are interesting because they show the contribution a specific publication has made to the acquisition of knowledge in a given field. The indicator which reflects the relative impact in comparison with the rest of the field is particularly informative (Moed, 2005; Van Raan, 1996; Moed et al. 1995). This is obtained by dividing a research group's average number of citations per article by the average number of citations of an article in the same field.

Figure 1 shows a bibliometric analysis of the eight university medical centres in the Netherlands (CWTS, 2006). Apart from the VU Medical Center, the identities of the various institutes have been concealed, but I can reveal that VUmc comes a close third behind Rotterdam and Utrecht. The final column shows that the Netherlands' university medical centres are cited 40% more often than the international average.

The recently published Leiden Ranking shows that VU University Amsterdam and the VU Medical Center combined are 35% above the world average when it comes to citation scores (www.cwts.nl/cwts/LeidenRankingWebSite.html; Council for the Humanities and Social Sciences Council, 2005). This puts us in 15th place in the European rankings and in fourth place among the universities of the Netherlands. While this is not bad, it also indicates that there is room for improvement. But even as we consider such matters, we must not lose sight of the limitations of this one-dimensional approach. As I see it, there are three.

First of all, this approach is largely dominated by the exact sciences. It does not work effectively for the arts and the social sciences, where a different publication culture applies (Council for the Humanities and Social Sciences Council, 2005). Secondly, citation analyses rely heavily on achievements from years gone by. In most cases, between four and eight years pass between the initial concept and publication. It then takes at least one more year before the first citations start to appear. Thirdly, only absolute citation scores are available for individual researchers, with all the disadvantages this entails. Nevertheless the information from Figure 2 is increasingly being used when deciding on promotions to associate or full professor. In sequence you can see the number of publications and citations per year, the average number of citations per publication and the h-index. The significance of this last criterion is rising dramatically. The h-index is the number of articles which received h or more citations (Hirsch, 2005). In other words, if a researcher's articles are ranked in descending order on number of citations, an h-index of 65 means that the 65th article will have

65 citations. A singular index such as this one is appealing in its simplicity but the influence of age and discipline means it is also potentially misleading. Researchers with the same h-index may also vary widely in terms of the number of publications to their name.

The above makes it clear that finding good indicators of scientific quality is no easy task. Operationalizing societal relevance is far more difficult still. But this does not strike me as grounds for giving up all attempts to achieve it.

The position of research

Research is becoming less and less the exclusive province of the universities (Wissema, 2005; Van Vught, 2004). Meanwhile, in both research and education, there has been a dramatic rise in the level of international competition. Such developments call for decisive cooperation in a variety of changing contexts. They also lead to the creation of new interdisciplinary scientific fields. In addition, the government is placing ever greater demands on quality, transparency and innovative ability. This requires a flexible, dynamic and entrepreneurial organization, but one which also retains sufficient academic distance and independence. And all of this has to be combined with a greater, more readily demonstrable commitment to society.

As a society, we have become far more interested in science and academic endeavour, as evidenced by the 25th anniversary edition of the science section of leading Dutch newspaper *NRC Handelsblad*, which was published last year (NRC, 2007). It featured the argument that innovation and new insights often occur unexpectedly, without being planned. This suggests that there is good reason for having sufficient freedom and room for manoeuvre in scientific practice. I wholeheartedly concur with this position. Societal relevance is a difficult thing to predict. It is far simpler to assess the impact in retrospect but even then, it can seldom be demonstrated beyond a reasonable doubt that a specific research project provided the missing piece of the puzzle (Oortwijn et al. 2007; AWT, 2005, 2007). The time frame also varies enormously: sometimes the societal impact of a study is readily apparent, but it often takes many years to make itself felt.

VU University Amsterdam has enjoyed a reputation for strong societal commitment since its foundation (Van Deursen, 2005). One sign of this commitment is the large number of political leaders among the university's former students. It can also be seen in the inspiring plans for a new campus in Amsterdam's dynamic new Zuidas business district, in which the university's academic functions are interwoven with living, working and cultural activities. In VU University Amsterdam's educational vision and in the recently published Institutional Development Plan, academic citizenship and academic entrepreneurship are central (Instellingsplan VU, 2007; Onderwijscentrum VU, 2006, www.onderwijscentrum.vu.nl). This means that, in addition to excelling in scientific quality, it is also important to be outstanding in terms of societal relevance. It is therefore high time to make societal relevance a tangible entity, expressed in concrete terms. This is something we need to do for the outside world in the interests of accountability. But more importantly we need to do it for ourselves, to serve as a compass for our choices in the world of science.

Relevance to society

As I go on to discuss how indicators of societal relevance have been taking shape, I will do so with reference to health research, the sector with which I am most familiar. This familiarity stems partly from my involvement in commissions at the Royal Netherlands

Academy for Arts and Sciences and the Council for Health Research, which focused on selecting indicators for this field of research (Council for Medical Sciences, 2002; Raad voor Gezondheidsonderzoek, 2007). However, it is certainly possible to imagine how my observations might be translated in terms of the arts, the exact sciences and the social sciences. Indeed, such translations are already available to some extent (Council for the Humanities and Social Sciences Council, 2005; AWT, 2007).

Clearly, the aims of health research ultimately lie in improving public health and healthcare. These should manifest themselves as improvements in people's life expectancy and quality of life. These are the measures of outcome that really matter. But, as we have already seen, their relationship with the research whose social relevance we want to evaluate is a complex one. It would therefore be unreasonable to come down too heavily on the researcher and his research for not fully realizing the potential impact of the new knowledge obtained. Bearing this in mind, it is better to choose indicators at the level of product or process, as Figure 3 makes clear/

Across the world, there have been many efforts to identify indicators of societal relevance (Bensing et al. 2003; Council for the Humanities and Social Sciences Council, 2005; Council for Medical Sciences, 2002; Bensing and Oortwijn, 2006; Bouter and Knottnerus, 2000; Buxton et al. 2000; Hanney et al. 2004; Hicks, 2005; Kingwell et al. 2006; Oortwijn et al. 1998; Roper et al. 2004; Spaapen et al. 2007; UK Evaluation Forum, 2006; Wooding et al. 2005). They vary from very simple attempts - 'quick and dirty' if you will - to all-encompassing systems which turn the process of evaluation into a field of research in its own right. We have now acquired a considerable amount of experience in this area. Sometimes people look almost exclusively at the economic value of the research (Ranga et al. 2003; Blakemore and Davidson, 2006; Clairborne Johnston et al. 2006). But many others consider this too limited (Van Oostrom, 2007). A number of institutes, including the NIVEL Institute for Health Services Research in Utrecht, the Netherlands, and our very own EMGO Institute, incorporate indicators of societal relevance in their annual reports (EMGO Institute, 2007; NIVEL, 2007).

As already mentioned, I distinguish between indicators that relate either to a product or a process. (Table 1). Products are concrete and countable, and do not generally present too much of a problem when it comes to establishing the plausibility of the relationship between the research results and the unit evaluated. This is a good deal more difficult for processes.

Turning first to products, it is a known fact that only 10% of Dutch doctors regularly read international scientific journals (Bouter and Knottnerus, 2000). For other professional groups, the situation is probably no different. If research results are to reach a group of professionals here in the Netherlands, professional publications in Dutch, either in article or book form, will be an important channel of communication. Books and articles are also an effective way of spreading knowledge among the general public. Academics also find out more about areas related to their own field mainly by reading the science sections of the newspapers (Willems and Woudstra, 1993). But to an increasing extent, the Internet is becoming their medium of choice.

Public relations and science communication are not part of the scientific researcher's core business. But to ensure the quality of the information provided, it is important that researchers are involved in these activities. Ideally, professional conduct should be based on weighing up all of the relevant and available scientific knowledge in a clear and balanced manner. This

means that authoritative guidelines and policy documents constitute a suitable indicator. Sometimes scientific research leads to a new service, method or technology.

I will now take a look at the process indicators. As I see it, the process of distributing and applying research results is also an aspect in which researchers should play an active part, although their role will certainly not always be a leading one. The extent to which research groups fulfil this role can be seen by looking at the membership of those commissions in the professional or public domain which is important in the distribution and application of scientific knowledge. Exactly which commissions should be included in such a survey will have to be established for each discipline separately. Other concrete process indicators are the research-based contributions to public information services or the retraining and continuing education of professionals.

Sometimes research results make a noticeable contribution to public opinion or political decision-making. One illustration of this is the research that followed an outcry in the Dutch media and among Dutch MPs about the fact that nursing-home staff in Groningen had left elderly patients with dementia to die if they were no longer able to drink for themselves. The press was outraged. But after the research, the headlines took a very different tone. It turned out that allowing patients to die by no longer administering fluids only took place after a painstaking decision-making process and led to a relatively peaceful death. The impact of a study will not always be this clear. Yet I still believe it is worthwhile to chart the media attention devoted to a certain department or institute.

We also want to know what the economic value of a scientific research project is, mostly in macro-economic terms. In other words, we want to see how research contributes to the knowledge economy. In this domain too, a distinction can be made between indicators at product level and at process level. First of all we can assess the amount of patents, as well as the sale of intellectual property. However, it is also important to remember that, as a rule, universities tend to make their research results public and therefore accessible to all. As far as I am concerned, that should definitely remain so. Knowledge is public property. Sometimes research can lead to a start-up company, usually one which is closely associated with the university in its early years. A prime example of this construction is the VU company that developed a new improved voting aid - the Electoral Compass - together with the Dutch national daily *Trouw*, winning a national journalism prize in the process. Currently the Electoral Compass is used for the USA presidential elections. In such circumstances, the researchers are often part-time entrepreneurs. Business initiatives of this kind provide very tangible evidence of the economic value of research. However, there are also risks attached to this dual role of researcher and entrepreneur. Independence can become compromised, the conclusions can become distorted, and public resources can be appropriated for private gain. I believe we should be more forthright in debating this darker side of academic entrepreneurship.

Challenges

The evaluation of the societal relevance of scientific research is still in its infancy. There is still plenty of room for discussion about the validity of the indicators, the optimum level of detail and weighing up the relative importance of the various aspects. Indeed, it is essential that such discussion takes place. However, it is clearly still too early to adopt a strong quantitative approach.

Societal relevance should be the focus of attention at both the start and the end of the empirical cycle (De Groot, 1961). The primary motivation of many academics is intellectual curiosity and of course there is nothing at all wrong with that. However, the process of selecting a research topic and formulating a research question should always be accompanied by a reflection on the expectations in terms of relevance to society. This reflection may serve as a compass, guiding the choices yet to be made. I believe that, at this stage in their work, researchers should take into account the burning questions being asked by stakeholders, whether they be citizens, patients, companies or politicians. Of course, the freedom to do so will be restricted by the available expertise and the resources available for research. But I am nevertheless convinced that researchers in this phase should have a clear ambition to carry out research that has real societal relevance. Once the project has been completed, it is the responsibility of the researchers to disseminate the results across the various scientific forums and, where relevant, among professionals, politicians and the general public as well.

Universities have to take the societal relevance of research seriously and report on it in terms of concrete performance indicators. Before this can be achieved, the indicators need to be developed in greater detail. I would therefore like to take this opportunity to invite the academic community to take up this challenge in a creative and constructive manner. A clearly identifiable focus on societal relevance also gives a powerful signal to students and young researchers. It shows that the academic process is not simply about chalking up publications and collecting citations. This message can be reinforced by rewarding researchers who have made a special achievement in this regard.

I hope I have succeeded in getting my message across: we should think more carefully about how we articulate societal issues in research that can provide useful answers. I believe that every researcher should not only ask themselves ‘Am I doing things right?’, but also ‘Am I doing the right things?’ And above all, we should be asking ‘What does it mean anyway?’

Figure 1.

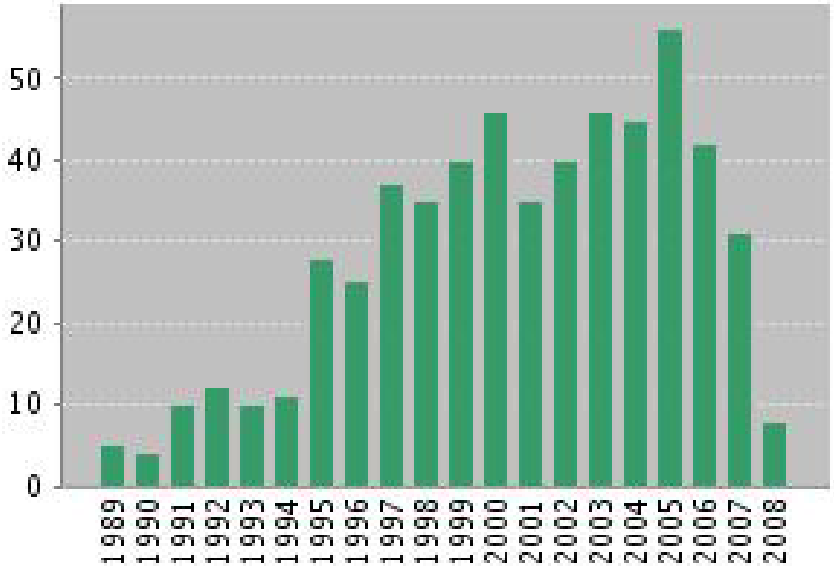
Output of University Medical Centres (UMC) in the Netherlands 1998 – 2005

UMC	Publications	Citations per publication (CPP)	CPP/FCSm
UMC a	9,034	15	1.59
UMC b	11,886	15	1.59
VUmc	7,711	14	1.52
UMC c	8,600	12	1.46
UMC d	8,937	15	1.44
UMC e	8,893	14	1.43
UMC f	9,023	12	1.27
UMC g	6,431	10	1.21
TOTAL	**59,664**	**13**	**1.40**

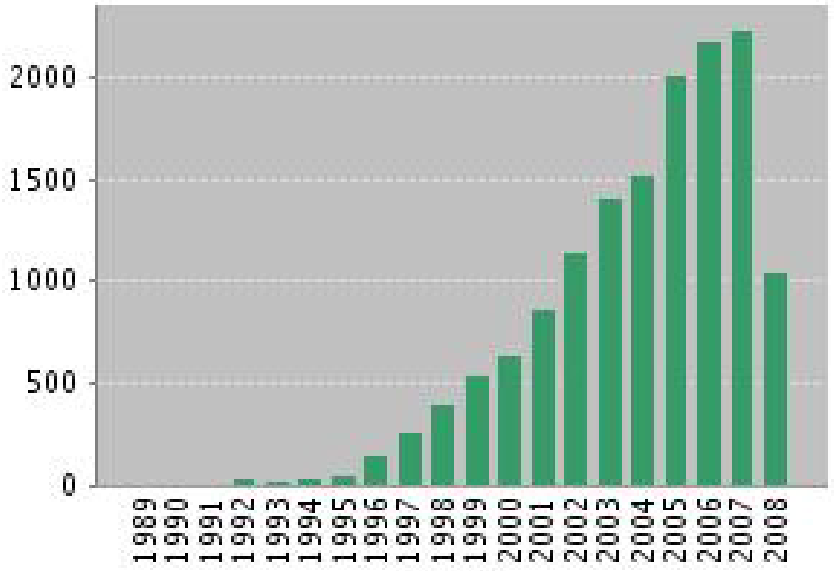
Figure 2.

Publications and citations

Published items per year



Citations per year



Total number of publications: 568
Total number of citations: 14,559
Average number of citations per publications: 25.63
h-index: 65

source: ISI Web of Knowledge

Table 1

Indicators of Societal Relevance of Scientific Research

indicators of social value		
	products	professional publications
		lay publications
		guideline or policy document
		service, method, technology
	processes	committees in professional or public domain
		continuing education
		public information services
		public opinion or political decision making
indicators of economic value		
	products	patents
		intellectual property
		start-up company
	processes	committees in commercial domain

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