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By-passing Barriers in Sustainable Knowledge Production

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1. Introduction

In search of quality and sustainability

Sustainable development is a frequently discussed concept (Palmer et al 1997). It is seen as one of the important qualities pursued by society. The quest for quality appears to have become an important catchword in the developing network society. Such a quest will not be easy. There appears to be a broad consensus on the need for quality. We could say that, in a sense, the need for sustainability has been universally defined. This definition has to do with survival and with the ability to develop a society without creating a scarcity of its basic elements and building materials.

At the same time, however, there seems to be general confusion on the question of what quality is and how it can be achieved. The more specific definitions of sustainable development vary considerably. In practice this means that sustainability may be achieved in multiple ways, in the sense that there is not one single agreed goal that should be reached. This important observation will serve as a basis for this article. How sustainability is defined, and how a 'better' situation is to be achieved, is in the eye of the beholder. The specific meaning of the concept 'sustainable development' is determined by different standards, beliefs, values and interests, but also by different perceptions of what our circumstances are and what they are likely to be in the near future.

It is not only the differences in 'point of view' in the perspectives of those involved, but also a fundamental uncertainty about data and the policy problems associated with this that play an important role here. The increasing complexity and interdependency of policy problems, certainly in the field of ecology, make it difficult to obtain acceptable knowledge. Uncertainty can no longer be reduced, but should be accepted as a fundamental feature of our knowledge (Ravetz 1999; Haag and Kaupenjohann 2001; Van Asselt 1999). It seems that we have to require knowledge production activities that are able to handle the variety in specific definitions used by the various actors involved in order to develop society in such a way that it becomes (much) more sustainable (Teisman 2001). Knowledge production is not in the first place an implementation project based on clear goals and planning schemes. Rather, it might be conceptualised as a quest for a joint vision on and a passable path towards sustainability. Such management should incorporate the idea that the organisations involved in the transaction process toward sustainability will have and will maintain different definitions of the most desirable results and the most suitable methods to achieve 'their' kind of sustainability (Teisman, 2001).

Main issue

In this article we argue that the problem of 'why there is not yet a sustainable society' is not that there is too little knowledge on sustainability for accomplishing that. The problem lies mainly in the fact that nowadays knowledge is produced in the wrong way. We will try to explain why scientific knowledge fails to have an impact on political thought and on the ideas held by social institutions about a sustainable society. In this article we state that we need new methods of knowledge production that can cope with the multiplicity of views on what sustainability stands for, and can bridge the huge gap between scientific theory and practice. We argue that traditional knowledge production systems or processes can no longer meet the new conditions of a complex network society. In addition we will stress that it should be recognised that uncertainty is an essential characteristic of knowledge. Such uncertainty is to be preferred over fake certainty.

Outline

In paragraph 2, we briefly discuss the changed social conditions within which knowledge has to be given shape nowadays. On the basis of these insights we proceed in to give recommendations on process management strategies in paragraph 3, i.e. how to achieve the right approach to knowledge production, taking the changed social circumstances into account. Finally, in paragraph 4 we give a brief review of our article and outline boundary conditions for a successful application of our recommendations.

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2. Problems in knowledge production

In this paragraph we will discuss some of the problems in knowledge production. These problems are strongly related to the traditional method of knowledge production within a changed social context for knowledge production.

FROM A WELL-ORDERED TO AN UNKNOWABLE SOCIETY

During the nineteenth and much of the twentieth century, Dutch society was still fairly well-ordered and intelligible. Government decrees were not, or hardly ever, doubted or contested. There was general faith in the idea that society was 'practicable', capable of being planned. This caused the government to develop from a passive 'night watchman' who guarded peace and security into a 'social engineer' who had the ambition to educate and to take care of society. Knowledge is indispensable to correctly fulfil this role of social engineer. Thus we see that during this period many organisations and institutions were set up and introduced in order to make society more transparent and more conveniently organised. 'To measure is to know' and 'knowledge is power'; these expressions convey the dominant mentality of this era, which is the very raison d'être of institutions such as the National Spatial Planning Agency [*'Rijksplanologische dienst'*] and the Central Planning Office [*'Centraal Planbureau'*].

During the seventies, the 'practicability concept' and the general belief in progress began to lose their potency. The adage 'knowledge equals power' lost its validity, and seemed to be replaced by another adage, 'knowledge is soft'. Data proved to contain multiple contents, depending on the interpretative and conceptual framework in which they were placed. This made developments in society less easy to comprehend and totally impossible to predict. The development of policies 'from the top' was no longer an obvious matter. The central authorities were no longer the sole owners of knowledge; they no longer guided knowledge, but were mostly guided by knowledge themselves. In addition, the acquired knowledge had only a limited shelf life. Because data were public, they caused citizens and (social) organisations to change their behaviour. It became more and more difficult for the government to survey and comprehend society.

In other words: society is developing more and more in the direction of a network society (Castells 1997). One of the features of such a society is that on the one hand an enormous quantity of reports and data is produced, while on the other hand unforeseen and unexpected developments continue to occur. This has also been called the 'paradox of the unknowable society' (Van Gunsteren and Ruyven 1995).

KNOWLEDGE PRODUCTION IN A POSTNORMAL PERSPECTIVE

Roughly speaking, knowledge production may be placed in two theoretical perspectives: the neopositivist and the postnormal perspective (Funtowicz et al 1999; In 't Veld and Verheij 2000). The *neopositivist* perspective is dominated by the image of the independent researcher or advisor who supplies objective knowledge to the policy-maker. The policy-maker asks the scientist or professional expert to deliver this knowledge, because it is assumed to be unbiased. After all, knowledge production is not connected to policy-making and is not controlled by the standards, values and interests applied by policy-makers. When taking decisions based on political motives, policy-makers can choose whether or not they wish to use the knowledge which has been objectively supplied to them.

The *postnormal* perspective, on the other hand, is dominated by the idea that knowledge is socially constructed. There is no such thing as objective knowledge, because different interpretations of the same data are possible (Rorty 1999; Weick 1995). *The* truth does not exist; several different truths may exist at the same time. In this perspective, the researcher or scientist does not supply objective information, but decides in mutual interaction with the principal, the target groups and the interested parties which truth is being shared and what has not yet been agreed upon. In this way it is possible to arrive at fully negotiated knowledge which is not free of bias, but has been the subject of a social debate (In 't Veld and Verheij 2000, 125). Thus, the emphasis shifts from the quality of the product to the quality of the knowledge-acquisition process.

Nowadays the second perspective is gaining in importance. Knowledge is no longer objective and unbiased, but charged with bias, uncertain and above all ambiguous. Particularly the concept of 'ambiguity' plays a major role in the postnormal perspective. We may speak of ambiguous knowledge if it involves a situation that can be approached and interpreted in multiple ways, without there being any clear criterion for distinguishing between valid and less valid interpretations. In a situation of ambiguity, it is difficult to determine what is 'true' knowledge and what is not. Several interpretations exist simultaneously, each of which gives a different meaning to the things we perceive around us (Morgan, 1986; Weick, 1995). Reality is not always one thing or the other, but can

sometimes be both at the same time.

KNOWLEDGE STRUGGLE AND REPORT WARS

The non-recognition of ambiguous knowledge can lead to problems in policy processes. People think that they are faced with uncertainty in knowledge, which can be reduced by getting rid of the lack of information. If uncertain knowledge is assumed while actually ambiguous knowledge is at stake, 'report wars', 'fragmented research' and/or 'knowledge races' may be the result. After all, the aim is to reduce uncertainty in decision-making by supplying more knowledge within a certain perspective. This blocks the way for other viewpoints, while it is typical of ambiguous knowledge that several different perspectives on the interpretation of this knowledge are possible. Because knowledge is delivered from a single individual perspective, actors who hold a different view of the matter will find this perspective meaningless and non-authoritative; the other parties will then counter with knowledge delivered from their own individual perspective. This is the genesis of 'report wars', in which actors fire from one trench (perspective) at the other. In projects the use of knowledge appears to be aimed mainly at convincing the opposition and substantiating one's own perspectives. Actors spend most of their time deconstructing each other's research, trying to prove that suppositions are contestable, a database inadequate, conclusions may also be interpreted differently, et cetera. It is easier to criticise knowledge than to construct it in joint cooperation (In 't Veld and Verheij 2000, 115). Fighting each other leads to an accumulation of reports which often contain contradictory conclusions. No attempt is made to search for knowledge that transcends the individual perspective. This greatly hampers the quest for well-negotiated and shared knowledge.

THE EXPERT/SCIENTIST HAS BEEN KNOCKED OFF HIS PEDESTAL

The changed social circumstances of knowledge production are clearly reflected by the reduced status of (scientific and expert-) knowledge. There are two reasons why the scientific and professional expert has lost his authority.

First, present-day citizens and social groups are less and less inclined to automatically accept in advance the research results and lines of argument supplied by scientific authorities. Actually, this is not just the case with scientific treatises, but with political-normative arguments as well (Advisory Council on Government Policy (WRR) 1998, 117). There are no longer any 'big' stories and all-encompassing truths; rather, these have become dependent on the specific situation and the perspectives used by the parties involved at that point in time.

Nowadays it happens rather frequently that experts on the subject, when carrying out parallel studies, arrive at contradictory and conflicting conclusions. In the American literature this is known as the 'contradictory expert problem' (Susskind and Cruikshank 1987). Due to these contradictions, citizens and social groups are no longer prepared to simply accept expert knowledge without reservation. Moreover, interested parties have come to the conclusion that expert analyses and scientific studies cannot/do not do any better than the lay knowledge possessed by 'normal citizens'. After all, expert knowledge has proved unable to solve complex social problems (Woltjer 2000). Thus, in the eyes of the citizen the validity of scientific knowledge is being visibly eroded.

In addition, the vocal, self-assured and well-read citizen of today has obtained much more insight into the nature of scientific knowledge (WRR 1998, 118). Knowledge is no longer the sole province of society's elites, because nowadays nearly everyone has received at least some form of (higher) education. Knowledge has become 'democratised', it has become public property. Furthermore, it has become easy for the citizen to obtain information from various media channels and to form his own picture. The increased amount of knowledge present in society enables more people to put the aura and superiority of scientific knowledge in perspective by asking clever questions, to criticise and debunk this knowledge.

Sharp questioning is able to expose the (sometimes) fragile basis (assumptions and suppositions) of scientific research in a (sometimes embarrassing) way. Scientific knowledge has become fallible (Hoppe 1998, 12):

> "Although we must begin any inquiry with prejudgments and can never call everything into question at once, nevertheless there is no belief or thesis, no matter how fundamental, that is not open to further interpretation and criticism" (Bernstein 1991, 327).

Secondly, the methods and techniques on the basis of which the scientist delivers knowledge for policy processes have come under increasing suspicion. Social criticism is based on the fact that science focuses too much on methods and techniques, and is therefore too technocratic and not democratic enough (Van Eeten and Ten Heuvelhof 1998). The methods used by scientists are often unfathomable for outsiders, and as such difficult to follow and to understand. An understandable response from outsiders is one of mistrust and suspicion: 'Seeing is believing'. The technocratic view of the acquisition of

knowledge has become obsolete, because the idea that information and knowledge are constructed in the course of social interaction processes has become increasingly accepted.

Besides, distinguishing between the values of policy-makers and the facts of scientists appears to be less easy than was thought to be the case in the post-war decades (Wildavsky 1987). During the fifties and sixties, the mainstream of policy science focused on a strict separation of values and facts. The discussion about values and goals to be pursued was seen as a matter exclusively for policy-makers. Policy science was supposed to deliver information ('truth') (for the benefit of decision-makers) about the actual cause-and-effect relation between social phenomena (WRR 1998).

Although this relation between knowledge and policy was subject to some criticism at the time (policy being perceived as excessively 'science-driven'), today we are faced with the opposite problem: much of science is seen as being 'policy-driven'.

Nowadays, science and politics have moved closer together. Because scientists sometimes tend to nestle too close to the 'warm place' occupied by the decision-making powers, scientific knowledge has lost much of its authority. Scientific researchers are suddenly given the opportunity to tell the truth through the decision-making powers (Wildavsky 1987). The reverse side of the coin is that scientists are forced to pay for their increased influence on policy-making with the corrosion of their autonomy and independence (Hoppe 1998, 6). To enhance the usefulness of research, all too often arguments tend to be based on the perspective and the interests of the 'client' or principal. Science has become politicised and entangled in the policy process (Van Eeten and Ten Heuvelhof 1998, 161). It has become too closely linked with the decision-making powers and sometimes even serves these powers; it uses problem definitions, objectives and alternatives set in advance (often by the principal), and all too often fails to subject them to a critical examination or to assess other problem definitions as part of the research. In doing so, science basically conceals a political-normative bias. This results in 'advocatory' studies and knowledge characterised by a 'd.j.-mentality': 'We take all requests'.

> "In (…) traditional decision-making arenas, proponents and opponents of a project might each hire technical experts to provide analyses, forecasts, and impact assessments to support or undermine a proposed project. … They (…) must go to great expense to 'buy' technical expertise so that they can participate effectively. And, it seems, there are always experts available to provide the answers that support each side's point of view" (Ehrmann and Stinson 1999, 376).

MARKET OF KNOWLEDGE SUPPLY AND DEMAND

On the basis of the above we may conclude that, due to changed social conditions, scientists or other professional 'knowledge producers' are beginning to lose their monopoly on the supplying of knowledge. Scientists have been knocked off their pedestal and have thereby lost their 'a-priori authority'. At the same time, research results are beginning to lose their 'a-priori authority' as well. These days, the authority of research results needs to be earned over again every time. In other words, a 'knowledge and ideas market' has emerged with many suppliers (and applicants), who have to compete in trying to prove the significance of their knowledge. On this 'knowledge market' knowledge is quickly supplied with counter-knowledge. In its professionalism, the counter-knowledge possessed by for instance conservationists and environmental groups, social interest groups or organised citizens is in no way inferior to the knowledge possessed by administrators on the basis of scientific support (WRR 1998, 119).

It is not just the supply of information, but also its interpretation and evaluation that have become 'de-monopolised'. Administration and decision-making no longer means being right on the basis of appealing to superior knowledge held by reputable research institutes, but being put in the right on the basis of persuasiveness, negotiating abilities and the approach to discussions with policy consumers.

Roughly speaking, the knowledge market consists of two types of knowledge: expert knowledge and lay knowledge. *Expert* knowledge is based mainly on training and professionalism. *Lay* knowledge is based on experience, knowledge of the environment and of the specific case in question. If only expert knowledge is used in processes, we speak of a *technocratic* approach to knowledge (Fisscher 1990). Such an approach is characterised by a one-sided focus of experts on the technical complexity of both problems and solutions. Such a knowledge approach leads to the conviction that:

- The problem can be precisely circumscribed within one or several (technical) disciplines;
- The desirability of the activity can be shown by means of standardised methods and procedures;
- The use of the available expertise is sufficient to enable an efficient implementation of the solution;
- The participation of other interested parties is unnecessary, because they do not have enough technical expertise to be able to understand the problem and the proposed solutions.

These characteristics of a technocratic approach lead to knowledge production in which there is no room for non-technicians (also called 'laymen'). Some authors emphasise that use should be made of both expert- and lay knowledge in the production of knowledge. In this approach, there is explicit recognition among traditional decision-makers (politicians, civil servants, experts) that others (NGOs, community groups, lay people) can fruitfully contribute to the identification and solution of problems. This requires a more open approach to what constitutes legitimate knowledge and expertise. Different claims to understanding and knowing – such as lay knowledge and scientific knowledge – need to be able to coexist and inform each other. This will then lead to the emergence of a so-called 'social learning environment' (World Bank Sourcebook on Participation 1996; Wenger 1998).

KNOWLEDGE PRODUCTION IN SEPARATE NETWORKS

Another factor which tends to restrict the use of knowledge is that knowledge is often produced in separate networks and arenas. A first separation is that between knowledge institutes (such as consulting firms and universities) and those who make use of this knowledge (such as authorities and private parties). This separation enables several forms of logic and paradigms to exist side by side. And this in turn is one of the main reasons why the knowledge supplied by experts and scientists has so little impact on decision-making. The research flow makes use of a rational approach, which assumes that it is the aim of decision-making to develop alternative actions, gauge their impact, and then make a choice based on its most favourable effect from the perspective of social preferences/problems. The policy flow, on the other hand, is often dominated by the role-playing paradigm (March 1999), which states that it is not the primary aim of decision-making to solve problems, but rather that it is a means to help individuals and organisations develop and strengthen their identity (in terms of attention, status, position and means) in relation to individuals and organisations in their environment. In other words, decision-making is seen as a situation or a series of consecutive situations in which individuals and organisations are able to establish their own visible identity through their actions.

So far, most scientific research has focused on the question how policy processes can be rationalised. In other words, the aim has been to teach policy-makers a rational perspective. This has proved rather unsuccessful so far. No interconnection between the logic of the 'knowledge client' - the policy-maker - and the logic of the 'knowledge provider' - researcher - has been established. Each actor has his or her own logic in order to value information and knowledge.

But even if the arenas of knowledge institutes and knowledge users are interconnected, a second separation may keep knowledge from being disseminated and used. In this case, several constellations of knowledge institutes and users exist side by side. The consequence of this is that while knowledge is being used within the arena because knowledge producers and –consumers have developed a workable relationship and logic, that same knowledge is not seen as credible in a different constellation of knowledge institutes and users; because the knowledge supplied does not correspond to the paradigm and the institutional context prevailing in this constellation, it is contested and rejected. Therefore, to enable knowledge to have an impact in other arenas and networks, links should be established between different knowledge production arenas.

FUNDAMENTAL INSECURITIES IN KNOWLEDGE PRODUCTION

Apart from the problems involved in the development of knowledge in the light of several different, conflicting perspectives and interests, we also find that there are a number of fundamental insecurities in the knowledge acquisition process. Gallopín et al (2001) mention three changes in current society which necessitate a new view of knowledge development:

- Changes of an ontological nature;
- Changes of an epistemological nature;
- Changes in the method of decision-making.

Changes of an *ontological* nature can be perceived in the increasing complexity and interdependency of the world around us. Interventions cause a chain of response that is impossible or almost impossible to survey. Uncertainty is a basic feature of research, because reality is impossible to depict. The time-honoured strategy that was always followed in the past to make phenomena more transparent (by reducing the units perceived) has proved inadequate: the failure to take all sorts of related phenomena, cross-connections, etc., into account trivializes the explanatory and predictive value of models (Haag and Kaupenjohann 2001).

Changes of an *epistemological* nature refer to the way in which we produce knowledge. More and more, the participation of laymen and attention for other perspectives is being seen as an indispensable part of knowledge production (Lindblom and Cohen 1979). Scientific knowledge is developed in interaction (or

should be developed in interaction) in order to achieve an effective problem-solving process.

Also the *method of decision-making* has been subject to changes. We have already discussed this fairly extensively above. Briefly put: the traditional institutions of state and market, as epicentres of decision-making, have lost their importance. Decision-making has become a social issue, and the mobilisation of knowledge has increased tremendously: knowledge has been demonopolised.

In this context, we may also speak of the development of transdisciplinary knowledge. As it functions at present, the knowledge infrastructure of the Netherlands is insufficient to achieve integral social problem-solving. While there is an existing knowledge base in the Netherlands, this base is quite narrow and (in the vast majority of cases) non-discipline transcendent. Currently much attention is being given in scientific research to developing toward a discipline-transcendent, or transdisciplinary, form of science (Gibbons 1994), a development that was characterised by Gibbons as a transition from 'Mode 1 science' to 'Mode 2 science'.

MODE-1 SCIENCE	MODE-2 SCIENCE
Academic context	Application-oriented
Instrumental, strategic rationality	Communicative rationality
Disciplinary	Transdisciplinary
Homogenous	Heterogeneous
Hierarchical and stable	Heterarchical and variable
Quality control academic	Quality measured by a broader set of criteria; context-specific (problem-oriented)

The notion of knowledge development as a complex, interactive process and no longer a linear one also fits this picture. Producers of knowledge may be users at the same time and vice versa. Here knowledge is a process that is developed in a process of co-production, disseminated over and shared by a large number of social actors, knowledge institutes, authorities, enterprises, social organisations, intermediaries and the general public. This means that actors such as authorities and intermediary organisations are not just users of knowledge; they are also producers of knowledge.

At a later stage (Nowotny et al 2002) the notion of 'Mode 2 science' was supplemented with that of the 'Mode 2 society'. The question how Mode 2 science was able to develop was answered by the authors with the statement that this was necessitated by the emergence of the Mode 2 society. Science has become increasingly contextualised; a necessary development if it wishes to retain its relevance in a changing society. Society is increasingly capable of confronting scientists with questions and criticism. The book advocates a contextualised form of scientific research: interaction with interested parties is crucial to produce the type of science that benefits society.

> "The increasing emphasis on the contribution of science to wealth creation (and social improvement), the growing deference to so-called 'user' perspectives, the great weight now attached to ethical and environmental considerations, are all examples of the intensification of what we call contextualization" (Nowotny et al 2002, 166).

The greater the contextualisation of knowledge, the more 'socially robust' it will be. Involving third parties (interested parties, experts, etc.) as much as possible is not just inevitable, it is also desirable. It will serve to increase both the quality and the quantity of the knowledge being produced.

3. Reorganisation of knowledge production: process management strategies

The previous paragraph leads us to conclude that there are a number of persistent problems with which knowledge production is faced. Due to changed social circumstances, scientific knowledge (on sustainable development, for instance) needs to be produced in a different way to give it impact and meaning.

Because of the multiplicity of the concept 'sustainable development', transition processes have to be organised and managed in terms of ongoing interaction, in which various forms of knowledge on what a sustainable society should look like are effectively combined (Teisman, 2001). Inter-organisational interaction should enable stakeholders to find a temporary balance between economic, social, spatial and ecological goals. Such a balance will be of good quality if it is satisfying to the actors afterwards as a result of interaction. The road to a more sustainable society is an open one, which pursues important changes towards sustainability on the one hand, but also deals with a variety of definitions regarding specific goals and the effectiveness of the methods applied, and even involves definitions of the situation on the other hand. This will require a method of knowledge production in which different stakeholders collaborate and compete with one another on the question of what, exactly, knowledge is. Such a joint fact-finding process will be necessary in order to achieve a long-term

transition towards sustainable (i.e. high-quality in multiple terms) development.

In this paragraph we argue that meaningful knowledge can only be created on the basis of *a process of interactive knowledge construction and –production*, in a 'joint fact-finding process' (Susskind and Cruikshank 1987) that … *"extends the interest-based, cooperative efforts of parties engaged in consensus building into the realm of information gathering and scientific analysis. In joint fact-finding, stakeholders with differing viewpoints and interests work together to develop data and information, analyse facts and forecasts, develop common assumptions and informed opinions, and, finally, use the information they have developed to reach decisions together"* (Ehrmann and Stinson 1999, 376). In a process of joint fact-finding, stakeholders, decision-makers and experts develop and implement a research strategy and –approach in mutual interaction, in order to answer questions on knowledge. Here some authors have used the term *interactive social science* (Caswill and Shove 2000). Below, we describe a number of process management methods to give substance to a process of joint fact-finding.

PROVIDING INSIGHT INTO THE MULTIPLE EXPERIENCING OF SUSTAINABLE DEVELOPMENT

The concept of sustainable development has been interpreted and given meaning in different ways. A first process management strategy involves mapping out this multiplicity and positioning it with respect to each other. The aim of this strategy is not to give higher or lower marks to the various interpretations; rather, the idea is to depict, throughout their whole range, the meanings of sustainable development that are commonly used and relevant to the project in question, without reducing this in any way. We could call this a 'problem-structuring process'.

ORGANISATION OF A SEARCH FOR ACCEPTABLE TRUTHS

Nowadays, faith in the creation of objective knowledge is being steadily eroded; intersubjective knowledge appears to be the most that can be achieved. People are seeking a common ground on the basis of which joint action becomes possible. One option is to pursue 'negotiated knowledge'. This form of knowledge is no longer seen as the 'real' facts, the 'right' interpretations or the 'real' situation. It means verifying in mutual consultation on which points agreement can be reached and on which points this is not (yet) possible ('agree to disagree'), and then deciding together how an agreement may perhaps be reached after all.

We can speak of negotiated knowledge if two conditions are met: (1) it is accepted by the interested parties, and (2) it passes the test of scientific character (expertise) (Jasanoff 1990, 1995; De Bruijn et al 1998, 178). The parties involved will have to negotiate about the question whether certain forms of knowledge are authoritative. But at the same time the fact remains that 'negotiated knowledge' is the result of scientific insights. These two requirements entail that knowledge from experts and that of so-called 'laymen' should be interwoven. Expert knowledge is not automatically seen as a superior form of knowledge which is self-evident. In order to obtain the status of meaningful knowledge, it has to 'compete' with other forms of knowledge such as the 'practical knowledge' or 'experiential knowledge' of interested parties. *"An expert is not a special kind of person, but each person is a special kind of expert, especially with respect to his or her own problems"* (Mitroff 1983, 125).

Knowledge that has been accepted (and thereby promoted to the status of shared knowledge) can be recorded in a document, a so-called 'single negotiating text' (a concept originating from the negotiating literature on thorny political issues, such as the Middle East conflict). The 'single negotiating text' is intended specifically to focus the discussion between the stakeholders and to put down in writing fundamental points on which agreement has been reached. The text is then revised several times and eventually produces an inventory of shared knowledge and facts.

LOOKING FOR ACCEPTABLE KNOWLEDGE ON THE BASIS OF A JOINTLY AGREED RESEARCH DESIGN

To eliminate gaps in knowledge and knowledge disputes, independent experts and various interested actors (such as private parties, authorities and social groups) draw up a research design in mutual consultation. In mutual interaction they search for workable methods in the quest for knowledge and the guiding principles, assumptions and suppositions on which these methods are based. Also the (fundamental, temporal and geographical) system boundaries and the scope of the study (e.g.: when will the study begin?, when will it be concluded? Which effects will be included in the study? On the basis of which criteria will these effects be evaluated? Which subjects will be part of the study, and which will not?) are ratified by mutual agreement. Briefly put: the research design is the outcome of a process of discussion and negotiation between stakeholders and external experts rather than – as in the neopositivist perspective – something that has been given in advance.

In case the stakeholders are unable to decide which methods should be used, they may decide to use several (competing) methods and/or sensitivity analyses to analyse to what extent the outcomes will vary for the different assumptions on which the various

methods are based. They may also decide to integrate various research models. And finally, they may decide to set up a Committee of Wise Men composed of independent experts from various disciplines, charged with the task to settle persistent knowledge conflicts.

ORGANISATION OF A KNOWLEDGE MARKET

Another process management strategy is the organisation of a knowledge market. Various forms of knowledge are active on this market, such as: expert knowledge, experience-based (experiential) knowledge, knowledge of the surroundings, et cetera. And on this market the various forms of knowledge will start to flow, increasing the chance of their becoming linked. This linking of knowledge should take place in such a way that each form of knowledge retains its own identity; the strength of the system lies precisely in the value added that the different forms of knowledge can supply to each other. Jasanoff (1990) calls this 'boundary work' . If experts retain their own identity, they have the opportunity to supplement knowledge production with a scientific and/or professional test. In this case the expert does not just act as a purveyor of knowledge; rather, he has become a 'knowledge broker' or 'contact' (Jasanoff, 1995).

ORGANISATION OF LINKS BETWEEN KNOWLEDGE PRODUCTION AND POLICY-MAKING

An important aspect in the organisation of a process of joint fact-finding is that of linking the knowledge production process to the policy-making process. In joint fact-finding, these two processes are not carried out in isolation, but are instead interwoven. This increases the chance that knowledge will lead to authoritative and consolidated decision-making (Jasanoff 1990). There is more chance of this occurring in policy processes where the boundaries between science and policy-making have become more fluid and the two are linked (De Bruijn et al 1998, 54). Such linkage can be realised by, for instance, actively involving formal decision-makers in addition to the other stakeholders in the joint fact-finding process.

ORGANISATION OF LINKS BETWEEN DIFFERENT KNOWLEDGE PRODUCTION ARENAS

As described above, the fact that, as we have found, knowledge is generated in closed network constellations of knowledge producers and –consumers, has led to a knowledge conflict or 'report wars'. Links will have to be forged between the different networks and acceptable agreements will have to be made on how knowledge is to be jointly produced. Knowledge produced in such a way has a certain level of authority, all the more so because many of those involved were able to express their opinions, which were taken into account in the study.

VALIDATION OF KNOWLEDGE

The last strategy deals with the validation of knowledge. The results of the knowledge-production process can always be subjected to an 'extended peer review' (Ravetz 1999) in which the results are tested by interested parties, scientists, experts and decision-makers together. Needless to say, a purely scientific arsenal of testing criteria is not sufficient here. It is precisely the multiplicity of criteria to which the results are tested which will give this review its value added.

4. Conclusion: retrospect and questions for future consideration

RETROSPECT

In this article we have discussed the problems affecting knowledge production in complex decision-making. Due to changed social circumstances, knowledge production these days is no longer the sole province of reputable consulting firms or the 'big names' in science. People no longer have faith in objective scientific knowledge; knowledge is a social construct, is determined intersubjectively and has become a negotiable good.

This insight emphasizes the need for a different approach to knowledge development. This article is an attempt to initiate such an approach, by stressing the organisation of a process of joint fact-finding, in which various stakeholders (experts, government agencies, private companies, and social groups) take the position of active seekers of knowledge. A transition towards a sustainable society can only be realised through a joint fact-finding process in which the different stakeholders have produced knowledge and information on what a sustainable society should look like and how it is to realised. So, in order to create sustainable development, new methods of knowledge production must be developed. We have provided some process management strategies in this article in order to accomplish this.

QUESTIONS FOR FUTURE CONSIDERATION

The process management strategies outlined in paragraph 3 cannot be applied just like that. They require careful institutional embedding into the existing methods of knowledge production, and often also call for actors to assume a different role perspective. If knowledge is sought in a more interactive manner, whereby many forms of knowledge (such as lay

knowledge and expert knowledge) are introduced at the same time, a different role is expected of the expert. He cannot simply take a solistic attitude, but will have to cooperate more not just with his principal, but also start seeking acceptable knowledge together with potential target groups and stakeholders. This stresses the need of institutional innovation, i.e. a reflection on and change of roles of people - policy-maker and (scientific) researcher - play in knowledge production processes.

References

Asselt van, M. 1999. *Uncertainty in decision-support. From problem to challenge* (Working Paper I99-E006). Maastricht: Maastricht University.

Bernstein, R.J. 1991. *The new constellation. The ethical-political horizons of modernity/postmodernity*, Cambridge Massachusetts: MIT Press.

Bruijn de, J.A., Ten Heuvelhof, E.F. and In 't Veld, R.J. 1998. *Process management (in Dutch)*. Schoonhoven: Academic Service.

Castells, M. 1997. *The Network Society*. Oxford: Oxford Press.

Caswill, C. and Shove, E. 2000. Introducing interactive social science. *Science and Public Policy*, Volume 27, Issue 3, 154-157.

Eeten van, M and Ten Heuvelhof, E. 1998. Serviceable truth: the process contigent use of scientific expertise. Argumentative Policy Analysis (in Dutch), edited by R. Hoppe and A. Peterse. The Hague: Elsevier, 161-173.

Ehrmann, J.R. and Stinson, B.L. 1999. Joint fact-finding and the use of technical experts. *The consensus building handbook. A comprehensive guide to reaching agreement*, edited by L. Susskind, L., S. McKearnan and J. Thomas-Larmer. London: Sage, 375-400.

Fisscher, F. 1990. *Technocracy and the Politics of Expertise*, New York: Sage.

Gallopín, G.C., Funtowicz, S., O'Connor, M. and Ravetz, J. 2001. Science for the twenty-first century: from social contract to the scientific core. *International Journal of Social Science*, Volume 168, Issue 2, 219-229.

Gibbons, M. 1994. *The new production of knowledge: the dynamics of science and research in contemporary societies*, London: Sage.

Gunsteren van, H. and Ruyven, E. 1995. Government in an unknown society (in Dutch), The Hague: SDU Publishers.

Haag, D. and Kaupenjohann, M. 2001. Parameters, prediction, post-normal science and the precautionary principle – a roadmap for modelling for decision-making, *Ecological Modelling*, Volume. 144, Issue 3, 45-60.

Hoppe, R. 1998. *Argumentative Policy Analysis* (in Dutch). Unversity of Twente: University Press.

Jasanoff, S. 1990. *The fifth branch; advisers as policy makers*. Cambridge MA: Harvard University Press.

Jasanoff, S. 1995, *Science at the bar: law, science, and technology in America*, Cambridge MA: Harvard University Press.

Lindblom, C.E. and Cohen, D.K. 1979. *Usable Knowledge. Social Science and Social Problem Solving*. New Haven and London: Yale University Press.

March, J.G. 1999. *The pursuit of organizational intelligence*. Malden MA: Blackwell Business.

Mitroff, I.I. 1983. *Stakeholders of the Organizational Mind, Towards a New View of Organizational Policy Making*. London: Jossy-Bass Publishers.

Morgan, G. 1986. *Images of organizations*. London: Sage.

Nowotny, H., Scott, P. and Gibbons, M. 2002. *Re-thinking Science. Knowledge and the Public in an Age of Uncertainty*. Cambridge: Polity Press.

Palmer, J., Cooper, I. and R. van der Vorst. 1997. Mapping out fuzzy buzzwords – who sits where on sustainability and sustainable development. *Sustainable Development*, Volume 5, Issue 2, 87-93.

Ravetz, J.R. 1999. What is Post-Normal Science. *Futures*. Volume 31, Issue 4, 647-653.

Funtowicz, S.O., Martinez-Alier, J., Munda, G. and Ravetz, J.R. 1999. *Information tools for environmental policy under conditions of complexity*. Environmental issues series no. 9. Copenhagen: European Environment Agency.

Rorty, R. 1999. *Hope in place of knowledge: the pragmatics tradition in philosophy*, Taipei: Institute of European American Studies, Academia Sinica.

Süsskind, L. and Cruikshank, J. 1987. *Breaking the impasse. Consensual Approaches to Resolving Public Disputes*, New York: BasicBooks.

Teisman, G.R.2001. *Mobilising co-opetitive governance* (in Dutch), Rotterdam: Erasmus University Rotterdam.

Veld in't, R.J. and Verheij, T. 2000. Wanting and Knowing. *Wanting and Knowing. The role of knowledge in environmental policy processes*, edited by R.J. in't Veld. Utrecht: Lemma, 105-145.

Weick, K.E. 1995. *Sensemaking in Organizations*. Thousand Oaks: Sage.

Wenger, E. 1998. *Communities of Practice: Learning, Meaning and Identity*. Cambridge: Cambridge University Press.

Woltjer, J. 2000. *Consensus planning. The relevance of communicative planning theory in Dutch infrastructure development*, Burlington USA: Ashgate.

Advisory Council on Government Policy (WRR). 1998. *The Politics of Spatial Development* (in Dutch). The Hague: SDU Publishers.

Wildavsky, A. 1987. *Speaking Truth to Power: The Art and Craft of Policy Analysis*. New Brunswick: Transaction Publishers.

World Bank. 1996. *The World Bank Participation Sourcebook*. Available online at
http://www.worldbank.org/wbi/sourcebook/sbhome.htm