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SETTING PRIORITIES IN PUBLIC RESEARCH FINANCING

- context and synthesis of reports from China, the EU, Japan and the US

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About VINNOVA

VINNOVA (Swedish Governmental Agency for Innovation Systems) is a State authority that aims to promote growth and prosperity throughout Sweden. Our particular area of responsibility comprises innovations linked to research and development. Our tasks are to fund the needs-driven research required by a competitive business and industrial sector and a flourishing society, and to strengthen the networks that are such a necessary part of this work.

The Government has assigned VINNOVA to

- contribute making Sweden a leading research nation in which research of high scientific quality is conducted.
- promote sustainable growth and increased employment by acting to increase competitiveness and the emergence and expansion of successful companies.
- support research and development work of the highest quality in areas such as engineering, transport, communications and working life in order to promote renewal and sustainable growth.
- stimulate Swedish participation in European and international R&D collaboration and in the exchange of experience in the field of innovation.

The VINNOVA Analysis series includes publications of studies, analyses, official reports and evaluations that have been produced or commissioned by VINNOVA´s Operational Development Division.

VINNOVA's vision is that: "VINNOVA makes a clear contribution to Sweden's development as a leading growth country."

Setting Priorities in Public Research Financing

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by

Göran Pagels-Fick

VINNOVA

VINNOVA´s Foreword

VINNOVA is the Swedish Governmental Agency for Innovation Systems and has a mission to promote sustainable growth by funding needs-driven research and developing effective innovation systems. The principles and institutional mechanisms utilised in setting priorities for public research financing and development are crucial aspects of any country's research and innovation system. As part of the development of its own strategies and positions, VINNOVA has decided to commission in-depth studies of the prioritisation mechanisms in the US, China and Japan, and the EU Framework Programmes. VINNOVA welcomes open discussion on issues relating to priority-setting and hopes these studies may also be of interest to other institutions in Sweden and internationally. Accordingly, they are published in English and made generally available.

VINNOVA needs a synthesis of the four reports. This will not entail a further summary, as the four individual authors have already drawn their own conclusions. Rather, there is a need to draw out significant elements from the studies and put them in context. This will aid understanding of what the project has achieved and stimulate further reading of the four reports. This task has been entrusted to Göran Pagels-Fick at VINNOVA's Operational Development Division, who is project manager for the whole study.

This report places the priority-setting mechanism into context in the midst of political, industrial, academic, economic and social forces. Göran also reminds us that priority-setting is a decision-making process and can be examined using the tools of those management scientists who study decision-making. Such a perspective adds some new dimensions to our thinking.

VINNOVA in June 2010

Göran Marklund
Director and Head of Operational Development Division

Author´s Foreword

Sweden is not at the forefront of national priority-setting for public research funding. This conclusion is overwhelmingly clear when reading the four VINNOVA studies of how priority-setting is being implemented in China, Japan, the US and in the EU's Framework Programmes.

As I write this foreword, I have just read an editorial in "Tvärsnitt" the magazine of the Swedish Research Council. The publisher writes[1]:

> *When I started my research career, science was supposed to gain if its servants, from PhD student to professors, showed great concern for a cause or research question they wanted to explore. By the same token, it was frowned upon if their main aim was answering questions handed them by supervisors or politicians.*

The author also offers this approach as a model for today's research policy. There is a wide gulf between this view and the approaches driving developments in the regions covered by the four reports. For me, it is therefore particularly important to help make these findings available to Swedish readers. My report appears in a small format, which may help draw readers to the subject.

The subject of priority-setting has also become essential for member states in the European Union since the adoption of the Lisbon targets where member states have committed themselves to make better use of research to stimulate sustainable growth.

My paper is not an attempt to give an "objective" account of all the conclusions of the four report authors; nor is it a full synthesis. It is an introduction to the theme and also my personal selection of observations and subsequent interpretations. I am not sure the authors would agree with my selection or my conclusions. However, I hope this "overview and synthesis" will encourage further reading of the four reports.

VINNOVA in June 2010

Göran Pagels-Fick
Programme Manager

[1] My own translation of the Swedish text by Arne Jarrick. "Tvärsnitt" no.4, 2009.

Contents

1 An introduction to priority-setting in public research financing

1.1 The role of science in society

Research has become a tool of growing importance in the arsenal of society to ensure future prosperity and quality of life. This instrumental approach to research is not new; it has been with us for centuries! The basic paradigm has been expressed thus[2]:

> *Research develops knowledge, which after some years, decades or even centuries results in applications. Thus, in a situation of scarce human and physical resources, prioritisation of research becomes a means of preparing for the future we want by attaining critical mass in one area before another.*

The mechanisms for such priority-setting have changed over the years in a way which reflects the wider understanding of the role of science in society. Three main paradigms[3] can be noted since WW2.

In the first period after WW2, research was looked upon as *"the engine of progress".* Research was carried out and defined by researchers. Research was in the service of society and the benefits were supposed to commence by themselves according to a linear development. This view dominated until the 1960s when research was called upon to be *"a problem solver."* Research was challenged by new needs in society and the need for and use of research was no longer determined solely by researchers themselves. The prevailing paradigm was that research could generate benefits for industry and society and could be steered and planned.

We now live in the third phase, with several schools of thought such as the "innovation system approach", "mode 1/mode 2 research", "triple helix" and others. These all have different theories but adhere to an understanding that research now has much more of a multi-faceted role. It is no longer clear who

[2] Quote from "Strategies for Research Prioritisation", Royal Swedish Academy of Engineering Sciences, 2009.
[3] This short account of the history of science's role in society follows "Forskning, Innovation och Samhälle – ett sammanflätat system i snabb omvandling" [Research, Innovation and Society – an interlaced system in rapid transformation] by Mats Benner, Enrico Deiaco and Olle Edqvist. Published by VINNOVA and the Swedish Academy of Engineering Sciences, 2007.

should conduct research and financing has become more heterogeneous. Science has become integrated in society. This third approach can be summarised as *"research as a strategic opportunity."*

The three authors of the quoted study conclude:

> *The three layers of research policy have remained largely separate. Policy instruments and structures from previous phases have not been abandoned when new ideas and goals have been introduced. New ideas in research policy have not replaced the old but have been added as new layers..... As a result the three paradigms compete for resources, financing and attention... Over time, a certain amount of interaction between the three layers has been established by developing new policy instruments, often with the clear objective of increasing such interaction.*

The authors conclude by saying that the resulting layered research system, at least in Sweden, is badly adapted to our time when the role, financing and management of research has been subject to so many changes and challenges.

Discussing "priority-setting in public research financing" is not simple. There is a good chance that the participants in such a discussion will use different semantics and refer to different contexts, objectives, types of research etc. This can easily make the discussion chaotic. However, it is probably close to the truth to say that all public research financing is subject to priorities in one way or another. Even so, the differences are very wide when it comes to why this is done, by whom, for what purpose or by which processes. This fact should not surprise anybody. Research is supposed to contribute to society in various ways (through education, advancement of science *per se,* economic growth through industrial development, health etc.) and it is no surprise that different mechanisms and prioritisation criteria ought to be used for different purposes.

It is useful to remind oneself that science and its sibling, research, are called upon to fulfil several important roles in society and that this calls for pluralism in priority-setting mechanisms and criteria.

It is not the intention of this synthesis report to summarise the four reports into a simple recommendation of what would be "the best prioritisation process." This would contradict the complexity of the issue, the path-dependency of any proposed process and the pluralism needed due to the above mentioned variety in the roles of science in society. Instead, three different dimensions of the priority-setting problem will be described. The intention is that those reading the original reports will thus be equipped with three different tools to reflect on their findings

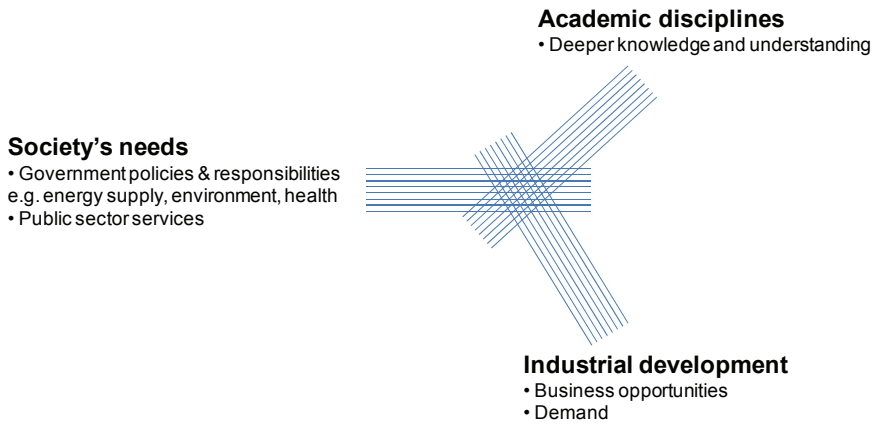
and translate these reflections into insights into the priority-setting mechanisms in his/her own context.

Section 1.2 will display three perspectives on the purpose of research. Section 1.3 will show the different priority levels. What is being prioritised? Chapter 3 will look at the priority-setting process as a process of decision-making and provide evidence that overly simple processes will omit significant elements of reality.

1.2 Three perspectives on purpose

Discussions on research priorities often follow patterns which can be derived from a simple model of three perspectives, as seen in Figure 1.

Figure 1. Three main perspectives on the driving forces of public research financing



Participants argue either for the one perspective they consider most important of the three, or they argue that all three should be combined into an effective common agenda that offers the most potential benefit to society at large.

The three dimensions are described differently in individual countries. Usually, the academic perspective is discussed as a non-instrumental purpose, for the advancement of science for its own sake. An example will illustrate this. In the Japanese[4] Third Basic Plan for Science & Technology, all public spending on research corresponds to clear policy goals and is in that sense instrumental. In the Japanese policy framework, the "Academic disciplines" in Figure 1 correspond to societal goals such as a "Quantum jump in knowledge",

[4] Table 10, chapter 4 of the Japanese report.

"Discovery & Creation" and "Breakthroughs in advanced S&T". Similarly, industrial development and economic growth are parts of society's need to "Maximise National Potential". Unnecessary conflict at the semantic level has thus been avoided. The Japanese approach also avoids the somewhat strange notion of industry and academia as sectors outside "society".

Research policy in most countries meets the needs of all three perspectives in Figure 1, both singly and in combination; the differences lie more in the balance between the three. At the risk of oversimplification, it seems from the four reports that the US has the greatest ability to find a harmonious blend of the perspectives and avoid unnecessary conflict. The EU report relates to the Framework Programme and conceals the fact that the European Research Council, with its aim to fund "investigator-driven frontier research", reduces potential priority tensions in the (current and future) Framework Programmes. Industrial influence in the Chinese "negotiation system" for public research financing appears weak. However, the strategic goals for Chinese society set by the politicians incorporate industrial issues, making this aspect stand out strongly in the process anyway. The Japanese system is more difficult to characterise. The proportion of total public research spending subject to strategic priority-setting is rather small. However, the priority-setting processes appear to be based on society's needs. This comes close to being a thematic approach but under this exterior, industry has a strong, recognised role to play in helping society reach its goals.

1.3 Research driven by other priorities

Research priorities are sometimes direct and explicit, but for other kinds of priorities they are very often indirect and implicit. In such cases, "implicit research priorities" derive from "fundamental priorities" such as:

A. *Grand challenges*, i.e. major economic, social or environmental issues that confront nations across borders. Such issues can be global, in the sense that no single country can significantly improve the situation alone. Alternatively, they can be universal, in the sense that many nations have the same difficulty and can take effective unilateral action within their own borders.
   Ageing, climate issues, pandemics, financial crises, access to clean water and other environmental issues are examples of *grand challenges*.
B. *National (or sometimes regional) strategic issues or transdisciplinary themes* focus attention on important problems (or opportunities) facing the nation (region). Immigration, Baltic Sea Ecology, economic growth or flooding are examples from different nations or regions.

1.4 Criteria of choice

Setting priorities of type A or B is mainly the responsibility of the political community. Political decisions determine what amount of taxpayers' money will be used to develop and improve different areas of society. Political decisions set the balance between different societal risks. From a democratic perspective, it would be odd if such areas were prioritised by the research community.

Priorities of type A and B are often associated with the allocation of financial resources and will increase available research funds to some degree.

Priority themes of type A or B above must be met with a broad range of measures, some of which will benefit from innovation and innovative insights based on research. In these situations, relevant sub-issues under the priority themes must be transformed into an appropriate research agenda. What are the essential issues if the scientific community is to create the necessary knowledge base to spur innovative responses for the priority theme? The precise contents of such transformations from priority themes to research topics can only be made on the basis of a deep scientific understanding of the issues, plus "informed speculation" about possible scientific breakthroughs and their implications. Effective advances require actual *dialogue* between researchers with the kind of foresight mentioned above and those who make development happen – be they industrialists, investors, civil servants or politicians. Effective change needs these actors and stakeholders to have common visions of how to go forward.

A or B themes are most often broad in regard to their scientific bases. An issue such as pandemics may require an understanding of the mathematical modelling of infection transmission, virus genetics and vaccines, or an understanding of social behaviour in the presence of risk. Therefore "transformation" of an A or B-type priority theme into a relevant research agenda requires a broad cross-section of scientific disciplines; often broader than commonly believed.

Priorities of type A or B are primarily made to meet criteria other than anticipated scientific excellence. They are mostly judged on a single social, economic or policy criterion, or a mixture of these. Scientific criteria can play a role, particularly when potential research developments may be expected to impact significantly on the priority theme.

In his report on the Chinese priority-setting mechanisms, Liu Li used a beautiful Chinese expression for combining criteria at different priority levels. Chinese science and technology should be *dingtian lidi*, which translates as:

> *"go forward with your head in the clouds and your feet on the ground".*

Dingtian means being at the frontier of world science and technology (S&T) and *lidi* means that Chinese S&T should be orientated towards economic and social demands.

1.5 Multi-level priorities

Multi-level priorities are often overlooked in public debate, but they are actually quite common. A typical first-level approach would be politicians choosing a particular theme because they want to prioritise research in a certain area that is relevant to developments in society. Alternatively, politicians simply want to ensure what they consider a "fair" distribution of funds among disciplines. They decide based on political reason and allocate funds for the theme. At the next level, funds will be distributed according to other criteria, very often intra-scientific quality and according to a peer-review process. In other cases, second-level criteria might include industrial relevance, or potential for business development and economic growth.

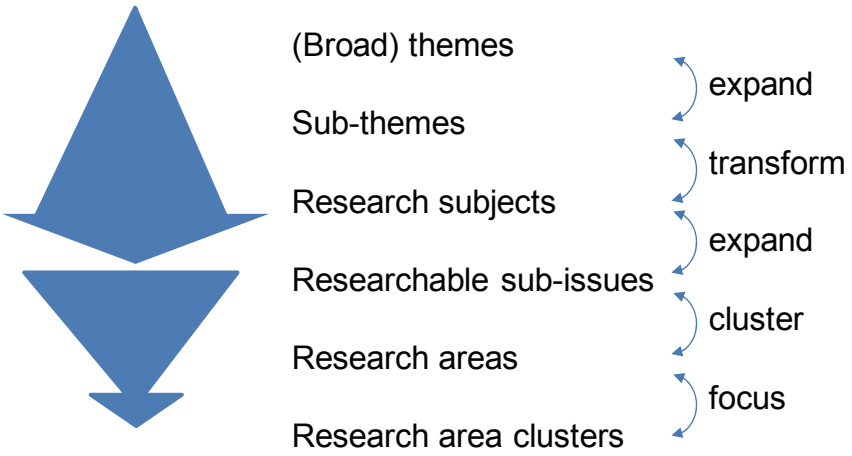
Cases of more than three levels of priority-setting mechanisms are also common and easy to find; in a cascade of government priorities, government agency priorities and contractor priorities, for example. Other cascading examples stem from government, faculty and institution levels or government, research council, programme groups etc. The combined effects on priorities of such multi-level priorities are not easy to understand. The most complex mechanisms displayed in the four VINNOVA reports stem from Japan (see section 4.3 in the Japanese report).

1.6 Expansion, transformation, clustering and focus – a common approach

Processes for setting national research funding priorities often start as type A political priorities. The next step is to break down these often broad themes into more manageable sub-themes (expansion). If developed successfully, these will have positive effects on the development within the main theme.

As mentioned above, the sub-themes need to be transformed into research subjects. Such a transformation can only be done sensibly in a *dialogue* between scientists with "scientific foresight abilities" and those with deep insights into the themes and their strategic developments.

Figure 2. A typical pattern of expansion, transformation, clustering and focus



The research subjects in turn need expanding into researchable sub-issues. Thus, many government agencies, science academies, foresight programmes etc. end up with long lists of detailed research issues. These are intended to build knowledge which contributes to the effective handling of grand challenges or other themes of national importance. The number of such research issues may be very high, e.g. over a thousand at this stage of expansion. However, many research issues will appear as potential contributors to several fields and it becomes natural to group them into related and reasonably coherent clusters. This clustering may need to be staged so as to achieve a sufficiently small number of research areas to be manageable in a policy process. Thus, the final selection of research areas for the advancement of the major themes are the outcome of a process of expansion of themes, transformation, expansion of research subjects, clustering and focus. This pattern can be found in many countries. The detailed processes, i.e. the use of different methodologies such as scenarios, Delphi, expert panels, statistical analysis etc. differ significantly between countries, but generally they follow the above pattern. This pattern is clearly visible in the work done in Japan, the UK, South Korea, China, Canada and to some degree the European Commission.

1.7 Priority-setting based on institutional competition

A different kind of priority-setting mechanism is to set "promotion" goals within the research funding system and then allow institutions to compete for such "promotion." Liu Li gives an example in his account of the mechanisms used by the Chinese Academy of Sciences (CAS):

> *CAS's vision is to strive to build itself into a scientific research base at advanced international level, a base for fostering and bringing on advanced S&T talents and a basis for promoting the development of China's new and high-tech industries. By 2010, CAS will have about 80 national institutes noted for their powerful capacities in S&T innovation and sustainable development or with distinctive features. Of these, 30 will become internationally acknowledged, high-level research institutions and three to five will be world-class.*

Thus, the end result of priority-setting is achieved through a competitive scheme. The intended goals are made public and institutions compete by proposing how they will reach the goals. Those institutions which perform best will win.

2 About the VINNOVA studies in four geographical settings

The four studies commissioned by VINNOVA examine settings which represent contexts very different from the one in Sweden. The US, China and Japan are all so much larger countries than Sweden, with much larger resources and governmental systems organised very differently to Sweden. No immediate comparisons can be made and thus reflection can hopefully be easier and less sensitive to different biases. Institutional differences also reduce the risk that thinking becomes dominated by Swedish vested interests when reflecting on achievements and shortcomings in the other national contexts.

On the other hand, the Framework Programme for research managed by the European Commission is a very different system. Sweden is a part of this programme and it significantly affects Swedish research funding mechanisms. Understanding the inner workings of priority-setting can thus be of immediate help when positioning Swedish interests to benefit Swedish knowledge production, growth and other developments.

2.1 Comparing statistics – a word of caution

Comparing statistics and funding levels between countries is a very difficult activity. The authors of the Japanese report write:

> *Funding of research projects at universities and government research institutes does not usually include the salary costs of permanent employees. These costs are normally covered by the general funding to the institutions; the same is true of most facilities costs.*
>
> *In other words, a research grant of a certain size buys much more research in Japan than in Sweden. The difference may frequently be as large as a factor of two.*

The face value of funding comparisons will be misleading for countries where all salary and facilities costs are covered by research funding. Attempts to transform figures into comparable values will produce unreliable results.

This and other stark differences make comparisons (at least in absolute terms) highly questionable as a source of conclusions.

3 Priority-setting as a result of decision-making mechanisms

3.1 A framework for analysis

Looking at priority-setting as a result of *a decision-making process* can aid reflection on the results of the four studies. A management science framework on how organisational decisions are taken may serve as an example. In the late '70s, George Huber[5] wrote a summary of how organisational decisions were formed. His model is still valid and in use and helps in understanding this dimension of the mechanisms. Huber claimed that decisions (such as priorities) come out of processes which are blends of four basic sub-models of decision-making behaviour.

It is naïve to think that decisions will normally be taken on a purely rational basis. Furthermore, it is not quite clear what *rational* means. Which criteria are to be judged *rational* in a rational process and which are not? There are obviously other forces and objectives involved than those contained in a "rational" analysis.

George Huber distinguishes between four "models" of behaviour: *the rational model, the power/political model, the process/organisational model and garbage can model*.

The *rational model* suggests that decisions are consequences of an intentionally rational use of evidence-based information.

The *power/political model* suggests that decisions are consequences of strategies and tactics by units or individuals seeking to influence the decision-making process in ways favourable to themselves.

The *process/organisational model* suggests that decisions are consequences of "the programming and programs" of the units involved. In other words, it is too troublesome to create new patterns of thinking. A person reverts to previous or established organisational patterns or processes, or other cognitive and motivational "programming".

[5] George Huber; "Organizational Science Contributions to the Design of Decision Support Systems." Chapter in (Pagels-)Fick & Sprague. "Decision Support Systems – Issues and Challenges", Pergamon Press 1980.

The garbage can model suggests that decisions are consequences of coincidental events. For example, problems that occur when a particular "solution" happens to catch a person's attention; or vice versa, when a "solution" happens to fit a current problem. Suddenly latching onto opportunities is also an example of this behaviour.

3.2 Applying the rational model

These four models may be used to reflect on the results of the four VINNOVA studies, from a decision-making perspective.

3.2.1 Concepts crucial to understanding

Lennart Stenberg and Hiroshi Nagano observe that:

> *An important element of the priority-setting system is the concepts being used to characterise different types of research and development.*

In some countries, there is tension between resources devoted to "basic" research and something which goes by different names such as "mission-oriented" or "applied" research. The conceptualisation in Japan goes one step further:

> *Type 1 basic research that is conducted based on the free ideas of researchers in S&T, including human and social sciences; and*
>
> *Type 2 basic research that aims at future applications based on policies.*
>
> *The main significance of this distinction is that Type 1 basic research is considered to fall outside the system of thematic prioritisation.*

An essential element in understanding priority-setting is therefore to estimate which parts of total public funding are subject to *thematic* prioritisation[6]. Basic research which is considered to *fall outside the system of thematic prioritisation* is normally subject to other types of prioritisation, such as peer review criteria on academic excellence. Hence, all public research funding is subject to priority-setting but not all is subject to *thematic prioritisation.*

[6] Comparisons in this respect are doubtful exercises. However, some figures are available, in China for example, where expenditure by the Chinese Academy of Science (CAS) R&D in 2007 was 33% basic research, 57.0% applied research and 14.2% development. However, it should be noted that CAS is only one of several funding organisations.

Kerstin Eliasson explains why the concepts of basic and applied research do not carry the same tensions in the US as they do in many other countries:

> *There is also the issue of setting priorities between basic research, applied research and development. This is not really done in the US because basic research can be financed by many departments and agencies, not just the NSF[7] which has this as its sole objective. It could also be argued that the NIH[8] has basic research as an important mission within its disease-oriented objectives.*

She further observes:

> *Some argue that the mission-oriented perspective, which is really prevalent in the American system, is the key to the success of US science. When such a perspective is prevalent, there is a lesser need to argue about the importance of basic versus applied research.*

A similar pattern may also be observed in other countries where the *mission* is very much the political focus of research funding. Chinese priorities seem to be firmly based on an instrumental approach to S&T. S&T gets funding *"to provide scientific support for the development of the country"* and there seems to be no great conflict between funding of basic research and mission-oriented research. Both areas are supposed to produce scientific results valuable for the development of society.

3.2.2 Rationality and transparency

The rationality of a priority-setting process is not necessarily closely related to the transparency of that process. However, its rationality can only be assessed if the process is transparent to those wanting to assess it. Closed mechanisms with no objective insight are therefore easily deemed non-rational. This may be right or wrong. Only participants of the process can have a valid opinion on whether it is true or not. Liu Li makes the following comment about the Chinese Medium and Long Term Plan (MLP):

> *Generally speaking, the MLP process is open and transparent especially in the strategic studies phase. However, the results of these strategic studies - the research reports - remain confidential. The draft phase is secretive and remains a black box. One can say*

[7] National Science Foundation.
[8] National Institutes of Health.

> *that the whole process is a grey box, rather than a black or white one.*

The secret part of the process may still be rational, but the process still deserves to be labelled "a grey box."

The concept of a "grey box" also applies to the EU mechanisms, according to Dan Andrée; although he never uses the concept. The "system" is a combination of open consultations at different levels and an internal non-transparent process within the Commission. Dan Andrée even concludes:

> *Nonetheless, it is likely that these general consultations have had only a limited impact on the thematic content as eventually put forward in the Commission's proposals.*

The openness of the American system to priority-setting is given specific mention by Kerstin Eliasson:

> *Not only in hearings in Congress with representatives from the science world, but also in the open protocols from meetings in Congress, at various departments and agencies (and at least at the NSF), there is open justification for not funding specific applications. There is also a constant, ongoing and open debate about the difficult issues in priority-setting.*

3.3 Applying the power/political model

The "power/political model", stating that institutions, individuals or groups influence the funding priorities based on their own interests is in opposition to the "rational model" which assumes that rational, objective reasoning is drawn to priorities. Politicians normally have a mandate to set priorities in respect of society's future development and favour their own values without further justification. This is part of the political process; it is the role of politicians to prioritise between societal goals, grand challenges and so on.

The political influence on research funding priorities is clearly visible in at least three of the four studies. In the case of Japan Lennart Stenberg and Hiroshi Nagano state that:

> *Many important aspects of the "real" priority-setting processes are not covered in the report. For example, under the rule of the Liberal Democratic Party (LDP), direct contacts between ministry officials and individual parliament members have been an important mechanism in building political support for specific policy measures.*

Chinese policies on S&T priorities seem more integrated into the wider political decision-making structures than in other countries. This also means that priorities are closely connected to other political priorities, societal grand challenges and the development of society at large.

The political leadership in China has also determined that the general thrust of priorities should be to develop areas where the country already holds strong positions, rather than building capacity in weak areas[9].

The need of the political system to consult wide groups of stakeholders in preparing research priorities is obvious, regardless of political system. Thus, Liu Li writes that the Chinese *Political Consultation Conference*:

> *is a political body of the Chinese political system. Political Consultation members are generally successful scientists, engineers, intellectuals and businessmen belonging to non-Communist parties or democratic parties.*

The White House (Office of Science & Technology Policy) guidelines for departments and agencies for 2011 is very clear that in their budget submissions, agencies should explain:

> *"how they will redirect available resources, as appropriate, from lower-priority areas to science and technology activities that address four practical challenges and strengthen four cross-cutting areas that underlie success in addressing all of them".*

The White House goes one step further and requires that the ability to redirect funding to prioritised areas should be substantiated by showing how:

> *"..assessments allowed agencies to eliminate or reduce funding for less-effective, lower-quality, or lower-priority programs in 2011…."*

Under the chairmanship of the prime minister, the CSTP[10] held the main responsibility for the development of the S&T priorities in the Japanese Third Basic Plan. Although dominated by seven government ministers , the CSTP contained eight members from academia and other external partners. The 27-person drafting committee[11] comprised 14 members from academia and six from industry. It is an interesting example of openness and a recognition of the importance of S&T to the whole society.

[9] However, the idea of "catch-up" is explicitly mentioned in connection to biotechnology (p.28).
[10] Council for Science and Technology Policy.
[11] Expert Committee for Basic Policy.

The quote from Dan Andrée in 3.2.2 hints at only weak influence from consultations during the formal preparation of a proposal from the European Commission. However, the *political institutions* seem sensitive to "external" positions:

> *These are all well-known areas with strong 'lobby groups' and where both Council and especially Parliament is keen to react on their behalf.*

Thus, according to Andrée for EU Member States (MS) and the European Parliament (EP), the options for influencing the priorities are:

- Proactive involvement from MS and stakeholders in the process leading up to the Commission proposal
- Better prioritisation by MS/EP in the political negotiation
- Proactive involvement of MS and other stakeholders in the process of drafting the annual Work Programmes

Academia itself is probably the most successful example of the "power model" at work. In many countries, it has been able to defend major parts of "basic research" from any prioritisation based on criteria other than scientific excellence.

3.4 Applying the process/organisational model

It is obvious that the design of the institutional framework will affect the outcome of the priorities. Still, the precise implications are not well understood. All four studies have been at pains to describe the institutional frameworks and explain what implications their inner workings have for the priorities. The institutions involved are often shaped with purposes in mind other than creating research priorities; thus, they may not be best suited for this purpose. Also, interconnected institutional frameworks which should interact smoothly sometimes meet difficulties because they have been developed with different purposes in mind. In regard to the European Research Area (ERA) Dan Andrée notes:

> *The EU system is tailored to discussing and negotiating formal proposals from the Commission which result in legislation. However, the governance of the ERA is not about legislation, it is about involving Member States and other stakeholders in a constructive debate and partnership.*

His conclusion, that *"Europe needs to be creative in preparing for this discussion"* is indirectly a warning that the formal structures are not sufficient

for the purpose of research agenda-setting. The case of the EU Framework Programmes (FP) from FP1 to FP7 contains a clear description of evolution and adaptation of the purposes, criteria, structure and consultation mechanisms of the research funding system as political goals and learning have evolved.

Lennart Stenberg and Hiroshi Nagano underline the importance of the institutional framework and the way its design influences the outcome of the priorities:

> *Priority-setting is largely determined by the institutional framework in which priorities are deliberated and decided. This includes the system of organisations performing research such as universities and research institutes as well as that of ministries and special funding organisations used for channelling government resources.*

The report on Japan thus underlines the connections between priorities and "system reform." A particular driving force within "system reform" is:

> *"The need for each university to develop its unique role and characteristics"*

and

> *"much of the focus has been on creating a limited number of truly internationally attractive and competitive universities."*

Andrée makes an observation about the transparency of later stages of the priority-setting mechanisms within the European Commission. He writes:

> *The subsequent political process up until the final decisions by the Parliament and the Council is laid out in the Treaty but is not very transparent, at least from the 'stakeholders' perspective, for whom the processes of "consultation" and "co-decision" remain opaque, probably as a direct consequence of their complexity.*

Reading all four studies leaves a strong impression (probably self-evident) that increased complexity of the organisational model for setting priorities decreases the ability to understand the true nature of the priority-setting procedures.

Regarding the complexity of the US funding system, Kerstin Eliasson argues:

> *The American science system is a large and complex structure with a loose coordination of efforts. Many levels of government, many units within each level, and many stakeholders are involved in decision-making at different levels and many give input to the process of priority-setting.*

> *Part of this complexity is that there is no single research budget in the United States. Federally funded science and research, including basic research, is financed through the overall budgets of 24 Federal departments and independent agencies…*

Still, it is interesting that despite this complexity, the White House requires research contributions to priority missions to be clearly reported. So complexity is not accepted as an excuse for reduced transparency:

> *Building on the unprecedented transparency and openness required for Recovery Act spending, agencies have a responsibility to explain how Federal science and technology investments contribute to increased economic productivity and progress, new energy technologies, improved health outcomes and other national goals.*

Thus, the Chinese system builds on a multi-layered cascade of priority mechanisms towards greater detail and operationalisation. Such cascading is an example of the multi-level priorities discussed above. Such a multi-levelled system with linked layers is shown in the following example

- Medium and long-term plan 2006-2020 Level 1
- 11th Five Year Plan 2006-2010 Level 2
- Priority fields Level 3
- Priority themes Level 4
- Mega-engineering projects Level 5
- Next generation wireless mobile communications Level 6

This can also be seen in Liu Li's list of the different levels of priority:

- Ideological level: Scientific Concept of Development, Harmonious Society
- National strategy level
- S&T priority at MLP level
- S&T priority at national S&T programme level
- S&T priority at research organisation level (Chinese Academy of Sciences, Universities etc).

The priority-setting criteria are different at these levels. Liu Li stresses that the policy and priority process is *a feed-back of bottom-up and top-down.* Thus, the totality of the priority-setting process is rather complex, which provides food for thought. Dan Andrée's comment about a lack of transparency due to organisational complexity may also apply in countries like China.

Japan's case shows an awareness of how important it is for "the system" to implement the priorities determined by policy. Stenberg and Nagano write:

> *"An important way in which CSTP influences policy implementation is by continuously collecting and presenting information of the totality of government S&T expenditure and the extent to which it conforms with the policy objectives decided by the CSTP."*

The "institutional framework" thus takes on an important role in ensuring "delivery" of the priorities.

Some countries locate the responsibility for R&D strategies and priorities within the same "institutional framework" that covers innovation policy. There appears to be a conscious "design" in fostering deeper integration between the two.

Another aspect of the institutional framework is its inability to adapt to newly emerging challenges, opportunities and threats. Stenberg and Nagano write:

> *...there were almost insurmountable constraints in the Japanese budget system against the quick reallocation of funds in response to new opportunities. Difficulties of combining and coordinating funding from different government sources also became apparent.*

The EU experienced similar difficulties with its Framework Programme some years ago during the BSE crisis (mad-cow disease). At this time, urgent research activities were called upon to improve the knowledge base for political decision-making. Quick reallocation of research funding proved very difficult due to the fixed institutional framework.

Japan has institutionalised (!) a policy instrument to circumvent the normal bureaucratic delays introduced by the institutional and regulatory frameworks when:

> *24 ...proposals were selected and assigned as "Super-Special Consortia". The latter will receive fast-track treatment in regulatory processes and the opportunity to side-step some of the normal constraints on combining funding from different sources etc.*

Stenberg and Nagano also note a close connection between prioritisation and coordination. Coordination of fragmented entities is a way to create a stronger critical mass and achieve prioritisation which may not need much additional funding.

3.5 Applying the garbage-can model

"Random" events such as financial crisis, national threats, changing political agendas etc. are also influencing priority-setting mechanisms and priorities. Kerstin Eliasson notes:

> *However, when major threats occurred, as they did during World War II and when the Soviet Union launched Sputnik, major changes in priorities took place even though the science system did not change that much. This was also true after the terrorist attacks on September 11, 2001 after which a new department was created, the Department of Homeland Security.*

VINNOVA has published a separate report[12] (spring 2009) on the effects of the "financial crisis" on public investment in research and innovation. The most striking conclusions with respect to priority-setting are that the additional investments in research and innovation focus mainly on a "low-carbon society" and a society of "healthy, long life" and that those countries which already have "national strategic technologies" have provided additional funding, mainly for these areas.

Stenberg and Nagano list a number of changes in "the real world" which have influenced the context of priority-setting in Japan. They mention governmental policies in other policy domains (such as the "Innovation 25" initiative), scientific breakthroughs which open up new possibilities (such as iPS cell research into reprogramming cells;), soaring oil, mineral and food prices, Japan as host of the G8 meeting in the summer of 2008 (which generated a focus on measures to counter global warming), intensification of the global financial crisis in September 2008 and the coming to power of the US Obama administration in January 2009. The new administration announced very large increases in Federal R&D spending, including areas of energy and environment considered particular Japanese strengths.

[12] "Fight the crisis with research and innovation?" VINNOVA Analysis VA 2009:14. This report is based on studies of Germany, China, Finland, the Netherlands, Japan and the US.

4 Perspectives from another study

The Royal Swedish Academy of Engineering Sciences in Stockholm recently conducted a comparison of research prioritisation in six small to medium-sized economies. The study covered Finland, the Netherlands, South Korea, Sweden, Switzerland and Taiwan. The final report[13] contains a number of "preliminary findings" which nicely complement the VINNOVA reports, as they cover similar mechanisms in six much smaller countries with advanced research capabilities. The tone of the report is set early on with its observation that:

> *All countries pride themselves in having a strong consensus culture within a fair democratic system. However,….., Sweden's and Switzerland's notion of democratic fairness results in less hierarchy and less top-down strategy than in the other countries. Taiwan and South Korea especially value efficiency over fairness, as stated by interviewees. This makes prioritisation seem more rational and less democratic in those countries. For better or worse, this "efficiency over fairness" in the name of global competitiveness is beginning to show itself in the development of both Finnish and Dutch research policy. Examples include the use of innovation platforms or advisory committees consisting a very small number of people of high standing (and at least half from industry) rather than large committees where all stakeholders are represented. There is also a strong trend towards merging ministries, departments and other policy bodies. This trend is not always reflected in actual organisational mergers, but more so in the selection of key individuals from different organisations who take decisions in newly created bodies.*

The balance between *democratic fairness* and *efficiency* has thus been singled out as an important distinguishing element in the national prioritisation cultures.

The use or non-use of roadmapping is another characteristic feature of the national systems, according to the IVA studies:

> *Roadmapping of one sort or another is performed by all countries. However, Sweden and Switzerland are alone in not creating one national roadmap intended as a blueprint for many ministries,*

[13] "Strategies for Research Prioritization" IVA 2009. Available for download from www.iva.se/prio.

agencies and organisations. In the other countries, these national roadmaps may not be followed by all intended recipients, but several interviewees pointed to the – perhaps primary – importance of roadmapping: to bring together the smartest people in the country (and outside it) to focus not on a specific research goal, but on the overall welfare of the country. The result is new understanding and new collaborations, which can have life-long benefits, both for researchers and the country.

Participative processes bring people together who in many cases might otherwise not meet, discuss and learn from each other. The value of such processes is largely the common focus and mobilisation effects that are created, rather than the visible and explicit, factual results of these processes.

The value and nature of participation of private sector representatives in priority-setting have brought mixed experiences in the countries surveyed:

All countries involve private sector representatives at some level of the decision-making and/or advisory tree. Match-funding also plays a role in all countries. It was interesting to note that in both Asian countries, the prevailing opinion was that industry advice (and matching funds) is useful for short-term projects of up to around three years, but that industrial representatives lack the visionary, wider perspective and actually hinder the creativity of more long-term advanced research projects. In Taiwan, the role of industrial representatives is actually being scaled down to allow new actors to flourish in new industrial arenas. In South Korea, venture capitalists are frequently used as more neutral advisors with a wider scope yet still with a firm footing in the private sector.

The idea of venture capitalists representing more long-term thinking in priority-setting than industrialists provides interesting food for thought.

The priority-setting mechanisms of the individual "national systems" in the three VINNOVA reports seem closer to each other than those for the six nations in the IVA report:

Overall, the interview results indicate a continuum of research strategies in the six chosen countries. This continuum may be described as ranging from laissez-faire research with little Government policy intervention (as is the case in Sweden and Switzerland), via a combination of laissez-faire university policy combined with a concerted and prioritised institute sector (as is

the case with the Netherlands, Finland and Taiwan), to a strong, centrally coordinated research effort (as is the case for South Korea).

China, Japan and the US exhibit more pluralism in their national priority-setting mechanisms than is the case for the six small countries.

5 Conclusions

It is worth examining the priority-setting mechanisms covered by the VINNOVA studies as decision-making processes and analysing them as such. This approach produces the anticipated balance of rational behaviour, significant impact from the institutional setting concerned, political influence, power-play andan element of coincidence (in the sense that unexpected societal events impact upon research funding priorities).

It is fascinating to note that priority-setting processes covered by the four VINNOVA studies have major similarities, even though they stem from very different national and regional contexts and have developed along different paths. The similarities between priority-setting in the Chinese science and technology system and the EU Framework Programme have been particularly striking. Both have a strong leaning towards supporting future developments in other policy areas.

The studies also provide some striking differences, such as the decentralisation of the American Federal system to create research priorities. This contrasts with China, the EU Framework Programme and Japan.

A comparison with the IVA study opens up a number of perspectives other than those in the VINNOVA project. The balancing of democratic fairness versus efficiency in research funding and the use of roadmaps at a societal level are two such perspectives.

The priority-setting mechanisms that have been reviewed provide a basis for consideration, reflection and learning. There is a “smorgasbord” of approaches, concepts and processes from which to choose and, potentially, adapt to individual tastes and contexts.

A common argument is the near-impossibility of adapting for one country, other processes or “solutions” which have proven successful in another. The belief is that differences in national institutional frameworks make it too difficult. The institutional framework is certainly an important restriction. However, it is also a valid question as to whether this restriction is not overrated as a defence against learning from foreign contexts.

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Priority-Setting in the European Research Framework Programmes
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Priority-Setting in Japanese Research and Innovation Policy
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Kerstin Eliasson
VINNOVA Analysis VA 2009:22

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