The Swedish National Innovation Council: Innovation policy governance to replace linearity with holism

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Keywords: Innovation; Innovation Policy; Holistic innovation policy; Research policy; Linear view; Systems of innovation.

JEL: 030; 038; 049; 052

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Contents

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1. Introduction

The Swedish National Innovation Council (NIC) was created by the Swedish Prime Minister, Stefan Löfven, in February 2015 and has now been operating for 18 months. It is personally chaired by the Prime Minister, which is unusual for such councils in other countries. Another atypical characteristic of the Swedish NIC is that it has a dominant and wide focus on innovation. In other countries, such councils focus predominantly on science and/or research and treat innovation, if at all, as an "appendix" to research (Vinnova 2015). By this emphasis on research, these councils are contributing to the cementing of the linear model in the design of innovation policy. This model has been completely rejected in the research in innovation during the latest decades and has been replaced by the systems approach (Lundvall 1992b; Nelson 1993; Edquist 1997. Hence innovation policy is lagging behind innovation research in this respect. The unique characteristics of the Swedish NIC means that it has the potential to make Sweden leave the linear model in innovation policy and develop a holistic innovation policy.

Very little information about the operation of the Swedish NIC is publicly available – to be discussed in section 4.2 of the paper. I feel that I can contribute to mitigating this shortage of information and knowledge, since I have been a member of NIC since its start.

Increasing the availability of information about NIC can, in turn, increase the public debate on innovation policy issues, and in this way, improve the quality of that policy. It may also be of interest to innovation researchers to know about how the close interaction between politicians on one hand and representatives of academia, industry and unions on the other hand operates in the innovation policy area is operating in Sweden. One purpose of this paper is therefore to disseminate and analyze information about the character and operation of the Swedish NIC and to thereby increase the awareness about the role of NIC among innovation researchers, policy-makers, politicians and the general public.

In the description and analysis of the Swedish NIC in this paper, I will give examples of four areas of NIC activity, and show that two of them have already been directly successful in influencing innovation policy in practice (state risk capital provision and innovation-related public procurement) and that an

interesting development has been taking place in the other two (holistic innovation policy and additionality). These examples will be placed within a framework of the relevant innovation theory and of the development of innovation policy in a larger context.

This paper will be based upon my experiences both as an innovation researcher and as a member of NIC. Hence, parts of the paper are my "participant observations". Having played a role on the council has made writing this paper a very difficult task for me. It is a delicate matter to write about something of which one has been a part. At the same time I have chosen to be explicit about my own role, when I have played one, since it can serve as an example of interaction between innovation policy and innovation research.

An earlier version of this paper has been commented upon by Wille Birksten, Ingvar Johansson, Kirsten Knafve, Jerker Moodysson and Margaret Newman-Nowicka. All remaining errors, deficiencies and shortcomings are my responsibility.

2. Definitions and theory

To provide conceptual clarity, I start this article by specifying what I mean by the key concepts used. This is not to exclude the possibility of alternative definitions of these concepts. Stipulative definitions are not right or wrong; they are good or bad for certain purposes. Hence, I present definitions that suit the purposes of my analysis, briefly and telegraphically, without arguing for my choices.[1] These definitions will be embedded in some theory.

Innovations are defined here as new creations of economic or societal importance, usually performed by firms.[2] Innovations can be new or improved products or processes. New products (*product innovations*) may be material goods or intangible services; it is a question of *what* is produced. New processes (*process innovations*) may be technological or organizational; here, it is a question of *how* the products are produced.[3] Of great importance, however, is that the new creations are not innovations before they are commercialized and spread to a considerable degree. New creations that are not commercialized are not innovations but prototypes.

The so-called *linear model* dominated the views on how innovations developed in the early days of research on innovation and in innovation policy (Bush, 1945). This model was based on the assumption that innovations are applied scientific knowledge. The model was called "linear" because innovations were assumed to be generated by a process consisting of well-defined, consecutive stages, e.g. basic research, applied research, and development work, resulting in new products and processes that ultimately influence growth and employment. It was a supply-push view.[4]

Research does not automatically lead to innovations, and innovations need not be preceded by research, however. Scientific knowledge is not sufficient; it has to be transformed into commercialized innovations in order to mitigate societal

[1] The definitions and conceptual specifications following, suit my purposes (and I therefore stick to them), although there are myriads of other possible ones. If definitions are reasonably clear and serve the purpose in question, it is futile to argue about them.
[2] However, the firms do not develop innovations in isolation from other organizations, but are parts of innovations systems; see below. Schumpeter talked about innovations as "new combinations," i.e. existing knowledge elements can be integrated into an innovation. Hence, innovations certainly do not need to be based on new scientific breakthroughs.
[3] Process innovations have been product innovations in earlier incarnations. This means that product innovations play a more dynamic role in the renewal of an innovation system and an economy than process innovations (Edquist et al, 2002). (Note that "process innovations" are not the same thing as "innovation processes", used later.)
[4] We are dealing with innovation policy for knowledge production and R&D in Borrás and Edquist (2014b).

and environmental problems and create growth and employment.[5] Some research results are never transformed into innovations and research is only one of the many determinants of the development and diffusion of innovations. Above all, research is never sufficient to achieve innovations and certainly not always necessary. Most innovations are developed without a direct basis in new research and development (R&D).

The *innovation systems approach,* which has diffused rapidly during the latest decades, has completely replaced the linear view in the field of innovation research.[6] This new approach is very different from the linear approach. It is usually, in its different versions, defined in terms of determinants of innovation processes, although different determinants are emphasized in different versions (Freeman, 1987; Lundvall, 1992b; Nelson, 1993; Braczyk, 1998; Breschi and Malerba, 1997; Carlsson, 1995; Cooke, 2001; Bergek et al, 2008; Asheim and Isaksen, 2002); Cooke et al, 1997, Edquist 1997, Edquist 2005). The innovation systems approach is also used in policy contexts by regional organizations, national governments, public agencies, and international organizations such as the OECD, EU, UNCTAD, UNIDO, etc.

There are many specifications and definitions of the systems of innovation approach. For me, innovation systems should be defined as ones that include "*all* important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations", as well as the innovations themselves (Edquist, 1997: 3, 11-12; Edquist, 2005: 184). Innovation systems may be national, regional or sectoral. Innovation systems cannot be internal to (large) firms, but firms are the most important organizations in innovation systems. The activities that are performed in innovation systems will be detailed later in this section.

In recent years, innovation policy has also increasingly been discussed using terms such as "broad-based innovation policies" and "a demand-pull view." Both terms refer to a wider view of innovation policy. I prefer to call this view the *holistic approach* to innovation policy (see below).[7] Demand-oriented innovation policy instruments are certainly a part of a holistic innovation policy,

[5] The development of a prototypes is not enough.

[6] In August 2016, the number of hits at Google was:

- "System of innovation": 739,000 hits
- System of innovation: 79,300,000 hits.

These figures are very high for a scientific approach. The acronym Vinnova is short for The Swedish Governmental Agency for Innovation Systems ("Verket för innovationssystem" in Swedish). Hence a public agency has taken its name from a scientific approach, which is unusual. This rapid diffusion is due to the strengths and advantages associated with this approach (Edquist, 2005: 184).

[7] I have previously dealt with holistic innovation policy in, for example, Edquist 2014a, 2014d and 2014e.

although they are not sufficient to warrant the name "holistic". Examples of demand-side policy instruments are public procurement of innovation (PPI) (Edquist and Zabala, 2012 and 2014), standard-setting, subsidies or tax incentives to support demand, and enhancing articulation of user needs. [8] These instruments are being encouraged by the European Commission but are still not widely used in the Member Countries. However, their use has enormous potential as innovation policy instruments (Edquist, 2014c; Edquist 2015b).

The concept of a *holistic innovation policy* is, in this paper, defined as a policy that integrates all public actions that influence or may influence innovation processes. A holistic policy requires a broad version of the systems of innovation approach as its basis. Innovation policies are normally practiced in a much more partial way, focusing on only a few of the ten activities in Figure1, below. Partial innovation policies are often based on the linear view – and therefore they become linear.

Additionality (sometimes also called market supplementation) refers to the division of labor between private and public organizations. Central to this concept is that activities that are important for the system, should be performed by public organizations only if they are not (or cannot be) carried out by private organizations. Innovation policy is sometimes needed, but must not replace, duplicate, or crowd out what private actors can accomplish.

Let me now briefly discuss the terms described above as they relate to the development of some parts of innovation theory in recent decades.[9]

The pioneers in the development of the innovation systems approach were Lundvall (1992b) and Nelson and Rosenberg (1993). All define national innovation systems in terms of determinants, or factors affecting innovation processes although they point out different determinants as important in their definitions. Lundvall writes that the "structure of production" and "the set of institutions" together define an innovation system (Lundvall, 1992b: 10). Nelson and Rosenberg emphasize the organizations that support R&D—that is, the organizations that support the creation and dissemination of knowledge—as the main source of innovation (Nelson and Rosenberg 1993: 5, 9 -13).

Interactive learning has been central to the concept of a national innovation system already from the beginning (Lundvall, 1992a and 1992b). The main

[8] Demand-side innovation policy instruments have been addressed by Edler (2009).
[9] What follows is based on Edquist 2014 e.

components of an innovation system are often said to be organizations and institutions. In my mind these two categories should be clearly distinguished from each other, but they are often not. For me more useful stipulative definitions are the following.

Organizations are formal structures (e.g. hierarchies) that are consciously created and have an explicit purpose. They are actors or "players." Examples include companies, universities and policy organizations. *Institutions* are laws, rules, regulations, routines and habits. They are the "rules of the game". Institutions may be external to organizations, or be located inside them. Organizations may influence institutions and they may be influenced by them. Key institutions in innovation systems are patent laws, national laws and rules that govern the relations between companies and universities, rules governing the approval of drugs, rules and laws governing public procurement, etc.[10]

Most of the attention in innovation research has long been paid to the components (organizations and institutions) of innovation systems. Less has been said about the processes that occur within the systems and how they change.

One way to address what occurs within systems of innovation is as follows. On a general level, the main role of the innovation system is to drive or enhance innovation processes, i.e. to develop and disseminate innovations. What we might call the activities of innovation systems are those that affect the development and diffusion of innovations. An example of such an activity is research and development (R&D) used as a means to develop socio-economically relevant knowledge that can (sometimes) form the basis of innovations. Another is the financing of the commercialization of such knowledge, i.e. the transformation of research findings and other kinds of knowledge into innovations and their diffusion. As we will see, there are other activities.

I believe that an emphasis on activities or determinants within innovation systems will become crucial for the development of both innovation theory and innovation policies in the future. It is also by influencing these determinants that

[10] These concepts, and the relations between them, are discussed in Edquist and Johnson (1997). To study the relations between them, they must be conceptually distinguished from each other. For Nelson and Rosenberg (1993) "institutions" are the same as different kinds of "organizations" ("players"), while the term "institution" primarily means "the rules of the game" for (Lundvall, 1992b). Hence, the term "institution" is used in different senses in the literature and they are often not clearly distinguished from each other.

enterprises and public agencies can influence the innovation processes through their strategies and policies.

My definition of innovation systems (presented above) is based on a *particular specification of the systems of innovation approach* where ten activities (or determinants of innovation processes) define an innovation system (Edquist 2005, Edquist 2011, Borrás and Edquist 2013). A list of these activities or determinants is presented in Figure 1.

Box 1: Key Activities in Systems of Innovation

I. Provision of knowledge inputs to the innovation process

1. Provision of R&D results and, thus, creation of new knowledge, primarily in engineering, medicine and natural sciences.

2. Competence building, e.g. through individual learning (educating and training the labour force for innovation and R&D activities) and organisational learning. This includes formal learning as well as informal learning.

II. Demand-side activities

3. Formation of new product markets, for example through public procurement of innovation.

4. Articulation of new product quality requirements emanating from the demand side.

III. Provision of constituents for SI

5. Creating and changing organisations needed for developing new fields of innovation.

Examples include enhancing entrepreneurship to create new firms and intrapreneurship to diversify existing firms, and creating new research organisations, policy agencies, etc.

6. Networking through markets and other mechanisms, including interactive learning among different organisations (potentially) involved in the innovation processes. This implies integrating new knowledge elements developed in different spheres of the SI and coming from the outside with elements already available in the innovating firms.

7. Creating and changing institutions—e.g., patent laws, tax laws, environment and safety regulations, R&D investment routines, cultural norms, etc.—that influence innovating organisations and innovation processes by providing incentives for and removing obstacles to innovation.

IV. Support services for innovating firms

8. Incubation activities such as providing access to facilities and administrative support for innovating efforts.

9. Financing of innovation processes and other activities that may facilitate commercialisation of knowledge and its adoption.

10. Provision of consultancy services relevant for innovation processes, e.g. technology transfer, commercial information, and legal advice.

Source: Adapted from (Edquist, 2005) and (Edquist, 2011).

This definition of an innovation system is much broader and more general than other variants (e.g. Lundvall's and, especially, Nelson's). It includes *all* determinants of innovation processes (as well as the innovations themselves). A holistic innovation policy requires a broad definition of innovation policy and a broad and systemic view of the determinants of innovation processes, which means that it also requires a broad definition of "systems of innovation," as proposed above.

If all the factors that influence innovation processes cannot be included in the definition, we have to choose the potential factors that should be excluded, and motivate why. This is difficult, because at any given moment we do not know, systematically and in detail, which all these determinants are. It seems risky to exclude certain potential determinants, as these may prove to be important when our knowledge has increased. Thirty-five years ago, for example, it was natural to exclude interaction between organizations as a determinant of innovation processes. Today, we know that these are very important (Edquist 1997: 14; Edquist 2005: 183). Therefore, a broad definition is highly useful.

Figure 1 presents a list of ten important activities in innovation systems. The activities, which are also the determinants of innovation processes, are not ranked according to importance, but are clustered as:

I. Provision of knowledge inputs to the innovation process (e.g. research),
II. Demand-side activities (e.g. public procurement for innovation),
III. Support to key elements in innovation systems (e.g. entrepreneurship),
IV. Support services for innovating firms (e.g. public seed funding of innovations).

The list of activities (also sometimes called functions in other lists) in Figure 1 is preliminary, hypothetical and one among several possible lists of activities. It will certainly be revised when our knowledge of the determinants of innovation processes has improved. Nonetheless, this list can still be used as a checklist or signpost to discuss the factors that - probably - affect innovation processes. This is important, as innovation processes are very complex and influenced by a variety of factors. Among other things, the list can serve as a tool to avoid monocausality, i.e. an overly strong emphasis on one single activity (be it research or seed funding), and a neglect of others, when causally explaining innovation processes and when selecting innovation policy instruments to mitigate policy problems.

The list may thus be useful in assigning causes to policy problems and to identify possible policy instruments to solve the problems. If the main cause of a problem is lack of research, then R&D should be in focus. If the cause is lack of demand for certain kinds of product innovations, then a demand-side instrument such as public procurement for innovation can be used. All ten activities in Figure 1 can be related to several innovation policy instruments. In fact, several instruments might have to be considered for each of the ten

activities in the innovation system, i.e. it can be a matter of choosing among scores of instruments (Borrás and Edquist, 2013).)

It is important to point out that public innovation policy is not included as one of the ten activities, for the simple reason that public innovation policy is a part of *all* the ten activities. That is, all the activities are carried out by organizations in innovation systems and these systems normally include both private and public organizations for most activities. As an example, in all innovation systems R&D is funded and performed by public organizations (universities, public research institutes) and by private organizations (enterprises). This also applies to education (although the balance between private and public here varies greatly between different national innovation systems). What is important is the division of labor between private and public organizations with regard to the implementation of each of the activities. The portion of the various activities carried out by public organizations actually *constitutes* innovation policy.

As stated above, in the realm of innovation policy, the linear model is still much more dominant than in innovation research. However, recent years have seen an increasing interest in "broad-based innovation policies," "systemic innovation policies," "a demand-pull view," and "demand-oriented policy instruments." This may constitute the beginning of a transformation towards a "*holistic innovation policy*." As mentioned above, such a policy approach requires a broad and systemic view of the determinants of innovation processes. It should indeed take into account all the determinants of the whole innovation system. My list of ten activities as part of an innovation systems definition is an attempt to provide such a holistic approach.

Provision of R&D results (including research policy) is only one of the ten activities forming innovation policy (see Figure 1) because it is only *one* of the (ten) determinants of the innovation process. R&D results dominate the linear view. At the other extreme in the continuum linear–holistic is a genuinely holistic innovation policy. It takes into account all the determinants of innovation processes.

A holistic innovation policy includes both determinants (of innovations) and innovation policy instruments. As such, it says nothing about the objectives of innovation policy. They have to be specified separately. Of course, the ultimate objectives of innovation policy are, and should be, determined in a political process. These objectives may be economic (growth, employment, competitiveness, etc.), environmental, social, or they may be related to health, defense and security, etc. How different ultimate objectives of innovation policy

should be balanced is an important political issue. The determination of innovation policy objectives is typically accomplished in a complex process, which in democratic societies involves executive government initiatives, parliamentary discussions, public agencies, civil society, and so on.

Once we have specified the objectives of innovation policy and have a general picture of the policy problems and their causes, it is possible to design policies to attempt to solve the problems. Politicians are not interested in innovations as such, but in their consequences for socioeconomic and political matters such as economic growth and the environment (Borrás and Edquist, 2013). The ultimate objectives or innovation policy are concerned with these consequences.

A useful way of addressing appropriate policy instruments, and for analyzing their role in the innovation system, is to relate different possible instruments to each of the ten activities. In the real world, however, the instruments of innovation policy are rarely used alone. Normally, they are combined in specific mixes of different instruments and used in a complementary manner. Instrument mixes are created because the solution of specific problems requires complementary approaches to the multi-dimensional aspects of innovation-related problems (Borrás and Edquist, 2013).

Of course, innovation policy instruments are not intended to (and cannot) influence the *ultimate* objectives (e.g. growth, the environment or the health system) in a direct and immediate sense. These instruments can only influence innovation processes. Problems to be solved by innovation policy must be identified and specified in innovation terms. That is, the ultimate socio-political objectives must be "translated" into concrete problems related to innovation intensities—problems that can be influenced directly by innovation policy instruments. For example, we need to know how the ultimate objectives of economic growth and environmental protection are related to (certain kinds of) innovations.

Objectives expressed in innovation terms may be termed *direct* objectives. Such objectives are "problems" to be solved by innovation policy. A *policy problem,* in our sense—a problem from a policy point of view—is, for example, low *performance* of the innovation system, i.e. low innovation intensity (or a low propensity to innovate) of a certain category of innovations (product, process, etc.). In other words, a "problem" exists if the objectives in terms of innovation

intensities are not achieved by private organizations.[11] Direct objectives (problems) must be identified and specified in innovation terms.

Fulfilling direct objectives is a means of (partially) achieving ultimate objectives, i.e. in a mediated way. Hence, innovation policy instruments are selected to achieve direct objectives and thereby the ultimate objectives (Borrás and Edquist, 2013). To solve or mitigate low innovation intensities by innovation policy, we need to know (be able to measure) the innovation intensities for specific categories of innovations in the context of the innovation system (Edquist, 2011; Borrás and Edquist, 2013).

[11] "Problems" and how they can be identified through empirical analyses comparing innovation systems are issues that are discussed in much more detail in Sections 3 and 4 in Edquist (2011).

3. European innovation policy is mainly linear - why? [12]

In section 2, we have addressed burgeoning changes towards what may become a "holistic innovation policy." But the use of the innovation systems approach for actual policy purposes is still often a matter of lip service. That is, the content of innovation policies is still dominated by the linear model. Let me show that this is so by summarizing some results from a recent study in this field.

The European Research and Innovation Area Committee (ERAC) of the European Commission asked me to design and organize a mutual learning seminar during the spring of 2014. The topic was "Efficiency of Research and Innovation Systems for Economic Growth and Employment."[13] As part of that project, I designed a questionnaire that was sent out to the twenty-three EU Member Countries that had indicated an interest in participating in the project.[14] The process, the seminars and the results are reported in detail in (Edquist 2014a and Edquist 2014e). Only the conclusions from that study are presented here.

The responses to the questionnaire indicate that "Provision of R&D results" (see Figure 1) was regarded by participants as the most important activity in terms of resources spent for innovation policy purposes and that little innovation policy was considered to be demand-side oriented. This also applies to the responses to the question of whether Public Procurement for Innovation (PPI)[15] was used as an innovation policy instrument. In other words, the innovation policies practiced were mainly of a linear character. Clearly, those countries that are

[12] This section is directly based upon Edquist 2014a and 2014e

[13] ERAC is a strategic policy advisory committee (DG RTD) whose principal mission is to provide strategic advice to the European Council, the European Commission, and EU Member States on research and innovation issues that are relevant for the development of the European Research Area (ERA).

[14] 19 countries responded

[15] Public Procurement for Innovation (PPI) occurs when a public organization places an order for the fulfillment of certain functions through a new product (Edquist and Zabala, 2012). Pre-Commercial Procurement (PCP) refers to the procurement of expected research results. Hence PCP is not a demand-side policy instrument in relation to innovation. However, it is a demand-side policy instrument in relation to research (Edquist and Zabala, 2014). What seems to be practiced on a fairly large scale in the UK (the SBRI programme) is PCP, but not PPI. In Ireland, an SBIR programme is being tried; these SBIR kinds of activities are PCP and not PPI. However, PCP might, in today's world, have a large potential as a R&D policy instrument operating from the demand side. In addition, functional regular public procurement has a much larger potential than both PPI and PCP when it comes to enhancing innovation (Edquist and Zabala, 2012; Edquist and Zabala, 2014; Edquist, 2014c, 2015b) – see section 4.3.2..

striving in the direction of pursuing a holistic innovation policy have a long way to go.

Innovation policy design is, accordingly, certainly lagging behind innovation research when it comes to being systemic, broad-based, or holistic. This is clearly an example of a disturbing failure when it comes to the communication between innovation researchers and politicians in the field of innovation.[16] This may be a strong reason to directly involve innovation researchers to a much higher degree in the design and implementation of innovation policy. There is a great deal that policymakers and, in particular, politicians can learn from innovation research, not only in principle or analytically, but also regarding policy practice.

Why then is innovation policy still mainly linear and not holistic, although the linear view has been completely abandoned in innovation research? Why is innovation policy behindhand?

Policymakers in the field of innovation that attend research conferences on innovation are more often than not in favor of holistic (systemic, broad-based, comprehensive, etc.) innovation policies. They too have abandoned the linear view, having learned from innovation research. As a result, the division between "linear" and "holistic" is located *within* the community where innovation policies are designed and implemented. This community is composed of policymakers (administrators/bureaucrats) and elected politicians. Perhaps the dividing line lies between these two groups because politicians, who actually make the decisions, may be believers in the linear view in an unreflected way. There may also be disagreements between (the leadership of) different ministries, e.g. between the Ministry of Finance and other ministries or between the Ministry of Research and Ministry of Industries.

It is also a fact that policymakers in areas other than innovation policy are influencing innovation policies to remain linear, especially policymakers and politicians in the field of research policy. One reason that innovation policy is still predominantly based on the linear model is that the research policy community is much better organized than the innovation policy community. The "research policy people" want to keep innovation policy as an area that is dominated by research – as a footnote in relation to research policy.

[16] Such communication seems to work much better in the field of the environment and climate.

This means that innovation policy being treated as a subcategory of research policy is a significant obstacle in the process of establishing innovation policy as an independent policy area. This continued integration of design of research policy and innovation policy tends to cement the linear character of innovation policy. In section 4.3.3., I will discuss reasons and mechanisms for separating the design of innovation policy and research policy from each other.

4. The Swedish National Innovation Council (NIC)

4.1. The establishment of the NIC

Above I have tended to drift into discussions of how a holistic innovation policy should be carried out by governments and be coordinated with other policy areas, as well as whether it should be given a higher priority than some other policy areas. The increasing interest in questions about such issues is probably the reason that "councils" for "science and technology (and innovation) policies" have been created in so many countries. In Sweden a "Research Policy Council" (Forskningsberedningen) exists and an "Innovation Council" (Nationella innovationsrådet) has recently been created. These issues of governance and organization of innovation policy as regards Sweden will be dealt with below.

In quite a few countries (20-30), Science, Technology and Innovation Councils (or Research and Innovation Policy Councils – or variants of these names) have been created. Such organizations are sometimes, at least formally, chaired by a leading politician, sometimes the President or Prime Minister. As indicated by their names, some of them cover both research policy and innovation policy. It is argued, in this paper, that this, in an unfortunate way, leads to research policy becoming dominant over innovation policy. Innovation policy does not get the 'space' for developing itself into an independent policy area, but is pursued as a "footnote" to research policy – and the linear view remains dominant.

About nine months after the date when the Swedish Prime Minister (Stefan Löfven) created the Swedish National Innovation Council (NIC), Vinnova, Sweden's public innovation agency, published a report entitled "National Research & Innovation Councils as an Instrument of Innovation Governance". . It can be assumed that the creation of the Swedish National Innovation Council triggered Vinnova's decision to produce this report. It is surprising, therefore, that the Swedish NIC is only mentioned in the report in a comment saying that NIC was not included in the analysis (Vinnova 2015: 20). This omission of NIC from the analysis might be due to the lack of public information about the organization.[17] However, not even the publically available information about the

[17] I will come back to the shortage of information and analyses about NIC, and the need for providing such information, in section 4.2.

creation, purpose and members of NIC was included in the Vinnova report. (Vinnova 2015)

The Vinnova report includes a description and comparison of 14 councils in 12 countries (Vinnova 2015: 20). They are called "national innovation councils" throughout the report (e.g. Vinnova 2015: 8, 20, etc.). This term is actually an example of highly inappropriate labelling. It may lead one to believe that all the councils in the 12 countries mainly focus on innovation. However, in the formal and official names of *all* the councils in the 12 countries described we find the words "research" or "science" (Vinnova 2015: Table of Contents). In most of the cases where the name also includes "innovation" this word has been added in later years. The specific descriptions of the councils in the Vinnova report also indicate that the councils are heavily focused on research/science policy rather than innovation policy.

Research is not the same as innovation. A research system is not the same as an innovation system. A council for innovation is not the same as a council for science/research and technology/innovation. I will discuss this issue with regard to Sweden below, and hope to show that it is important to sort out the differences between councils for research and for innovation. In addition, it is important to understand the relations between these councils on one hand and innovation theory and innovation policy on the other.

In Sweden, there is (now) a Research Policy Council as well as a National Innovation Council. The political governance of these two areas are thus separate.

The Research Policy Council (Forskningsberedningen), which has existed for decades, is normally chaired by the Minister of Education or Research. This Council has advised the government when it develops a research bill that is presented to Parliament every fourth year. The latest two bills have carried the name "Research and Innovation Bill". However these bills have only marginally addressed innovation policy, and only in relation to research, i.e. in a linear manner (with innovation as an 'appendix' to research). There has certainly not been any holistic perspective on innovations or innovation policy in those bills.

In February 2015, the Prime Minister created the Swedish National Innovation Council (NIC) (Nationella Innovationsrådet).[18] He personally chairs the 5-8 hour meetings that occur four times per year – something that is extremely uncommon for corresponding (Science and Technology/Innovation) Councils in other countries. This is evidence of his dedication to dealing with innovation policy. My impression is that this dedication is not only a political priority of his, but also a personal interest. With his background as a trade union negotiator and leader, he understands the importance of innovations for the economy and for society – e.g. for productivity, wages, profits and taxes.

The NIC consists of 10 external advisors from industry, unions and academia, including three university professors, one union representative and representatives of large and small firms.[19] In addition to the Prime Minister, the Ministers of Finance, Enterprise/Innovation, Research and the Environment participate in the meetings[20]. The small secretariat of the Swedish Innovation Council is placed under the auspices of the Office of the PM, i.e. above all Ministries.

The NIC is thus *not* a science/research and technology/innovation policy council. Instead, it is dedicated to dealing with innovation policy in a much broader sense than most of the Science, Technology and Innovation Policy Councils in other countries, which are strongly dominated by a focus on issues of research. The Swedish NIC also partly deals with research policy issues, but in the broader context of innovation. This approach is similar to the way the Swedish Research Policy Council is dealing with innovation policy, which means that the areas of responsibility of these two Councils partly overlap.

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[18] When forming his government after the election in September 2014, the Prime Minister had also changed the name and responsibility area of the Minster of Enterprise into the "Minister of enterprise *and Innovation*".

[19] I am a member of the Innovation Policy Council from 2015. I was a member to the Research Policy Council in 2012-2013. This paper will partly build upon these experiences. Hence, part of this paper is based on "participant observation". It means, of course, that it is very delicate task for me to write this paper.
However, as will be mentioned later, very little information about the operation of the council is publicly available. This is also indicated by the fact that the Vinnova report on Science and Technology Councils did not include any information about the Swedish NIC (Vinnova 2015). I feel that I can contribute to mitigate this shortage of information. I actually believe that an increased availability of information about NIC is a virtue; it may increase the public debate on innovation policy issues, and in this way, improve its quality. It may also be of interest to innovation researchers to be informed about how a close interaction between politicians on one hand and representatives of academia, industry and unions on the other hand is functioning.
That very little information about NIC is publicly available does not mean that the activities of the Council are secrets.

[20] The Minister of the Environment resigned from the Government in April 2016 and has not been replaced by the new Minster of the Environment. The CEO of Ericsson is a member of the council. He had to resign as the CEO of Ericsson in July 2016, which may influence his participation in the council meetings.

For the benefit of developing an innovation policy independent of (but coordinated with) research policy, it is a great advantage that two separate councils exist, one for research policy and one for innovation policy. The establishment of this organizational framework means that Sweden has the potential to become the first country to break with the linear model in its innovation policy and to develop a holistic innovation policy. It is, potentially, a basis that will allow Swedish innovation policy to escape the linear model.

4.2. How does the Swedish NIC operate?

The work in and around the Swedish NIC is organized as follows. The dates of the four meetings each year are decided upon in the beginning of the year. General indications of the issues to be addressed are sent out to the council members about a month before each meeting and a detailed agenda is distributed about a week before the meetings. The agenda is created by the Principal Secretary of the Council (Wille Birksten, who is a political advisor to the Prime Minister) and the Secretariat (which is composed of three civil servants). The external members of the Council may propose agenda issues. The agenda is decided upon in interaction with the Prime Minister.

The agenda sets out who will present each agenda issue. These people might be members of the Council (external members or Ministers), other Government Ministers or other external experts that are specialists on the various issues. No attachments accompany the agenda. The discussions at the meetings are, in my view, very well informed and lively. Any advice presented by the external council members can, of course, be accepted or not by the government.

The external council members are not asked to write any reports. However, some of the 10 external members write reports and articles on innovation-related issues in their everyday professional practice outside the council – and these may, of course, spill over into the discussions at the council meetings.

No formal or official minutes of the meetings are kept; however, anyone present (including political advisors) can, of course, take notes. As a result, the transparency of the operation of the NIC is very limited. Therefore, media and other external actors have limited possibility to obtain information about the operation of the council. However, there are no secrecy requirements; the members can speak freely about any discussions.

The State Secretaries (Deputy Ministers) of the 4-5 ministers participating in the NIC meeting have a follow-up discussion after the Council meetings to decide what to implement and how. Between NIC meetings, individual council members are sometimes involved in discussions with ministers or the administration on specific issues.

As is evident from the above, the operation of the NIC is very informal. This has been criticized by some commentators. However, as indicated above and discussed below, mechanisms exist for transforming the advice of the council members into political decisions if the government so wishes.

4.3. What has been achieved by NIC?

A wide range of issues have been discussed at the Swedish NIC meetings. A few examples are risk capital provision by the state, the life sciences, digitalization, innovation-related public procurement, the development of a holistic innovation policy and the issue of additionality in innovation policy making.

I will now address the discussions in the NIC as regards four of these areas and take up the effects they have had on policy. Whether a certain structure and organizational form of the council is appropriate and good or not will be shown by whether the discussions in the council influence government innovation policy or not, and whether it is influenced in good directions or not.

The four issues listed below will serve as examples of discussions at the NIC meetings and of their influence on government innovation policy in practice. The first two issues have, in fact, been transformed into political decisions and the other two have been discussed in interesting ways, reported below.

- Risk capital provision by the state (section 4.3.1.)
- Innovation-related public procurement (section 4.3.2.)
- Holistic innovation policy (section 4.3.3.)
- The need to characterize innovation policy intervention as additionality (section 4.3.4.)

I have not chosen these four areas randomly. They are issues in which I have been doing research previously and on which I should thus be expected to have some competence. I also raised those four issues (and others) in my presentation at the very first meeting with the innovation council at Harpsund on February

24, 2015.[21] Hence, I have been selective among a large number of issues. My examples can – and should - be supplemented - with accounts of other issues discussed in NIC and reported by other observers and analysts.

4.3.1. Provision of risk capital by the state

Since financing is absolutely crucial for turning knowledge into commercially successful innovations and facilitating their diffusion, it is one of the most important activities in innovation systems (see Figure 1). Resources for financing of innovations come primarily from *private* actors, for example from innovating firms themselves (internal capital markets), stock exchanges, venture capital funds and firms, banks or individuals ('business angels'). However, in many countries – including the United States – *public* agencies also provide such financing, in the form of seed capital for instance, in support of innovation activities. Such public activity may certainly be an element of (a holistic) innovation policy.

If private capital is available, public funding agencies should not provide funding since this would compete with private organizations (in an 'unfair' manner) by using public (tax-payers) money. On the contrary, public agencies should add support to the innovation system that no private actor is able to contribute, i.e. the concept of "additionality" should be applied. Another way to express this is that the public risk capital providers should be "market supplementing" actors. This is, of course, the reason for the creation of public risk capital funds in the first place. In other words, private initiatives should not be duplicated or crowded out by public agencies.

Hence, determining the line of demarcation between the spheres of activity relevant to private versus public actors is an important issue to resolve in the design of innovation policy. That is, an important part of the process of designing public policy is to establish where and when there should be public intervention to solve "problems" that private organizations cannot solve. The reasons why private organizations are unable or uninterested to invest in certain situations are normally uncertainty or risks that are too large. If public action is motivated, it may therefore need to include an element of subsidy.

A crucial issue to address is, accordingly, whether or not there is an actual need for public financing of innovation. This requires detailed analysis that is actually

[21] The idea behind selecting issues raised at the first meeting is, of course, that they have been allowed more lead time than other issues to be transformed from advice at the council into practical policy.

not that easy to carry out in an exact manner. However, it is possible to perform such analyses (see below), and with the help of analyses the decision to pursue innovation policy or not need not be determined by political ideologies, lobbyism or vested interests. Rather, such determinations can be a matter of establishing that private innovation financing is not available in certain situations in which funding is needed for the operation of the system, i.e. that we do have cases of additionality.[22] This is all the more complicated since the potential availability of private financing changes as the innovation processes develop. Risks often decrease over time with the process of developing the innovation and the availability of private risk capital thereby increases.

In this context, the issue arises that public policy includes actions already carried out by public organizations. What are the characteristics or features of these actions? If the characteristics of these actions are not appropriate, it is a policy issue to determine why and how they should be changed. In other words, public organizations need to figure out whether the solutions attempted by public policy might not be working well or are the best ones. It could be that the public organization is unable to solve the problems, or may even be aggravating them. If so, policies must, of course, be changed. Innovation policy design thus includes the identification of what should be achieved by new policies, but also how existing policies should be changed.

According to Svensson (2011), only 16 % of all public support for equity investment in Sweden targeted the seed stage. He also points out that the seed stage presents the lowest risk of the government crowding out private funding. At the same time, the bylaws of many public funding agencies (agencies in which the state is represented) require the funding actors not to make losses or even to make a profit (rather than providing a subsidy). As a consequence, the funding agencies seek projects with low risk, i.e. projects in late or mature stages. (Svensson 2011; OECD 2013)

Accordingly 84 % of the public funding was allocated to firms that already had made sales and were in a period of expansion. This means that public capital was crowding out private capital, and that public funds were used for purposes that were not motivated. This is extremely problematic from an additionality point of view.

The analysis by Svensson summarized above was followed by a report on public provision of risk capital by the highest Swedish auditor, Riksrevisionen, an

[22] See section 2 and section 4.3.4 for a general discussion of additionality in the context of criteria for when public intervention is motivated and in which situations it is not.

agency created and governed by the Parliament (Riksrevisionen 2014). This report presented similar conclusions, as summarized below.

Riksrevisionen (2014: 48) divided investments into the following stages: “seed”, “start-up”, “early growth”, “expansion” and “mature”. The “seed” and “start-up” phases can be considered to be early phases. The agency found that private financers were mainly active in the three later phases, with the mature one being absolutely dominant. According to Riksrevisionen, the “seed” phase received only 0.2 % of public capital during 2011-2012, which must be considered to be extremely low. About 28 % of the public capital went to the “start-up” phase. Hence more than 70 % of the funds went to the more mature phases. (Riksrevisionen 2014: 49) Clearly, the additionality condition was, according to the numbers presented by Riksrevisionen, fulfilled only for a small part of the public investments.

The Swedish example above illustrates a “spontaneous” tendency not uncommon in public innovation funding organizations to drift into funding of later stages in the innovation process – instead of concentrating on the early stages, where innovating companies do not yet have any sales. The provision of such funding actually competes with private providers of capital, which may partly be explained by the fact that public risk capital providers often require co-investments by private investors.[23] In fact, the additionality condition was, according to the research of both Svensson (2011) and Riksrevisionen (2014), not fulfilled in most of the cases where public risk capital was invested.

I stressed the fact that the additionality condition was not fulfilled in Swedish state risk capital provision in my presentation at the first meeting of the Swedish NIC in February 2015. The Minister of Enterprise and Innovation (Mikael Damberg) and his State Secretary raised the same issue later at that meeting. During the subsequent discussion, there was general agreement that additionality (market supplementation) should be assured. The Minister authorized an investigation immediately after that meeting and the investigator presented his results on June 15, 2015. The issue was again discussed at the NIC meeting in September 2015. The investigation was then sent out for comments and review and the Ministry, on this basis, presented a bill to Parliament in February 2016. This bill was discussed in Parliament in June 2016 and a decision was taken, completely following the proposals in the bill (which indicates unity among all political parties). Very soon after the decision in Parliament (in early August 2016), the Minister of Enterprise and Innovation created a new public risk

[23] The co-investment strategy ”drew” public capital to late stages rather than ”drawing” private capital to early stages.

capital company called Saminvest with a capital of five billion Swedish crowns (0.55 billion euros).

To complete this process (from discussion in the council to a decision in Parliament and the creation of the public risk capital company) in 17 months is enormously rapid. I believe that the fact that it was discussed in NIC, created and chaired by the Prime Minister, is a partial explanation for the speed of action. In other words the mere existence of the NIC gave the innovation policy issues a much higher status and degree of importance within the government itself and within the government agencies, i.e. in the entire state apparatus. The swiftness of the action of the Ministry of Enterprise and Innovation is the second part of the explanation for the rapid action.

Problems remain, of course, in the operation of Swedish public risk capital provision. One problem is that the need for public risk capital has to be more clearly identified by means of analysis - in terms of sectors and stages of development. Another is that the size of the subsidy that is involved in the public risk capital provision has to be defined.[24] A third one is that the fund-in fund solution chosen means co-investments between Saminvest and private capital providers.[25] All these problems have to do with the additionality condition, to be further discussed in section 4.3.4. However, it is highly probable that the quality of the public risk capital provision will be much better after the changes described above.

4.3.2. Innovation-related public procurement

Public procurement occurs when public agencies (national, regional, local) purchase products (goods, services, systems). Public procurement can be a driver of innovation as well as an instrument of innovation policy. The purpose and point of departure of public procurement should always be to solve societal and environmental problems, to satisfy human needs or to meet global challenges.[26]

[24] A substantial subsidy may be required to make early stage investment viable – since the risk of failure in these stages is the basis for the need of public risk capital in the first place.
[25] That such co-investments may be problematic and may "draw" public capital to late stages was indicated by the history of public rick capital provision told above. It is a problem that should be solved by the directives to Saminvest from the government and then be dealt with by the board of Saminvest.
[26] This subsection is to a large extent based on (Edquist 2014c, Edquist 2015 and Edquist 2016, but also on earlier publications co-authored with Jon Mikel Zabala-Iturriagagoitia – please see the list of references).

How can we achieve an increased use of innovation-related public procurement? What types of procurement have the potential to enhance innovations, and how can they be used to a larger extent? These issues, and how they have been handled by the Swedish NIC will be addressed in this subsection.

The demand-side factors that influence innovation processes are emphasized to a much greater extent in the innovation systems approach than in earlier theoretical approaches. Demand-side activities are, for example, 'the formation of new product markets' and 'the articulation of quality requirements emanating from the demand side with regard to new products' (see section 2 and Category II in the list of activities in systems of innovation in Figure 1).

Demand-based innovation policy can be defined as a "set of public measures to increase the demand for innovations, to improve the conditions for the uptake of innovations and/or to improve the articulation of demand in order to spur innovation and the diffusion of innovations." (Edler 2009: 3) In this section, I will very much concentrate on one kind of demand-side innovation policy instrument: innovation-related public procurement. I have dealt with analyses of innovation-related procurement as a (policy-interested) researcher since the mid-1990s. [27]

The reason for choosing innovation-related public procurement in particular is that it is potentially the most powerful kind of demand-side innovation policy instrument available – see below. It might even potentially become the most powerful instrument among all innovation policy instruments. Public procurement of different types may affect both the *speed* and *direction* of innovation development.

Total public procurement in 2009 accounted for 19.4 percent of the EU's GDP, that is, the enormous sum of 2.3 trillion euro (Kahlenborn et al, 2010). The annual public procurement in Sweden is estimated to be about 600 – 800 billion crowns (16 – 22 percent of GDP for 2013).[28] I assume here that the amount was 700 billion crowns, or 19 percent of GDP for 2013. Regular procurement

[27] One of my first publications in this area was Edquist et al (Eds) 2000. In Edquist 2016, Edquist 2015, Edquist 2014c, Edquist et al 2014, Edquist and Zabala-Iturriagagoitia 2012, Edquist and Zabala-Iturriagagoitia 2014, we have discussed taxonomies of various categories of public procurement at great length - which cannot be repeated in a systematic way here.

[28] There are estimates of 500 to 900 billion crowns. What is important is not the exact amount, but that it is a *very* large part of the economy.

accounts for an overwhelming proportion of this public procurement.[29] It is my view that parts of this regular procurement could and should be transformed into public procurement that leads to innovations.

Public procurement is related to demand and occurs when a public agency or unit purchases a product (i.e. a good, a service – or a combination of these, as a system). Existing products (”off-the-shelf”) are purchased in *regular* public procurement, and the procuring authority/unit does not, in this case, demand any innovations (new products) from the bidders. Regular procurement may, for example, be the purchase of pens, paper, towels, trains, telecommunication services, cars, etc. In regular public procurement the procuring part normally describes the desired product in the tender documentation (“förfrågningsunderlag”).

A large number of regular public procurements are perfunctorily conducted, i.e. the procuring agency or unit describes the same product as in previous procurements in a routine manner. These solutions or products must obviously be existing ones, since they can be described. They may even be obsolete. If that is the case existing, qualitatively superior, products (innovations) may be excluded. A routine of simply describing the previously procured products makes it difficult or impossible for new products (innovations) to be accepted. This is a major obstacle to innovation. You get what you ask for – even if it is an obsolete product.

Public innovation procurement [30] takes place when a public agency or unit places an order for a product to fulfil certain functions within a given time period, but for which a product does not exist at the time of the order. [31] This type of procurement must result in some form of product innovation before delivery can occur.

The sub-category *direct public innovation procurement* occurs when the procuring authority/unit is also the (end) user of the product that – at best –

[29] Our empirical knowledge of how large various types of procurement are is, however, poor and needs to be developed. An estimate of the size of innovation-related public procurement was made in Edquist (2014c).
[30] Private companies can conduct private regular procurement as well as innovation procurement. These forms of procurement are not discussed in this paper..
[31] The main focus is on functions that satisfy human needs or solve societal problems by means of the development of new products.

results from the procurement. This is the ”classical” case.[32] The procuring agency uses its own demand or need to promote an innovation.

The sub-category, *catalytic [33]public innovation procurement* occurs when the procuring agency functions as a catalyst, part-financier, coordinator and/or knowledge resource for the (end) user, which is represented by a ”purchase group.” In this type of innovation procurement, the need lies “outside” the public organisation, which acts as a coordinator. The procuring agency, although not the end user of the resulting product, has the task of ”purchasing” the new product ”on behalf of” other actors, both public and private. The agency thus acts as a “catalyst” for the development of innovations for wider use, and not for the direct satisfaction of needs of the procuring organisation. The purpose of conducting catalytic innovation procurement may be to mitigate global challenges.

Innovations may sometimes occur ”spontaneously” in regular procurement. They may, however, be very much facilitated by so-called *functional procurement.*[34] Functional procurement is thus a special kind of regular public procurement. Functional procurement can be defined as the procurement of products by an authority/unit that describes *a function to be performed (or a problem to be solved) instead of describing the product that is to perform the function*. In functional procurement a public agency specifies *what* is to be achieved rather than *how* it is to be achieved. It opens up for innovation but does not require it. The old product can still be procured (if it fulfills the - functional - specifications). This means that the risk of failure is smaller with functional procurement than with innovation procurement.

An example of functional procurement might be a Public Transportation Agency or local government offering to buy a specified maximum decibel level in

[32] Direct innovation procurement has long been practiced in Sweden and other countries. Several examples are described and analyzed in Edquist, Hommen and Tsipouri (2000), in Edquist and Zabala-Iturriagagoitia (2012) and in Edquist, C., Vonortas, N., Zabala, J.M., and Edler J. (Eds.), (2015a). These studies show that direct innovation procurement has been a Swedish success story and that this country has an “impressive” history in this respect. The transmission of high-power electricity and the first electronic telephone switch are examples. Both were developed through direct public innovation procurement in Sweden. These two products contributed to the consolidation of two large multinational corporations (ASEA/ABB and Ericsson) and created tens of thousands of jobs and billions of Euros in sales.

[33] This concept was first formulated in (Edquist et al, 1998) and further developed in (Edquist Hommen and Tsipouri, 2000).

[34] During the last year or so, i.e. simultaneously to my membership of the National Innovation Council, I have developed the perspective on functional procurement in Edquist 2015, and 2016, partly based on Edquist 2014c.

apartment buildings close to a road or railway – instead of buying a noise barrier (a fence). The targeted decibel level can be achieved by suppliers/innovators in many ways (an earth wall, trees and plants, 'quiet' asphalt, lower speed, something not yet imagined by anyone, etc.) – and which particular method or device does not matter.

In actual practice, direct innovation procurement in Sweden is currently limited, apart from in the procurement of defense material. A political decision to enhance direct innovation procurement can certainly change this situation. Possible alternatives may be to use approaches such as catalytic and/or functional innovation procurement.

Sweden has in fact had long, unique and successful experience of catalytic innovation procurement, through the Swedish Energy Agency (Energimyndigheten) and its predecessor. It has carried out about 60 catalytic procurements to date. An early example is refrigerators with a low energy use and no use of freon (Edquist and Zabala-Iturriagagoitia 2012). It can and should be used as a role model for other authorities.

Catalytic innovation procurement could and should be used to a much higher degree in Sweden, and elsewhere, to enhance innovation in ways that solve problems and satisfy needs. In addition, intensive efforts should be made to further develop effective catalytic innovation procurement procedures and build on the past successes of applying this approach. Catalytic innovation procurement could well provide an alternative to direct innovation procurement.

In my experience, however, the most important and powerful means to enhance innovation through public procurement is by formulating regular procurement in functional terms. All *innovation* procurement, both direct and catalytic, must be conducted through functional specification if it is to produce the desired results. This is so by necessity, since products that do not exist cannot be described.

From an innovation perspective, it is, accordingly, very important how calls for tenders are formulated in procurement processes. In the calls, either the desired product can be described ("product procurement") or alternatively, the function that the product shall perform or the problem it is supposed to solve can be described ("functional procurement"). In functional procurement the bidders can offer an existing product, or a new innovation-based one. And the procurers can choose between the old and the new products.

Private firms are often open to innovation when they buy from each other – and they often require improved products. Public procurers do so more rarely. This means that both they and their suppliers are left behind. *To achieve innovation through public procurement it is, paradoxically, more important to emphasize functional procurement than to pursue innovation procurement.* Functional procurement opens up for innovations in *all* public procurements - not only those requiring innovations (i.e. innovation procurement).

As large a proportion as possible of all regular procurement should thus be described in terms of the functions to be fulfilled or the problems to be solved. My proposal is that the proportion of the regular procurement volume (state, county and municipality) to be described in functional terms should increase by five percent points every year over the next five years. When 25 percent is achieved after five years, the programme should be re-evaluated and new decisions made. [35]

The main reason for this proposal is that its implementation would release enormous creativity and innovativeness among suppliers – and for the public sector - within a very large proportion of the economy as a whole. The proposed approach would also lead to increased competition, not only among different potential suppliers of similar products, but also among radically different products that solve the same problem. All this leads to a higher quality of the public services. Functional public procurement has, in my mind, the largest potential to enhance innovations in all kinds of public procurement. This potential has, so far, been harvested to a very limited degree. [36]

It must here be mentioned that there is resistance against pursuing functional public procurement among procurement administrators, which I discussed at length in Edquist (2016c). Reasons are that bureaucrats prefer to cut-and-paste from the previous call, and describe the product. They often believe that it is much more complicated to describe functions. This may be true in some cases, but certainly not in the decibel example. At the same time, there are many

[35] Regular procurement constitutes 15-20 percent of Europe's economies. For Sweden, our proposal means that functional public procurement would amount to 175 billion crowns after five years. This is actually 5 % of the Swedish GDP. How much innovation this would lead to is impossible to say. The total Swedish public research budget is about 35 million crowns per year, i.e. a fifth of the above. Measured in economic terms, a transformation such as the one proposed here is an extremely powerful innovation policy instrument.

[36] It is, of course, also very important that other restrictive conditions that prevent small or innovative firms from submitting tenders are not included in the calls for tenders. At the Region of Skåne, which is a very advanced procuring organizations, Louse Strand (Director of procurement) calls this an "innovation friendly washing machine".

examples where functional procurement has actually been carried out in Sweden and elsewhere (although no systematic record of these exists). One very interesting description of various cases of "problem-based procurement" in several countries is available in Rosenberg (2016).

To systematically use functional procurement as an innovation policy instrument may be under way in Sweden. After the election in September 2014, the new Prime Minister (Stefan Löfven) appointed a Minister for Public Administration for whom the responsibility for public procurement is a very important duty. From September 2015, this Minister (Ardalan Shekarabi) created a new separate public agency for "procurement support", with support to innovation-related procurement as an important task.

The importance of innovation-related public procurement was a topic that I had addressed in my presentation on innovation policy at the above-mentioned meeting of the NIC in February 2015. In November 2015 a meeting to discuss public procurement was organized by the main secretary of the NIC (Wille Birksten) between Annelie Roswall-Ljunggren, the State Secretary to Ardalan Shekarabi, and me. At that meeting, I emphasized functional procurement. In December 2015, I used an opportunity to talk to the Prime Minister about functional public procurement as a very important innovation policy instrument operating from the demand-side (and therefore potentially balancing the linear view). During 2015, I had also gradually developed the analysis of innovation-related public procurement in the direction of increasingly stressing the importance of functional procurement for innovation. The result was published in an article in the daily economic newspaper *Dagens Industri* in February 2016 (Edquist 2016).

A National Public Procurement Strategy was simultaneously being formulated by Ardalan Shekarabi during the first half of 2016. How enhancement of innovation can become a part of this strategy has been discussed in some detail at two meetings (in February and June) in NIC during the spring 2016, after presentations by Ardalan Shekarabi. As regards the relations between innovation and public procurement, the discussions in NIC led to a gradual re-orientation. An initial focus in the presentation on "innovation-friendly public procurement" was changed to a focus on functional innovation procurement as an innovation policy instrument. In May 2016, I was called in for discussions of a draft of the national procurement strategy with Ardalan Shekarabi. The discussion at that time focused only on how functional procurement can be used to enhance

innovation. This influenced the procurement strategy as can be seen in the excerpts from the strategy in the list below.

The government took a decision to adopt the National Procurement Strategy in late June 2016. Functional procurement is an important element in that strategy. (Regeringskansliet 2016)One of seven parts of that strategy has the title “Public procurement that enhances innovations and alternative solutions”. The following are quotes from this part:

- “There is a large potential in using procurement as an instrument to enhance development and innovation.”
- “The public sector can also enhance innovation in suppliers by, in procurement, demand functions rather than ready solutions.”
- “By requiring functions instead of having specific requirements with regard to goods and services, the creativity and ability to innovate of the potential suppliers are enhanced.”
- “To demand functions can increase competition in the procurement, since a larger number of firms and organizations can respond to the tenders, which is beneficial particularly for small and medium-sized firms.”
- “… your agency formulates functional requirements and emphasizes the result that shall be achieved instead of specific requirements with regard to the goods and services.”
- “… your agency uses assistance from the initiatives and means of support that The National Agency for Public Procurement has developed to formulate functional requirements in procurement.” (Regeringskansliet 2016: 18-19)

The fact that functional public procurement is an important part of the National Public Procurement Strategy will not mean any substantial new costs (except in education and training).It will be an alternative way of using the funds that are already allocated to public procurement. Public procurement accounts for 20 % of GDP. If 10 percent of the 700 billion crowns used for public procurement will stimulate innovation in the future, this corresponds to 70 billion crowns (8 billion euros). The public annual research is 35 billion crowns (4 billion euros). Hence, the application of this new strategy has great potential to increase the resources that will be used to obtain products with a higher quality (innovations). This, in turn, could lead to better needs satisfaction and/or problem solving and lower costs in the long run.

Of course, the strategy remains to be implemented. If the implementation process turns out well, Sweden will be the first country to systematically use functional public procurement as an innovation policy instrument. As a result of these recent changes, functional public procurement may develop into the most important instrument in Swedish innovation policy. Since this instrument operates from the demand-side, it constitutes a supplement to research policy and other instruments that drive innovation from the supply side. It could thereby be an important element in transforming Swedish innovation policy from a linear to a holistic one, and thereby making it more efficient.

The possible breakthrough for functional procurement in state policy would not have happened without the notion of ”holistic innovation policy”, without the discussions in NIC and if NIC had not operated as a stimulus to policy development.

4.3.3. Holistic innovation policy

A holistic innovation policy is, in this paper, defined as a policy that seeks to integrate all public actions that influence or may influence innovation processes. It takes all determinants of innovation into account (e.g. the ten activities in Figure 1). A holistic policy requires a broad version of the systems of innovation approach as its basis, as discussed in section 2. Innovation policies are, however, normally practiced in a much more *partial* way, focusing on only a few of the determinants of innovation processes. Partial innovation policies are often based on the linear view of innovation by focusing strongly on research – and therefore the policies themselves become linear. This means that innovation policy as practiced is far behind innovation research.

At my presentation at the first meeting with the Swedish National Innovation Council, I addressed, among other things, the fact discussed in section 3 above that innovation policies in 19 EU countries - including Sweden - are (still) linear and not holistic. In these countries, the most important innovation policy instrument is research - which works from the supply side - and almost nothing is done from the demand side.

I argued at the NIC meeting, that Sweden should develop a holistic innovation policy. This would mean that innovation policy would be established as an

independent policy area. In an op-ed article published in March 2015 in Sweden's largest newspaper (Dagens Nyheter), I made a specific proposal that the Swedish government could achieve this by presenting an innovation bill to Parliament as a logical step in the development of a holistic innovation policy. I also described, in some detail, what could be the content of such a bill. (Edquist 2015a)

Consolidating innovation policy as an independent policy area would, in this respect, make it similar to research policy – which has been an independent policy area in Sweden, as in many other countries, for decades. But it would also make innovation policy independent and separate from research policy. This would be a major change, since innovation policy has been treated as a "part" of research policy for very long. I would argue that such a separation between innovation policy and research policy is very important if the linear view is to lose its hegemonic dominance in the field of innovation policy.

Of course, if we use broad definitions of innovation policy and research policy (as I think we should), there must be overlaps between the two policy areas with them "intruding" into each other's "territories." This can be generalized: they also intrude into the territories of other policy areas, such as labor market policies, public procurement policies, defense equipment policies, energy policies, transport policies, health care policies, environmental policies, and regional policies. The effect of the resulting "intrusion" or "trespassing" makes it clear to everyone that policy areas do overlap and that they therefore have to be coordinated.

Innovations emerge in complex systems where many factors have an influence as determinants of innovation (see Figure 1). Research is certainly not always a basis for innovations, and much research funding is intended for basic research and research in areas with little relation to innovation. Since research and innovation are different activities, we must distinguish between innovation systems and research systems. We should therefore not talk about "research and innovation systems", which is actually a common expression. Research policy and innovation policy are self-evidently also different activities. They have different objectives and use different policy instruments. A separation between the two is an obvious way of facilitating the transformation of innovation policy from linear to holistic. It may lead to better policies in both cases.

In this context, it might be noted that many countries use the label "science and technology policies." Recently, some countries, such as Japan, have added innovation, and hence talk about "science, technology, and innovation policies." This is, of course, tautological since all new technologies are normally included in the concept of innovation (see the definition of innovation in section 2 above). In addition, everyone using the expression "science, technology and innovation policy" is an implicit subscriber to the linear view.

In the discussion above of the relations between policy areas, it was noted that it is natural that policy areas are partly mutually overlapping. Research-related innovation issues should be addressed within research policy and innovation-related research issues within innovation policy. Innovation policy and research policy should be separate from each other in the design phase – but it must be ensured that they support each other when implemented (in the same way as many other policy areas have to be coordinated with each other).

But, does the existence of two councils in Sweden – one for research and one for innovation – mean that the two policy areas are independent and equal? The answer is no. This has not (yet) happened in Sweden (or anywhere else). The Research and Innovation Bill in Sweden is prepared every fourth year by the Ministry of Education and Research and the Minister of Research is advised in this task by the Research Policy Council.[37] No independent innovation bill has been developed and presented to Parliament by any Minister or Ministry. However, the existence of two councils opens up for a separation of the two policy areas. For the benefit of developing an innovation policy independent of (but coordinated with) research policy, it is a great advantage for there to be two different councils.

To sum up, innovation policy is slowly being established as an independent policy area in Sweden. At the same time there are strong tendencies transforming this policy area into an increasingly holistic one in Sweden. Indications in this direction are that:

- An Innovation Council exists, with the Prime Minister (Stefan Löfven) as the Chairman. The existence of this governance tool is important, since the forces defending the linear view are strong. The discussions in the

[37] The Bill to Parliament to be presented 2016 will be called "Bill for Research, Innovation and Education". It is likely to be strongly dominated by research issues and innovation and education will probably be treated only to the extent that they are closely related to research, i.e. in a very partial manner.

NIC address all the potential determinants of innovation processes (including research), as seen in the examples above.

- Sweden has a Minister of Enterprise *and Innovation* for the first time (Mikael Damberg). This is an upgrading of the importance of innovation policy in relation to other policy areas. Mikael Damberg is in charge of several of the policy areas that would be parts of a holistic innovation policy.[38]

- Sweden has a Minister for the first time (Ardalan Shekarabi) for whom public procurement is a main responsibility. He has developed a National Public Procurement Strategy in which functional procurement that enhances innovation is very important (see section 4.3.2.). This has been done in no other country. Functional procurement is potentially a very powerful innovation policy instrument, and it operates from the demand side. Therefore, the policy emphasis on functional procurement can serve to balance the dominance of research in Swedish innovation policy. Functional procurement may develop into a major contribution to developing a holistic innovation policy in Sweden.

- About the role of the Innovation Council the following is written at the NIC home page: "The Innovation Council contributes to giving innovation policy a clear holistic perspective. It means that the Innovation Council raises issues that cover several policy areas and that are of importance for enhancing the framework conditions for the development of innovations, for the innovation work in the public sector itself and for the direct actions that are carried out within the national innovation policy. The emphasis on giving innovation policy a holistic perspective also means that the Innovation Council raises horizontal issues…." (http://www.regeringen.se/regeringens-politik/innovationsradet/innovationsradets-roll/ - 2016-08-23)

- In the *Research Europe* issue of March 2015, the following was reported: "The establishment of the innovation council means that research policy

[38] The previous government, before September 2014, gave innovation policy a much lower priority in general and also within the Ministry of Enterprise, which I argued in an op-ed article in 2013 (Edquist 2013), partly based on OECD´s review of the Swedish innovation policy (OECD 2013). A second OECD review of Swedish innovation policy was published in 2016 (OECD 2016).

> and innovation policy will be separated, with research issues dealt with by a separate group. According to Löfven, the council is intended to take a holistic and realistic approach to innovation." (Maukola 2015: 17)

Although, the Swedish government has not developed and presented an innovation bill to Parliament, Swedish politics during the recent two years has certainly developed in this direction, and an innovation bill can be argued to be "in the cards". This means that Sweden has the potential of becoming the first country that breaks with the linear model in its innovation policy and continues developing innovation policy in a holistic direction. This is very much thanks to the creation and operation of the Swedish NIC, and the fact that the Prime Minister is its chairman. In other words, it has been very important that the governance tool of the innovation council has been established and is in operation.

4.3.4. Additionality

Additionality refers to the division of labor between what private organizations carry out in systems of innovation, and what is carried out by public organizations. Innovation policy by public organizations is sometimes needed, but must not replace, duplicate, or crowd out what private actors can do. Public action should *supplement* what private actors do. A very important source of policy failures has been that the additionality condition was not fulfilled when a policy was initiated. Lack of additionality has its roots in a lack of analysis of the reasons for and suitability of public intervention.[39]

At the first meeting of the Swedish National Innovation Council in February 2015, I raised the issue of additionality. My impression of the discussion following at this and later meetings with the council is that some politicians were not particularly used to thinking in these terms. At the same time it is important that the state is doing only things that private organizations cannot or are not doing, i.e. that public organizations, through policy intervention, are acting in a supplementary way. The division of labor between what private and public organizations do is important, i.e. additionality is key.

[39] Additionality has been addressed, for example, by Georghiou 2002 and Bergman et al 2010.

Hence it is important to find out (A) what is important for the innovation system, and at the same time (B) what cannot or will not be performed by private actors.

These two issues were discussed, in some detail, with regard to risk capital provision in section 4.3.1. In that discussion, I showed that large amounts of public resources had been spent for many years without the additionality conditions having been fulfilled. It was a political failure caused by lack of detailed analysis and, maybe, the vested interests of various actors in the field. Later analysis by Svensson (2011) and Riksrevisionen (2014) established that the additionality condition was, in fact, not being fulfilled. [40]

To establish whether or not the additionality condition is fulfilled requires detailed analysis and is actually not that easy to establish in an exact manner. But it is possible to carry out such analyses – which means that the decision to pursue innovation policy intervention or not need not be a matter of political ideology.

That policy failures often have their roots in non-fulfilment of the additionality condition indicates that policy problems are often created by (earlier) policies themselves. Such failures can also be caused by lack of basic data and evidence when designing innovation policies or by the previous use of (the wrong) policy instruments.

I believe that it should always be established that the additionality condition is fulfilled before innovation policy action is taken. This means that much more effort and analysis should be invested in securing that the additionality condition is fulfilled when innovation policies are designed. This also requires additional conceptual and theoretical work as well as research on relevant indictors and data, to provide underpinnings for such decisions. It is essential that innovation policy be evidence-based to a larger degree. The discussions in relation to state risk capital funding in the NIC has increased the awareness of the importance of understanding the complexity of additionality issues within the context of innovation policy.

5. Summary and conclusions

[40] I could give many other examples where innovation policy has been pursued in spite of the fact that the additionality condition has not been fulfilled.

Introduction

The Swedish National Innovation Council (NIC) was created by the Prime Minister (Stefan Löfven) in February 2015 and has now been operating for 18 months. It is personally chaired by the Prime Minister, which is unusual for such councils in other countries. Another characteristic of the Swedish NIC is that it focuses on innovation (and not on research, for which there is another council).

In other countries the "corresponding" councils focus predominantly on science and research and treat innovation, if at all, as an "appendix" to research. As a result, these councils are contributing to the cementing of the linear model in the design of innovation policy, i.e. they are overemphasizing research in innovation policy. Innovation policy does not therefore get the 'space' needed to develop into an independent policy area.

The linear model has been completely rejected in innovation research and replaced by the systems of innovation approach. Hence innovation policy is lagging behind innovation research in this respect. The unique characteristics of the Swedish NIC mean that Sweden has the potential of becoming the first country to break with the linear model in its innovation policy and to start developing a holistic innovation policy.

The Swedish NIC has been described and analyzed in this paper. I exemplified its operation with four areas of NIC activity and showed that in two of them there have already been directly successful transformations of innovation policy (state risk capital provision and innovation-related public procurement). I have also indicated that an interesting development has been taking place in two others (holistic innovation policy and additionality). These examples were placed in a framework of relevant innovation theory and of the development of innovation policy in a larger context. The four examples are summarized further below, after a brief overview of the NIC.

A brief overview of the Swedish National Innovation Council

The council consists of 10 external advisors from industry, unions and academia. The external members include three university professors, one union representative and representatives of large and small firms. In addition to the

Prime Minister, the following ministers participate in the meetings: Finance, Enterprise/Innovation, Research and the Environment. The small secretariat of the NIC is placed in the Office of the PM, i.e. above all Ministries.

The operation of the NIC is very informal. This has been criticized by some commentators. However there are mechanisms for transforming the advice of the council members into political decisions if the government so wishes. The State Secretaries (Deputy Ministers) of the ministers in the NIC have a follow-up discussion after the Council meetings to discuss what to implement and how. Between NIC meetings, individual council members are sometimes involved in discussions with ministers or with the administration on specific issues.

State risk capital provision

In Sweden in the past there seems to have been a "spontaneous" tendency for public innovation funding organizations to drift into funding of later stages in the innovation process – instead of concentrating on the early stages, where innovating companies do not yet have any sales. As a consequence, the provision of this funding often competed with private providers of capital, which may be partly explained by the fact that it was often required that public risk capital providers should co-invest with private investors. Hence, the additionality condition was not fulfilled for most of the public risk capital invested.

This issue was discussed at the first meeting of NIC in February 2015. There was general agreement that additionality (market supplementation) should be assured. The Minister of Enterprise and Innovation (Mikael Damberg) authorized an investigation immediately after that meeting. The investigator presented his results on June 15, 2015. The issue was also discussed again at the NIC meeting in September 2015. The investigation was then sent out for a wide review and the Ministry presented a bill to Parliament in February 2016. This bill was discussed in Parliament in June 2016 and a decision was taken, completely following the proposals in the bill (which indicates agreement among the political parties). Already very soon (in early August 2016) after the decision in Parliament, the Minister of Enterprise and Innovation created a new public risk capital company called Saminvest with a capital of five billion Swedish crowns.

To complete this process (from discussion in the council to a decision in Parliament and the creation of the public risk capital company) in 17 months is enormously rapid. I believe that the fact that it was discussed in NIC, a created and chaired by the Prime Minister, is a partial explanation for the speed of action. In other words the mere existence of the NIC was important. The swift action of the Ministry of Enterprise and Innovation is the second part of the explanation of the rapid action.

Innovation-related public procurement

Public procurement occurs when public agencies (national, regional, local) buy products (goods, services, systems). It can be an important driver of innovation. When using public procurement as an instrument of innovation policy, the purpose and point of departure should always be to solve societal and environmental problems, to satisfy human needs or to meet global challenges.

Innovations may sometimes occur ”spontaneously” in regular procurement. This may, however, be very much facilitated by so-called “*functional procurement*”. Functional procurement is thus a special kind of regular public procurement. Functional procurement can be defined as the procurement of products by an authority/unit that describes a function to be performed (or a problem to be solved) instead of describing the product that is to perform the function. In functional procurement a public agency specifies *what* is to be achieved rather than *how* it is to be achieved. It opens up for innovation but does not require it.

An example of functional procurement, would be that a Public Transportation Agency or the local government buys a certain maximum decibel level in apartment buildings close to a road or railway – instead of buying a noise barrier (a fence). The targeted decibel level can be achieved by suppliers/innovators in many ways (an earth wall, trees and plants, ’quiet’ asphalt, lower speed, something not yet imagined by anyone, etc.) – and which way does not matter.

Functional procurement releases creativity and innovativeness among suppliers – and for the public sector - within a very large proportion of the economy as a whole. It also leads to increased competition, not only among different potential suppliers of similar products, but also among radically different products that solve the same problem. All this leads to a higher quality of public services.

Functional public procurement has, in my mind, the largest potential to enhance innovations of all kinds of public procurement. This potential has, so far, been harvested to a very limited degree.

To systematically use functional procurement as an innovation policy instrument may be under way in Sweden.After the election in September 2014, the new Prime Minister (Stefan Löfven) appointed a Minister for Public Administration for whom the responsibility for public procurement is a very important duty. From September 2015, this Minister (Ardalan Shekarabi) created a new separate public agency for ”procurement support”. Assisting innovation-related procurement is an important task for this agency.

Innovation-related public procurement was addressed as an innovation policy issue at the first meeting of the NIC in February 2015. Separate meetings and discussions were also organized with those politically responsible for public procurement.

The government took a decision to adopt a National Procurement Strategy in late June 2016. Functional public procurement is an important part of the Strategy. In practice, this will not mean any substantial new costs, but an alternative way of using the funds that are already allocated for public procurement. If 10 percent of the 700 billion crowns used for public procurement stimulate innovation in the future, this corresponds to 70 billion crowns (8 billion euros). The annual public research budget is 35 billion crowns.

The adoption of this new strategy means that functional public procurement may develop into the most important instrument in Swedish innovation policy. Since this instrument operates from the demand-side, it constitutes a supplement to research policy and other instruments that drive innovation from the supply side. It could thereby be an important element in transforming Swedish innovation policy from a linear to a holistic one, and thereby making it more efficient.

The possible breakthrough for functional procurement in state policy would not have happened without the notion of ”holistic innovation policy”, without the discussions in NIC and if NIC had not operated as a stimulus to policy development.

Holistic innovation policy

In this paper, *a holistic innovation policy* is defined as a one that integrates all possible public actions that influence or may influence innovation processes. It takes all determinants of innovation into account. Innovation policies are, however, normally practiced in a much more *partial* way, focusing on only a few of the determinants of innovation processes. Partial innovation policies are often based on the linear view of innovation by focusing strongly on research. This means that innovation policy as practiced is far behind the predominant views expressed in current innovation research.

The development of a holistic innovation policy requires that these existing innovation policy elements be coordinated and integrated. In some cases, the innovation policy elements should be given a higher priority than other policy areas, which requires tough prioritizations. Establishing priorities may mean that innovation policy is given superiority in relation to the existing priorities of specific ministries and require that they collaborate concerning innovation policy. This is easier to achieve when an innovation council exists, with the Prime Minister as its chairman and when placed in the Prime Minister's Office (and not in a Ministry).

Innovation policy and research policy should be separate from each other in the design phase – but means must be found to ensure that they support each other during implementation (in the same way as many other policy areas have to be coordinated). Doing so is another way to get away from the linear model.

To sum up, innovation policy is gradually being established as an independent policy area in Sweden. At the same time there are strong tendencies transforming this policy area into an increasingly holistic one in Sweden. This means that Sweden has the potential to become the first country that breaks with the linear model in its innovation policy and that continues developing a holistic innovation policy. This is very much thanks to the creation and operation of the Swedish NIC as a governance tool.

Additionality

Additionality refers to the division of labor between what private organizations carry out in systems of innovation, and what is carried out by means of the

policy of public organizations. Only activities that are important for the innovation system, but are not carried out by private organizations, should be performed by public organizations – if they have the ability to do so. Innovation policy is sometimes needed, but must not replace, duplicate, or crowd out what private actors can do. Public action should supplement what private actors do. A very important source of policy failures has been that the additionality condition has not been fulfilled when innovation policy initiatives were designed and initiated. Lack of additionality has its roots in a lack of analysis of the reasons for intervention.

To establish whether the additionality condition is fulfilled or not requires detailed analysis and it is actually not that easy to determine in an exact manner whether these conditions have been fulfilled. It is, however, possible to carry out such analyses – which means that the decision to pursue innovation policy intervention or not need not be a matter of political ideologies.

That policy failures often have their roots in non-fulfilment of the additionality condition indicates that policy problems are often created by (earlier) policies themselves. Such failures can also be caused by lack of basic data and evidence when designing innovation policies or by the previous use of (the wrong) policy instruments.

The existence of NIC has given innovation policy issues a much higher status and degree of importance within the government itself and within the government agencies, i.e. in the whole state apparatus. NIC has been a major governance instrument to transform Swedish innovation policy from a linear one towards a holistic one.

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