Paper no. 2014/08

Efficiency of Research and Innovation Systems for Economic Growth and Employment

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This version: May 2014

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WP 2014/08

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Abstract

The concept of a *holistic innovation policy* is defined in this paper, and it is discussed what it is, why it is relevant and how it can be implemented. One of the main conclusions is that the *innovation policies in European countries are still linear* (and not holistic), in spite of the fact that the linear view has been completely abandoned by innovation researchers – and replaced by a systemic view on innovation processes. Why innovation policy is still linear is also discussed. Further it is noted that a considerable number of EU Member States have created public organizations (Councils) for innovation and/or research policy placed above ministries and usually chaired by the Prime Minister. The role and character of these bodies is discussed. The empirical results are based on a questionnaire sent to 23 EU Member States, out of which 19 (83%) responded. The work with this report was carried out for the European Research and Innovation Area Committee (ERAC) of the European Commission (DG RTD).

JEL codes: L38, M38, O25, O31, O32, O33

Keywords: Innovation, Innovation Policy, Holistic innovation policy, Research policy, The linear view, Systems of innovation

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Efficiency of Research and Innovation Systems for Economic Growth and Employment

Final report from the SESSION I of the 2014 ERAC Mutual Learning Seminar on Research and Innovation policies

March 20, 2014

European Commission, Berlaymont building, room SCHUM, Brussels, rue de la Loi 200

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Efficiency of Research and Innovation Systems for Economic Growth and Employment

Final report from the 2014 ERAC Mutual Learning Seminar (MLS) on Research and Innovation policies: SESSION I. This work was funded by the European Commission (DG RTD) as part of the expert group supporting the policy learning activities of the European Research and Innovation Area Committee (ERAC) in 2014.

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May 29, 2014

1. Introduction

It is widely recognized that research and innovation are key determinants of economic growth and employment, and that they can also operate as means to address global challenges. How research and innovation policies can be instrumental in enhancing growth and employment, and in addressing challenges, will be dealt with in this report.

The European Research and Innovation Area Committee (ERAC) is a strategic policy advisory committee whose principal mission is to provide strategic input 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. On March 20, 2014, ERAC organized a Mutual Learning Seminar (MLS) in Brussels on national Research and Innovation policies. The first session of the seminar was designed and moderated by me.

Research policy was in focus in the two previous ERAC Mutual Learning Seminars (2012 and 2013). This year (2014), innovation policy and its relation to research policy was emphasized more.

I wrote an Introduction to the MLS topic in January 2014. It was sent out, in the same month, with an attached questionnaire to the 23 countries that had indicated an interest in participating in the 2014 MLS. 19 of these countries responded to the questionnaire.[1] On the basis of the responses, I also wrote a Discussion paper which was made available to all participants before the seminar and constituted a basis for the seminar discussions. The present Final Report is based on previous policy-relevant research, on the Introduction, on the Discussion paper, on the questionnaire and the 19 responses, and on the lessons learned at the Seminar. The report includes new empirical material on research and innovation policy thanks to the responses to the questionnaire.

The main findings of policy relevance are summarized in section 3.

When the paper was published in the CIRCLE Electronic Working Paper Series, a number of additional references were included.

[1] The 19 responding countries were: AT, BE, CY, CZ, DK, EE, FI, FR, HU, IE, LT, MT, NL, PRT, SE, SI, UK, CH, and NO. Hence the response rate was 83%. Germany also submitted input, which did not constitute direct answers to the questions. The German input is taken into account with regard to some of the issues discussed below, but obviously not in any calculations of percentages of responses to specific questions. The questionnaire was sent by the European Commission to the contact persons in the administrations of those member states that had indicated that they were interested in participating in the Mutual Learning Seminar. These contact persons, who were key individuals with regard to innovation and research policy in their national state administrations, often consulted with colleagues in other sections of the national administrations. Hence, it is not possible to say exactly who responded to the questions.

2. Themes selected and issues discussed at the MLS

To achieve specificity, Session I at the MLS only focused on a few themes and issues related to *policy* within the (vast) field of research and innovation. Public policy is defined as *all* actions by public organizations that influence certain societal processes – in this case research and innovation.[2] Hence, *research policy* is all actions by public organizations that influence research. *Innovation policy* is all actions by public organizations that influence innovation processes. They have different objectives. It should also be noted that very wide notions of research and innovation policies are used here.

Session I focused upon the *three themes* developed in sections 2.1 – 2.3 below. For each of the three themes, a few specific issues were identified. The issues chosen for the discussions were those for which the participating member states, according to the responses, either:

- tried to provide different solutions in their respective countries, or
- had different views on how to tackle the issues.

This means that this report will focus on "new" and/or "hot" issues on which the Member States do not agree. The idea is to create a fruitful basis for discussions, analysis and policy. In other words, it is hoped that this will create an atmosphere of Mutual Learning among EU member countries.

2.1. Theme 1: Transformation of innovation policy - from linear to holistic.

Research is undertaken primarily to acquire new scientific knowledge. Innovations are new creations of economic or societal importance, usually performed by firms.[3] They 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; it is a question of *how* the products are produced.[4]

[2] Public policy *includes* actions by public organizations that *un*intentionally affect these processes. However, it is important to make a distinction between policy (instruments) that are intended to influence (for example) innovation activities and policy (instruments) which influence innovation activities anyway.

[3] However, the firms do not produce innovations in isolation from other organizations, but are parts of innovation systems.

[4] The process innovations have been product innovations in an earlier "incarnation". This means that product innovations play a more dynamic role in the renewal of an economy than process innovations (Edquist et al, 2002). See also (Oslo Manual 2005) and section 2.3 for arguments.

In the early days of *innovation research and innovation policy*, the so-called *"linear model"* dominated the views on how innovations developed (Bush 1945). The model was based on the assumption that innovations are applied scientific knowledge. It was called "linear" because the process was seen as well-defined and consecutive stages that innovations were assumed to go through, 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. However, research does not automatically lead to innovations, i.e. to new products and processes. Scientific knowledge is not sufficient – it has to be transformed into innovations in order to create growth and employment. Some research results are never transformed into innovations and research is only one of the many determinants of the innovation process. It is not always necessary, and it is never sufficient to achieve innovation-based growth.

In the realm of *academic research* on innovation, the linear model has been practically completely replaced, in the last couple of decades, by the systems of innovation approach, which stresses interaction and interactive learning between organizations. This new approach, in its different versions, is defined in terms of determinants of innovation processes, although different determinants are emphasized in different versions. (Freeman 1987; Lundvall 1982; Nelson 1993; Braczyk 1998; Breschi and Malerba 1997; Carlsson 1995; Cooke 2001; Bergek et al 2008; Asheim and Isaksen 2002); cooke et al 1997) A general, and very broad, definition of systems of innovation is that they include "all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations" (Edquist 1997).[5] Such factors are discussed below, and a list of ten activities (determinants) is presented in Annex 1.

In the realm of innovation *policy*, the linear model is still much more dominant than it is in academic work. 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' - such as Public Procurement for Innovation (PPI) or Pre-Commercial Procurement (PCP) (Edquist and Zabala 2012). This may constitute the beginning of a transformation towards a *"holistic innovation policy"*.[6] Such a policy approach requires a broad and systemic view on the determinants of innovation processes. It must indeed take into account all the determinants of the whole innovation system.

Annex 1 presents a list of 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),

[5] If a definition of a system of innovation does not include all the determinants of innovation processes, then which of the potential determinants to exclude, and why, have to be justified. Therefore a broad definition is useful.
[6] "Holistic innovation policy" will be defined below in this section.

II. Demand-side activities (e.g. public procurement for innovation),

III. Support to key elements in innovation systems (e.g. entrepreneurship), and

IV. Support services for innovating firms (e.g. public seed funding of innovations).

- The list of activities in Annex 1 (also sometimes called functions) is preliminary, hypothetical and one among several. It will certainly be revised when our knowledge of the determinants of innovation processes has improved. It is important to point out that public innovation policy is not included as one of the ten activities. The reason is simply that public innovation policy is a part of *all* the ten activities. Part of each activity is performed by public organizations, which *is* policy (see definition early in section 2). What is important is the division of labor between private and public organizations with regard to the carrying out of each of the activities.

- When we have specified the objectives (see below) of innovation policy, and when we have a general picture of the policy problems and their causes, we can design policies to mitigate the problems.[7] It may be helpful to use the ten activities as a checklist and signpost, to avoid mono-causality, when selecting innovation policy instruments to achieve policy objectives. The list may also be useful in assigning causes to 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 the ten activities in Annex 1 can be related to several innovation policy instruments (Borras and Edquist 2013).

- A useful way of addressing appropriate instruments, and analyzing their role in the innovation system, is to relate them to each of the ten activities. In the real world, however, the instruments of innovation policy are rarely used standing 'alone'. Normally, innovation policy instruments are combined in specific mixes, using groups of different instruments 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 (Borras and Edquist 2013).

Provision of R&D results (including research policy) is only *one* of the (ten) determinants of the innovation process; it is only one of the *ten* activities forming innovation policy (see Annex 1). It dominates the linear view. The other extreme in the continuum linear – holistic is a genuinely holistic innovation policy. *A holistic innovation policy is defined as a policy that integrates all public actions that influence or may influence innovation processes, for example by addressing all the ten activities in Annex 1 in a coordinated manner.* A holistic innovation policy requires a broad definition of innovation policy and a broad and systemic view on the determinants of

[7] Identification of policy problems as one of the two reasons for public policy intervention will be discussed in sections 2.2 and 2.3.

innovation processes, which means that it also requires a broad definition of "systems of innovation", as proposed above.[8] Hence, a holistic innovation policy is about determinants (of innovations) and about innovation policy instruments. Demand-side innovation policy instruments must certainly be part of a holistic innovation policy, but more is required for it to warrant the name "holistic".

As such, a holistic innovation policy approach says nothing about the objectives of innovation policy. They have to be specified separately. Indeed, the *ultimate* objectives of innovation policy are determined in a political process. These objectives may be economic (growth, employment, competitiveness, etc.), environmental, social, 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 done in a complex process, which in democratic societies involves executive government initiatives, parliamentary discussions, public agencies, the civil society, and so on. The ultimate objectives of innovation policy are concerned with the important *consequences* that innovations have for socio-economic and political matters such as economic growth and the environment (mentioned above). Politicians are actually not interested in innovations as such, but in their consequences (Borras and Edquist 2013).

Problems to be mitigated by innovation policy must be identified and specified in innovation terms. A *problem*, in our sense - i.e. 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 or public organizations. As low innovation intensities are problems to be solved or mitigated 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; Borras 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 an immediate sense, because these instruments can only influence innovation processes (i.e. innovation intensities). This implies that the ultimate socio-political objectives must be "translated" into concrete problems related to innovation intensities – problems which 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. The objectives expressed in innovation terms may be called *direct* objectives, which are to solve the innovation intensity "problems". The ultimate objectives may (partly) be achieved by means of fulfilling the direct

[8] It may even be argued that the "seed" that "leads to" the holistic innovation policy approach presented here is the very broad definition of innovation policy employed in this report (see section 2).

objectives, i.e. in a mediated way. Hence, innovation policy instruments are selected to achieve the direct objectives – and thereby the ultimate objectives[9] (Borras and Edquist 2013).

I will now address some of the ERAC MLS participants' 19 responses to the questionnaire. For reasons of focus, I will deal only with those issues that are the most relevant from a policy point of view, and those that are considered important by the participants.

In the Discussion paper, and above, I have argued that the linear model is much more dominant in the field of innovation policy than in innovation research. This is strongly confirmed by the responses from the participants.

When it comes to the design of innovation policy, some countries report that the policy is quite linearly oriented, for example Belgium (e.g. regions of Flanders and Brussels). Ireland frankly says "To date the linear model has not been replaced by a holistic innovation policy…". The Netherlands write that "Most governmental instruments are still based on the linear model.[10] Malta states that "Malta's innovation policy instruments are largely focused on supply-side instruments."

There are also differences in the ambitions with regard to how comprehensive governments want innovation (and research) policy to be. Switzerland, for example, writes that "The government restrains itself to foster favorite framework conditions for research and innovation". It simply gives the state (national, regional, local) a limited role. At the same time the response makes it clear that "Switzerland never had an innovation policy based on an exclusively linear approach". Cyprus responds that "A holistic business innovation policy, instead of the linear model, has started being used only in the last three years…". France writes that "The linear model is still present in France, regarding the support to innovation research, but it is progressively completed /complemented/ by a more holistic approach….".

The last two quotes actually capture the position of most of the 19 responding countries. The responses indicate, in one way or the other, that the countries are pursuing, or are trying to develop, a "holistic"[11] innovation policy. In Norway, the white paper on research from 1993 criticized the linear model and introduced the "national innovation system" as a more appropriate perspective. Analytically, a systems perspective has been part of research and innovation policy in Norway since then. The Norwegian response adds: "To what extent innovation (or research) policy in its design and implementation is "holistic" could of course be discussed".

In summary, the responses indicate that at least 16 of the 19 countries (84%), in one way or another, are striving in the direction of developing innovation policy into a more holistic one.

[9] "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).

[10] They also write: "However, the way of working in the PPP's (Private-Public-Partnerships) is totally based on the acknowledgement that a more holistic approach is needed." The Netherlands hopes to spend 500 million euros on the new PPP program in 2015.

[11] Alternative terms used are "systemic", "broad-based", "comprehensive", and "demand-oriented".

This includes countries such as Ireland (see also quote above), Cyprus, Norway, Lithuania, Finland, Estonia, Sweden, Denmark, Austria, France, Hungary, regions in Belgium, the Netherlands, Portugal, Slovenia, and the United Kingdom.[12] Exceptions may be Switzerland, Czech Republic and Malta.

However, when the countries respond to the questions about which demand-side policies are the most important, most of them reveal that they are not actually pursuing much innovation policy that can be considered demand-side oriented. This also applies to the responses to the question of whether Public Procurement for Innovation (PPI)[13] is used as an innovation policy instrument. Those countries that practice PPI at all have done it only for a few years or are just planning to start. Finland may be an exception here, as well as Estonia and Belgium, and also the United Kingdom when it comes to the demand-side research policy instrument of PCP (see footnote). Hence, at most 4 of the 18 countries (22%) use demand-side innovation policy instruments to any considerable degree. However, not even these countries pursue a holistic innovation policy in the sense the term is used here.

At the same time, many of the responses indicate that "Provision of R&D results" (see Annex 1) is the most important activity in terms of resources spent for innovation policy purposes. Countries that clearly indicate this are: Sweden, Switzerland, Cyprus, Ireland, the Czech Republic, Estonia, Hungary, Belgium (regions of Flanders and Brussels), France and Slovenia, i.e. 10 out of 19 countries (53%), (Some countries did not respond at all to this question.).

This points to the very important question of how to measure or estimate the importance of an innovation policy instrument – which came up at the March 2014 ERAC seminar. As just indicated, this is sometimes done by means of looking at how much *money* is *spent* on an instrument such as publicly funded R&D.[14] There are several problems associated with this. Firstly, not all the resources spent on public R&D will have an effect on innovation. This may be because some kinds of research are irrelevant for innovation processes, or because the research effort is inefficient or simply failing, which reflects the fact that R&D expenditure is an input measure. A better measure (of R&D performance) would be an indicator of research results of the

[12] Also Germany is striving in this direction, but it is not included in the calculation of the ratio. They write "The Federal Government has used this national innovation strategy, which it launched in 2006, to pool a great number of research and innovation activities whose scope spans all policy areas. The idea that innovation occur in a linear process is outdated in the context of shaping and implementing modern innovation policy. The holistic approach of the High-Tech Strategy sees all the steps in the innovation process ….. as part of a whole."

[13] Public Procurement for Innovation (PPI) occurs when a public organization places an order for the fulfillment of certain functions through a new product. 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 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 larger potential than PPI. And "innovation- friendly" regular public procurement has a much larger potential than either of them (Edquist and Zabala, 2012; Edquist and Zabala, 2014; Edquist, 2014; and Edquist et al 2014, forthcoming).

[14] Spending public money directly is equalized here with tax credits.

R&D, such as scientific citations or patents. Still, scientific knowledge and patents may, or may not, be transformed into innovations and innovations must not necessarily be based on patents.

The situation with resources spent on education is similar. All education is not intended to influence innovation processes and/or does not do so for other reasons. It is also hard to know exactly what kinds of education have (what kinds of) effects on (what kinds of) innovation and what kinds do not. In addition, education systems vary substantially in terms of quality between countries. Again, it would be better to measure the results achieved by the students. As the PISA analyses have clearly shown, the quality varies considerably between countries. For example, Sweden is a big spender on education, but shows very low results in terms of student performance. In addition, the competencies and abilities of graduates may or may not be useful for innovation processes.

As a consequence, not all public resources spent on research or on education can, with certainty, be called innovation policy.

Some things might be important innovation policy instruments without costing a lot of money. One example could be the creation of an effective patent law or a public procurement law that really enhances innovation, which does not need to be very costly in money terms. It may require a lot of knowledge, though. Thus, things other than economic expenditures are also very important, for example creating framework conditions that enhance innovation processes.

Hence we cannot measure the importance of different innovation policy instruments by the economic resources spent on them.

A much better measure of the importance of innovation policy instruments would be to try to systematically measure the *consequences* of the instruments for the innovation processes as such. Ideally, we should be able to estimate the importance of each innovation policy instrument[15] by measuring its effects on (different kinds of) innovations. This would be much more preferable. Unfortunately, it is also more difficult. Nonetheless, it may be achieved by means of considerable effort aimed at more widespread, profound and independent evaluations. In the longer term, this is the only reasonable way. Evaluations are badly needed.

As just proposed above, we should stop talking so much about what instruments cost and concentrate more on instruments that have large effects on innovation processes.

Together, these responses clearly indicate that many of the countries striving in the direction of pursuing a holistic innovation policy have a long way to go on the path from linear to holistic. It is a "path", because it is not necessarily a matter of reaching an innovation policy that is 100% holistic. It is rather a matter of getting away from a mono-causal (linear) view in the direction of

[15] It is also important to measure the effects of combinations of instruments, and even of instrument packages, i.e. policies as a whole.

a broader and multi-causal one. There may also be countries that are paying lip service to holism, but have actually not achieved very much at all.

There seem to be three possible positions with regard to the linear/holistic spectrum:

1. There are countries which mainly pursue a linear innovation policy and find no reason to change this.

2. There are countries that strive in the direction of a "more" holistic (systemic, broad-based, comprehensive,) innovation policy.

3. The third possibility is that a country could pursue a genuinely holistic innovation policy in the sense defined above. None of the 19 countries has yet achieved this.[16]

Clearly, it is relevant to analyze the pros and cons of these three possibilities, in the context of the arguments above and below. Obviously, the "linear" element should be seen as partly integrated or contained in the "holistic" approach, since part of research is obviously relevant for innovation processes. In addition, the discussion should include what to prioritize in an evolutionary paradigm change from a linear to a holistic perspective. At the same time, the design of a holistic policy must always be based on politically determined objectives as well as on the identification of problems and their causes, as emphasized elsewhere in this report. Such discussions may also be related to issues of governance and coordination for pursuing a holistic innovation policy, see Section 2.2 below.

A last comment related to this issue addresses the relations between research policy and innovation policy.

In some countries, these two policy areas are kept apart when it comes to which public organization (Ministry) is the leading one. For example, this applies to the following countries: Norway,[17] Lithuania, Finland, Estonia, Switzerland, Portugal, the Netherlands and Slovenia (i.e. 8 countries = 42%). In the following countries the two policy areas are under the same Ministry: Ireland, Cyprus, United Kingdom, Denmark, Hungary, Sweden, and Malta (i.e. 7 countries = 37%). The situation is unclear in the cases of Belgium, Austria, the Czech Republic and France (i.e. 4 countries = 21%).[18]

According to the Irish response, research policies and innovation policies have traditionally been considered to be almost the same thing. In practice, however, research policy has taken

[16] Perhaps this is what the Norwegian response hints at when they write: "A comprehensive innovation policy includes nearly all policy areas, including competition, taxation, infrastructure, education and research policy, regional, labor market policy and public procurement policy." It can also be pointed out here that Norway, in the quote in the main text above, expressed some doubts about the extent to which the policy actually is holistic "in its design and implementation".

[17] In Norway two different ministries are responsible for research policy and innovation policy, but at the level of public agencies "The Research Council of Norway" plus "Innovation Norway" deal with much of both.

[18] In policy implementation, Research and Innovation policies are more separated from each other than they are in their design. This is simply because different policy instruments are (have to be) used for the two policies. Sweden and Switzerland are examples of this.

preference over innovation policy. It might also be mentioned that, in some countries, there is a separation between research policy and innovation policy going on. In Malta, traditionally, the design of innovation policies has always been closely linked to the design of research policies. However, over time, innovation policy design has taken on a more distinct niche for itself.

The OECD thoroughly reviewed Sweden's innovation policy in 2012 (OECD, 2013) and revealed that innovation issues were not prioritized, even within the Ministry of Enterprise, Energy and Communications. For example, its website had no mention of "innovation" as one of its nine areas of responsibility (page 28, page 224). The OECD report also stressed that innovation issues should have higher priority on the agenda of the Ministry of Enterprise, Energy and Communications (page 29, page 234).[19] It may also be mentioned that it is the Ministry of Education and Research which has the formal responsibility for coordination in the government on all matters relating to research *and* innovation (p. 233). "Innovation" does not constitute a separate policy area in the Ministry of Education either (p. 224). It is also said that coordination seems weak between the two ministries (page 28). Hence, the national innovation strategy is developed by the Ministry of Enterprise, Energy and Communications, despite the fact that the Ministry of Education is responsible for coordinating innovation issues in the government.

Why then is innovation policy (still) linear and not holistic, although the linear view has been completely abandoned in innovation research? This question was raised at the ERAC Seminar. In principle, one answer could be that it is as it should be. But this is not consistent with innovation research or with the fact that the absolute majority of the participating countries strive in the direction of pursuing a more holistic innovation policy. Sometimes policy-makers attend research conferences on innovation policy and they are always in favor of more holistic (systemic, broad-based, comprehensive, etc) innovation policies. They too have abandoned the linear view. As a result, the division is located within the community where innovation policies are designed and implemented. This community is composed of policy-makers (administrators/bureaucrats) and elected politicians. Perhaps the dividing line is between these two groups in that politicians, who actually take the decisions, may be believers in the linear view in an unreflected way? There might also be disagreements between (the leaderships of) different ministries, e.g. between the Ministry of Finance and other ministries or between the Ministry of Research and Ministry of Industries? Issues of governance and coordination will be further discussed in Section 2.2.

These examples might lead to reflections on whether it would be justified to separate innovation policy from research policy in the design and implementation and in terms of the public organization that is responsible. After all, it was argued in section 2 that research policy and innovation policy are actually different things, and that such a separation might be a way of facilitating the transformation of innovation policy from linear to holistic. This is so because a

[19] ”Far from being a cross-cutting government issue, innovation policy is not even a strong field in the Ministry.” (OECD, 2013: 224).

continued integration of research and innovation policies might cement the linear character of the policy, partly because research policy is still considered to be so central.

Of course, given the wide definitions of research policy and innovation policy that we use (see section 2), there are also, and must be, overlaps between the two policy areas. They actually "intrude" into each other's "territories". This can be generalized: they also intrude into additional policy areas, such as labour market policies, public procurement policies, defense equipment policies, energy policies, transport policies, health care policies, environmental policies and regional policies. This is corollary if (all or most) policy areas are defined in a broad sense, which I think they should be. 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.[20]

It is important to note that the state in practice allocates very large resources to all the policy areas listed above. If the government wants to emphasize and strengthen innovation policies, they can "exploit" this overlapping of policy areas. Just to mention one example, procurement policy can be adapted or "twisted" so that it stimulates innovation to a much larger degree. Regular public procurement can in this way be transformed into public procurement that triggers innovation. It is important here to note that public procurement accounts for about 20% of GDP in Europe (2.3 trillion Euros). To coordinate policy areas in this way does not need to increase the combined resources needed for the two policy areas. It may even decrease cost and improve efficiency thanks to innovation (Edquist 2014).

Innovation policy design is certainly lagging behind innovation research when it comes to being systemic, broad-based or holistic. This is clearly an example of a failure when it comes to the communication between innovation researchers and politicians in the field of innovation.[21] This may be a strong reason to involve innovation researchers in policy design (formulation) and implementation to a much higher degree. There is a lot that policy-makers and, in particular, politicians can learn from innovation research, not only in principle or "analytically", but also in policy practice.

2.2. Theme 2: Governance and coordination for pursuing a holistic innovation policy.

A continuation of the transformation of innovation policy from linear to holistic seems to be wanted in many countries. It may, however, require, or be facilitated by, changes in the *governance* (organization) of the design and implementation of research policies and innovation policies. This is because a holistic policy requires a larger number of policy instruments, and this, in turn, requires a larger degree of coordination between them.

[20] The issue of coordination will be further discussed in section 2.2.

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

Some organization in the political system must be in charge of *designing* (developing) a holistic policy. The design must be based upon a continuous analysis of the innovation system in question, achieved through comparing it with other systems (because the notion of optimality is irrelevant in the field of innovations and innovation systems). The purpose of such analyses is to identify those problems in the innovation system that should be the objects of mitigation by means of innovation (or research) policy. The design work must also include the identification of those instruments that are to be used by public organizations when they *implement* the policy (Edquist, 2011).

Several policy instruments may be used for each activity (Annex 1) in the innovation system; i.e. scores of different instruments may be relevant (Borras and Edquist 2013). Avoiding fragmentation, and instruments offsetting each other, requires *coordination* between them (both in the design and in the implementation process). Hence the issues of governance and coordination are closely related.

The governance and coordination of research and innovation policies differ greatly between countries. Outside Europe, Japan has a coordinating Council for Science, Technology and Innovation policy that is placed above the Ministries. South Korea had one until 2012. Among the group of 19 countries that have responded to the questionnaire sent out in preparation for the 2014 ERAC MLS, the following have a research and/or innovation policy body, which is placed above the Ministers and Ministries in the political system:

- Lithuania: the (Strategic) Council on Research, Development and Innovation chaired by the Prime Minister.
- Cyprus: The National Research and Innovation Council…a political body chaired by the President of the Republic, with six other ministers as members.
- Ireland: The Cabinet Committee on Economic Recovery and Jobs encompasses the role of the previous Cabinet Committee on Science, Technology and Innovation and is chaired by the Taoiseach, the Prime Minister.
- Finland: The Research and Innovation Council, chaired by the Prime Minister, advises the Government and its Ministries on important matters concerning research, technology, innovation and their utilization and evaluation. The Council is responsible for the strategic development and coordination of Finnish science and technology policy as well as the national innovation system as a whole.
- The Czech Republic: The Governmental Council for RDI involves representatives of all major stakeholders (including industry) and has the position of coordinator.
- Estonia: The National Research Council (chaired by the Prime Minister, including members from both industry and academia, the Minister for Education and Research, the

Minister of Economic Affairs and Communications, the Minister of Finance), deals also with innovation issues.

- Portugal: In 2012 two councils presided by the Prime Minister were created, one focusing on research (Conselho Nacional de Ciencia e Tecnologia – CNTC) and one focusing on innovation (Conselho Nacional de Empreendedorismo e Inovacao – CNEI).[22]

Obviously, 7 countries[23] (out of 19, i.e. 37%) have been motivated to create a political body above the ministerial level for issues related to research policy or innovation policy – or both.[24] This means that they have given these policy areas a higher status than most other policy areas pursued in the country.

However, the 7 bodies are certainly quite different from each other. This was indicated at the 2014 ERAC MLS when representatives from the seven countries briefly reported on the Council/body in their own country. For example:

- Some of the bodies were quite new, others older
- They might meet often or only once per year
- Some had a fairly large secretariat (20 persons), while others had only a few people
- Some had only ministers as members, while others also had researchers and industrialists
- None of them controls a large budget for pursuing research and/or innovation policy
- Most have no formal decision power, but an advisory role.

A general comment is that the bodies/councils are rather weak, although chaired by the Prime Ministers. If they shall be instrumental in creating a holistic innovation policy, they should certainly be made stronger.

One task, which bodies such as those mentioned above could be responsible for, is the identification of innovation or research policy problems. One of the questions in the questionnaire was:

> "How is the analysis of the innovation system to identify innovation policy problems and their causes organized? How is the identification of innovation policy instruments organized in the country?"

[22] In the UK, there is also something called the Prime Minister's Council for Science and Technology. But this is probably not the kind of supraministerial body that we are discussing here.
[23] The leader of the largest opposition party in Sweden has indicated that he will create an Innovation Council with the Prime Minister as chairman if he wins the September 2014 election.
[24] In the other countries these policy areas are coordinated by one ministry or two different ones, as discussed in section 2.1.

This task is a very complicated and demanding one. The responses to the question indicate that it is relevant to raise this issue in relation to the discussion of the body addressed above. In addition, the task is organized in many different ways in the 19 countries. It may be located at three different levels in the political administration: supraministerial, ministerial, and in a sub-ministerial public agency – or in some combination of the three. The participating countries organize this task quite differently. For example:

- In Sweden, one government agency (VINNOVA) has an overall responsibility, although analyses are done at various levels and with specific aims. For example, the National Innovation Strategy was developed by the Ministry of Enterprise, under which Vinnova is placed.

- In Ireland, identification of innovation policy problems is led through Forfás (agency) and the Ministry of Jobs, Enterprise and Innovation. In 2014, the policy research functions of Forfás will be integrated into the Ministry. The aim of the move is to strengthen the capacity of the Ministry to drive job-creation and innovation policy. Therefore this function is being moved upwards from the level of a public agency (Forfás) to the level of a Ministry.

- In Switzerland, two public agencies "can initiate reports and propose new instruments if necessary".

- In order to identify innovation policy problems, the Ministry of Economy in Lithuania consults foreign and local experts, business and research entities and public organizations. The Innovation Strategy is monitored annually. The country receives help from the EU Commission and the OECD will carry out Lithuania's innovation Policy Review in 2015.

- In Cyprus, no permanent system exists, and ad hoc evaluations are carried out when deemed necessary. The Council of Ministers appointed a National Committee for Research, Innovation and Technological Development in 2013.

- The Norwegian innovation system is subject to frequent analysis and evaluation. For example, the Report on Science and Technology Indicators for Norway is published biannually by the Research Council of Norway. The OECD published a country review of Norway's innovation policy in 2008. Other international reviews and national reports are also carried out. Challenges (objectives) are mainly identified by the Ministry, but agencies may also advise the Ministry in this regard.

- In Finland, the activities of the innovation policy actors are evaluated by impartial, often international evaluators.

- In Hungary, The Department for Innovation and R&D of the Ministry for National Economy (MNE) governs the analytical work; most of it is performed by the National Innovation Office (there is a S&T Observatory within the NIO since 2012).

- Belgium: The Belgian innovation system (or rather systems) has been analyzed in depth by means of the "ERAC peer review". Also relevant are the yearly reports by ERA-Watch, the Innovation Union Competitiveness Report and the like. As usual there are also regional differences.

- Estonia: A system of monitoring and evaluation has been established, analyzing the policy developments (incl. outputs and outcomes) on a yearly basis. This is complemented by ad hoc evaluations. Moreover, external expert advice has been used a lot (ERAC peer-review of the Estonian R&I system, 2012).

- UK: A wide range of stakeholders is engaged in the early stages of policy development. This enables a clear identification and articulation of problems for which suitable innovation policy can be created.

- Denmark: DASTI (agency) has organised an ERAC peer Review of the Danish innovation system. Furthermore, in 2013, as a follow up to the innovation strategy and a reorganisation of the ministry, a department for research and innovation analysis was set up in DASTI. The new department is to conduct systematic analyses of the Danish R&D and innovation system.

- Malta: An extensive analysis of the innovation system was undertaken as part of the review of the implementation of the National R&I Strategic Plan 2007-2010 and the preparation of the National R&I Strategy 2020. The response also says that "Available indicators and scoreboards are often unsuitable to identify innovation policy problems and their causes since these indicators are difficult to scale down to a micro-level."

- Slovenia: The systematic monitoring and evaluation of the field is performed by the Science and Technology Council. The evaluation of the Research and Innovation Strategy (2011-2020) will biannually be performed by independent experts.

- In the Czech Republic, the Governmental Council for RDI performs the analysis of the entire RDI system on an annual basis.

- Portugal: The Cabinet of the Secretary of State for Innovation (under the Ministry of Economy) is ultimately responsible, with the assistance of CNEI, AdI and IAPMEI, for identifying policy problems.

- The Netherlands: The Advisory Council for Science and Technology Policy (AWT) advises the Dutch government and parliament on policy in the areas of scientific research,

technological development and innovation and reports to both the Ministry of Economic Affairs and Education and Science.

- Austria and France did not respond to the question.

The system for identification of innovation policy problems seems to be quite weak in many countries. However, such an identification of policy problems and their causes needs, as a basis, a specification of the objectives[25] of the innovation policy. As mentioned in section 2.1 such objectives are formulated in a political process. In the responses to the questionnaire not much was said about how this is done – or about the result thereof.

In the further analysis of issues of governance and coordination it seems relevant to address the following issues:

- Is a policy body placed above ministries called for in the field of innovation (and research)?
- Why should innovation and/or research policy be given a higher position than other policy areas in the political hierarchy of the country?
- What tasks should such a body be given?
- Should the tasks include the design of research and innovation policies or only innovation policy?
- Is it easier to develop a holistic innovation policy if such a body exists?
- Should it have a secretariat?
- How should the objectives for research and innovation policies be decided upon?
- Should the identification of innovation policy problems be performed at the supraministerial, ministerial or the agency level?
- How should a body placed above ministries be organized and equipped to really have an impact on innovation processes?

[25] See Section 2.1. for a discussion of the relations between a holistic policy and the objectives of that policy.

2.3. Theme 3: Policy support to existing industries and/or to the emergence of new ones?

It is widely known and accepted that innovation is a major driver of long-term economic growth and employment, and that it can also help to mitigate global challenges presented by the environment, transport, energy and health. Hence innovations affect a variety of socioeconomic conditions.

The relationship between innovation and employment is especially complicated. It is because certain types of innovations reduce the number of jobs, while other types increase the number of jobs. In order to clarify this, I must first explain what I mean by different types of innovations. At the beginning of section 2.1., I made a distinction between process innovations and product innovations. It is the difference between process innovations and product innovations that explains innovation's "double character" in relation to employment. The introduction of process innovation leads to productivity increases, and a smaller amount of labor is therefore needed to produce the same volume. This is an important aspect of the basis for increased welfare. If there is a problem of high unemployment (as in Europe in 2014), a partial solution is to compensate for the loss of jobs by producing new products. Product innovations actually lead to the creation of new jobs, and this compensates for the jobs lost through process innovations.[26]

If this compensation mechanism does not work spontaneously and automatically in the economic and innovation system, then public intervention, in the form of an innovation policy that stimulates the development, implementation and diffusion of product innovations, is called for. This is essential to achieve low unemployment in the medium and long term.

Industrial policy is often associated with support for the old and dying sectors. Still, rather than providing public support to the old sectors and established firms as a matter of course, policy should focus on helping the new to emerge, i.e. (product) innovations.

We know that innovations in the early stages of their development are associated with uncertainty and with such great risks that private actors often shy away. Hence, there is a *problem* that is not solved by private actors, and then government action, such as risk financing in the early stages (public seed funding of innovations), is justified.[27] So, instead of talking about industrial policy, let us talk about innovation policy aimed at enhancing new creations of economical or societal

[26] There are, of course, many other compensation mechanisms and dimensions involved in such development processes. They are analyzed in some detail in Edquist et al. (2002). To increase the number of jobs, an alternative to product innovations could, in principle, be to distribute the number of hours worked in the economy among more individuals.

[27] The existence of a *problem* in this sense is what should first be ascertained to justify policy intervention. The other condition that must be fulfilled is that the public organization must have the *ability* to mitigate the problem (Edquist, 2011: 17).

importance.[28] In fact, such future-oriented innovation policies are being pursued to an increasing extent in our competitor countries, in Asia for example, in a very conscious way.

Innovation policy is sometimes/often needed, but it must not replace or duplicate what private actors can do. Public action should only contribute to solving problems that the private actors cannot handle. Producing and further developing old processes and products are the tasks of established firms, while helping to develop brand new products can be an important task for innovation policy. It will obviously be an advantage if these new products help to satisfy human needs, solve societal problems and mitigate global challenges presented by the environment, energy, health, etc. Innovation policy can be given such an orientation, if the objectives of the policy are formulated in an appropriate way.[29]

Additionality (i.e. non-duplication or non-crowding out of private initiatives) arguments constitute a basis for policy support to new and emerging industries rather than to existing ones. Emerging and growing sectors are also often argued to contribute more to growth and employment than traditional ones. Established industries should be expected to care for their own renewal, research and innovation on the basis of accumulated profits. Emerging sectors, on the other hand, are characterized by uncertainties and large risks, which sometimes cannot be absorbed by private actors. At the same time, lobbying forces tend to try to influence policy in the direction of securing public support for existing and traditional sectors.

The responses by the participants to the questions in this area were very uneven. Many provided quite detailed responses, while several did not respond at all. This might be a good argument for discussion this issue further. Another reason is that we know that knowledge and innovation are two of the most important long term sources of growth and employment in all economies.

I will now provide a synthesis of the responses from the ERAC participants (see below) and formulate specific questions for further analysis.

According to the Norwegian response, innovation policy addresses both existing and future industries. The division of "old" and "new" is sometimes invisible. It is hard to distinguish between existing and new industries. The "new" often build on knowledge bases in existing industries. The representative argues that there is currently a need to ensure a dynamic development of Norwegian industries and renewal and restructuring over time, due to an estimated decrease of petroleum activity in the future and grand challenges such as sustainable development and demographic development. The response also points out that a methodology to assess the impacts on economic growth across instruments and policy areas is lacking. Therefore,

[28] All responses (except Norway, Belgium and the United Kingdom) talked about innovation policies rather than Industrial policies.

[29] This is the question of the content of growth, which is discussed and analyzed far too little. A product can be both a good and a service. The good can be a car, a pleasure craft or weaponry. A service may be a flight, a train ride, a heart operation or a violin concerto. The effects on society and the environment obviously vary with the content of growth.

it is hard to say what the right balance is. Austria has no views on the balance between "old" and "new", and points out the use of targeted innovation oriented RTDI-programmes in domains like ICT, energy, transport production (competitive funding). These programmes address fields with well-established industry, but are also aiming at developing new themes and sectors.

The response from Switzerland argues that the balance between supporting existing industries and enhancing the emergence of new ones is the result of the economic history of the country and it seems to work. Therefore there is no need to change it now.

In Lithuania, the Ministry of Economy aims at increasing entrepreneurship and the number of SMEs. Therefore, a lot of effort is put into supporting innovative start-ups and spin-offs. Young innovative companies are in greater need of financing and other support measures, such as tax incentives, in order to kick off their businesses. However, existing industries will also be eligible to apply for support. The Innovation Development Program 2014-2020 states that the competitiveness of existing industries has to rely strongly on innovation. Policy instruments to support innovation processes that enhance the emergence and development of new sectors of production are both fiscal (grants, infrastructure support, tax-incentives etc.) and non-fiscal (human resource development, networking provision, improving the legal basis etc.). There are separate sectorial programmes for this purpose, such as the Green Industry Innovation Programme and the National Programme on Development of Research, Technologies and Innovation in the Space Sector for 2010-2015.

The Portuguese response says that "…most innovation occurs in SMEs, so if the focus is increasing innovation, there should be a significant investment in incentives for entrepreneurship. However, recently more "traditional" and established PT industry sectors have been modernized and because of that experienced significant growth, which serves as evidence that there is room for innovation within established sectors also."

The Netherlands writes: "Existing industries should become more innovative; efforts must be directed towards that and the support for new emerging sectors and industries."

In Cyprus, a way of setting the balance, between supporting existing industries and enhancing the emergence of new ones by means of research and innovation policies, is the relative weight of each category in the total budget for grant schemes financed through national and EU funds. In the new grant scheme of the Ministry of Energy, Commerce, Industry and Tourism for developing innovative products/services, the balance is 75% of the budget for existing industries and 25% for emerging new industries. This approach by Cyprus is based on a step-wise strategy whereby new and more risky industries receive a fair share of the budget, enabling them to prove themselves in order to receive more funding once they have established proven results.

In Ireland, The Prioritization Action Group is addressing the balance between supporting existing industries and enhancing the emergence of new ones as part of the "research prioritization exercise". The balance is made on the basis of opportunities in existing and new industries for

economic growth and job creation which can be supported by public investment in research and innovation. A detailed Framework of Metrics and Targets has been drawn up as part of Research Prioritization to measure the outputs and impact of funding provided. Innovation in services and business processes is a nascent priority area for Ireland, and new policy is being put in place to support activity in this area through the Prioritization Action Group.

The Estonian view is that supporting existing industries should mean enhancing their productivity and competitiveness, and therefore the focus should be on reinventing the existing industries to open their maximum potential. It should be kept in mind that reinventing old industries brings more benefits in terms of value-added and jobs in the medium term. Enhancing the emergence of new ones is important to ensure the long-term competitiveness of the economy. Therefore, the balance should be approximately 2/3 vs 1/3 resource-wise.

The Belgian response is concerned that policy instruments should not stimulate the creation of spin-offs to such an extent that existing companies are disadvantaged (Flanders). The Flemish government is in favor of a bottom-up process for identifying strengths for the future (or smart specializations) by road mapping and self-organization in cluster platforms, to stimulate the transformation of the economy. There is a holistic approach in the new industrial policy that aims at aligning all policy fields that are needed to support the creation of new value chains.

As well as looking at sectors and industries where the United Kingdom has existing comparative advantage, the Government's Industrial Strategy has four horizontal, cross-sectoral strands: improving access to finance for businesses, developing the skills business will need measures to improve government procurement and support for emerging technologies. Hence, four "*activities*" are primarily focused on rather than *sectors* of production, although support to the activities will certainly influence sectors – perhaps unevenly, though.

According to the UK response, there are interventions that can support research in areas with no current industry. Much of the UK Research Council's funding is applied to blue skies and theoretical research - though there has begun to be more significant consideration of the potential impacts, both economic and social, of research in the last few years.

An example of a new technological area where research has been funded in advance of industrial emergence is novel materials. Nano-materials and graphene in particular have emerged from research in this area. As well as new industrial structures forming around these technologies, existing industries are also beginning to take advantage of the potential of these materials.

On the innovation side, the development of products and services based on nano-materials has been assisted by support Government has given to the priority development of standards for nano-materials to enable innovative and interoperable products to be developed.

The UK Technology Strategy Board (TSB) also provides several policy interventions that support new technologies in areas where there is no well-developed industry. Included in these is support

for 15 Knowledge Transfer Networks (KTNs), each of which focuses on a single specific field of technology or business application and, again, materials, including nano-materials and graphene, is a good example of such a network.

The TSB also funds seven Catapult centers, which are intermediate research organizations each focused on a particular industrial sector, but able to look at potential industries as well as those already in operation.

The Danish response indicates that both areas are important, but existing industries are given greater attention in Denmark, since these industries invest most in R&D and innovation activities. In terms of policy instruments, mention is made of incubator programmes and policies for emerging clusters. The Council for Independent Research, the Council for Strategic Research and universities support new research areas. Recently, tax credit instruments for R&D investments have been introduced. Such instruments are regarded to be relevant also for emerging industries.

As a small, open economy, flexibility and nimbleness to respond quickly to emerging opportunities and changing scenarios are very important for Malta. However, existing industries is where the economy's strongest sectors are most likely to be found, and where more efforts could therefore be invested. Malta's National R&I Strategy 2020 balances out these dual realities by calling for the building of a 'baseline' holistic innovation support ecosystem, which would be independent of thematic specialization and therefore support emerging new industries, as well as identifying thematic specialization areas to which additional resources and assistance could be directed.

Malta's R&I Strategy 2020 is highly business-driven and gives priority to applied research and experimental development, which is close to market. However the first of the Strategy's three goals, namely putting in place a 'baseline' holistic innovation support ecosystem which is independent of thematic specialization, provides, in principle, for supporting research in areas where no industry exists at present.

Sweden, the Czech Republic and Finland had no or almost no answers regarding this theme.

It is interesting that none of the responses from the participants mention criteria for public intervention (additionality, non-crowding-out of private actors, etc). Instead, the responses focus upon whether various sectors of production are "important" or not. However, the importance of a sector is *not* a reason to provide it with public support, if private organizations handle the sector in a satisfactory manner, i.e. there is no additionality. The criteria for public policy intervention (additionality, non-crowding out) not only point to what public organizations should do in terms of policy. They also indicate what public agencies should *not* do.

Another comment is that some of the responses above discuss priorities in terms of sectors of production or industries. Others point out priorities in terms of identifying activities that influence innovation processes in all or many sectors of production, albeit probably unevenly

(Annex 1 lists 10 such activities). Support to activities that enhance innovation may be designed to support new sectors. The pros and cons of both these modes should be thoroughly analyzed. Other questions that should be addressed are:

- Is the additionality argument a reason to support only the emergence of new products and industries?
- Is such a policy best formulated in terms of sectors of production, or in terms of activities (incubation, seed funding, etc), which may be bottlenecks for the development of (product) innovations?
- In what circumstances is a sectoral or an activities approach to be preferred?

3. Summary of main findings of policy relevance

In this final section I will repeat the main findings of policy relevance.

- *A holistic innovation policy is defined as a policy that integrates all public actions that influence or may influence innovation processes.* A holistic innovation policy requires a broad definition of innovation policy as well as a broad and systemic view on the determinants of innovation processes, which means that it also requires a broad definition of "systems of innovation". Hence, a holistic innovation policy is about determinants (of innovations) and about innovation policy instruments. Demand-side innovation policy instruments must certainly be a part of a holistic innovation policy, but more is required for it to warrant the name "holistic".

- A linear view, on the other hand, places most of the emphasis on supply-side instruments, such as research and education. The linear model was based on the assumption that innovations were applied scientific knowledge. It was called "linear" because the process was seen as well-defined with consecutive stages that innovations were assumed to go through, 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.

- The linear model has been completely abandoned by innovation researchers in the latest couple of decades.

- Most EU Member States (84% = 16 of 19 responding countries) strive to develop innovation policy into a more holistic one, but only a few (22%) use demand-side policy instruments to any considerable degree, i.e. innovation policy is dominantly linear and far behind innovation research. The point of departure (linearity) is clear, but the exact characteristics of a holistic policy must be developed. Obviously, the "linear" element should be seen as partly integrated or contained in the "holistic" approach, since part of research is obviously relevant for innovation processes. In addition the discussion should include what to prioritize in an evolutionary paradigm change from a linear to a holistic perspective. At the same time, the design of a holistic policy must always be based on politically determined objectives as well as on the identification of problems and their causes, as emphasized elsewhere in this report.

- Public Procurement for Innovation (PPI) is a very important demand-side innovation policy instrument. PPI occurs when a public organization places an order for the fulfillment of certain functions through a new product. 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 and it might, in today's world, have larger potential than PPI. And "innovation- friendly" regular public procurement has much larger potential than either of them, when it comes to contributing to growth and employment through innovation – and to mitigate global challenges.

- Why then is innovation policy (still) linear and not holistic, although the linear view has been completely abandoned in innovation research? In principle, one answer could be that it is as it should be. But this is not consistent with innovation research or the fact that the absolute majority of the participating countries strive in the direction of pursuing a more holistic innovation policy. Sometimes policy-makers attend research conferences on innovation policy and they are always in favor of more holistic (systemic, broad-based, comprehensive, etc) innovation policies, i.e. they too have abandoned the linear view. As a result, the division is located within the community where innovation policies are designed and implemented. This community is composed of policy-makers (administrators/bureaucrats) and elected politicians. Perhaps the dividing line is between these two groups in that politicians, who actually take the decisions, may be believers in the linear view in an unreflected way? There might also be disagreements between (the leaderships of) different ministries, e.g. between the Ministry of Finance and other Ministries or between the Ministry of Research and Ministry of Industries?

- Innovation policy design is certainly lagging behind innovation research when it comes to being systemic, broad-based or holistic. This is clearly an example of a failure when it comes to the communication between innovation researchers and politicians in the field of innovation. This may be a strong reason to involve innovation researchers in policy design (formulation) and implementation to a much higher degree. There is a lot that policy-makers and, in particular, politicians can learn from innovation research, not only in principle or "analytically", but also in policy practice.

- As such, a holistic innovation policy approach says nothing about the objectives of innovation policy. They have to be specified separately. Indeed, the *ultimate* objectives of innovation policy are determined in a political process. These objectives may be economic (growth, employment, competitiveness, etc.), environmental, social, related to health, defense and security, and so on. The ultimate objectives of innovation policy are concerned with the important *consequences* that innovations have for socio-economic and political matters such as economic growth and the environment. Politicians are actually not interested in innovations as such, but in their consequences.

- *Problems* to be mitigated by innovation policy must be identified and specified in innovation terms. A *problem*, in our sense - i.e. 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 or public organizations. As low innovation intensities are the problems to be solved or mitigated 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.

- 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 an immediate sense, because these instruments may only influence innovation processes (i.e. innovation intensities). This implies that the ultimate socio-political objectives must be "translated" into concrete problems related to innovation intensities – problems which may 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. The objectives expressed in innovation terms may be called *direct* objectives, which are to solve the innovation intensity "problems". The ultimate objectives may (partly) be achieved by means of fulfilling the direct objectives, i.e. in a mediated way.

- The importance of an innovation policy instrument is sometimes measured in terms of how much *money* is *spent* on an instrument such as publicly funded R&D. There are several problems associated with this. Firstly, not all the public resources spent on R&D will have an effect on innovation. This may be because some kinds of research are irrelevant for innovation processes, or because the research effort is inefficient or simply failing, which reflects the fact that R&D expenditure is an input measure. A better measure (of R&D performance) would be an indicator of research results of the R&D, such as scientific citations or patents. Still, scientific knowledge and patents may, or may not, be transformed into innovations and innovations must not necessarily be based on patents.

- The situation with resources spent on education is similar. All education is not intended to influence innovation processes and/or does not do so for other reasons. It is also hard to know exactly what kinds of education have (what kinds of) effects on innovation and what kinds do not. In addition, the education systems vary substantially in terms of quality between countries. Again, it would be better to measure the results achieved by the students. As the PISA analyses have clearly shown, the quality varies considerably between countries. For example, Sweden is a big spender on education, but shows very low results in terms of student performance. The competencies and abilities of graduates may or may not be useful for innovation processes.

- As a consequence, not all public resources spent on research or on education can, with certainty, be called innovation policy.

- Some things might be important innovation policy instruments without costing a lot of money. One example could be the creation of an effective patent law or a public procurement law that really enhances innovation, which does not need to be very costly in money terms. It may require a lot of knowledge, though. Thus, things other than economic expenditures are also very important, for example creating framework conditions that enhance innovation processes.

- Hence we cannot measure the importance of different innovation policy instruments by the economic resources spent on them.

- A much better measure of the importance of innovation policy instruments would be to try to systematically measure the *consequences* of the instruments for the innovation processes as such. Ideally, we should be able to estimate the importance of each innovation policy instrument by measuring its effects on (different kinds of) innovations. This would be much more preferable. Unfortunately, it is also more difficult. Nevertheless, it may be achieved by means of considerable effort aimed at more widespread, profound and independent evaluations. In the longer term, this is the only reasonable way. Evaluations are badly needed.

- As just proposed above, we should stop talking so much about what instruments cost and concentrate more on instruments that have large effects on innovation processes.

- Depending on the country, the design of innovation policy is performed at different "levels" of the state: sub-ministerial (public agencies), ministerial and supraministerial – or some combination of the three. In some countries this function is being moved "upwards" in the hierarchical system, which may be a way to give more importance and higher status to innovation policy.

- 7 out of 19 countries (37%) have created a public organization (council) for innovation policy and/or research policy placed above ministries, usually chaired by the Prime Minister. In this sense these policies have been given a higher status or priority than most other policy areas within the political structure in these countries. However, the seven bodies are certainly quite different, which probably means that they can learn from each other. For example:

    - Some of the bodies are quite new, others older.

    - They might meet often or only once per year.

    - Some have a fairly large secretariat (20 persons); others have only a few people.

    - Some have only ministers as members; others have also researchers, industrialists.

- None of them controls a large budget for pursuing research and/or innovation policy.
- Most have no formal decision power, but an advisory role.

A general comment is that the bodies/councils are rather weak, although chaired by the Prime Minister. If they shall be instrumental in creating a holistic innovation policy, they should certainly be made stronger.

- One way to support the transformation of linear policies to holistic policies is to separate the two policy areas (innovation policy and research policy) in their design and in terms of which unit in the political system is responsible for them. After all, research policy and innovation policy are actually different things, with different objectives. And such a separation might be a way of making it easier to transform innovation policy from linear to holistic.

- Of course, given the wide definitions of research policy and innovation policy that we use (see section 2), there are also, and must be, overlaps between the two policy areas. They actually "intrude" into each other's "territories". This can be generalized: they also intrude into additional policy areas, such as labour market policies, public procurement policies, defense equipment policies, energy policies, transport policies, health care policies, environmental policies and regional policies. This is corollary if (all or most) policy areas are defined in a broad sense, which I think they should be. 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.

- It is important to note that the state in practice allocates very large resources to all the policy areas listed above. If the government wants to emphasize and strengthen innovation policies, they can "exploit" this overlapping of policy areas. Just to mention one example, procurement policy can be adapted or "twisted" so that it stimulates innovation to a much larger degree. Regular public procurement can in this way be transformed into public procurement that triggers innovation. It is important here to note that public procurement accounts for about 20% of GDP in Europe (2.3 trillion Euros). To coordinate policy areas in this way does not need to increase the combined resources needed for the two policy areas. It may even decrease cost and improve efficiency thanks to innovation (Edquist 2014).

- In the further analysis of issues of governance and coordination it seems relevant to address the following issues:
  - Is a policy body placed above ministries called for in the field of innovation (and research)?

- Why should innovation and/or research policy be given a higher position than other policy areas in the political hierarchy of the country?
- What tasks should such a body be given?
- Should the tasks include the design of research and innovation policies or only innovation policy?
- Is it easier to develop a holistic innovation policy if such a body exists?
- Should it have a secretariat?
- How are the objectives for research and innovation policies decided upon?
- Should the identification of innovation policy problems be performed at the supraministerial, ministerial or the agency level?
- How should a body placed above ministries be organized and equipped to really have an impact on innovation processes?

- Innovation policy is sometimes/often needed, but it must not replace or duplicate what private actors can do. Public action should only contribute to solving problems that the private actors cannot handle. Producing and further developing old processes and products are the tasks of established firms, while helping to develop brand new products can be an important task for innovation policy. It will obviously be an advantage if these new products help to satisfy human needs, solve societal problems and mitigate global challenges presented by the environment, energy, health, etc. Innovation policy can be given such an orientation, if the objectives of the policy are formulated in an appropriate way.

- Additionality (i.e. non-duplication or non-crowding out of private initiatives) arguments constitute a basis for policy support to new and emerging industries rather than to existing ones. Emerging and growing sectors are also often argued to contribute more to growth and employment than traditional ones. Established industries should be expected to care for their own renewal, research and innovation on the basis of accumulated profits. Emerging sectors, on the other hand, are characterized by uncertainties and large risks, which sometimes cannot be absorbed by private actors. At the same time, lobbying forces tend to try to influence policy in the direction of securing public support for existing and traditional sectors.

- That a production sector is very important according to the objectives of the policy of a country does not, by itself, justify public action to support that sector, if private organizations can handle it (i.e. there is no additionality). The condition of additionality (non-duplication or non-crowding out of private initiatives) should also be fulfilled. This

often motivates public action in support of new (or non-existing) production sectors rather than mature ones. The criteria for public policy intervention (additionality, non-crowding out) not only point to what public organizations should do in terms of policy. They also indicate what public agencies should *not* do.

- It is the difference between process innovations and product innovations that explains innovation's "double character" in relation to employment. The introduction of process innovation leads to productivity increases, and a smaller amount of labor is therefore needed to produce the same volume. This is an important aspect of the basis for increased welfare. If there is a problem of high unemployment (as in Europe in 2014), a partial solution is to compensate for the loss of jobs by beginning to produce new products. Product innovations actually lead to the creation of new jobs, and this compensates for the jobs lost through process innovations.

- One might discuss priorities in terms of supporting innovation in sectors of production or industries, as above. An alternative to supporting sectors is to support activities that influence innovation processes in all or many sectors of production (although unevenly), such as research, education, rule-making, incubation and seed funding, in which private actors are weak. (Annex 1 lists 10 such activities). The pros and cons of both these modes should be thoroughly analyzed. Questions that should be further addressed are:

    - Is the additionality argument a reason to support only the emergence of new products and industries?

    - Is such a policy best formulated in terms of sectors of production, or in terms of activities (incubation, seed funding, etc), which may be bottlenecks for the development of (product) innovations?

    - In what circumstances is a sectoral or an activities approach to be preferred?

May 29, 2014,

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Annex 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 organizational 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. Support to key elements in innovation systems

5. Creating and changing organizations 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 organizations, policy organizations, etc.

6. Networking through markets and other mechanisms, including interactive learning among different organizations (potentially) involved in the innovation processes. This implies integrating new knowledge elements developed in different spheres of the SI and coming from 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 organizations 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 (2011)

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