Rethinking Nordic Added Value in Research

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PREFACE

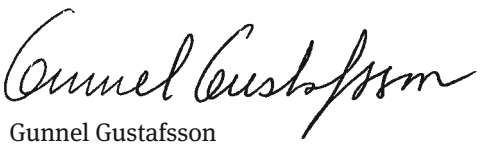
NordForsk is a platform for joint Nordic research and research policy development. Our aim is to contribute to the development of the knowledge society in the Nordic region, and consequently to a globally competitive European Research Area (ERA). To implement this, our strategic actions are inter alia developing the knowledge basis for sound Nordic research- and research policy coordination, and promoting cooperation that adds value to national initiatives in the Nordic region.

The main framework for research priorities in Europe are set in the EU, and EU research policy has wide-ranging implications for Nordic researchers and policymakers. Participation in EU research cooperation is therefore a main political priority in all the Nordic countries. The EU Framework Programme for Research and Technological Development (FP7) is, for the time being, the main instrument to respond to Europe's needs in terms of growth and European competitiveness. FP 7 covers the entire range from basic to applied research, and represents a key pillar in the establishment of the ERA. This represents substantial opportunities for Nordic researchers. At the same time, the size and complexity of FP7 represents challenges for actors from small countries, when it comes to influencing relevant decision-making processes and mobilizing sufficient resources to fully participate.

Against this background, NordForsk has commissioned three reports to describe and analyse key aspects of Nordic research cooperation in a European context, both at the research policy and – strategy level (research responsible ministries and research councils) and the research-performing level (researchers, universities and institutes). The reports have all been developed by NIFU-Step and Technopolis in cooperation with NordForsk. This third report analyses the concept of 'Nordic Added Value' in light of the development of the ERA.

I would like to thank the author, Erik Arnold from the Technopolis group, as well as the rest of the project group[I] for the work on this report. Let me also express special thanks to the Advisory Board[II] for their very valuable input to the reports.

Oslo April 2011



Gunnel Gustafsson
Director NordForsk

I Erik Arnold (project manager), James Stroyan, Göran Melin and Tommy Jansson from the Technopolis group, Aris Kaloudis, Inge Ramberg and Lisa Scordato from NIFU. Marianne Røgeberg has been NordForsk's main responsible for the project.

II Carl Jacobsson (Swedish Research Council), Unni Nikolaysen (Norwegian Ministry of Research and Higher Education), Hans M**ü**ller Pedersen (Danish Agency for Science, Technology and Innovation), Eili Ervela-Myreen (Finland)

SUMMARY

This NordForsk Policy Brief is about the idea of 'Nordic Added Value', namely the justification for acting at the Nordic level, in relation to research. It explores the changing meanings of the 'added value' of cooperation in research at both the Nordic and European levels. It shows that the Nordic cooperation in practice already strong and considers the implications of possible futures on the continuing value and effectiveness of the cooperation. It makes a number of policy suggestions for increasing the strength and effectiveness of the Nordic cooperation in the future.

Added Value and networking

The nature of knowledge makes it not only a proper investment for the state, but also means that its creation and use are intimately tied to networks. Knowledge production and use is therefore an intensely **social** process, in which researchers need constantly to interact with their colleagues, their rivals and those with an interest in what they produce. Especially in small countries like the Nordic ones, this means that researchers – like innovators – need to be 'born global', i.e. they have to have **international** networks. However, entry into the needed networks is not easily achieved. These networks do not tolerate free riders – you have to 'bring something to the party' in the form of ideas, research capability and resources in order to belong. The networking has therefore to be supported by capacity building and funding at the national level.

The specific configurations of knowledge production and use networks change over time and differ among sciences and technologies. There is no 'one size' that fits all. Thus, to ask whether the 'right' level of networking is Nordic or European – as has been done at times in the debate over Nordic Added Value – is to ask a pointless question. The answer is always "It depends".

The Nordic cooperation, in both its formal and its informal manifestations, is a long-standing one. Its original driving forces were cultural and geographical but it had clear benefits in supporting international networks. As Nordic countries began to join a European Community with increasingly federalist ambitions, and as advances in travel and communications technologies increasingly shrank the world, Nordic cooperation has had to evolve.

Co-evolution with Europe means that the nature of Nordic Added Value has had to change. In the mid-1990s, it shifted from being 'obvious' and culturally based to take on a more economic character. Nordic Added Value was about achieving the benefits of scale and competitiveness while respecting subsidiarity (in the sense of not doing things that could better be done at the national or the European level). In this century, Nordic Added Value has shifted towards the idea of building platforms and virtual communities that strengthen and structure the research and innovation resources of the Nordic area. This enhances competitiveness, strengthens national research and innovation systems and increases the ability of the Nordic nations' ability to address European and global cooperation and competition by building Nordic strength. The over-riding aim of the Nordic cooperation is to strengthen the individual Nordic nations through cooperation. This is the opposite of the aim of current EU policy.

European Added Value (EAV) was for a long time defined as networking three or more Member States together to tackle issues that were hard to resolve at national level. Since2000, restructuring the fabric of European research, building larger and more globally competitive entities, also creates EAV. EAV is obtained through the alignment of national research and innovation policies and the creation of self-organising, trans-national interest groups that define research and innovation agendas. Shifting research competition up from the national to the European level creates EAV. Finally, EAV requires the creation of strong European-level institutions and arrangements that 'optimise' the research and innovation system at the Euro-

pean – and not at the national – level. EAV has evolved to become part of European nation building and the creation of a Federal state.

From the national perspective, the Nordic and European cooperation therefore offer rather different opportunities – and the differences go beyond mere size. The changes at European level will force increased scale and specialisation at national level.

Nordic cooperation

Cooperation is deeply rooted as a phenomenon among Nordic researchers. They reach out to the world for network relationships based on needs, but end up turning to their neighbours disproportionately often. There are many areas of research where Nordic countries are strong and where there is scope for building Nordic strength as well as areas of shared need where the logic of cooperation is equally compelling.

Nordic cooperation in research is extensive and wide-ranging. However, the institutional focus is on three organisations: NordForsk, Nordic Innovation Centre (NICe - "Nordic Innovation" from March 2011) and Nordic Energy Research (NER). These organisations are successful and visible, but their collective resources are small: under € 30 million per year.

The governance of the Nordic cooperation is a work in progress. The structure of the Nordic Council of Ministers incorporates the same inter-ministerial barriers as those recognised at the national level as posing an obstacle to achieving cohesive policies for innovation, research and other cross-cutting questions such as climate change. The Nordic level also lacks the kind of policy 'arena' provided at the national level by organisations such as the Finnish Research and Innovation Council, which address the need for coordination among ministries and set overall research and innovation strategy for the State.

NordForsk, NICe and NER all have different governance arrangements. NordForsk and NER are well placed to participate in joint programming among the Nordic countries. In practice, however, their resources are spread thinly across a wide range of instruments and thematic areas. The Nordic Top-level Research Initiative, launched by the five Nordic Prime Ministers, represents a disruptive change and a new vision of how to achieve Nordic Added Value. It is not realistic to expect a continuing flow of such interventions from the prime ministerial level to direct changes in Nordic research cooperation policy. The new version of Nordic Added Value, rooted in the idea of building common platforms, requires strategic choices and more resources – at least some of which will have to be reallocated from other things. The existing governance and structure of the Nordic research and innovation cooperation is not well adapted to doing this.

The involvement of the Nordic countries' national agencies is crucial to the implementation of larger platforms such as the Top-level Research Initiative, but it is also clear that stimuli are needed at the policy level in order to determine what these larger platforms should be. This implies that the problem of the missing Nordic-level policy 'arena' Nordic level spanning responsibilities of the different councils of ministers needs to be solved so that such impulses can be provided. However, in the sense that the Nordic organisations are involved in joint programming of national resources, their governance needs also to be closely linked to the national level.

Future developments

The future is always uncertain but there is every reason to believe it will involve a continuing need for knowledge-intensive production and that the Grand Challenges being discussed in EU RTD policy will not only generate a need for research, but also provide major economic opportunities for innovation.

We considered the implications for Nordic actors under four scenarios:

- One in which the Nordic and European cooperation remain about the same level as they are today
- A second in which the Nordic cooperation develops in scale and strength while the European one is unchanged
- A third in which both Nordic and European cooperation develop in strength and scale
- A fourth one in which the European cooperation develops but the Nordic one stays as it is

In the first case, we would expect Nordic-level cooperation to have limited effect. Europe would undoubtedly go on to address some of the Grand Challenges, but without growth in European-level resources there will be limited scope to tackle any but those that are of universal relevance. With few resources at the Nordic level, cooperation quickly runs out of resources for building further platforms like the Top-level Research Initiative. In the second case, the Nordic level takes more initiative and can build a number of common platforms of Nordic strength, accessing both European resources and potential global cooperation and competitions as a result. In the third case, increased European activity provides more opportunities to exploit platforms built at the Nordic level. The fourth case is a disaster in terms of reaching Nordic objectives. Resources and initiative shift to Brussels. Small countries are marginalised and the Nordic region is too fragmented to respond.

The Nordic policy conclusion from considering these scenarios is clearly that developing the Nordic cooperation further creates the most opportunities and the strongest positions for the Nordic nations, giving them the best chance to improve their national research and innovation systems.

What needs to be done?

International cooperation in knowledge production and use is a necessity, not a luxury. The issue in relation to policy is how best to provide a framework for supporting cooperation that does not emerge naturally – typically because it demands more resources than researchers and knowledge users can provide from their existing funding. While their coverage is not perfect, Nordic and European cooperation combined would entail quite a wide range of opportunities, especially if Nordic cooperation could extend its principle of variable geometry outwards as well as inwards, bringing in non-Nordic countries à la carte, where needed.

It is not clear that a major increase in resources is needed at the Nordic level. Existing Nordic arrangements offer a range of small-scale instruments that support the development of individual Nordic platforms. These activities should be maintained. As the Top-level Research Initiative demonstrated, it is harder to work at larger scale because this effectively means jointly reprogramming resources that are sometimes best used nationally and other times best used in a collaborative effort.

Unlocking the potential revealed by the Top-level Research Initiative to generate Nordic Added Value by programming larger-scale joint activities requires:

- Creating a Nordic-level research and innovation policy ‘arena’ that can decide when and where such platforms should be constructed.
- Linking the governance of all three Nordic research and innovation organisations clearly to the national as well as the Nordic level.
- Continuing and extending the strategic intelligence and analysis activities of the Nordic organisations, so that that arena has the information it needs.

- Implementing future initiatives in closer consultation with the member countries' policymakers and their agencies and on a timescale that makes it possible for the nations to allocate resources.
- Agreeing that such initiatives can have variable geometry – and that additional countries can be invited to join in, on a cost-sharing basis.

These arrangements would effectively allow Nordic cooperation to develop on a case-by-case basis, constructing platforms and networks that fit the individual needs of different thematic areas. This is not a substitute for European or global cooperation, but provides a complement to them and a way to build greater Nordic strength in research and innovation.

Rethinking Nordic Added Value

1. INTRODUCTION

This NordForsk Policy Brief discusses the concept of 'Nordic Added Value' (NAV), i.e. the justification for cooperating at the Nordic level. It focuses on research, in which NordForsk is the major Nordic organisation responsible for taking action.

There is disagreement about the degree to which Nordic cooperation makes sense at this stage of the 21st Century:

- Some people see it as self-evident that Nordic cooperation is beneficial, and should be continued in research as in many other areas.
- Some believe that while Nordic cooperation may have made sense in the past, this role has largely been taken over by the European Union (EU).
- Others see Nordic cooperation as having become so routine that it scarcely needs to be actively promoted – it just happens automatically among friends and neighbours.
- Still others think that, under a variable geometry model, the optimal geometry is only very rarely going to be the five Nordic countries. As the environment grows more competitive, the quality of the configuration becomes increasingly important, which means cooperation at the Nordic level may develop into a weakness rather than a strength.

This Policy Brief aims to explore the changing meaning of Nordic Added Value.

To do this, we begin by considering the way science and technology work and, in particular, why cooperation in science and technology makes sense. Chapter 2 takes up these questions, looking first at the history of Nordic and European R&D cooperation and thereafter at the changing ways in which Added Value has been conceptualised and realised at each of these two levels.

Chapter 3 starts with a small celebration of the existing intensity of cooperation in Nordic research. Evidence from bibliometrics and from participation in the EU Framework Programmes shows that the Nordic community is used to working together, works well together and still finds potential in building on areas of Nordic strength and excellence to extend that cooperation. It then catalogues the main Nordic organisations responsible for cooperation today, discusses their governance and looks at the recent experience of setting up the first Top-level Research Initiative. This is a much larger-scale intervention in research and innovation than has previously been attempted at the Nordic level, and it was pushed through on the initiative of the five Nordic prime ministers. It offers important lessons about the governance of the Nordic cooperation and hints at new ways to conceive of Nordic Added Value.

Chapter 4 is a thought experiment intended to answer the question: Does it really matter whether Nordic collaboration continues to develop and grow stronger? It does this by constructing and combining scenarios under which Nordic and European cooperation, respectively, continue much as they are today or expand significantly.

Chapter 5 draws conclusions for Nordic research and innovation policy.

This paper is a companion to the two previous reports in this series of NordForsk Policy Briefs. It relies on input from the interviews conducted in connection with those Policy Briefs as well as extensive secondary work in the Nordic and European cooperation literature.

As is clear from this summary, the authors believe there is a continued and important role for Nordic cooperation in research and related areas. While NordForsk's task is, of course, to develop and implement aspects of that cooperation, the reader should not assume that NordForsk agrees with the specific opinions and judgements made here. Those – together with any errors that may remain, despite the generous support and advice of NordForsk and our reference group – are of course solely the responsibility of the authors.

2. NORDIC AND EUROPEAN ADDED VALUE

The Nordic and European research and innovation cooperations are instances of a much more general need for cooperation. In this chapter, we therefore need to begin by thinking about the way science and technology work and in particular why cooperation in science and technology makes sense. We then look in turn at the history of the Nordic and European R&D cooperations and at the changing ways in which Added Value has been conceptualised and realised at each of these two levels. We conclude that Added Value at these two levels means somewhat different things and hence that the Nordic nations need to exploit these two levels as the complementary sets of opportunities that they are.

2.1 INTERNATIONAL COOPERATION AND THE ECONOMICS OF RESEARCH

International cooperation in research often has an important political element. Bilateral research agreements between countries are frequently established as gestures of diplomacy, which researchers and research funders later have to fill with content. At the Nordic level, cooperation in research as in other matters has an important symbolic value, and is sometimes pursued as an end in itself rather than a means to other things[1]. In practice, the European Union also uses research cooperation to achieve political goals. However, there are other good reasons for implementing cooperation activities as well; these are an inherent part of the economics of research and the knowledge production process itself. Since these are more general than the instances of cooperation at Nordic and European level, let us explore them first.

2.1.1 Economics of research and the production and use of knowledge

The standard economic argument for the state to pay for research is that the special nature of research makes it an unattractive investment for the private sector. This idea of 'market failure' leading to under-investment in research has been the principal rationale for state funding of R&D[2] throughout the post-War period. Of course, governments had been funding research long before the economics profession produced a reason. Ken Arrow (see footnote 2) is generally credited with describing the three major sources of market failure which, from a neo-classical perspective, make it useful for government to fund research:

- **Indivisibility**, because of the existence of minimum efficient scale.
- **Inappropriability** of the profit stream from research, leading to a divergence between public and private returns on investment. This results from two essential (and economically efficient) freedoms that scientific researchers have: namely to publish and to change jobs.
- **Uncertainty**, namely divergence in the risk factors associated with research for private and public actors, respectively.

Arrow's argument is particularly relevant to more 'basic' (and, by implication, generally applicable) forms of knowledge because capitalists' inability to monopolise the results of such research mean they would be unlikely to invest in it. The inappropriability of research results mean that they tend to 'spill over' from one economic actor to others. For the individual capitalist, spillovers are economic losses that make investment unattractive. From the perspective of society these spillovers make knowledge a good investment – the spillovers provide the societal returns because many different parts of society can use the knowledge.

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1 Karl Erik Brofoss, Inge Ramberg and Vera Schwach, *Felles Nordisk forskningsstøtte: Styring og nytte*, NIFU Skriftserie nr. 23/2003, Oslo: NIFU, 2003

2 Ken Arrow , "Economic Welfare and the Allocation of Resources for Invention," in Richard Nelson (Ed.) *The Rate and Direction of Inventive Activity*, Princeton University Press, 1962; see also Richard Nelson, "The simple economics of basic scientific research," *Journal of Political Economy*, 1959, Vol 67, pp 297-306

In economic terms, knowledge is a 'non-rival' good – meaning that many people can consume it at the same time. (Most goods, for example cake, are 'rival'. If I eat the cake, then you cannot. Knowledge is one of the special cases where you **can** have your cake and eat it.) Knowledge is also 'non-excludable' – it is hard to stop people having access to it (as totalitarian governments tend to discover, to their cost). Non-excludable, non-rival goods are known as 'public goods'. In theory the market cannot produce these, so if we need them then the state must pay.

While these arguments for state investment in knowledge appear valid, mainstream economics traditionally makes another assumption about knowledge that is clearly false. It assumes that companies have perfect access to all knowledge and that they incur no costs in making use of that knowledge. There are whole branches of economics (the economics of imperfect information and most of the newer 'innovation systems' tradition) that explore this problem more closely. For our purpose here the important thing to note is that real companies (and other producing organisations in the economy such as hospitals or farms) vary in their ability to make use of external knowledge, such as that produced by research.

Wesley Cohen and Daniel Levinthal introduced the idea of varying ability to use external knowledge or 'absorptive capacity' to the R&D and innovation literature in a landmark 1990 article.[3] They define absorptive capacity as "the ability of a firm to recognise the value of new, external information, assimilate it, and apply it to commercial ends," and state that absorptive capacity is closely linked to the ability of companies to carry out internal R&D. This idea is widely accepted in the case of technology. Michel Callon[4] has pointed to evidence that not only technology but also **science**, in fact, is very costly for the individual company to exploit. It requires still greater absorptive capacity, not only in terms of people and their abilities but also in terms of other resources such as equipment and facilities. Thus, while scientific knowledge is in principle a 'public good', it is not always publicly **accessible** because users typically have to invest a lot of resources in order to use it.

The difficulties in using as well as producing knowledge help to explain the importance of knowledge in competition. They also underline the importance of **people** – many of those who 'use' knowledge in companies come from and have tight network links with those in 'knowledge producing' organisation such as research institutes and universities. In economic terms, the education and training of these people through research and in research-based teaching is far more important at the national level than the production of new knowledge itself. In principle, a country could choose to 'free ride' on world science by conducting no research of its own, and instead buy subscriptions to scientific journals. In practice, a country that tried this tactic would find it had nobody who could understand what the journals said.

If we look at the production and the use of knowledge, it turns out that both are highly networked activities. Derek de Solla Price[5] pointed out a long time ago that leading scientists tend to work in 'invisible colleges', which do not respect national borders. The leading scientists are simultaneously in fierce competition and in close cooperation with each other. They depend on knowing what the latest research questions, methods and results are. Keeping their friends close and their enemies closer, they share this information informally, long before it appears in scientific journals. As a result, the journal reader who is not a member of such an invisible college finds it extremely hard to keep pace with the leading edge in research. Admit-

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3 Wesley M Cohen and Daniel A Levinthal, "Absorptive capacity: a new perspective on learning and innovation," *Administrative Science Quarterly*, Vol 35 (1), March 1990, pp128-152

4 Michel Callon, "Is Science a Public Good?" *Science, Technology and Human Values*, Vol 19, 1994, pp 395-424

5 Derek de Solla Price, *Little Science, Big Science*, New York: Columbia UP, 1963

tance to these colleges is usually gained by working closely with someone who is already a member, demonstrating skills and gradually building trust. This is the logic of joining most social to networks – and it certainly applies to participation in the EU Framework Programmes, both at the individual and at the national level.[6])

Technology networks have similar dynamics. Often they focus on supply chains and there is much greater emphasis on process aspects such as dependability and timeliness, but like scientific networks they rely on trust and they provide access competitively important information that is not available to outsiders. This is not the only reason why "innovators do not innovate alone"[7] – for example, clustering creates markets for labour with scarce skills and builds the scale that enables others to offer specialised producer services that bring rivals to live side by side in 'industrial districts'.[8] But the networked nature of technology is itself a strong reason for clustering.

Scale drivers in research tend to be tied to the shared use of costly facilities. These underpin much international cooperation, such as CERN, ITER and the coming European Spallation Source at Lund.

Policymakers often argue that there is a need for 'critical mass' in research. While this is self-evident in the case of large and complex projects (such as the Manhattan or Human Genome projects), there is no real evidence to suggest that there are economies of scale in research once groups have reached the minimum scale of operation – typically 5-10 people. Above that level, there is a linear relationship between the number of researchers and output. Only when one reaches very large scale indeed (into the thousands of researchers) does one see the production of scientific articles going up more quickly than the number of researchers. This effect is caused not by economies of scale, however, but by 'economies of scope'.[9] These are typically seen in big universities that conduct research across a large number of different disciplines. The increased productivity is caused by the increased ability to access problems and to do interdisciplinary research offered by large organisations that allow the researcher to reach out to almost any partner discipline that she or he needs.

2.1.2 Research-industry links

Researchers like to think about the kind of innovation that is connected to research. In fact, the vast majority of innovation has nothing to do with research but involves 'new combinations' of existing knowledge[10]. In effect, the inventive and innovative process of firms involves (1) choosing a (valuable) problem and (2) searching for solutions to these problems.[11]

Smith and West argue cogently (hence, it is worth quoting them at length) that:

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6 Ernst Rietschel (Chair), Erik Arnold (rapporteur) et al, Evaluation of the Sixth Framework programmes for Research and Technological Development, 2002-2006, Brussels: DG-Research, 2009

7 Christopher de Bresson, "Networks of innovators: a synthesis of research issues", *Research Policy*, 20 (5), 1991, 499-514

8 Alfred Marshall, The Principles of Economics, London: MacMillan, 1890

9 Luke Georghiou et al, Report of the ERA Expert Group, *Challenging Europe's Research: Rationales for the European Research Area (ERA)*, Brussels: DG Research, 2008

10 JA Schmpeter, *Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process*, Philadelphia: Porcupine, 1939; RR Nelson and S Winter, *An Evolutionary Theory of Economic Change*, Harvard University Press, 1982

11 Daniel Ljungberg and Maureen McKelvey, "Academic involvement in patenting: A study of firms' academic patents in Sweden", DRUID Conference, 2010

It is sometimes argued that innovation consists of the discovery of new scientific or technical principles (perhaps occurring in universities), followed by engineering development in companies, leading to commercialisation. One of the key themes of modern innovation studies is rejection of this idea. Innovation cannot be understood in terms of a discovery phase followed by a commercialisation phase. Recent innovation research has recognised that the innovation process varies considerably across industries, and follows different sequences in different technologies. Robust conclusions from innovation studies include the following:

- *Innovation involves continuous interaction and feedbacks between perceptions of market opportunities, technological capabilities, and learning processes within firms. The strategic capabilities of firms are central here: the ability to perceive opportunities and to invest in realising them are the main characteristics of an innovating firm. These strategic capabilities are not automatically present in firms and in fact seem to be very unevenly distributed among them.*

- *Research and Development (R&D) is often not a source of innovation but an effect of innovation decisions. Firms very often seek to innovate by exploiting their existing knowledge assets. Unforeseen problems often emerge, however, and these require R&D for their solution. From this perspective R&D should be seen not as a process of discovery that initiates innovation, but as a problem-solving activity within already-existing innovation processes.*

- *Solving innovation-related problems often requires recourse to knowledge and skills outside the firm.*

- *A key characteristic of innovation capabilities, at the levels of both firms and countries, is that they are cumulative. They build up over time, and they often depend heavily on past investments and sustained investment over long periods."*[12]

While much innovation, therefore, does not depend on research, there is also clear evidence – for example from the Community Innovation Survey and its equivalents outside Europe – that more prolific innovators have close links to public research organisations. Literature reviews on this issue, carried out by SPRU scholars between 1996-2007, have pointed out that considerable direct and indirect economic benefits from public research to firms do exist, but that the importance of these benefits varies depending on the scientific field, the industrial sector and the technology. In the most recent review, Martin and Tang identify 7 main 'exploitation channels', or benefits, for the economy and society related to public research activities and outputs. [13] These are interconnected and mutually supportive. The 7 'exploitation channels' are:

- Channel 1: increase in the stock of useful knowledge;
- Channel 2: supply of skilled graduates and researchers;
- Channel 3: creation of new scientific instrumentation and methodologies;
- Channel 4: development of networks and stimulation of social interaction;

12 Keith Smith and Jonathan West, Australia's Innovation Challenges: The Key Policy Issues, Submission to House of Representatives Standing Committee on Science and Innovation, Inquiry into Pathways to Technological Innovation, April 28, 2005

13 Ben R. Martin and Puay Tang, The Benefits from Publicly Funded Research, SPRU Electronic working Paper Series No. 161, Sussex University: SPRU, 2007.

- Channel 5: enhancement of problem-solving capacity;
- Channel 6: creation of new firms;
- Channel 7: provision of social knowledge;

Channels 1 and 2, are considered as the most beneficial to firms as they help them enhance their internal capabilities and absorptive capacity, thereby reinforcing the strategic capability of firms. Access to unique university facilities is an additional benefit for firms,[14] particularly for smaller and larger firms seeking to strengthen their core and non-core technological capabilities, respectively.[15] Surveys show that recruitment of skilled university graduates and researchers is cited by industry as the most important knowledge transfer mechanism.[16]

This mechanism is associated with the transfer of 'tacit' knowledge (including know-how, skills and expertise) that cannot be captured through published research, as this kind of knowledge remains with the researcher – it is 'sticky' and difficult to transfer.[17] Tacit knowledge acquired through recruitment enhances a firm's internal knowledge base and its capacity to innovate.

Prior experience of collaboration and correspondingly high trust reduce barriers to academic-industrial collaboration.[18] A UK study points to strong relationships between major firms and leading universities: "Universities with a greater number of links to large R&D-intensive firms have significantly higher levels of research income. Also, firms with a greater number of links to high research-income universities invest more in R&D." [19] David and Metcalfe point out that successful academic-industry links involve network relations among individual people at the level of research. These networks are constantly being configured and reconfigured – transforming a multi-purpose innovation ecology into a succession of what they call 'innovation systems', i.e. functioning cooperative networks.[20]

Recent evidence reveals that there is considerable complementarity between patenting and publishing as well as between the former and additional mechanisms, notably, joint and contract R&D, consultancy, spin-off and joint Ph.D. training. This is the case in technology areas related to chemistry, computer science and sub-fields of engineering and physics.[21]

In fact, in many if not most fields, university-industry links improve research performance.

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14 Erik Arnold and Ben Thuriaux, *Developing firms' Technological Capabilities,* Report to OECD, Brighton: Technopolis, 1997.

15 Michael D. Santoro and Alok K. Chakrabarti, "Firm size and technology centrality in industry-university interaction," *Research Policy,* 31 (7), 116-1180, 2002.

16 Martin and Tang, *The Benefits of Publicly funded Research.* Cosh and Hughes, "Never mind the quality."

17 Von Hippel, "'Sticky Information' and the Locus of Problem Solving."

18 Ammon Salter, Johan Bruneel and Pable D'Este, "Investigating the factors that diminish barriers to university-industry collaboration," DRUID Conference 2010

19 Robert Huggins, Hiro Izushi and Daniel Prokop, "University-Industry Networks: Interactions with Large R&D Performers", Regional Studies Association Conference, Pécs, Hungary, May, 2010

20 Paul David and J Stanley Metcalfe, "Only Connect: Academic-Business Research Collaborations and the Formation of Ecologies of Innovation, SIEPR Discussion Paper 07-33, Stanford Institute for Economic Policy Research, January 2008

21 Gustavo Crespi, Pablo D'Este, Roberto Fontana and Aldo Geuna, *The Impact of Academic Patenting on University Research and its Transfer,* SPRU Electronic working Paper Series No. 178, Sussex University: SPRU, 2008.

A UK study indicates that – except in the special cases of patenting and spin-off generation – most academics engage with industry to further their research rather than to commercialise their knowledge[22]. Industrial interaction provides important signals about what problems are of practical and industrial interest in research terms, as well as often leading to the provision of resources[23]. For example, in the case of GSM-relevant research in Sweden, interaction between the research department of Ericsson Radio and three Swedish universities triggered significant growth in research and teaching activities, over time providing Ericsson with the R&D manpower it needed to take a leading position in mobile communications markets and inducing the number of professors working in relevant areas to grow from 3 to 41 over a couple of decades[24].

2.1.3 Implications for international research cooperation

These characteristics of knowledge production have important consequences for international cooperation, especially for small nations such as the Nordic countries, where there are economic and physical limits to the breadth and depth of the research and technological activities that can be carried out domestically.

- Within these economic and physical limits, a strong research community is needed in order absorb as well as to generate knowledge. It is also a necessary 'entry ticket' to international scientific and technological networks, into which only those who bring something to the party are invited.
- For this reason, capacity building is not an activity that can be pursued in conventional research cooperation (except in the special case of aid).
- Nonetheless, the centrality of human capital as a main output of the research system and the principal vector of knowledge within the innovation system – as well as being the means through which scientific and technological networks operate – means that a great deal of international cooperation has to focus on mobility and interactions among people.
- Resource scarcity combined with the need for excellence requires specialisation within the national research community. This may be an explicit (top down) strategy or a de facto (bottom up) one. In the latter case, there is limited scope for policy to align research capacity with changing national needs.
- Participation in international networks of science and technology is a precondition for competitive success in science and industry. These networks may be informal as well as formal. Typically, such networks need to stretch well beyond national borders – especially in small countries
- Such international networks help share the costs of **using** as well as producing knowledge.
- They are also useful as 'focusing devices' – providing more information about research needs and opportunities than can be provided by purely national networks.

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22 Pablo D'Este and Markus Perkman, "Why do academics engage with industry? The entrepreneurial university and individual motivations," *Journal of Technology Transfer* (forthcoming)

23 Edwin Mansfield, "Academic research underlying industrial innovations: Sources, characteristics and financing," *Review of Economics and Statistics*, 77 (1), 1995, 55-65; Donald S Siegel, David Waldman and Albert Link, "Assessing the impact of organisational practices on the relative productivity of university technology transfer offices: an exploratory study," *Research Policy*, 32, 2003, 27-48

24 Erik Arnold, Barbara Good and Henrik Segerpalm, *Effects of research on Swedish Mobile Telephone Developments: The GSM Story*, VA 2008:04, Stockholm, VINNOVA, 2008

- The problems of indivisibility and uncertainty that make it more rational for the state than industry to tackle some kinds of research also apply at the national level: some problems are so big that an international effort makes sense – hence the 'grand challenges' currently so much discussed in Europe
- Access to costly facilities (infrastructure) is a driver for international cooperation in research and technology.
- The type and scale of international cooperation needed differs among technologies, countries, industries and institutions. International cooperation instruments will therefore need to be very flexible, adapting to different types of cooperation need.
- International cooperation provides a means to by-pass some national lock-ins (e.g. the shape and specialisation of the research community, funding lock-ins, and so on). However, it should be noted that at least some forms of international cooperation –such as the EU Framework Programme – are strongly consensus based and therefore can give rise to lock-ins of their own.

2.2 NORDIC RESEARCH POLICY AND ADDED VALUE

2.2.1.Nordic policy

The Nordic cooperation is among the oldest and most extensive regional arrangements in the world. As Dan Andrée argues, the Nordic cooperation has two parts

- It is formalised through the Nordic Council and the Nordic Council of Ministers. Together, these two organisations engage in one of the most comprehensive regional cooperations to be found in Europe.
- Further, it is also 'non-formalised' through numerous bilateral and multilateral cooperation initiatives between research councils and agencies in the Nordic countries[25].

The Nordic Council was established in 1952 as a forum for Nordic[26] parliamentarians. Early achievements included an agreement on the free movement of labour in 1954 and the passport union, operative in 1958. Repeated efforts to create a customs union were abandoned in 1959, when Denmark, Norway and Sweden applied to join the European Free Trade Area (EFTA). Denmark and Norway also applied to join the European Community (precursor to the EU). This early history already shows both the desire to cooperate at the Nordic level and the pull towards the European level that Nordic countries have to differing degrees felt, and continue to feel. Denmark finally joined the European Community in 1973, Finland and Sweden in 1995.

The Helsinki Agreement of 1962 more or less functions as the 'constitution' of the Nordic cooperation. The agreement – which formally relates to the Nordic Council – says that members shall "seek to preserve and further develop cooperation amongst the countries in legal, cultural, social and financial fields as well as in matters relating to transport and environmental protection."

In 1971, the Nordic governments set up the Nordic Council of Ministers (NMR) as an intergovernmental (as opposed to inter-parliamentary) forum – or, rather, fora, for there are ten 'sectoral' councils of ministers plus an eleventh Council for cooperation. The NMR is therefore to be understood as a series of parallel cooperations among ministries – industry ministries with industry ministries, health ministries with health ministries and so on. One consequence

25 Dan Andrée, The Nordic Research and Innovation Area (NOIA) and synergies with the European Research Area (ERA), TemaNord 2008:597, Copenhagen: Nordic Council of Ministers, 2008

26 Denmark, Finland, Iceland, Norway and Sweden as well as the three autonomous areas: the Faroes, Greenland and the Åland Islands. Finland joined in 1955

is that the Nordic level does not map exactly onto the (changing) national divisions of labour among ministries. Another is that the Nordic level tends to reproduce the divisions among national ministries that make it difficult to produce holistic policies in areas such as research and innovation, climate change or ageing.

The first Nordic budget for research was created in 1972 and a growing number of research institutions were created through the 1970s. A series of Nordic institutions were established in 1973, including the Nordic Industry Fund, precursor of today's Nordic Innovation Centre (NICe). A Nordic advisory body on research policy, *Nordisk forskningspolitiskråd* (Nordic Research Policy Council),was established in 1983. Following the Brändström report[27], the operation of many Nordic research institutions was pushed down to the national level, leaving two major cooperation agencies answering directly to the Nordic Council of Ministers: the Nordic Innovation Centre (NICe), answering to the industry ministers; and NordForsk, responsible to the education ministers.

The driving force for restructuring the Nordic research cooperation in the past decade has been a response by the Nordic level to the idea of a European Research Area[28] (ERA), launched by European Commissioner Busquin in 2000. The Nordic Research and Innovation Area idea – discussed in green and white books in 2002[29] and 2004[30] – offers a vision of NORIA as comprising: more Nordic Centres of Excellence (NCoEs, distributed across Nordic countries), increased researcher and student mobility within the Nordic region, more Nordic graduate schools, coordination among the research councils, more research-related networking (especially using ICT to share data and work) and more efficient creation and use of common research infrastructures. As a result, the Nordic region should have greater influence on future Framework Programmes and become a more attractive international research cooperation partner.

The NORIA White Paper proposed three alternative models for organising Nordic research cooperation:

- setting up a Nordic research fund;
- creating a Nordic research and innovation council;
- establishing a 'two pillar' system with agencies for research and innovation.

A decision was taken in favour of the third 'two-pillar' option. As a result, the Nordic structures for cooperation in R&D have been dramatically simplified, and now focus on the domains of the industry (innovation) and education (research) ministers. NICe and the then Nordic Council of Ministers for Industry (now the Nordic Council of Ministers for Business, Energy and Regional Development) developed an 'Innovation Book'[31] as an innovation counterpart to the NORIA documents. It proposed three priority areas on which the Council of Ministers for Industry should focus:

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27 Dan Brändström, *En nordisk dimension i nationale forskningsmiljöer. Nordiske forskningsinstitutioner under nationalt ansvar*, 2003 (unpublished)

28 *Towards a European Research Area*, Communication from the Commission to the Council, COM(6), January 2006

29 Nordiska forskningspolitiska rådet, *Norden som en internationellt framstående forsnings- och näringsregion*, Copenhagen: NMR,2004

30 Gustav Björkstrand, *NORIA Vitbok om nordisk forskning och innovation*, TemaNord 2004:502, Copenhagen: NMR, 2004

31 *Innovationsboken. Nordisk styrka, nationell nytta och global excellence: Förslag till nordiskt innovationspolitiskt samarbetsprogram 2005-2010*, ANP2004:748, Copenhagen: Nordic Council of Ministers, 2004

- international cooperation at the strategic policy level;
- cross-border interaction between the 'operative' parts of the innovation system, especially companies and the institutions that support them;
- 'spearhead actions' involving highly visible industrial clusters and networks.

The ideas from the Innovation Book formed the basis for the innovation 'pillar' of the new Nordic institutions.

A third Nordic R&D 'agency' in fact exists, in the form of Nordic Energy Research. This is a cooperation of Nordic countries' energy ministries and their agencies, which formally does not involve the Nordic cooperation structures. The new energy injected recently into the Nordic cooperation is typified by a recent survey[32] of Nordic opinion formers, which stresses the need for the Nordic region as a whole to tackle growing international competition, the protection and exploitation of common Nordic values and the need for common Nordic leadership. It points to the need to establish positions of **Nordic strength**, rather than to base cooperation solely on lowest-common-denominator problems or issues that can **only** be tackled at the Nordic level.

2.2.2 Nordic Added Value (NAV)

The entry of Sweden and Finland into the EU in 1995 meant that three of the five Nordic states were now EU members. This led to a debate about the usefulness of the Nordic level in the context of a unifying Europe, and therefore about what constitutes 'Nordic added value' (*Nordisk nytte*).Prior to the *Nordisk nytte* debate, Nordic cooperation on research had not been problematised. In effect, it was seen as an obvious part of cultural cooperation, even if in practice most of it was in areas with high potential social relevance (such as energy and innovation), rather than the kind of curiosity-driven research that is more typically seen as having a cultural component (for example, astronomy, particle physics).

The reform report of 1995[33]defined *Nordisk nytte* as

- activities that otherwise could be undertaken at the national level, but where concretely positive effects are achieved through common Nordic solutions;
- activities that demonstrate and develop Nordic solidarity;
- activities that increase Nordic capabilities and competitiveness.

A report on Nordic cooperation in innovation in 1998 introduced the idea of 'subsidiarity' into the definition, though without using the word, by including the idea that the desired results of Nordic initiatives "should not better (i.e. more efficiently) achievable via national or European-level action".[34]

The working group on *Nordisk nytte* sought to operationalise the concept primarily in economic terms and in terms of scientific quality – arguably undermining the earlier and more traditional role of the Nordic cooperation in maintaining the common Nordic cultural iden-

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32 Huset Mandag Morgen, Nordisk Råd, Nordisk Ministerråd, *Norden som global vinderregion. På sporet af den nordiske konkurrencemodel*, ANP 2005:777, Copenhagen, Nordic Council and Council of Ministers, 2005

33 Nordiska Rådet och Nordiska ministerrådet, Nordiskt samarbete I en ny tid. Det nordiska samarbetet i ljuset av folkomröstningarna om EU-medlemskap för Finland, Norge och Sverige, Copenhagen: Nordiska Rådet och Nordiska Ministerrådet, 1995

34 PLS Consult, *Hele Norden som base: Utredning om nordisk erhvervs-/næringsrettet innovationssamarbejde*, Copenhagen: PLS Consult, 1998

tity[35]. Following pressure to maintain this more traditional idea as a component of *Nordisk nytte*, the working group reiterated its earlier three-point definition[36].

Following the meeting of the Nordic prime ministers at Punkaharju in 2007, fourteen globalisation projects were launched. The largest is the Top-level Research Initiative on climate, energy and the environment. As our discussion below shows, this represents a break with the patterns of governance and practice of Nordic research cooperation because it imposed an agenda and a programme from the top down onto a cooperation process that generally works in a bottom-up way. In many ways this discontinuity has been positive. In particular, it has begun to redefine NAV. The main emphasis in the Initiative is to do science that will help us understand and mitigate climate change. The non-scientific goals are to:

- profile the Nordic region as a leader within certain areas of the energy and climate sectors;
- strengthen national research and innovation systems;
- create larger professional communities which extend across national borders and pave the way for greater mobility of competencies;
- ensure the highest quality in research and innovation by combining the strongest Nordic communities;
- provide a platform for increased international cooperation both within the EU and beyond;
- enhance Nordic participation in EU programmes;
- strengthen Nordic competitiveness by using research and innovation to counter economic downturns.[37]

The prime ministers were explicit that this was the first stage in reinforcing research and innovation by coordinating an increasing number of national research and development projects and by promoting cooperation between national bodies that finance research.[38]

In 2010, the Nordic Council of Ministers for Education and Research (MR-U) set out a new strategy, arguing that research poses significant challenges and science-based knowledge provides an important foundation for creating development and growth. As a result of globalisation, education and research must become much more internationalised and competition on talent and successful innovation must be intensified. As a result, research ventures will improve the Nordic countries' competiveness in a globalised world.The goals of the MR-U strategy are to:

- further refine the Nordic Research and Innovation Area (NORIA), which aims to develop the Nordic region in Europe and other parts of the world;
- improve research and innovation through increased efforts in the joint Nordic research and innovation institutions, as well as intensify co-operation between the national research funding bodies;

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35 Karl Erik Brofoss, Inge Ramberg and Vera Schwach, *Felles Nordisk forskningsstøtte: Styring og nytte*, NIFU Skriftserie nr. 23/2003, Oslo: NIFU, 2003

36 Nordisk Ministerråd, 1999: "Intensiveret Nordisk Samarbejde", Rapport fra en fellesnordisk arbeidsgruppe juni 1999.

37 NordForsk Brochure, Top-level Research Initiative– a major Nordic venture for climate, energy and the environment, Oslo: NordForsk, 2010

38 Andrée, *Op Cit*, 2008

- develop and strengthen NordForsk's central role in the coordination of Nordic research activities;
- identify Nordic positions of strength in the area of research and innovation;
- promote cooperation in relation to research infrastructure.

The proposed justification for the strategy in effect offers a new definition of NAV:

- It creates a critical mass for success and expertise.
- It develops platforms for international cooperation.
- It creates the profile of a leading knowledge-based region.
- It increases the ability of the region to attract talent and investments, and enhances its appeal as a partner in cooperation.
- It strengthens the Nordic Region and its efforts in EU programmes and initiatives
- It creates a model for Europe in transnational research co-operation[39]

NAV has an informal dimension that so far is missing at the European level. It is based on trust, experience, shared history, geography and some degree of cultural similarity. Unlike European Added Value (EAV), NAV is very often expressed through variable geometry, and it is largely bottom-up in the sense that thematic priorities are set by the participants or the Nordic states. Looking across developments in the more formal idea of NAV, we can discern at least the following components:

- activities whose benefits are greater if they are performed at the Nordic level;
- developing Nordic solidarity, profile and image;
- building the capacity and competitiveness of the individual Nordic countries by strengthening their national research and innovation systems;
- de-fragmenting the research system across the Nordic countries;
- building scale;
- promoting excellence;
- creating platforms from which Nordic stakeholders can more effectively project themselves at EU or global level;
- focusing Nordic research efforts on areas of growth, opportunity or societal need;
- creating Nordic-level strategic intelligence in order to support individual and collective decision-making about research and innovation by the Nordic countries.

Unlike EAV, NAV is not about nation-building, but about helping individual Nordic countries to position themselves in Nordic, European and global competitions and partnerships. To summarise, it involves

- focusing on opportunities and areas of Nordic strength;
- building scale and scope through de-fragmentation and rationalisation of the Nordic research system;promoting excellence;
- building platforms to tackle European and global opportunities and threats;
- solidarity and image – in culture as well as research.

39 www.norden.org/en

2.3 EU RESEARCH POLICY AND VALUE ADDED

2.3.1EU policy

Since its earliest days the European Union has been expected to justify its R&D support actions in terms of the value added these might have over the actions of individual Member States. This principle of 'subsidiarity' implies that actions could be funded at European level only if they could not be sufficiently achieved through actions at national level – or could in some way be better achieved at European level. The principle of proportionality specified that the EU actions should not go beyond what was needed to fulfil the objectives of the Treaty.

We can distinguish between three distinct periods in European research and innovation policy: before 2000, when the Commission aimed mainly to network and stimulate activities at the Member State level; 2000-2010, when building the European Research Area (ERA) and enhancing competitiveness via the Lisbon Agenda and the Open Method of Coordination (OMC) came onto the agenda; and the period from the present, when the Commission is moving towards stronger coordination of research and innovation policy across the Member States but increasingly decentralising this coordination.

The Maastricht Treaty (1993) attributed to the Commission the role of leading the coordination of national RTD policies and extended the scope of the Framework Programmes (FPs), starting with Fourth Framework Programme (1994- 1998), which came to include basic research, applied research, technology development and the demonstration of new technologies. Industrial policy considerations were more prominent than ever in FP4, and activities were to be geared towards enhancing competitiveness and productivity. Especially in the second half of FP4, activities were particularly focused on applied research, involving a wide range of stakeholders.

A major change in policy thinking was introduced by the Commission's White Paper "Growth, Competitiveness, Employment. The Challenges and Ways Forward into the 21st Century" (1993)[40] followed up by the Green Paper on Innovation (1995).[41] In contrast to the previous explicit focus on single industry sectors, a holistic view of innovation was presented. The White Paper called for action to create jobs, but simultaneously emphasized the need for education, training and job flexibility and stressed the importance of more and better coordinated spending on research and development. It identified as a major weakness the so-called "**European paradox",** i.e. Europe's "comparatively limited capacity to convert scientific breakthroughs and technological achievements into industrial and commercial successes." The context for this paper was one of increasing globalisation and changing market structures, the advent of the pervasive role of ICT for the innovation of products and services, and the economic crisis that Europe was experiencing in those years.

The Green Paper intended to initiate consultations with a view to developing a "genuine European strategy for the promotion of R&D". The focus of the debate in the 1980s on how Europe could become competitive in the *making* of new technologies now shifted to debates concerned with *using* new technologies.[42]

Before 2000, the Commission made rather separate efforts in R&D policy on the one hand and innovation policy on the other. In both cases, the over-riding goal was industrial competitiveness. Europe's contribution (added value) was largely to network existing stakehold-

40 Growth, Competitiveness, Employment: The Challenges and Ways Forward into the 21st Century - White Paper. Parts A and B. COM (93) 700 final/A and B, 5 December 1993. Bulletin of the European Communities, Supplement 6/93

41 "Green paper on Innovation", European Commission, COM (95) 688 final

42 John Peterson, Margaret Sharp, *Technology Policy in the European Union*, MacMillan Press Ltd, 1998

ers, exposing them to good practice and to competition and encouraging the formation of networks.

The Framework Programmes date from the mid-1980s: the First (FP1) in 1984-7; the Second (FP2) in 1987-91. Their initial focus was nuclear energy and IT – actually as part of an OECD-wide push to increase IT research that followed the spectacular successes of Japanese industry in consumer electronics and telecommunications in the final years of the 1970s. Over time, the scope of the FPs has grown broader, covering a very wide range of themes, and the repertoire of instruments has increased from the early focus on collaborative research to areas such as human mobility. Via the CRAFT and BRITE-EURAM programmes, they established an agenda of working with SMEs that continues to this day. The thrust of the Framework Programmes in this period was the desire to achieve social, especially economic, impacts. The early efforts in IT and industrial technology exemplify this strand, which was sometimes informally described as 'the Commission's industry policy'. Up to and including FP4 (1994-8), European Added Value in the form of networking, cohesion, scale benefits and so on was largely seen as sufficient justification for the FPs. In FP5 (1998-2002), the focus shifted towards socio-economic benefits.

The European Commission has been involved in general innovation and research policy since the early 1980s. Its first innovation programme was launched in 1983 by what is now DG-ENTR, and was renamed SPRINT in 1986. It focused on technology transfer and SMEs, expanding to take on issues such as promoting the science parks and venture capital movements and establishing Innovation Relay Centres, especially in the 1990s. The VALUE programme (1989-94) focused on disseminating the results of Community-funded research. From the early days, there has been thematic overlap with the Commission's work in the Regions and in Research. The year 2000 marked the start of a period in which the Commission has aimed to articulate a European level research policy – not necessarily well linked to its actions in innovation more widely. This marked a shift in focus from R&D in the pre-2000 period towards research in the years that followed.

The Lisbon Strategy was decided upon during the Council summit in Lisbon in 2000. It set out a ten-year plan to make Europe "*the most competitive and dynamic knowledge-based economy in the world by 2010, capable of sustainable economic growth with more and better jobs and greater social cohesion.*" At the 2001 Stockholm European Council, a sustainable development dimension was added to economic and social policy as a third 'pillar' of the Lisbon strategy. The i2010 initiative was a flagship policy initiative for the renewed Lisbon agenda, launched in 2005. Its aim was to foster growth and jobs in the information society and media industries. It was the first Commission initiative to be adopted under the EU's renewed Lisbon strategy and was intended to serve as a coherent strategy for innovation, regulation, deployment and R&D investment, expressed through each Member State's integrated Lisbon action plan.

The 2000 Communication on the ERA[43] argued that Europe lagged behind the US and Japan in industrial competitiveness and the ability to make social and economic use of research. Complaining that there was no European policy on research, it proposed a unified research area, comparable with the idea of the EU as a common market for goods and services. "Decompartmentalisation and better integration of Europe's scientific and technological area is an indispensable condition for invigorating research in Europe."

This meant breaking down borders between the Member States in order to 'optimise at the European level' features such as policy coordination, overall investment in research and technological development (RTD), networking and the building of critical mass in RTD. Also targeted were increased human mobility and the bringing together of the scientific communities of the new Member States with those of the EU-15, the creation of more opportuni-

43 COM 2000 (6) Final

ties for female and young researchers and steps to make Europe a highly-attractive place to do research based on common ethical values. Two months later, the Lisbon Declaration set Europe "a new strategic goal to become the most competitive and dynamic knowledge-based economy in the world, capable of sustained economic growth with more and better jobs and greater social cohesion." Research and innovation actions building on the idea of the ERA were to be pursued but broader policies were also evolved that included improved policies for the information society, modernising the 'European social model' and macroeconomic policies. Not long afterwards, the Council set the Barcelona target of spending 3% of EU GDP on R&D.

The idea of ERA has been evolving since it was introduced in 2000. Today it is, in effect, to build a globally competitive research and innovation system optimised at the European level. A new Communication in 2002 was clearer about what ERA really meant, namely

- the creation of an 'internal market' for research – an area of free movement of knowledge, researchers and technology which would contribute to increasing cooperation, and would stimulate competition and better allocation of resources;
- a restructuring of the European research fabric; in particular by improved coordination of national research activities and policies;
- the development of a European research policy that would address not only the funding of the research activities, but also all relevant aspects of other EU and national policies.[44]

In 2007, the Green Paper that 're-launched' the ERA[45] described its key features as:

- **An adequate flow of competent researchers** with high levels of mobility between institutions, disciplines, sectors and countries.
- **World-class research infrastructures**, integrated, networked and accessible to research teams from across Europe and the world, notably thanks to new generations of electronic communication infrastructures.
- **Excellent research institutions** engaged in effective public-private cooperation and partnerships, forming the core of research and innovation 'clusters' including 'virtual research communities', mostly specialised in interdisciplinary areas and attracting a critical mass of human and financial resources.
- **Effective knowledge-sharing** notably between public research and industry, as well as with the public at large.
- **Well-coordinated research programmes and priorities**, including a significant volume of jointly-programmed public research investment at European level involving common priorities, coordinated implementation and joint evaluation.
- **A wide opening of the European Research Area to the world** with special emphasis on neighbouring countries and a strong commitment to addressing global challenges with Europe's partners.

FP6 was designed at the time when the Commission launched the European Research Area policy, aiming to concentrate research resources and create a system whose most excellent parts could compete readily with those of the USA and Japan. This led to increased concern with research (as against the earlier industry policy and impact focus), which should be excellent and in which Europe should build scale. FP6 (2002-6) therefore included new, larger

44 COM(2002)565 of 16/10/2002, p. 4.

45 Commission of the European Communities, *Green Paper, European Research Area: New Perspectives,* COM(2007) 161 final, Brussels 4.4.2007

instruments. The previous industrial strand continued but was less of a focus and – especially outside ICT – involved proportionately less effort.

FP6 also marked the creation of Technology Platforms and ERA-NETs, in which the Commission encouraged groupings within the union to self-organise and try to develop cross-border groupings that would drive R&D and innovation policies for their sectors or technologies. The thrust of the Technology Platforms is continued in FP7's Joint Technology Initiatives (JTIs) and increased interest in Article 169 consortium arrangements. By and large, these initiatives group together existing strong interests. Key features of these newer initiatives include the following:

- They involve stakeholders in selecting themes and in developing programmatic strategies, as distinct from the apparently more top-down approach[46] of the Framework Programme.
- They rely on variable geometry – not all Member States need to be involved. Where the Commission detects a significant European interest in something that involves a sub-set of Member States, it may intervene.
- The effects of these changes on the attractiveness of the FPs to potential participants are not clear. There is a moderate but distinct pattern of reducing industrial participation in the traditional 'cooperation' activities of the FP going back at least to FP4. At the same time, the newer instruments largely favour the participation of large companies.

FP7 marked a significant shift in the Framework. The Treaty text that provides the legal basis for the FP was changed to indicate that it could pursue competitiveness **in research** as well as economic competitiveness. Launching the European Research Council (ERC) also introduced NSF-style funding of individual **Principal Investigators** rather than consortia for the first time.

DG-ENTR brought its innovation programmes together in the Competitiveness and Innovation Framework Programme (CIP), with a budget of just over € 3.6 billion for 2007-2013 (equivalent to about 7% of the € 51 billion budget of FP7 for the same period). It has continued activities to promote entrepreneurship, adding the ICT-PSP programme (aiming to demonstrate and create market conditions for the take-up of ICT-based innovations) and the Intelligent Energy Programme. It has been supplemented with six Lead Market Initiatives, where demand-side stakeholders as well as various EU R&D groupings (such as the European Technology Platforms) have been consulted about how to create demand conditions that will encourage innovation in areas where Europe has the potential to supply them. This includes areas of public procurement. Both ICT-PSP and the Lead Markets Initiative aim to provide links to the Framework Programme. The linkage is not strong, and the policies for research and innovation have been developed separately during this decade, but nonetheless these do represent some steps towards the kind of cohesive research and innovation policy sought at home by increasing numbers of Member State governments.

It is broadly agreed that the Lisbon Agenda was not achieved, and by a very wide margin. The policy response has been to decide that Europe must try harder and to become even more ambitious. The new vision to replace Lisbon is *Europe 2020*[47] *– a strategy for smart, sustainable and inclusive growth that aims to:*

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46 In fact, the design of the FP and its Work Programmes involves a great deal of stakeholder consultation, but the final proposals for programmatic activity come from the Commission Services rather than the other stakeholders

47 Communication from the Commission, *Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth*, COM (2010) 2020, Brussels 3.3.2010

1. Increase the employment rate to 75%.
2. Boost spending on R&D to 3% of GDP (i.e. the former Barcelona Goal has had its deadline extended from 2010 to 2020).
3. Attain 20/20/20 climate energy targets.
4. Lift 20 million people out of poverty.
5. Cut the school dropout rate to below 10%.

The strategy involves seven flagship initiatives to boost growth and employment, which at the time of writing were still being articulated:

6. 'Innovation union'
7. 'Youth on the move'
8. 'A digital agenda for Europe'
9. 'Resource efficient Europe'
10. 'An industrial policy for the globalisation era'
11. 'An agenda for new skills and jobs'
12. 'European platform against poverty'

The Commission published details of the Innovation Union flagship initiative in October 2010. It represents an important departure from previous policy in that it tries to bring together user communities, innovators and researchers, including the use of public procurement where possible, to ensure a link to the demand side.

> *Perhaps the biggest challenge for the EU and its Member States is to adopt a much more strategic approach to innovation. An approach whereby innovation is the overarching policy objective, where we take a medium- to longer-term perspective, where all policy instruments, measures and funding are designed to contribute to innovation, where EU and national/regional policies are closely aligned and mutually reinforcing, and last but not least, where the highest political level sets a strategic agenda, regularly monitors progress and tackles delays.*[48]

Figure 1 summarises the intended actions.

48 Communication from the Commission, *Europe 2020 Flagship Initiative: Innovation Union*, SEC(2010) 1161, COM(2010) 546 final, Brussels, 6.10.2010

FIGURE 1 INTENDED ACTIONS OF EUROPE 2020 FLAGSHIP INITIATIVE INNOVATION UNION
Source: Communication from the Commission, *Europe 2020 Flagship Initiative: Innovation Union*, SEC(2010) 1161, COM(2010) 546 final, Brussels, 6.10.2010

Flagship Initiative: "Innovation Union"

1. In times of fiscal constraints, the EU and Member States need to continue to invest in education, R&D, innovation and ICTs. Such investments should where possible not only be protected from budget cuts, but should be stepped up.
2. This should go hand in hand with reforms to get more value for money and tackle fragmentation. EU and national research & innovation systems need to be better linked up with each other and their performance improved.
3. Our education systems at all levels need to be modernised. Excellence must even more become the guiding principle. We need more world-class universities, to raise skill levels and attract top talent from abroad.
4. Researchers and innovators must be able to work and cooperate across the EU as easily as within national borders. The European Research Area must be completed within four years – putting in place the frameworks for a truly free movement of knowledge.
5. Access to EU programmes must be simplified and their leverage effect on private sector investment enhanced, with the support of the European Investment Bank. The role of the European Research Council should be reinforced. The framework programme's contribution to nurturing fast growing SMEs must be boosted. The European Regional Development Fund should be fully exploited to develop research and innovation capacities across Europe, based on smart regional specialisation strategies.
6. We need to get more innovation out of our research. Cooperation between the worlds of science and the world of business must be enhanced, obstacles removed and incentives put in place.
7. Remaining barriers for entrepreneurs to bring "ideas to market" must be removed: better access to finance, particularly for SMEs, affordable Intellectual Property Rights, smarter and more ambitious regulation and targets, faster setting of interoperable standards and strategic use of our massive procurement budgets. As an immediate step, agreement should be reached on the EU patent before the end of the year.
8. European Innovation Partnerships should be launched to accelerate research, development and market deployment of innovations to tackle major societal challenges, pool expertise and resources and boost the competitiveness of EU industry, starting with the area of healthy ageing.
9. Our strengths in design and creativity must be better exploited. We must champion social innovation. We must develop a better understanding of public sector innovation, identify and give visibility to successful initiatives, and benchmark progress.
10. We need to work better with our international partners. That means opening access to our R&D programmes, while ensuring comparable conditions abroad. That also means adopting a common EU front where needed to protect our interests.

Further details of how this flagship initiative will be implemented should emerge following consultations in 2011. However, the language of the Communication strongly suggests that the Commission expects implementation to involve substantial coordination of national resources or resources (such as structural funds) normally under national control.

This year has seen the appointment of a Commissioner with responsibility for both innovation and research and the launch of a new EU ERA 2020 Vision, which has five major components,[49] in effect to build a globally competitive Research and Innovation System **optimised at the European level**, aligning regional and national policies and institutions to this new scale. The components are:

- Knowledge Activities: Volume and Quality - "The ERA defines the European way to excellence in research and is a major driver of EU competitiveness in a globalised world".
- Knowledge Triangle: Flows and Dynamics - "Strong interactions within the 'knowledge triangle' (education, research and innovation) are promoted at all levels"
- Fifth Freedom: Intra and Extra-EU Openness and Circulation - "The ERA provides a seamless area of freedom and opportunities for dialogue, exchange and interaction, open to the world".

49 2020 Vision for the European Research Area, Brussels: European Council Conclusions, December 2008

- The Societal Dimension - "The ERA is firmly rooted in society and responsive to its needs and ambitions".
- Sustainable Development and Grand Challenges - "The ERA is firmly rooted in society in pursuit of sustainable development".

While the current research and innovation policy discussion in the EU focuses increasingly on 'Grand Challenges', there is as yet no agreement as to what these are. The Lund Declaration in 2009 cemented the discussion of refocusing the FP on 'Grand Challenges' – a discussion largely promoted up to that point by researchers rather than industry. Challenges often mentioned include: climate change and the need for clean energy; sustainable transport; sustainable consumption and production; improved public health; food, water and energy security. However, there is no definitive list.

FP8 is the subject of intense discussion and negotiation at the time of writing. The final design is by no means clear, but seems likely to involve some combination of 'Grand Challenges' – perhaps implemented through the Innovation Union Innovation Partnerships – an extended ERC, and major Joint Programming Initiatives. The extent to which the 'cooperation' programme will continue or will be replaced by the Innovation Partnerships is unclear.

The pattern of events described indicates constant policy entrepreneurship within the Commission, leading to continuous development and refinement of research and innovation policies, but also to competition and fragmentation within the Commission, in which DG-Research has so far emerged as the major winner.

With growing budgets, DG-Research has experienced major bottlenecks in administration, as it has not been allowed to increase staff in line with the budget rises. While this aspect is not normally referred to in policy discussions, it does provide a significant pressure on the Commission to design instruments that relieve it of administrative tasks and to focus its efforts on policy development rather than operations. This lies behind the creation of an executive agency to handle administration and the growing use of large, decentralised instruments.

A recurring theme is the use by the Commission of new measures that leverage or 'structure' the spending of Member State resources. This not only extends the Commission's sphere of influence but also creates a shift in the structure of cooperation in the FP, with Member States increasingly participating 'à la carte' in a chain international cooperation. Thus, for both administrative and policy reasons, Commission research and innovation policy is moving from inclusive measures, where the entire Union can compete in an arena defined top-down, to more self-organised measures, into which stakeholders must elect themselves – and in doing so must pass various informal tests of trust and membership of relevant stakeholder communities. Since membership of these networks is substantially based on track record, this shift may make it increasingly difficult for the FP to include capacity building measures. This contrasts with some of the earlier achievements of the FP, for example in establishing and strengthening academic research capacities in ICT in Greece and Ireland. The multiplication of efforts within the Commission leads to the need for multiple responses at national level. Funders and R&D performers alike are finding it increasingly hard to keep up with the proliferation of policies and measures.

2.3.2 European Added Value

From the start, the EU and its predecessor Communities have been expected to justify their actions with reference to the additional value created compared to action at Member State level. This principle of 'subsidiarity' was clarified in the Maastricht Treaty, which also required that EU interventions should be 'proportional': i.e., they should not go beyond what is needed to reach the goals of the EU. The Treaty goes on to say that EU action is only justified if:

- it has transnational aspects which cannot be satisfactorily regulated by action by the Member States;
- actions by Member States alone would conflict with the requirements of the Treaty;
- lack of action by the EU would conflict with the requirements of the Treaty;
- action at the level of the EU would produce benefits of a scale or impact that could not be achieved by Member States alone.

Council resolutions in 1974 established the legitimacy of the Community's activity to develop a science and technology policy. Three years later, the Commission articulated criteria for ensuring that such a policy would be consistent with generating EAV. These were:

- efficiency, where community involvement allowed avoidance of duplication and rationalisation of effort (e.g. nuclear fusion);
- transnational research, involving issues crossing national boundaries, such as telecommunications and some environmental problems;
- the size of the market, where R&D costs were high and potential markets were international;
- common requirements, e.g. international standards.[50]

From FP1 onwards, the Commission applied the principles that have since become known as the Reisenhuber criteria in order to justify Community support for R&D. These were:

1. Research activities of such a scale that single Member Countries either could not provide the necessary financial means and personnel, or could only do so with difficulty.
2. Research that would obviously benefit from being carried out jointly, after taking account of the additional costs inherent in all actions involving international cooperation.
3. Research that, owing to the complementary nature of work carried out at the national level in a given sector, would achieve significant results in the whole of the Community for problems the solutions to which call for research conducted on a vast scale, particularly in a geographical sense.
4. Research that contributes to the cohesion of the common market and which promotes the unification of European science and technology as well as research that leads when necessary to the establishment of uniform laws and standards.[51]

There was a specific reference in the FP3 Council Decision of 23/4/1990 to the concept of added value, where Community action was said to be justified "where it presents advantages (added value) in the short, medium or long term from the point of view of efficiency and financing or from the scientific and technical point of view as compared with national and other international activities (public or private)." The familiar themes of **cohesion**, **scale**, **financial benefits**, **complementarity** and **unification** were again put forward as selection criteria justifying Community action:

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50 Yellow Window, Technofi and Wise Guys, *Identifying the constituent elements of the European Added Value of the EU RTD programmes: conceptual analysis based on practical experience*, study commissioned by DG Research, Antwerp: Yellow Window, 2000

51 United Kingdom Parliamentary Office of Science and Technology, *Research and the European Union*, POST Report Summary, No 83, 1996

- Research which contributes to the strengthening of the economic and social cohesion of the Community and the promotion of its overall harmonious development, while being consistent with the pursuit of scientific and technical quality (**cohesion**).
- Research on a very large scale for which the individual Member States could not, or could only with difficulty, provide the necessary financing or personnel (**scale**).
- Research, the joint execution of which would offer obvious financial benefits, even after taking account of the extra costs inherent in all international cooperation (**financial benefits).**
- Research which, because of the complementary nature of work being done nationally in part of a given field, enables significant results to be obtained in the Community as a whole in the case of problems whose solution requires research on a large scale, particularly geographical (**complementarity**).
- Research which contributes to the achievement of the common market and to the unification of the European scientific and technical area, and research leading, where the need is felt, to the establishment of uniform rules and standards (**unification**).

An additional criterion covering the development of scientific and technical potential in Europe via different routes was added for FP4: 1994-1998. This justified research actions which contribute to the mobilisation or improvement of European scientific and technical potential and actions which improve coordination between national RTD programmes, and between Community programmes and work in other international fora (**S&T potential**).[52]

The Council decision approving FP5 included a shorter and perhaps more ambiguous definition of EAV as interventions that:

- establish a 'critical mass' in human and financial terms, in particular through the combination of the complementary expertise and resources available in the Member States;
- make a significant contribution to the implementation of one or more Community policies;
- address problems arising at Community level, or questions relating to aspects of standardisation, or questions connected with the development of the European area.

Figure 2 provides the Council's elaboration on these criteria.
As in the Nordic case, there have been worries that the idea of 'added value' can be interpreted in overly narrow terms, for example in the field of culture. According to the Council, "European Added Value is a dynamic concept and should therefore be interpreted in a flexible way."[53] The European Parliament has also protested against "excessively economistic interpretations" of the concept. "The 'cultural value added' should not be forgotten ... [and] ... the concept of 'European Added Value' must not be limited to advanced cooperation between Member States but should also contain a 'visionary' aspect."[54]

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52 Yellow Window, 2005

53 C 13/5, OJ 18.1.2003, point 8

54 European Parliament resolution on building our common future: policy challenges and budgetary means of the enlarged Union 2002-2013 (COM(2004) 101 – C5-0089/2004 2004/2006(INI)). Ref. P5_TA(2004)0367; cited from Tarscgys, 2005

FIGURE 2 ANNEXE TO FP5 COUNCIL DECISION

1. Criteria For Selectiong The Themes And Objectives Of Community Activities
The European Community's RTD policy is directed towards strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting all the research activities deemed necessary by virtue of other Chapters of the Treaty. It shall also contribute to promoting the quality of life of the Community's citizens and to the sustainable development of the Community as a whole, including the ecological aspects.
Its implementation is based on the twin principles of scientific and technological excellence and relevance to the above mentioned objectives.
Moreover, in pursuit of a cost-benefit approach dictated by concern for optimum allocation of European public funding and in accordance with the subsidiarity principle, themes for the Fifth Framework Programme and the related objectives are selected on the basis that the Community shall take action only if and in so far as the objectives cannot be sufficiently achieved by the Member States.

2. In application of the foregoing principles, the framework programme shall be defined on the basis of a set of common criteria, divided into three categories

Criteria related to the Community 'value added' and the subsidiarity principle
Need to establish a 'critical mass' in human and financial terms, in particular through the combination of the complementary expertise and resources available in the various Member States
Significant contribution to the implementation of one or more Community policies
Addressing of problems arising at Community level, or questions relating to aspects of standardization, or questions connected with the development of the European area
So as to select only objectives, which are more efficiently pursued at the Community level by means of research activities conducted at that level

Criteria related to social objectives
Improving the employment situation
Promoting the quality of life and health
Preserving the environment
in order to further major social objectives of the Community reflecting the expectations and concerns of its citizens.

Criteria related to economic development and scientific and technological prospects
Areas, which are expanding and create good growth prospects
Areas in which Community businesses can and must become more competitive
Areas in which prospects of significant scientific and technological progress are opening up, offering possibilities for dissemination and exploitation of results in the medium or long term
in order to contribute to the harmonious and sustainable development of the Community as a whole

3. The criteria referred to in paragraph 2 will be used, and where necessary supplemented, for the purposes of the implementation of the fifth framework programme, in order to define the specific programmes and select research and technological development activities, including demonstration activities. The three categories of criteria will apply simultaneously and must all be met, although to a different extent from case to case.

Stampfer[55] points out that the use of the EAV concept by the Commission up to this point is frequently inconsistent or sloppy. Following the Five-year Assessment of the Framework Programme covering FP5, the Commission actually launched a project aiming to tighten and monitor the use and implementation of the concept of European Added Value in the Framework Programme,[56] but its results were not used. Rather, subsequent attempts to define EAV have been rare and imprecise. The relevance of EAV in research and innovation policy has shifted outward from the FP to the wider ERA agenda. If, as Larédo[57] plausibly argues, "ERA is not a state but the repeated outcome of a long-lasting process of Europeanisation", then the definition of EAV becomes similarly flexible. The Busquin Communication and the decision to build the ERA fundamentally changed the nature of the Framework Programme, which from FP6 (2002-2006, i.e. the first planning period after the Busquin Communication) became one of several means of implementing the Commission's new research policy. While the criteria for EAV used in FP6 were formally the same as those in FP5,[58] the scope of the activities changed. New instruments were included in FP6 that were intended to influence the **structure** of the

55 Michael Stampfer, *European Added Value of Community Research Activities: Expert analysis in support of the ex post evaluation of FP6*, Vienna: WWWTF, 2008

56 Yellow Window, 2005

57 Philippe Larédo, *Discussing the role of the ERA in the Lisbon Process, the diverse understandings of the ERA and the role of the Framework Programme in fostering Europeanisation: Background paper for the FP6 Expert Panel*, Paris: Université Paris Est, 2008

58 Communication from the Commission, Making a reality of the European Research Area: Guidelines for EU research activities (2002-2006), Brussels 4.10.2000, COM(2000) 612

European research community, widely defined to include industry. (In practice, they failed to do this.[59])

The CREST OMC (Open Method of Coordination) process began before FP6, but FP6 itself then included a modest budget for projects in support of this new objective of trying to **persuade** the Member States to align their research and innovation policies. In the early years, the focal point of the OMC was to try to persuade Member States to raise their R&D expenditures in order to meet the Barcelona Goal: namely, to spend a total of at least 3% of GDP on R&D, of which 1% should be state expenditure and 2% should be expenditure by business. During FP6, however, the Commission and Member States gained experience with an early form of joint programming via the ERA-NETs. These were variable geometry groups of Member State agencies, working to identify common needs and to launch joint calls for proposals in order to buy projects that would satisfy the needs. The ETPs encouraged groups of stakeholders to develop joint research strategies, again under variable geometry. This trend culminated in the Joint Programming now established as practice under FP7 and which gives a different meaning to coordination of national policies. This process of empowering stakeholders to define and act upon common interests that are not restricted within national boundaries clearly extends the concept of EAV. As Terttu Luukkonen[60] points out, these new ERA initiatives also blur the distinction between 'research policy' and 'research funding' instruments by serving as both.

Larédo argues that the processes of the Framework Programmes more broadly serve as 'focusing devices', signalling desirable themes to the research and innovation communities and focusing both policy attention and money on them. In particular, he argues that attention to genomics and nanosciences has strengthened the European position. "So concentrating European efforts on 'fast growing fields' is a central 'European added value' because it enables European research to remain in the global competition. Thus this should be an important role and achievement of European programmes."[61]

A little-noticed novelty of FP5 was the 'mainstreaming' of participation in the FP by Third Countries, i.e. those that are neither Member States nor associated countries. This partly involved bringing in a range of development projects aimed at poor countries and regions outside Europe but – especially in FP6 – it also involved growing participation in mainstream FP projects, not least by Russia and China.[62] FP7 involves a greater degree of what the Commission terms 'internationalisation' (as if the EU were a nation – we should more properly speak of 'globalisation'). As yet, there is little clear strategy for globalisation and the issue appears to receive little priority in EU policymaking, but the gradual transition from more or less a 'Fortress Europe' position towards an interest in globalisation represents a further extension of EAV.

59 Rietschel, 2009

60 Terttu Luukkonen, The European Research Council in the European Research Area, Deliverable 7.1 in the EUREOIA project, Helsinki: ETLA, 2010

61 Laredo, 2008

62 Erik Arnold, Sylvia Schwaag-Serger, Neil Brown and Sophie Bussillet, Evaluation of Chinese Participation in the EU Framework Programme, Brighton: Technopolis, 2008

In parallel with the development of FP6, the Commission expanded the definition in another new direction.

> *Until now we have defined European Added Value as the collaboration of teams. Now it is time to bring a new definition to European Added Value, one that incorporates the principle of allowing a researcher in any of our member states to compete with all other researchers to win funding. Competition therefore becomes an essential new, forward-looking definition of European Added Value.*[63]

This expansion of the concept of EAV was incorporated in the Communication "Europe and Basic Research"[64] in 2004 but did not really become operative until the creation of the European Research Council under FP7.

FP6 took up the question of research infrastructure by prompting the creation of a European Strategy Forum on Research Infrastructures (ESFRI), which identified and prioritised the development of a series of large-scale research infrastructures that would have to be international in character, owing to their high costs. Results of the work were incorporated into FP7, further extending the notion of EAV to joint investments in research infrastructure. While the Busquin Communication clearly pointed to the need for a properly functioning European market in knowledge services, especially research, little was done about this in FP6 or FP7. However, as the Lisbon Expert Group points out,[65] this will be a crucial requirement if the Commission is to realise its other research policy objectives. The Innovation Union Communication brings forward the new deadline for 'completing the ERA' from 2020 to 2014, but is sensibly a little unclear about what ERA means in this context. It also offers a definition of EAV in relation to the Innovation Partnerships:

> *Partnerships should be launched only in areas – and consist only of activities – in which government intervention is clearly justified and where combining EU, national and regional efforts in R&D and demand-side measures will achieve the target quicker and more efficiently.... The choice of the 'right' partnerships will largely determine their success. In order for them to deliver on their promise, the following conditions, which are all interlinked, need to be fulfilled:*
> *(1) Focus on a specific societal challenge that is shared across the EU ...*
> *(2) Strong political and stakeholder commitment ...*
> *(3) Clear EU-added value: Action at EU level should result in efficiency gains and large scale impact through critical mass (e.g. simplification and streamlining, pooling and more efficient use of scarce public resources, i.e. by aligning research or procurement programmes across Member States; better quality solutions, interoperability and more rapid deployment)*
> *(4) Strong focus on results ...*
> *(5) Adequate financial support.. All stakeholders will be expected to contribute; the Commission will seek to leverage the EU budget to raise further the overall level of funding ...*[66]

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63 Achilleos Mitsos, *Speech at the ELSF-Euroscience Conference of the European Research Centre*, Dublin, 21-22 Octiober 2003; quoted from Daniel Tarschys, *The Enigma of European Added Value: Setting Priorities for the European Union*, Sieps 2005:4, Stockholm: Swedish Institute for European Policy Studies, 2005

64 COM (2004) 9, final, 14.1.2004

65 Georghiou et al, 2008

66 Communication from the Commission, Europe 2020 Flagship Initiative: Innovation Union, SEC(2010) 1161, COM(2010) 546 final, Brussels, 6.10.2010

The other major innovation of the past few years has been the introduction of the idea of 'Grand Challenges' as ways to focus the EU research and innovation effort. The start of Joint Programming provides one mechanism for starting to tackle aspects of these, but until the design of FP8 becomes clearer we will know little about which challenges are prioritised and how they will be addressed. Whatever the final design, it is clear that selecting and focusing on societal Grand Challenges has become a further dimension of EAV.
Bringing together the different aspects of EAV from this discussion, we end up with quite a long list:

- rationalising, avoiding duplication – including sharing infrastructure;
- tackling research needs that are inherently transnational, such as for regulation, but also to address shared transnational problems;
- attaining research scale not available to individual Member States;
- enabling research to benefit from multinational contributions, for example where different aspects of problems or of the research capacities available in different countries are complementary;
- research that increases Community cohesion, in the sense of evening out imbalances, strengthening weaker performers and systems;
- research where an international approach provides increased financial benefits;
- de-fragmentation and restructuring of the 'fabric' of European research, i.e. the research community, its infrastructures and its institutions;
- focusing the attention and effort of the European research and innovation system on areas of growth and opportunity;
- promoting a higher level of excellence than can be fostered at the national scale through Europe-wide competition;
- opening the European research and innovation system to the wider world;
- addressing societal 'Grand Challenges' that are too big to be addressed effectively at the Member State level.

Some of these dimensions may be conflicting. For example, the cohesion and focusing objectives can have opposite policy implications. We can simplify the list as follows by saying that EAV involves carrying out the following things within the European research and innovation system:

- Focusing/structuring
- Building scale and scope
- Promoting excellence
- Addressing wider policy challenges
- Regulating
- Globalising

Whichever way we look at it, the overall objective is clear: to build a research and innovation system optimised at the European (not the national) level. EAV is about nation-building at the continental level.

2.4 CONNECTING THE NATIONAL, NORDIC AND EUROPEAN LEVELS

The theoretical and practical considerations discussed at the start of this chapter suggest that international cooperation in research and technology is important, especially for small countries. However, specific cooperation needs will vary among situations, so the national interest

is best served by cooperations, each of which is tailor made. From this perspective, both the Nordic and the European frameworks for **formal** cooperation on research and technology are set at completely arbitrary levels. This is now acknowledged in their designs, which in both cases allow for 'variable geometry' within the overall frameworks they define. Of course, their ability to deal with all possible situations is limited. Member States therefore face a trade-off between, on the one hand, accepting arrangements under the Nordic and European frameworks that are to some degree sub-optimal and, on the other hand, paying the costs (money, organisation, information, networks, building trust, etc., etc.) involved when there is only ad hoc cooperation. In practice, being able to turn to both Nordic and EU-level arrangements is a huge advantage, since ad hoc cooperation is very hard to set up in the short term.

Of course, there is also a great deal of **informal** cooperation at both the Nordic and the European levels. The social capital that this represents is not free. It has been built up at considerable cost over long periods of time – in part bottom-up, but a significant portion is a product of past formal arrangements as well. And the amount of social capital the Nordic states bring to the Nordic cooperation is significantly larger than that which they bring to the EU level – even if the latter is clearly increasing with experience. From the national perspective, the two cooperation levels offer different opportunities – and this is a little more nuanced than to say that the European cooperation is bigger than the Nordic one. Figure 3 summarises the arguments, using dimensions derived from the earlier discussion of reasons to collaborate and the analyses of EU and Nordic Added Value.

The first point to observe is that it is hard to develop international cooperation opportunities without a national strategy of some sort that – formally or de facto – leads to specialisation and strength and therefore enables national actors to 'bring something to the party'. The development of the strengths that enable cooperation is a national business. The small scale of the Nordic cooperation means that the barriers to establishing Nordic partnerships with the aim of building capacity are lower than those at the European level, where – by and large – only those with well-established capacities are welcome. However, once national research capacity reaches a minimum level, the opportunities to exploit it are greater in European than Nordic cooperation. There are now examples of cooperations established through NordForsk forming the basis of strong Nordic positions in Framework Programme projects.

FIGURE 3 ADDED VALUE OFFERED BY THE NORDIC AND EU COOPERATIONS

Dimensions	Nordic	EU
National strategy, specialisation	-	-
Building capacity	√	-
Building scale and scope	√	√
Excellence	√	√√
Mobility	-	√√
Infrastructure	√	√√
Accessing invisible colleges	√	√√
Focusing devices	√√	√√
Tackling societal challenges	√	√√
Influencing the direction of cooperation opportunities	√√	(√)

The argument for international cooperation in relation to excellence is that the larger the competition the more difficult it should be to win, and therefore the higher the expected quality of the winners. In this sense, the EU level is preferable – provided that one is good enough to win against many tough opponents. In other situations, the greater developmental opportunities at Nordic level may be preferable.

The EU now has a long tradition of promoting researcher mobility – something that is not matched at the Nordic level. However, it is worth noting that the EU schemes themselves can

be used for intra-Nordic mobility, so this may be a rare case where the EU arrangements can be used for Nordic ends. In accessing expensive infrastructures and invisible colleges, the greater scale of the EU interventions clearly offers advantages, though there are still cases where the Nordic level is adequate.

The 'focusing device' function of collaboration is valid at both levels, with both the Nordic cooperation and the EU level providing signals and incentives to focus on particular themes and problems. Since the EU foci are developed top-down but with consultation, while the Nordic ones are more bottom up, there may be some complementarity between the two. To some degree the same argument can be made about societal challenges – though it seems likely that the Nordic portfolio of societal challenges and interventions to deal with them will be narrower than the European one, if only for reasons of scale.

The degree to which the direction and topics addressed can be influenced from the national level is of course large. In reality, an individual Member State – especially a small one – has very limited influence over the EU agenda, while at the Nordic level the influence is greater. In one case there is small influence over something big while in the other case there is big influence over something small. It remains an open question as to whether the Nordic countries can arrange themselves into a cooperative 'bloc' that gains greater influence at the EU level. There seems so far to be little evidence of this happening.

3. SUCCESSES AND CHALLENGES FOR NORDIC COOPERATION

This Chapter starts with some evidence about the existing intensity of cooperation in Nordic research. Evidence from bibliometrics and from participation in the Framework Programme shows that the Nordic community is used to working together, works well together and has continuing opportunities to build on areas of Nordic strength and excellence to extend that cooperation. We go on to catalogue the main Nordic organisations responsible for the cooperation today, discuss their governance and look at the recent experience of setting up the first Top Level Research Initiative. This is a much larger-scale intervention in research and innovation than the Nordic level has previously attempted, which was pushed through on the initiative of the five Nordic Prime Ministers. It offers important lessons about the governance of the Nordic cooperation and hints at new ways to conceive Nordic Added Value.

3.1 NORDIC RESEARCH COOPERATION – AN ACCOMPLISHED FACT

In discussing Nordic Added Value and the desirability of Nordic cooperation in research and innovation, it is easy to overlook the fact that de facto collaboration within the Nordic area is very strong.

As Figure 4indicates, the Nordic countries tend to do well in the Framework Programme. In the Figure, we have compared the Nordic shares of funding from the Sixth Framework Programme with the Nordic shares of European GDP. (There are other ways of normalising but they tend to show similar pictures.) All the countries but Norway rank highly on this measure.

FIGURE 4 – NORDIC FUNDING ACHIEVED FROM FP6 – FACTORED BY GDP

Country	FP6 funding (million)	Share of EU25+IS&NO FP6 funding	Share of EU25+IS&NO GDP (2004)	Ratio of share of FP6 funding to share of GDP	Rank out of 27 countries[1]
Denmark	396	2.6%	1.8%	140%	11th
Finland	342	2.2%	1.4%	156%	8th
Iceland	24	0.2%	0.1%	157%	5th
Norway	284	1.8%	1.9%	95%	18th
Sweden	677	4.4%	2.7%	164%	4th
Nordic 5	1,723	11.1%	8.0%	140%	8th

Sources: FP6 participation data (E-CORDA, September 2009) and Eurostat (GDP data)

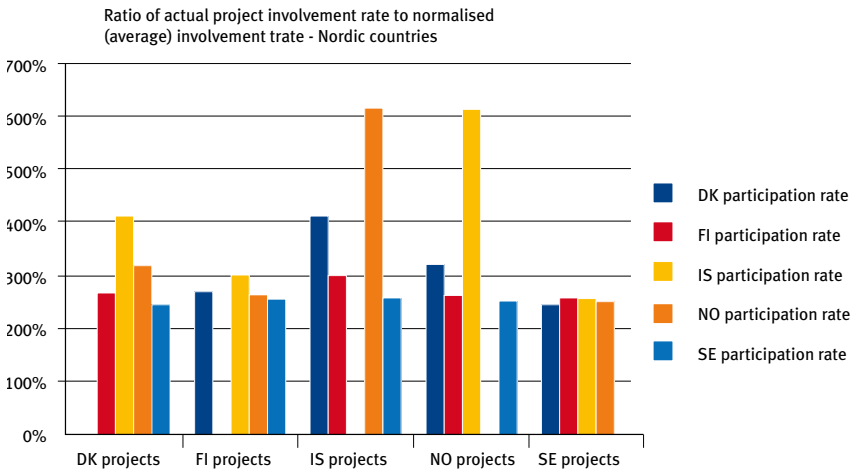
In FP6 the Nordic countries had 7,160 participations in 3,183 FP6 projects, so it is clear that in many cases more than one Nordic partner was involved in the same project. In fact, there were 1,582 FP6 projects with more than one Nordic partner involved, 50% of all those with Nordic involvement.

In order to investigate the level of collaboration between Nordic countries in FP6 projects we calculated the normalised level of involvement of each (other) country in each of the Nordic countries' FP6 projects. These 'standardised' participation rates were then used as a benchmark against which the actual level of participation of each Nordic country could be assessed. Figure 5 shows that in all cases the actual project involvement rate of each (other) Nordic country is above the normalised level (shown as 100% on the chart) for each individual Nordic country's FP6 projects. In most cases the involvement rate is between two and two and half times the normalised level, but in a small number of cases a more significant level of intra-Nordic collaboration is evident.

- Iceland has a particularly high level of involvement in projects that also involve Norway, and vice versa. In both cases the actual level of project involvement is more than six times the normalised level.
- Denmark has a high level of involvement in projects that that also involve Iceland, and vice versa. In both cases the actual level of project involvement is more than four times the normalised level.

Based on this analysis we can say that there is clearly a high level of Nordic collaboration within FP6 projects and this is evident for all of the Nordic countries. However, the pattern of Nordic collaboration is particularly emphasised between Iceland and Norway, and to a lesser extent between Denmark and Iceland.

FIGURE 5 - COMPARISON OF ACTUAL NORDIC PROJECT INVOLVEMENT RATES TO NORMALISED NORDIC PROJECT INVOLVEMENT RATES WITHIN EACH NORDIC COUNTRY'S FP6 PROJECTS

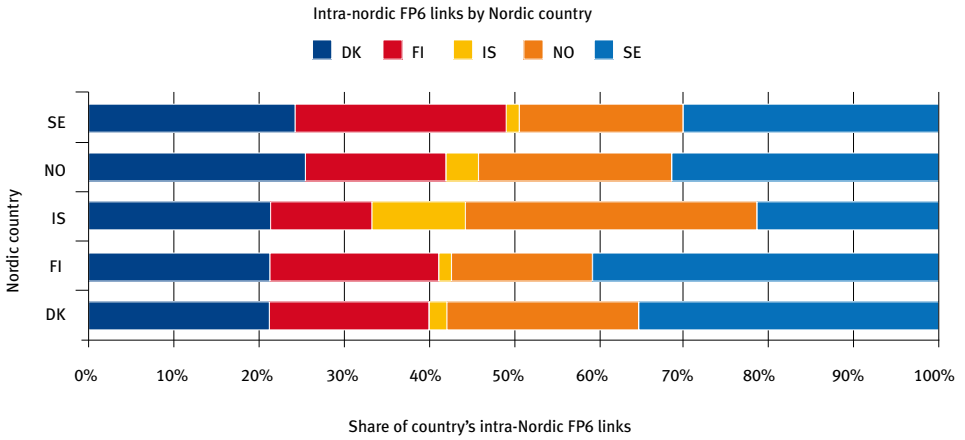


Source: FP6 participation data (E-CORDA, December 2009)

We conducted a more detailed assessment of intra-Nordic collaboration within FP6 projects based on an analysis of the number of links between individual participants within every FP6 project that contained two or more Nordic participants (n=1,582 projects). A total of 10,944 intra-Nordic links were found, of which 6,703 (or 61%) were between organisations from two different Nordic countries, and 4,241 (or 39%) were between organisations from the same Nordic country.

Figure 6 shows graphically the distribution of each Nordic country's intra-Nordic links by country. Overall, the patterns of intra-Nordic collaboration within FP6 suggest particularly strong collaborative links between Sweden and Finland and also between Iceland and Norway, with the latter being of more significance as viewed from the perspective of Iceland.

FIGURE 6 - INTRA-NORDIC FP6 LINKS, BY NORDIC COUNTRY



Source: FP6 participation data (E-CORDA, December 2009)

Co-publication is another way to see the Nordic cooperation in action. Figure 7 shows the proportion of the Nordic countries' international co-publications in 2004-8 that were made with a selection of other countries. (The figure has to be read vertically – it shows, for example in the top right cell, that 4.9% of Swedish co-publications were with Danish authors.) Nordic authors most frequently co-published with US, UK and German authors, as would be expected given the large size of these countries. Surprisingly, co-publication with Swedish authors is only slightly less frequent than with these large countries. The strong links between Iceland and Norway and Iceland and Denmark that were evident in the FP6 collaborations are also visible in the IS column here. The Finland-Sweden link is also clearly visible in the FI column, though it turns out that Sweden is more important to Finland than Finland is to Sweden. More generally, Sweden is a strong hub for Nordic co-publication.

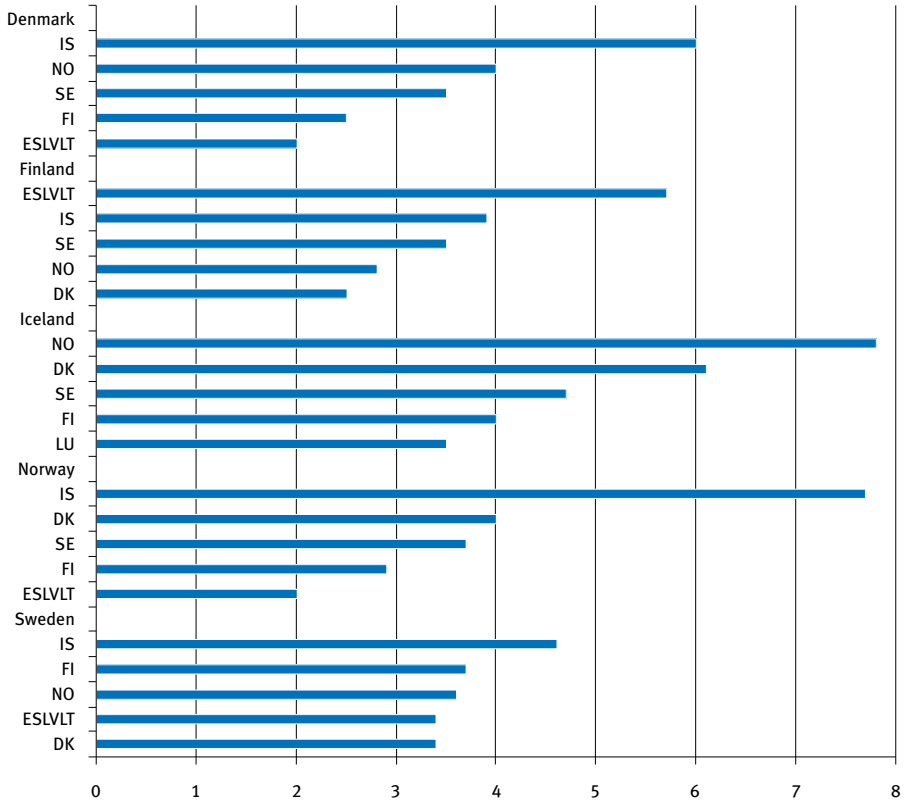
FIGURE 7 INTERNATIONAL CO-PUBLICATION 2004-8 BETWEEN NORDIC AND SELECTED OTHER COUNTRIES IN % OF NORDIC COUNTRIES' TOTAL INTERNATIONAL CO-PUBLICATION

Country	DK	FI	IS	NO	SE
Denmark	-	3.5%	8.6%	5.7%	4.9%
Finland	2.9%	-	4.7%	3.4%	4.3%
Iceland	0.7%	0.4%	-	0.8%	0.5%
Norway	4.4%	3.1%	8.4%	-	3.9%
Sweden	8.3%	8.7%	11.0%	8.7%	-
Germany	9.0%	8.5%	4.5%	7.3%	8.7%
UK	10.3%	9.3%	10.8%	10.2%	9.5%
USA	13.8%	12.5%	12.7%	13.6%	14.2%

Source: Magnus Gunnarsson (ed.) *International Cooperation in the Nordic Countries*, Oslo: NordForsk, 2010

Figure 8 shows the relative frequency with which authors in the Nordic countries co-publish. It contains information about the top five co-publication partners for each of the Nordic countries in turn. Thus, the first bar shows the proportion of Danish co-publications that are with Iceland divided by Iceland's share of all co-publications. In this case, Danish co-authorship links with Iceland constitute 0.66% of Denmark's total international co-authorship links. However, since the Icelandic share in the total pool of international co-authorship links is only 0.11%, a share of 0.66% is quite high. The share in the total pool of international co-authorship links can be considered the expected share, and so the ratio between the observed and the expected share is 6 for Denmark in relation to Iceland.

FIGURE 8 INTENSITY OF NORDIC CO-PUBLICATION, 2004-8. TOP FIVE CO-PUBLICATION PARTNERS OF THE NORDIC COUNTRIES



Source: redrawn from Magnus Gunnarsson (ed.) *International Cooperation in the Nordic Countries*, Oslo: NordForsk, 2010. ESLVLT = the Baltic States

Below these top five partners, the ratio for other countries quickly falls away to near 1, where the observed and expected shares are similar, so the focus on co-publication within the Nordic area is rather strong.

It is clear from earlier bibliometric work[67] that there are areas of common Nordic scientific strength that offer good opportunities to collaborate and build strong Nordic platforms. In that work we identified ten scientific sub-fields where Nordic publication performance is strong in terms of numbers of publications and citations, where there is a critical mass of publication and where at least three of the Nordic countries are individually strong. These fields were

- Fisheries
- Obstetrics and Gynaecology
- Anaesthesiology
- Marine and Freshwater Biology
- Ecology
- Sports Sciences
- Dentistry, Oral Surgery and Medicine

67 Yann Cadiou, Erik Arnold, Marie-Louise Eriksson and Barbara Good, Nordic Excellence: A Bibliometric Exploration of Common Nordic Research Funding Opportunities, Policy Brief 2008-5, Oslo: NordForsk, 2008

- Rheumatology
- Public, Environmental and Occupational Health
- Environmental Sciences

We suggested some alternative funding strategies that would allow NordForsk selectively to invest in these. The final choice would depend upon whether NordForsk wanted to invest in existing strengths, smaller fields with growth potential or attempt to revive larger fields where Nordic performance appeared to be stagnating. So – whether we look from the perspective of Framework Programme participation, co-publication performance or the perspective of a research funding investor, the Nordic research collaboration appears to be strong and to offer a good basis for continued investment.

3.2 Nordic cooperation in research and innovation

Official and unofficial cooperation in research and innovation is woven into the fabric of Nordic societies. In a recent tabulation[68] we found 105 different organisations, networks and initiatives – and we are certain that our list is not complete. Strikingly, almost all this activity is related to research and virtually none to innovation. Three organisations function more or less as agencies of the Council of Ministers for Education (MR-U) and Nordic Council of Ministers for Business, Energy and Regional Development (MR-NER). NordForsk, which answers to MR-U, was established in 2005 as a direct result of the NORIA discussions. The Nordic Innovation Centre (NICe) resulted from the reorganisation of the Nordic Industry Fund and answers to MR-NER. These are the 'two pillars' of the Nordic research and innovation cooperation or NORIA and are funded by their respective Councils of Ministers. Nordic Energy Research is a long-standing cooperation between the Nordic nations and is funded directly from the national level. However, MR-NE nominates its Board.

NordForsk's mission is threefold: coordinating research policies; funding research; and providing research policy advice at the Nordic level. Its budget in 2008 was some NOK 110 million (€ 14 million). It has launched or taken over an impressive number of initiatives. Most prominent are perhaps the Nordic Centres of Excellence – research collaborations involving a minimum of three Nordic countries. Originally started in 2002 by the Joint Committee of the Nordic Research Councils for Natural Sciences,[69], the NCoEs have increased substantially in number under the coordination of NordForsk. NordForsk also funds a number of research networks, researcher training courses and graduate schools, thematic programmes and a programme for joint use of Nordic research infrastructure.[70] It operates a Nordic industrial doctorate scheme, linking doctoral students employed by companies in one Nordic country to a university in another. All these schemes involve project selection via peer review and most have to include participants from at least three Nordic countries or autonomous areas.

Generally, the schemes leverage national funding – NordForsk pays one-third of the grants and the corresponding national agencies the remaining two-thirds. There is no 'juste retour' principle in NordForsk funding, so individual countries may take out either more or less than they put into the common pot. Inspired by the EU ERA-NET scheme, NordForsk also runs NORIA-NETs that encourage national agencies to coordinate their research needs and to issue

68 Erik Arnold and Malin Carlberg, *Mapping Nordic R&D Cooperation Instruments*, Report to the Nordic Council of Ministers, Brighton: Technopolis, 2009

69 A number of such thematic cooperation committees co-exist with Nordforsk

70 A more detailed description is provided in Pernille Rieker, Monica Lund and Mads Peter Schreiber, *Formalised and non-formalised Nordic research and innovation cooperation*, NORDERA deliverable 2 and 3 Oslo: Nordforsk, 2010

joint calls for proposals. NordForsk took over the role of providing Nordic-level research policy input from the Nordic Research Policy Council (*Nordisk forskningspolitiskråd*), which comprised 15 members of the Nordic research community, three from each nation. NordForsk makes a significant effort to generate strategic intelligence at the Nordic level, notably by publishing policy briefs such as this one. However, a number of our interviewees argued that it lacks research policy influence because it is an agency governed by national agencies. That means it struggles with giving advice at both Nordic and the national policy levels. It also lacks the academic legitimacy of the former Nordic Research Policy Council.

NICe's mission is to finance cross-border innovation projects in the Nordic region and also to provide innovation policy advice at the Nordic level. It had a budget of about NOK 76 million (€ 9.5 million) in 2008. On principle, NICe does not subsidise product development but it does finance consortia for pre-competitive or common-good research, training and networking, often involving Nordic applied research institutes in consortia with companies.

Nordic Energy Research (NER) began as a research programme in 1985 and was institutionalised in 1999. It aims to maximise the impacts of energy research in the Nordic region, especially by encouraging and funding work on new energy technologies. Its 2008 budget was some NOK 40 million (€ 5 million), but this was subsequently reduced in order to provide some of the funding for the first Top-level Research Initiative. NER funds a mixture of *capacity and competence-building projects* in the research sector and *business development and innovation projects*, which must involve industrial partners as well as researchers. A recent evaluation found that NER projects tended to reach their objectives and that NER was very successful in networking Nordic energy researchers but less successful in attracting industrial participation. It was argued that – especially in the light of its very limited resources – NER should focus more on a smaller number of thematic areas that have distinctly a Nordic dimension. This, coupled to closer involvement of policymakers in defining objectives would increase its Nordic Added Value.

These three institutions have collectively demonstrated that the opportunities clearly exist for a certain amount of Nordic joint programming in research and innovation, and they have been able to implement a number of such activities.

3.3 GOVERNANCE OF NORDIC RESEARCH AND INNOVATION COOPERATION

As a system of minister-level cooperation, the NMR tends to reproduce the structures of national government at the Nordic level. In particular, it has the same set of divisions between ministries, echoing the same problem of coordination among ministries as that found at the national level. MR-U and MR-NER are acutely aware of this and have made efforts to strengthen inter-council links, notably at the level of NordForsk and NICe, which are represented on each other's boards.

Each of the three Nordic institutions is governed in a different fashion. NordForsk receives its budget from MR-U, which also appoints the Board. But it has little freedom in whom it chooses. Five of the members are representatives of the Nordic research councils (one from each country). A further three are appointed by the Nordic universities' network NUS. The last must come from an R&D-intensive Nordic company – and is nominated by MR-NER. There are an additional seven observers.

This governance structure has the important strength of linking NordForsk directly to the national research councils, giving them a voice in NordForsk strategy and making it legitimate for NordForsk activities to commit the national level to co-funding. It can sometimes be hard to set thematic priorities, because this can conflict with some of the ways the national research councils operate, but in practice NordForsk has been able to prioritise some themes. The tight links to the national level mean that while in principle NordForsk is an agency of MR-U, in practice the Council of Ministers has little opportunity to steer it. A heavy national influence

is accompanied, however, by a lot of thematic diversity and a wide range of instruments for what is in practice a very small organisation.

MR-NER funds NICe and appoints its board. Three members come from national innovation agencies, two from national companies and there is in addition one member from the NICe staff. The director of NordForsk and the head of the MR-NER secretariat sit as observers. The board members act in a personal capacity – unlike in NordForsk, where the research council members represent their institutions. As a result, the national innovation agencies complain that they have no power to steer NICe. In the absence of a clear Nordic innovation policy or strategy, MR-NER does not have strong steering mechanisms to offer either so while some of our interviewees argue that NICe is a free spirit, others are more prone to describe it as a loose cannon. NICe does not cooperate or coordinate activities with the national agencies but acts as a complementary innovation agency at the Nordic level. As a result, it can operate a strategy with thematic priorities but it does not have a structuring effect on the national level effort (except indirectly via ERA-NET participations).

The NER is funded by the national authorities responsible for energy policy, and MR-NER nominates its board from among these authorities. Currently, this means that Swedish board members come from the industry ministry while others come from the respective energy agencies. This may not be as clear-cut as one would like but it seems to work reasonably well. A disadvantage of the lack of a clear principal is that NER has a very wide thematic scope, despite its small size. These governance sketches suggest that a strong member state role in governance increases the opportunities to coordinate or structure national efforts but makes it harder to achieve strategic focus. Conversely, in NICe where the governance links focus on NMR, there is more opportunity to make strategy but less influence on the national level.

More broadly, while the Nordic countries individually have been trying to make their governance of research and innovation more holistic, the Nordic level lags behind. Like other countries, the Nordic states have tended to try to create 'arenas' for policy coordination, most famously the Finnish Research and Innovation Council[71]. At lower levels, they tend to implement coordination committees across ministries and agencies (admittedly, often with little effect). In Norway, bringing the research councils and the innovation agency together into the Research Council of Norway has been a giant experiment in trying to achieve policy coordination at the agency level. The results of these various attempts to build holistic research and innovation policy are distinctly mixed. It is notable that the Finnish Council, which is globally seen as a major success, works at the level of the key government ministers by setting broad strategic directions and leaving the details to others. More detailed policy coordination at lower levels tends to be less successful.

3.4 Disruptive Change: The Top-level Research Initiative

In 2009, after a long and difficult process, the first Nordic Top-level Research Initiative (TRI) in climate, energy and environment was launched, with a budget of DKK 400 million over 5 years. This represents a break with past forms of cooperation:

- It pre-emptively starts work on one of the 'Grand Challenges', potentially strengthening the Nordic region's competitiveness in tackling climate, energy and environment and positioning it as a stronger partner in the coming global cooperation on that challenge.
- It was initiated top-down by the prime ministers of the Nordic countries, rather than emerging in a more bottom-up fashion from discussions among the Nordic research funders.
- It represents a larger targeting of resources on a single thematic area than has been

71 Formerly the Science and Technology Policy Council

achieved in the past – even though the annual budget of DKK 80 million can hardly be characterised as large.
- It involves cooperation across the three Nordic research and innovation institutions: NordForsk, NICe and NER.

The roots of the TRI are in the *Norden som global vinderregion* report[72] of 2005 and the renewed focus on research, innovation and building a Nordic version (NORIA) of the European Research Area that was established during the Norwegian presidency in 2006. During the summer of 2006, the Nordic Council[73] formally requested the NMR to pursue the recommendations of the *Norden som global vinderregion* report, in part through a joint seminar between the Nordic Council and the Nordic Council of Ministers. However, it appears that the seminar was overshadowed by events at the annual meeting of the Nordic prime ministers (prime ministers and leaders of the main opposition parties) in the autumn of 2006, where the Danish Prime Minister Anders Fogh Rasmussen took the initiative to declare it was time the prime ministers became properly engaged in Nordic cooperation. Shortly thereafter, Denmark presented a long list of potential areas for cooperation, mostly involving research, innovation and environment.

Consultations regarding the research component of the proposal followed among the NMR secretariats, with the National Council of Ministers of Education (MR-U), the National Council of Ministers of Business , Energy and Regional Policy (MR-NER) and the three Nordic organisations (NordForsk, NICE and NER). It was assumed that these organisations would in turn consult with the relevant national agencies but this appears not to have happened. In any case, the Office of the Finnish Prime Minister was working in parallel on its own set of proposals, which overlapped with but were not identical to those of the NMR, and which ultimately formed the basis of the 'Punkaharjupress release' by the Nordic prime ministers in June 2007. This set out a number of common globalisation aims and activities to make the Nordic area more knowledge-intensive, visible and efficient. Key foci included research, innovation, energy and environment.

The NMR was instructed to develop plans for promoting top Nordic research in cooperation with industry, taking account of the opportunities to link together centres of research excellence in the Nordic countries and those working on innovation. The prime ministers proposed that the ministers responsible for Nordic cooperation should define a new budget of DKK 60 million in 2008. It took until December 2007 to appoint a steering committee to develop the proposal for the first TRI. The steering committee was to be responsible for accepting and delivering the proposal for a TRI plan to the NMR as well as for linking it to national priorities. The committee encompassed a mix of R&D funders and researchers nominated by the member states and convened for the first time at the end of January 2008. A planning group led by Professor Peter Lund was appointed by the NMR secretary general and began work in January 2008 to design the TRI on climate, environment and energy. In addition to Lund, the group comprised three staff members from each of the Nordic organisations.

The amount of funding available for the programme was not established in advance of the planning process but the NMR indicated that it should be in the region of NOK 300-500 million over four years. Nor was it decided at the outset where the money would come from. In other words, the decision of the prime ministers to increase funding for Nordic cooperation had not at the time of designing the intervention been translated into any changes in budget.

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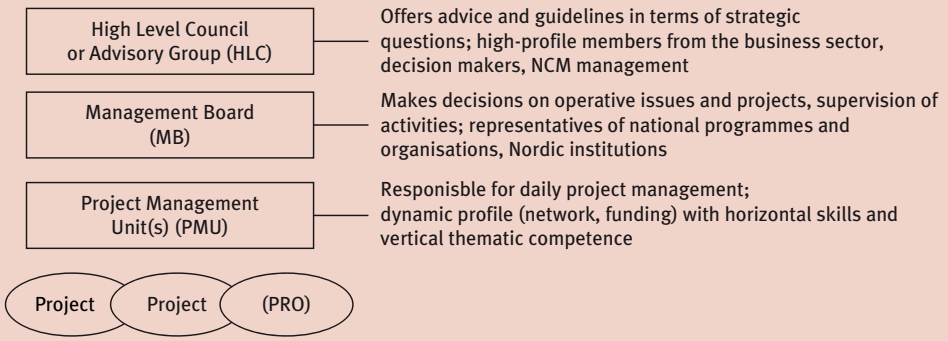
72 Huset Mandag Morgen, Nordisk Råd, Nordisk Ministerråd, *Norden som global vinderregion. På sporet af den nordiske konkurrencemodel*, ANP 2005:777, Copenhagen, Nordic Council and Council of Ministers, 2005

73 In a letter dated 7 July, 2006

The planning group proposed a three-level system of governance for the TRI (Figure 9). It argued that a High Level Council was necessary in order to attract additional funding, industrial involvement, wider participation and to build the scale of intervention envisaged. It set out thematic priorities and two alternative budgets: a modest, Nordic budget in line with the NMR's suggestion; and a much more ambitious one that involved leveraging large amounts of national and EU funding.

FIGURE 9 PROPOSED TRI GOVERNANCE



The NMR invited interested parties and the national and Nordic levels to comment on the proposals. It received thirteen responses, all politely phrased but mostly negative in their content. The regional committee (EK-R) made a point, echoed by many of the commentators, that:

> *The proposed TRI is characterised by a 'top-down' approach that will lead to difficulties in obtaining consensus and implementing the programme within the existing Nordic cooperation where questions of common interest have been developed after many years of constructive cooperation.*

The agencies that responded tended to make the point that they had not been consulted and should be more closely involved in the definition and management of the programme. As the Research Council of Norway (RCN) put it:

> *In the process going forward, a key requirement is to establish a good dialogue with the national research councils and to develop a model for realistic cooperation and interplay between national, Nordic, European and global efforts and goals.*

Once the proposal was handed over to the NMR, the Swedish presidency took the initiative to organise the joint preparation of a proposal for the MR-U.
The group decided:

- the scope of the programme;
- the governance issue, removing Lund's proposed High Level Council so that the TRI is managed by a programme board comprising 15 representatives of the Nordic funding organisations, academia and industry appointed by MR-U;
- that the participating countries would fund the TRI on the basis of the normal proportions among the member states used in Nordic cooperation, and that it would be left to the individual states themselves to determine the sources of their national contributions;
- the division of labour and organisation of the TRI secretariat, which is provided jointly by the three Nordic organisations.

Resolving the roles of the Nordic organisations was itself a major task. While they now share office space in Oslo, they are independently organised, employ largely incompatible systems and processes, fund different kinds of work and have different governance mechanisms.

The result of the process described here has been to establish and begin to implement a TRI that largely rearranges existing funding rather than providing the deepening of Nordic cooperation originally intended by the prime ministers. Nonetheless, the initiative has the effect of focusing and structuring Nordic research cooperation to an extent not previously achieved, and it has demonstrated a practical form of governance for a more focused effort of this type. It therefore opens the door to a more effective way of working together, as well as providing a practice that can serve as a platform for the participation of Nordic countries in future joint programming at the European level. However, it has also disrupted aspects of the existing cooperation, especially at NER, because the themes addressed by the TRI are already important at the level both of the member states and of Nordic cooperation.
We can conclude that:

- The TRI was 'top-down' in that it was detached from the normal processes of Nordic cooperation and consultation.
- However, if it had not been detached, it is unlikely that the TRI would exist today.
- The planning process was not adequately connected into the existing cooperation mechanisms.
- The Nordic system is not tuned to 'joined up' action, reflecting the sectoral divisions of the member states.
- The three Nordic organisations do their individual or 'sectoral' jobs well but are not structured to work in the new 'joined up' reality.
- Perhaps not the least important point is that the Nordic cooperation system is not used to dealing with a strong and positive push from the top – even people well used to the complexities of cooperation were caught off-guard.

It is unreasonable to expect that the prime ministers will provide this kind of stimulus every time it is needed – or that they will necessarily notice when such stimulus would be helpful. If it is useful to undertake this kind of larger-scale, 'structuring' action at the Nordic level then there is a need for a Nordic-level 'arena' that is supplied with strategic intelligence and is capable of leadership in setting directions. Such an arena should probably be broad enough at least to cover the responsibilities of the MR-U and MR-NER; and probably it should be broader still. The first TRI fortunately involved energy, which is one of MR-NER's responsibilities. The intended second TRI relates to health, which would require the involvement of the Nordic Council of Ministers for Health and Social Affairs (MR-S). Other Grand or more specifically Nordic Challenges are likely to involve other important sectors.

The research focus of the first TRI is probably unfortunate.

As the European Commission has recognised in the design of the Innovation Union Innovation Partnerships, many if not all of the Grand Challenges are linked to a need not only for new knowledge but also for implementation through innovation. Both the process of setting strategy for further large-scale Nordic cooperation and the mechanisms for implementing it thus need to be more cohesive than is normally possible in the sectorised world of Nordic cooperation. NordForsk and NICe therefore need better routines for working together; there are even arguments for merging them, as in the RCN model. In any case, the poor linkage between NICe and the national innovation agencies needs to be strengthened if large-scale initiatives are to have a structuring effect on Nordic innovation as well as Nordic research.

All this rests, of course, on the assumption that the TRI makes a difference. An early 'health check' evaluation of its implementation is therefore crucial.

4. DEVELOPMENT PATHS FOR NORDIC COOPERATION IN RESEARCH AND INNOVATION

This chapter considers the implications of different development paths for cooperation at the Nordic and European levels. It starts by discussing some of the megatrends likely to shape developments over the next ten years or so, then develops four scenarios for the development of Nordic and EU cooperation and discusses some of the likely impacts of each.

4.1 TRENDS IN THE NEXT FEW YEARS

Thinking about the future is always difficult, and is bedevilled by unexpected events, such as 9/11 or the recent banking crisis and the subsequent financial downturn. The economic situation will certainly diminish our collective ability to increase investments in research and cooperation in the next few years. Widely recognised megatrends include:

- globalisation and uneven development;
- energy and resource constraints, probably made more severe by climate change;
- ageing populations in the OECD and China;
- political stability and security;

Globalisation involves not only greater cross-border integration of research and industrial communities but also the declining importance of geography in integrating supply chains. While the spread of ICT means that the ability of communities to function virtually across long distances is only likely to increase, it is not equally clear that the long underlying trend of declining real transport costs will continue, as fossil fuel supplies run out at an accelerating rate (driven by increasing population and industrialisation). This could well support some resurgence in European manufacturing competitiveness against more distant parts of the world in low-value goods; high-value goods (such as capital goods) are less affected by transport costs. Long-distance transport (air, sea) is more vulnerable to a high oil price than regional transport (especially rail), which can use renewables or nuclear energy for electric propulsion.

Other key aspects of globalisation include the rapid development of the BRIC countries, which are likely to be followed by other developing countries. This means larger markets – but also more intense competition – for capital goods, with Europe forming a declining fraction of both demand and supply and needing to compete increasingly on knowledge and a range of 'soft' factors in order to maintain current high levels of welfare. Supporting European competitiveness in both research and business will likely require self-confident, knowledge-based involvement with the leading centres of global growth. (In that case, the lack of global ambition in Commission strategy and policy for research and innovation is problematic.)

Energy and resource constraints go well beyond chasing declining fossil fuel supplies. They imply massive new global markets in renewables and technologies for mitigating the effects of using fossil fuels as well as huge research and development efforts to accompany these. Increased food production will be needed to handle rapid population increases in some parts of the world, with corresponding needs for R&D. Water is an emerging resource issue even within Europe. Over time, climate change may result in physical dislocation and may prompt significant migration pressures northwards into Europe. Resource issues drive several of the obvious Grand Challenges being discussed in European research and innovation policy. While these are conventionally viewed with some alarm, it is worth recollecting that they imply changes that are cumulatively disruptive and offer major investment opportunities.

Ageing population is an issue not only in the OECD but also in China, as a result of the 'one child' policy. It implies a need for increased service provision as well as a shift in the nature of some goods. At the same time, on the supply side it implies reductions in production capacity for knowledge as well as other goods and services. Despite its current political unpopularity, immigration is probably part of the solution and there will be significant need for R&D.

Political stability and security is the wild card among the megatrends discussed here. Since well before 9/11, terrorism has led to a shift in research priorities and created new technological opportunities in security – as well as a large amount of unproductive employment in places such as airports. In reality, the effect of terrorism in Europe has been so small as to be almost invisible compared to the carnage on the roads or the effects of smoking. Sudden shifts in political alignments, for example in the Middle East, or increased isolationism among some branches of religion could have a disruptive effect on resources, prices and development. Here it is not clear that carrying out more R&D will help.

As Niels Bohr famously said, prediction is difficult, especially about the future. This brief look at the most obvious megatrends suggests that, for the most part, they hold economic opportunities as well as threats and that, in general, more intensive and efficient knowledge-related activity is one of the key needs in addressing them. Re-establishing capabilities in manufacturing industries may be an important part of the mix. Addressing the Grand Challenges implied by the megatrends will be critical to the research and innovation agenda, not only at the European but also at the Nordic and global levels. Especially in the light of the continuingly inwards-looking character of EU research and innovation policy, it will be important to pursue global partnerships and interests. Our research, innovation and education systems will have to be able to withstand potentially large population movements. These ideas inform the scenarios set out below.

4.2 FOUR SCENARIOS: ERA AND NORIA

Here we develop four scenarios intended to help think through how to position Nordic cooperation in research and innovation over the coming decade or so. In the light of the discussion in Section 4.1, there seems little point in exploring the possibilities of retrenchment in research and innovation policy. Except in the United Kingdom, this does not seem to be seen as a serious policy option. We therefore consider two possibilities for ERA and NORIA. The first is a 'business as usual' scenario that extrapolates current trends. The second involves more of a step function with significant increases in political commitment, budget and impact of ERA and NORIA policies. First we explain each scenario in turn; then we consider the implications of their possible permutations for key stakeholder groups in the Nordic countries.

Our paired analysis of scenarios has the unfortunate side effect of focusing the analysis of NORIA on the European context. If we for the moment disregard the European level entirely, there are still good reasons to increase cooperation at the Nordic level. Elements of NAV are identified in more detail above. Benefits of a strong NORIA include:

- larger scale interventions, increasing the capacities and focus of the research fabric;
- improved joint governance of innovation and research;
- better ability to tackle both general and Nordic-specific Grand Challenges;
- avoiding the costs involved in supporting international projects in areas of no interest to the individual Member State;
- improved access to international networks;
- improved influence over other policies, for example at the European level.

4.2.1 NORIA scenarios

Figure 10 sets out two simple scenarios for NORIA, which are primarily organised around the short list of NAV dimensions, set out at the end of Section 2.2.2. The 'Flat' scenario involves a potential repackaging of Nordic cooperation in various forms without any growth in scale or intensity. This leaves little scope to extend cooperation to other countries, as may be desirable in addressing issues affecting the polar regions of places with climates similar to the Nordic region, or indeed in simply building intermediate-level platforms on the way to gaining a bigger role in global competition. At current cooperation levels, there is little scope to address any major challenges at the Nordic level or to build scale. Limitations of scale and strategic intelligence would mean the Nordic region has little policy influence at European or global levels.

In contrast, the 'Developing' scenario allows the Nordic level to be an option for addressing some important challenges and for strengthening national positions in the Nordic area. It addresses the need for strategy and specialisation that results both from globalisation and from the movement towards a European Research Area. It could allow the Nordic level to extend itself with 'upwardly flexible geometry', adapting better to real cooperation needs in some cases where a Nordic configuration is too small but a European one is too large. And it provides opportunities for Nordic capacity building.

FIGURE 10 SCENARIOS FOR THE DEVELOPMENT OF NORIA

'Flat'	'Developing'
Budgets and national policy interest in NORIA remain small	Significantly increased research and innovation budgets approved at the Nordic level as a result of growing policy interest
Governance of Nordic cooperation is unchanged or changed relatively little compared to today	A more unitary governance and organisational structure is adopted for the Nordic cooperation, resolving the 'horizontal coordination' issue and creating an arena in which strategic priorities can be set at Nordic level
Limited budgets leave Nordic cooperation unable to build effective cooperation with countries outside the region	Greater flexibility enables the Nordic cooperation to extend its geometry case by case to tackle interests common to other countries, for example wood and forest issues with Austria and Switzerland; Baltic Sea issues with the Baltic states
Grand Challenges Few can be tackled at Nordic level, owing to lack of resources	More challenges can be addressed. In particular, there is scope for addressing selected global challenges but also some more specific to the Nordic region
Building scale and scope Limited effects on building scale and scope among research performers; effects mostly limited to networking	Sufficiently large projects can be established to produce structural changes in the research fabric, increasing national specialisation
Excellence Little impact	Some impact on **building** global excellence through the support of top Nordic researchers
Platforms The current level of platform-building is maintained, allowing selected groups to project themselves at European level	More and larger platforms can be built, with both European and global reach
Solidarity/image/influence Cultural, political and interpersonal solidarity among the Nordic nations remains strong. However, fragmentation means they have little policy influence, e.g. with the European Commission	Cultural, political and interpersonal solidarity among the Nordic nations remains strong. Creating a common arena on research and innovation policy increases the collective ability to influence policy at the European level

4.2.2 ERA scenarios

Figure 11 sets out two simple scenarios for ERA, which are primarily organised around the short list of EAV dimensions, set out at the end of Section 2.3.2.

At the European level, the 'Flat' scenario already implies significant change compared to the recent past. EU ambitions to structure both research funding and performance are already considerable but will be hampered by failure to increase the Framework Programme and related budgets. One consequence will be that European policy remains rather inward-looking.

In the 'Developing' scenario, there is a much more radical shift of power and budget to the centre. So far, the European level has largely acted as an addition or complement to the national level, although ambitions to influence national research policy have been rising. In this scenario, EU activities start to substitute for national activities, especially in displacing some of what is carried out by national research councils today, and therefore moving towards a US model where more basic research is funded from the federal level while more applied research and innovation is a local matter. With significant changes in the fabric of research such as concentration in bigger centres, small countries will increasingly need to specialise or they will lose out. However, a greater effort at the EU level is likely to make European research more open to the world at large.

FIGURE 11 SCENARIOS FOR THE DEVELOPMENT OF ERA

'Flat'	'Developing'
Framework Programme budget peaks at about 5% of EU government spending on R&D. Despite the use of new instruments, the 'cooperation' aspect continues and the FP's role is little changed.	The FP becomes a much more significant R&D funder. Budget shifts from national research councils to ERC so that eventually about 50% of EU bottom-up funding comes from this source Joint Programming becomes a major factor in the applied research and innovation funding of Member States.
Grand Challenges Some are handled at EU level, but only those that are of interest to almost all Member States.	More challenges are tackled, including some niche issues of interest to only a minority of Member States.
Building scale and scope Growth in the networking of different parts of the EU R&D communities continues but there is little structural change.	There is significant change in the structure of the research fabric, especially towards existing strong centres. Small countries and small players are marginalised.
Excellence Little impact	The ERC promotes excellence in the 'hard' and social sciences, raising quality standards beyond national levels, leading to low success rates, and becoming a major funder of leading research groups
Focusing Continued slow evolution of European networks of R&D towards FP themes.	Faster increases in network building, focusing on established players and leading to increasing exclusion of marginal players
Regulating Mix of proactive and responsive regulation – partly based on RFP (request for proposal)-derived knowledge – has a positive effect on competitiveness.	Stronger regulatory position is enabled by the improved knowledge base from large-scale Grand Challenge research and improves European competitive position
Globalisation EU knowledge generation remains inwardly focused and ERA fails to engage adequately with global knowledge generation. EU research and industry become increasingly marginal.	The EU's strong focus on Grand Challenges and on opening the ERA to the world makes it a strong and trusted R&D partner of other parts of the OECD, the BRICs and a significant proportion of the developing world

4.3 IMPLICATIONS OF THE SCENARIOS

In this section we consider the likely implications of the scenarios, working through all the possible permutations of 'Flat' and 'Strong' scenarios at Nordic and European levels.

4.3.1 Flat NORIA, Flat ERA

This combination represents 'business as usual' at both the Nordic and the European level. With limited budgetary room to manoeuvre and a governance system that makes it hard to set large-scale thematic strategies, it is difficult for policymakers to agree on thematic directions at the Nordic level – either as a basis for trying to influence EU policy or as a way to focus joint Nordic efforts. It appears unrealistic to expect a string of high-level interventions to set major priorities, as the prime ministers did in order to launch the Top-level Research Initiative. This combination is not a disaster – it involves a continuation of the existing positive trajectory of co-evolution among national, Nordic and European levels. R&D networking is gradually becoming stronger. The Nordic area is able to build some cooperation platforms as a basis for going forward into the Framework Programme and beyond. But there is limited scope to select and tackle many of the Grand Challenges at Nordic level and little freedom within the ERA to

tackle niche issues of special interest to the Nordic countries. With comparatively weak signals and incentives about how to restructure, we would expect Nordic research systems to react slowly to the need for thematic specialisation in order to tackle the greater scale of emerging ERA research and industrial competition. All classes of R&D performers will continue to find it useful individually to lobby and provide the Commission with good ideas for the FP and its work programmes.

Under this combination of scenarios, universities can safely continue (as most do) to operate with bottom-up, de facto thematic strategies. There will tend to be other reasons for more explicit thematic specialisation – such as the need to build links with a manageable set of knowledge users – but the stimulus from Nordic or European policy in that direction will be modest.

Tackling the Grand Challenges will involve both science and development. Applied research institutes ought to do well in scenarios where there is a lot of implementation work or work that integrates new and existing knowledge, as much innovation does. However, this combination of scenarios provides few new opportunities for them.

Large and technologically capable companies (small as well as large) are already involved at the European level, through initiatives such as the ETPs, JTIs, KICs and so on. Their involvement in relation to Nordic research is much more limited, since research and innovation policies at the Nordic level are not well connected and NICe pursues a valuable but rather separate trajectory from NordForsk. Business as usual at the Nordic level would under-exploit some of the industrial opportunities created by the Grand Challenges.

4.3.2 Strong NORIA, Flat ERA

The voluntary nature of Nordic cooperation means that the Nordic states have the opportunity to tune it to their own needs, in a way that is not possible in the more top-down European situation. Implementing a strengthening of NORIA would inevitably mean reaching a series of agreements about priorities that comes close to small-scale joint programming. This in turn would increase the ability to transform Nordic platforms into larger cooperation at the European or global levels, strengthening the competitiveness of Nordic research and promoting the interests of the Nordic countries as knowledge users. Together, these influences are likely to promote changes in the Nordic research fabric. Increasing the number of common Nordic R&D foci also provides opportunities to enhance the role of industry, increasing the economic pay-off for research investment.

A strong NORIA could also provide opportunities to act with 'extended geometry' on a case by case basis – inviting other countries to participate where there are common interests, without the need to pass through the complexities of the European level.

In a flat ERA scenario, however, the number of European-level opportunities available to be addressed by Nordic platforms is more limited than under the strong ERA scenario. But a positive aspect of flat ERA is that the extensive learning acquired over the years about how to participate and operate in the 'Cooperation' part of the Framework Programme can continue to be exploited. Clearer, stronger and more common priorities at the Nordic level provide opportunities for increased influence over the contents of the Framework Programme. The strong ERA version would probably rewrite the rules of the game.

Under this combination, universities and research institutes will more clearly benefit from opportunities to build Nordic platforms, to create and share Nordic capacities that reflect both the strengths and the interests of the region. Quality would tend to rise as a result of the cooperation because the best Nordic environments can be chosen from a wider selection environment than is offered at the national level. There will of course be many cases where the optimal partners are not Nordic. There is no compulsion about the Nordic mechanisms if something better is on offer. A strong NORIA is especially interesting in cases where the

quality and strength of Nordic capacity is good but could be improved.

Industry would benefit from a strong NORIA not only as a result of the improvements it would bring to the research fabric but especially because it should provide increased opportunities to participate in larger research-related projects, for example tackling some of the Grand Challenges relevant to the Nordic area.

4.3.3 Strong NORIA, Strong ERA

This combination, of course, tends to preserve the benefits of strong NORIA described above. The strong ERA scenario involves a major transfer of research funding to the European level and a wider transfer of programming and strategy to Joint Programming. There will be correspondingly fewer resources that can be programmed at national – and Nordic –levels. A strong NORIA helps the Nordic countries to build research platforms where that is in the common interest; strong ERA increases the opportunities to exploit these platforms at the European level, tackling more Grand Challenges and niche issues as well. A larger ERC – at the cost of national research council funding – may raise the quality bar but also makes capacity building at national or Nordic level more difficult. The ERA measures should tend to restructure the research fabric – but not necessarily in directions beneficial to the Nordic countries, so there is value in being able to act at the Nordic level (a strong NORIA).

The stronger regulatory opportunities available under a strong ERA should broadly benefit Nordic actors, as would a more vigorous approach to opening the ERA to the world.

For universities and institutes, this combination of scenarios provides many opportunities but also tough competition, in which there will be losers as well as winners. Many of the winners are likely to be large, central universities and institutes in continental Europe, so the pressure on Nordic institutions to specialise at high levels of quality will be intense.

Companies would enjoy the richest set of opportunities under this pair of scenarios, compared with other combinations.

4.3.4 Flat NORIA, Strong ERA

This combination produces the fewest options for Nordic policymakers. Fragmentation of the Nordic countries leaves them with little influence at the European level. While these countries are mostly strong in research and innovation terms, individually they comprise very small parts of the European whole. With a weak NORIA and a strong ERA, the initiative essentially passes to the European level.

In this combination, the research performers are still subject to intense competition and pressures to restructure and specialise, but have almost only national resources to help them to do this and to build capacity. Companies will optimise against the European level, since there are few attractors to the Nordic level.

5. CONCLUSIONS FOR POLICY

This final chapter draws conclusions from our analysis and sets out a small list of action points that will facilitate development of the Nordic cooperation.

5.1 KNOWLEDGE PRODUCTION, USE AND 'ADDED VALUE'

In our initial discussion of the economics and process of knowledge production, we found that, due to its intrinsic qualities, knowledge is not only an appropriate object for investment by the State but also that its creation and use are intimately tied to networks. Interaction and competition among researchers drive progress, focusing attention and effort on the new and interesting research questions. Because knowledge can be used without being consumed, whole communities can share and improve it. Progress results not only from the interplay between theory and experiment but through interaction with knowledge 'users', whose need to solve problems in the course of innovating provides powerful signals about which research directions are interesting in practical terms. These needs act as 'focusing devices' both because they provide information and because they are often accompanied by access to resources. Knowledge production and use is therefore an intensely **social** process, in which researchers constantly need to interact with their colleagues, their rivals and those with an interest in what they produce. Access to the relevant networks is as important to knowledge use as it is to knowledge production.

Especially for small countries such as those in the Nordic region, this means that researchers, like innovators, need to be 'born global'. There is too little competition and inspiration locally to enable them to function at a world class level; they have to have international networks. In many cases, research infrastructure is so expensive that it has to be shared internationally, providing a further driver for international networking. The smaller the country, the quicker the internationalisation.However, entry into the needed networks is not easily achieved They do not tolerate free riders – you have to 'bring something to the party' in the forms of ideas, research capability and resources. The networking has therefore to be supported by capacity building and funding at the national level.

The specific configurations of knowledge production and use networks change over time and differ among sciences and technologies. There is no 'one size' that fits all. Thus, to ask whether the 'right' level of networking is Nordic or European – as has been done at times in the debate over Nordic Added Value – is to ask a pointless question. The answer will always be "it depends". A more interesting question would be "When do Nordic and European cooperation, respectively, provide a usable means of supporting networking needs, and when do we have to find something else?" From the national researcher's perspective, it is useful if these forms of cooperation can be configured flexibly to meet a range of networking situations. They must have flexible geometry and an adequate range of funding instruments.

Nordic cooperation, in both its formal and its informal manifestations, extends far back in time. In research as in other areas, its original driving forces were cultural and geographical but it provided clear benefits in supporting international networks. As Nordic countries began to join a European Community with increasingly federalist ambitions, and as advances in travel and communications technologies increasingly shrank the world, Nordic cooperation has had to evolve. Many of the changes of the last fifteen years or so have essentially been a **reaction** to European-level initiatives, copying good continental ideas on a more humane scale. But Nordic cooperation has long been ahead of Europe in at least one dimension: accepting the idea of 'variable geometry'.

Co-evolution with Europe means that the substance of Nordic Added Value has had to change. In the mid-1990s, it shifted from being 'obvious' and culturally based to take on a more economic character. Nordic Added Value came to revolve around achieving the benefits of scale and competitiveness while respecting subsidiarity (in the sense of not doing things that could better be done at the national or the European level). In this century, the meaning of Nordic Added Value has shifted towards the idea of building platforms and virtual communities that strengthen and structure the research and innovation resources of the Nordic area. This enhances competitiveness, strengthens national research and innovation systems and increases the ability of Nordic nations to address European and global cooperation and competition by building Nordic strength. The cultural ideal has not been abandoned, but it is no longer as central as before. The overriding aim of Nordic cooperation is to strengthen the individual Nordic countries through cooperation. This is the opposite of the aim of current EU policy.

For a long time, European Added Value was defined in pretty much the same terms as the Nordic Added Value of the mid-1990s. A wide range of R&D activity was seen to generate EAV because it linked three or more Member States together to tackle issues that were hard to resolve at the national level. The Maastricht Treaty (1993) gave the Commission a role in 'structuring' European research, but this was not taken all that seriously until 2000, when the Busquin Communication announced the plan to establish the ERA and the Lisbon and Barcelona goals were adopted. From that point on, the restructuring of the fabric of European research, building larger and more globally competitive entities, also has been seen as generating EAV. EAV is obtained through the alignment of national research and innovation policies and the creation of self-organising, transnational interest groups that define research and innovation agendas. Shifting research competition up from the national to the European level creates EAV. Finally, EAV requires the creation of strong European-level institutions and arrangements that 'optimise' the research and innovation system at the European, not at the national, level. EAV has evolved to become part of European nation-building and the creation of a Federal state.

From a national perspective, Nordic and European cooperation thus entail rather different opportunities – and the differences go beyond mere size. Both national and Nordic policies provide opportunities to expand capacity and scale, which are prerequisites for participating at the European level. The European level presents more intense competition and larger-scale resources, but is not well designed to tackle local or regional needs that tend to be ignored as insufficiently European. Capacity building is not possible in such a competitive environment.

The changes at European level will spawn increased scale and specialisation at national level. National influence on the European policy level is small. Such influence can be correspondingly greater at the Nordic level. But to have influence you have to know what you want. For both reasons, nations require strategies – a fact not easily accepted in all the Nordic countries.

5.2 NORDIC COOPERATION

Cooperation is deeply rooted as a phenomenon among Nordic researchers. They reach out to the world for network relationships, based on needs, but end up turning to their neighbours disproportionately often, as we can see from partnering behaviour in the Framework Programmes or in publication activities. There are many areas of research where Nordic countries are strong and where there is scope for building Nordic strength as well as areas of shared need where the logic of cooperation is equally compelling.

Nordic cooperation in research is extensive and wide-ranging. However, the institutional focus is on three organisations: NordForsk; NICe; and NER. NordForsk operates a 'true common pot' and a wide range of research funding instruments, most of which involve an additional two-thirds of national co-financing. NICe functions as a Nordic-level innovation agency

with a range of thematic foci, while Nordic Energy Research is a vehicle for research funding and cooperation among national energy agencies. These organisations are successful and visible but their collective resources are small: under € 30 million per year.

The governance of the Nordic cooperation is a work in progress. Historically, the Nordic Council of Ministers has reflected national ministry structures, with separate councils of industry ministers, education ministers, and so on. It therefore incorporates the inter-ministerial barriers that are recognised at the national level as posing a major obstacle to achieving cohesive policies for innovation, research and other cross-cutting issues such as climate change. The NMR is acutely aware of this problem, and increasingly aims to build in linkages among its constituent councils – notably between education and research on the one hand, and industry and energy on the other. The Nordic level lacks the kind of policy 'arena' provided at the national level by organisations such as the Finnish Research and Innovation Council, which address the need for coordination among ministries and set overall research and innovation strategy for the State.

NordForsk, NICe and NER each have different governance mechanisms. National research councils and universities effectively govern NordForsk, though it is formally an agency of the Council of Ministers for Education and Research. It is therefore strongly connected to the national agency level. NICe and NER are agencies of the Council of Ministers for Business, Energy and Regional Policy. NICe's board members serve in an individual capacity, so while three of them come from national innovation agencies they can exert no real national influence over NICe actions. NER is governed by the national organisations that provide its funding. NordForsk and NER are therefore well placed to participate in joint programming among the Nordic countries. In practice, however, their resources are spread thinly across a wide range of instruments and thematic areas.

In 2006-7, the Nordic Prime Ministers took an step that could change the character of the Nordic research and innovation cooperation. Initially as part of a globalisation initiative, they called for a Nordic Top-level Research Initiative (TRI) to address problems of energy and climate change. Initially they had hoped to provide new money for the TRI, but this proved impossible to deliver. Unlike previous forms of cooperation, the TRI was not planned and agreed on among the agencies, but rather by an external party. The reaction of the national agencies – who in practice had to find the money for the initiative – was that this was top-down and unacceptable. It proved hard to get the three Nordic organisations to cooperate and a new system of administration had to be devised to enable them to implement the TRI jointly. But by 2009 the initiative was in place and is now largely seen as a good thing, building a first significant Nordic platform and strengthening Nordic competitiveness. A key deficiency in the initiative, however, remains the low level of industrial involvement, which reduces the amount of information obtained about needs and the practicalities of implementation while creating difficulties relating to technology transfer at a later stage.

It is not realistic to expect an ongoing flow of interventions from the prime ministerial level to direct changes in Nordic research cooperation policy – nor would this be likely to produce good decisions. The new version of Nordic Added Value, rooted in the idea of building common platforms, requires strategic choices and more resources – at least some of which will have to be reallocated from other things. The existing governance and structure of the Nordic research and innovation cooperation is not well adapted to doing this. Cooperation has in practice been dominated by the national agencies, which in principle are favourably disposed towards it, but which in practice also understand that the use of budgets at the Nordic level implies a loss of budget at the national level – as indeed proved to be the case in the implementation of the TRI. It can be argued that the de facto control of much of Nordic cooperation by national agencies helps to explain its small size and tendency toward fragmentation.

The involvement of national agencies is crucial to the implementation of larger platforms such as the TRI, but it is also clear that stimuli are needed at the policy level to determine what these larger platforms should be. This implies that the problem of the missing Nordic-level 'arena' needs to be solved so that such stimuli can be provided. To the extent that the Nordic organisations are involved in joint programming of national resources, their governance needs to be closely linked to the national level.

5.3 FUTURE DEVELOPMENTS

The future is always uncertain but there is every reason to believe it will involve a growing need for knowledge-intensive production and that the Grand Challenges will not only generate a need for research but also provide major economic opportunities for innovation.

We considered the implications for Nordic actors under four scenarios:

- one in which Nordic and European cooperation remains at roughly the same level as today;
- a second in which Nordic cooperation develops in scale and strength while European cooperation remains unchanged;
- a third in which both Nordic and European cooperation develop in strength and scale;
- a fourth in which European cooperation develops but Nordic cooperation stays as it is.

In the first case, we would expect Nordic-level cooperation to have limited effect. Europe would undoubtedly go on to address some of the Grand Challenges, but without growth in European-level resources there will be limited scope to tackle any but those that are of universal relevance. With few resources at the Nordic level, cooperation quickly runs out of resources for building further platforms such as the Top-level Research Initiative. In the second case, the Nordic level takes more initiative and can build a number of common platforms of Nordic strength, accessing both European resources and potential global cooperation and competitions as a result. In the third case, increased European activity provides more opportunities to exploit platforms built at the Nordic level. The fourth case is a disaster in terms of reaching Nordic objectives. Resources and initiative shift to Brussels. Small countries are marginalised and the Nordic region is too fragmented to respond.

The Nordic policy conclusion from considering these scenarios is clearly that further development of Nordic cooperation yields the greatest opportunity and the strongest position for the Nordic nations, affording them the best chance to improve their national research and innovation systems.

5.4 WHAT NEEDS TO BE DONE?

International cooperation in knowledge production and use is a necessity, not a luxury. The policy issue is how best to provide ways to support to that which does not happen naturally – typically because it demands more resources than researchers and knowledge users can bring to the party from their existing funding. The coverage is not perfect, but between them the Nordic and European cooperations could provide quite a wide range of opportunities – especially if the Nordic cooperation could extend its principle of variable geometry outwards as well as inwards, bringing in additional countries a la carte, where needed.

It is not clear that a major increase in resources is needed at the Nordic level. Existing Nordic arrangements offer a range of small-scale instruments that support the development of individual Nordic platforms. These activities should be maintained. As the Top-level Research Initiative demonstrated, it is harder to work at larger scale because this effectively means jointly reprogramming resources that are sometimes best used nationally and other times best used in a collaborative effort.

Unlocking the potential revealed by the Top-level Research Initiative to generate Nordic Added Value by programming larger-scale joint activities requires:

- Creating a Nordic-level research and innovation policy 'arena' that can decide when and where such platforms should be constructed.
- Linking the governance of all three Nordic organisations clearly to the national as well as the Nordic level.
- Continuing and extending the strategic intelligence and analysis activities of the Nordic organisations, so that that arena has the Nordic-level information it needs.
- Implementing future initiatives in closer consultation with the member countries' policymakers and their agencies and on a timescale that makes it possible for the nations to allocate resources.
- Agreeing that such initiatives can have variable geometry – and that additional countries can be invited to join in, on a cost-sharing basis.

These arrangements would effectively allow Nordic cooperation to develop on a case-by-case basis, constructing platforms and networks that fit the individual needs of different thematic areas. This is not a substitute for European or global cooperation, but provides a complement to them and a way to build greater Nordic strength in research and innovation.

NordForsk, 2011
Stensberggata 25
N–0170 Oslo
www.nordforsk.org