New Governance for Innovation
The Need for Horizontal and Systemic Policy Co-ordination

Report on a Workshop

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1.   Introduction

Analysts and policy-makers increasingly notice a changing nature of innovation. More and more, innovation is perceived as a systemic, horizontal phenomenon caused by, and influencing, a broad spectrum of factors, while the related political institutions are quite narrow and vertical in their thematic focus, working in a departmentalised and fragmented manner. These discrepancies, nevertheless, are becoming one of the most dangerous bottlenecks of future innovation systems.

Against this background, the Six Countries Programme held a workshop on *"New Governance for Innovation? The Need for Horizontal Policy Coordination"*. The workshop was organised by the Fraunhofer Institute for Systems and Innovation Research together with the Department of Innovation Studies of the Copernicus Institute for Sustainable Development and Innovation at the University of Utrecht and was held in Karlsruhe on November 14 and 15, 2003. The organisers gratefully acknowledge a support grant by the German Federal Ministry for Education and Research (BMBF, PLI2031).

More than 50 international participants exchanged their thoughts on the issue and traced the preconditions, models and cases of new modes of governance for innovation. The workshop format facilitated brainstorming and a free, open-minded discussion among creative analysts and policy-makers, touching upon typical policy deadlocks and exploring new ways of policy co-ordination.

After a short welcoming address by *Engelbert Beyer* of the German Federal Ministry for Education and Research, *two key note presentations* explored the political and the conceptual need for systemic policy approaches. In order to learn about and discuss concrete challenges and practices, *two thematic cases* were dealt with in depth: (1) innovation in the area of *health/food*; (2) innovation in the area of *transportation and sustainability*. The presentations both sketched the problem dimensions of horizontal policy co-ordination and introduced promising cases. Thereby, particular attention was paid to the relationships between various ministries or other public authorities involved, as well as advisory bodies, parliaments, research institutions, non-governmental stakeholder organisations, and of course industry. A *round-table* of policy-makers from heterogeneous fields debated what 'horizontal co-ordination' would mean in real life policymaking circumstances. On the basis of this debate, the *"Karlsruhe-Utrecht Principles for Horizontal Innovation Policymaking"*, which were drafted by the organisers before the workshop, were discussed, and comments by the participants were gathered and fed into the final version of the principles.

The purpose of this paper is threefold. First, it restates the thematic context of the workshop by summarising the major challenges for innovation policy-making in face of the given institutional settings and new as well as traditional characteristics of the innovation

process. Second, it summarises the presentations, discussions and major results of the workshop.[1] Finally, it states the final version of the Karlsruhe-Utrecht principles .

2. The Context: Challenges for Horizontal Innovation Policymaking

Catchwords emphasising the emergence of a new mode of transdisciplinary and multi-site knowledge production (Gibbons et al. 1994), or the advent of "post-academic science" (Ziman 2001), or of "post-modern science" driven by heterogeneity (Rip 2002) may not distract our attention from the fact that most of today's public "bread-and-butter" research and innovation policies still are conceptualised and run in quite a traditional departmental-ised manner. How can potential innovation – i.e. creative destruction – enter the power games of institutionalised policy arenas and traditional markets? Quite often, potentially path-breaking socio-technical ideas (findings, "solutions") emerge in environments rather different from those of their final application and diffusion (think e.g. of the "European paradox": excellent science but low innovation rates ...). The departmentalisation and fragmentation of innovation-related policy arenas is twofold:

(1)   The "research system" of academic science, research, and industrial technology de-velopment – modern birthplaces of findings and ideas relevant to innovation – is constructed through quite a specific set of departmentalised institutions like univer-sities, non-university institutes and private laboratories, each with different interests, value-orientations and incentives. Over years related actor groups have established a specific, rather closed policy arena and learned to arrange their co-operation and competition games vis-à-vis public policies. Fragmentation within the research sys-tem reinforces (and is reinforced by) fragmentation of its relations to public policy.

(2)   The worlds of potential innovation users – i.e. related markets, industries, stakeholders, politics – are constructed along historical trajectories of ideologies, in-terest coalitions, institutions, nested around established problem perceptions. Related public policies are pursued in many different thematic policy arenas which have evolved apart from the innovation policy arena.

Thus, new combinations of knowledge, demand and public interventions are hampered yet: public policymaking capitalising effectively on the innovation potential of "mode 2 knowl-edge production" and of "post-modern heterogeneity-based science" would have to bridge the diverging perspectives (interests) of societal subsystems and related policy arenas. A horizontally and systemically co-ordinated innovation policy conceptualised as *bridging (or systemic) policy requires a new governance for innovation*. This policy concept would

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[1]   We stress that these summaries are based on our perceptions of the presentations, i.e. citations referring to the authors shall not be based on this report.

have to be guided by an "innovation system" approach: "A system of innovation is that set of distinct institutions which jointly and individually contributes to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies" (Metcalfe 1995).

Presently the governance of politico-administrative systems in general and innovation policy in particular in most OECD countries is characterised by (see also Smits/Kuhlmann 2002)

- a high degree of departmentalisation, sectoralisation of the political administration, and low inter-departmental exchange and co-operation
- heterogeneous, un-linked arenas: often corporatist negotiation deadlocks
- failing attempts at restructuring responsibilities in government because of institutional inertia
- dominance of "linear model" of innovation in policy approaches (and of related economists as consultants)
- "innovation policy" run in a very specific, narrow field focusing on introduction of new technologies in SMEs, IPR or VC issues etc.
- emerging multi-level governance in the context of the European integration makes the launching of "bridging/systemic" policy approaches even more difficult.

Jacobsson and Johnson (2000), in an analysis of the innovation systems approach in energy systems, identified typical weaknesses of under-co-ordinated innovation policymaking: there is poorly articulated demand; local search processes which miss opportunities elsewhere; too weak networks (hindering knowledge transfer); too strong networks (causing 'lock-in', dominance of incumbent actors); legislation in favour of incumbent technologies; flaws in the capital market; lack of highly organised actors, meeting places and prime movers.

Based on their analysis they propose *new – innovation-focused and co-ordinating – roles for government*: supporting different designs, safeguarding variety, addressing a large portfolio of technologies and innovations; strengthening linkages, management of interfaces, reinforcing of user-producer relations, building new networks (Neue Kombinationen) and deconstructing old ones (creative destruction); stimulating learning processes; raising awareness, stimulating articulation of demand; monitoring the struggle between proponents of new technologies and incumbents of the old ones; stimulating prime movers; taking care of (very) long time horizon related to institutional change.

Thus in the future new modes of governance (and relatedly: government) would require a broader understanding of policies for innovation:

- organisation and content of governance would have to take into account the systemic nature of innovation, including the notion of complex, non-linear interaction (e.g. fostering university – industry co-operation rather than transfer units, stimulating multi-disciplinary research, fostering the debate on implications of mode 2 for universities and other institutions in the innovation system, more in particular with regard to missions, culture, reward structures, relations between institutions, quality control, ...)
- government and administration would have to deal more proactively with the challenge of moderating cross-sectoral linkages and supporting the (re-) structuring of cross-sectoral networks (e.g. horizontal taskforces, sectoral councils, UK-Foresight like activities, ...)
- this would include consequent attempts to re-organise administrations in a way that enables flexible horizontal co-ordination and exchange among formally divided entities (task-oriented mobility of staff, training of staff, changes in reward systems that stimulate horizontal initiatives, ...)
- a holistic notion of innovation policy, keeping in mind and taking advantage of the inter-dependence of single specific policy measures as well as the inter-relation of different policy areas (fostering cluster approaches, infrastructures facilitating the identification of and access to strategic intelligence, co-ordinating bodies with a real mandate, a parliamentary committee on innovation, …)
- more elaborated forms of institutionalised co-ordination between the European level on the one hand and the national and regional level on the other (e.g. initiating a political debate on the 'division of labour' between the various administrative levels resulting in clear decisions and strategies, furthering the development of networks of excellence, ...).

3. New Governance for Innovation: conceptual considerations from a political science perspective

In the first key note presentation of the conference, *Dietmar Braun,* University of Lausanne, discussed the need for a "New Governance for Innovation". The main argument of his both analytical and normative contribution was that the institutional structures and policy approaches have not yet adjusted to the radically changing conditions for innovation policy. For his analysis Braun combined three major concepts: (1) interactive instead of linear models in the innovation process, (2) mode 2 of the production of knowledge and (3) the systems of innovation approach. The consequences of these concepts for innovation policymaking are straightforward: "knowledge" must be put in the centre when thinking about the production and innovation process, therefore, collaboration between basic research and the technological trajectory are crucial. Furthermore, innovation is a result of systemic and interactive rather than linear processes, which means that the institutional setting, that emerged under the condition of mode 1 knowledge production, is put under severe pressure to adjust both the institutions themselves and the design of policy. For Braun, the two major problem categories of the current institutional design for innovation

policymaking are (a) the *lack* of *horizontal, inter-systemic cooperation and coordination* and (b) *the institutional fragmentation.*

In order to overcome the lack of *horizontal coordination*, Braun demanded a new policy design which defines the role of the state as a *moderator* and *enabler* within a network-, interaction- and process-oriented approach rather than a hierarchical interventionist oriented towards "picking the winners". In his view, the process-orientation needs to be accompanied by a legal infrastructure favourable to innovation, such as appropriate IPR structures and more flexible career structures of researchers enabling them to move between industry and academia. Furthermore, to support spontaneous horizontal coordination by interaction and openness, Braun – with reference to Guston (2000) – called for specialised boundary organisations that span the friction between the science and the political system.

Braun's approach to overcome *institutional fragmentation* is based on building up new institutional rationalities and cultures and of capacities to reflect on the systemic nature of science and innovation. With reference to the Austrian Council for Research and Technology Development, one key for Braun is the permanent integration of major stakeholders in the policymaking process who have a say in the *strategic* design of policymaking. Thus, different rationalities and interests are reconciled and fed into the policy process of all ministries involved. Coordination of ministries would be achieved indirectly, but more effectively than with inter-ministerial committees. In addition, funding agencies – with all their embedded expertise and experience – need to be involved in the strategic thinking of innovation policy, ideally enabling their cooperation, e.g. following the model of the UK Council.[2]

Above all, however, a new governance for innovation is needed to enable and foster *reflexivity* throughout the system, understood as the "capacity to think in terms of the whole, of problems and solutions and to anticipate the future. Thereby, the system and its actors are empowered with the ability and potential to constantly adjust ongoing processes and to question existing or emerging structures. Reflexive institutions can take very different forms, such as systemic evaluations, structured national priority-setting, mediation systems such as in the Netherlands or participatory approaches like the Science Council (Wissenschaftsrat) in Germany with its various working groups. Further possible models mentioned were the Austrian Council for Research and Technological Development or the respective House of Lords structures. For Braun, the major prerequisite to structurally embed horizontal coordination is to anchor such reflexive institutions and processes in scientific, industrial and political (and one might add administrative) interests.

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[2] Examples given were the NWO (Nederlandse Organisatie voor Wetenschappelijk Onderzoek, Netherlands Organisation for Scientific Research) and the DFG (Deutsche Forschungsgemeinschaft, German Research Association) in Germany.

In the discussion that followed Braun's key note speech it was stressed that although formal coordination was an important prerequisite, the merit of "enabling policies" through informal means should not be forgotten. The representative of the German Federal Ministry (BMBF) mentioned the example of the take-off in the venture capital market in Germany. Here, without formal coordination many different public and private actors worked in the same direction in recognition of the opportunities opened up by the use of risk capital. It was agreed that both mechanisms are not alternative, but complementary.

While the concept of reflexive institutions was not controversial, the discussion of specific examples showed that there are a couple of functional preconditions to be met, most importantly: independence and not relying solely on one ministry and people should be selected on the basis of expertise rather than seniority. One example that apparently managed to work was the Finnish inter-ministerial committee, while the Austrian Council was described by one of the analysts from this country as ineffective.

4. Innovation Policy in Selected Issue Areas

4.1 Health and Food

The convergence of Health and Food leading to new food products that promise to provide an additional health benefit ("functional food") to the consumer is an issue area that is especially suited to be discussed in the context of horizontal co-ordination for several reasons. As the chair of the session, Thomas Reiss, ISI, pointed out, the area is populated by very diverse actors and different agencies. The knowledge that is needed for health and food stems at least from two scientific areas with their own institutional settings and rationals, i.e. medicine/ biology on the one hand and food research/engineering on the other hand. Finally, although at the very end consumers have to be involved and convinced, the area is highly regulated and it is not only the taste and norms of consumers that decide about market success but public regulatory agencies. Besides, functional food is a relatively new area and each innovation in this area must not only conform to regulation, but establish itself against broad scepticism. Finally, both the end consumer's attitudes and regulatory institutions and rules differ considerably on the global market and even within the EU. This not only results in very diverse conditions for the competition of companies but also calls for complicated co-ordination on different policy levels, especially as most companies in the area are international players.

The major framework conditions for the health and food sector is globalisation, and therefore the global meaning of national or regional regulation, the ageing of society and the technological possibilities opened up by the information age and genomics.

Hans Zevenbergen, R&D director Heart Health of Unilever, reported on efforts to introduce novel food. His basic argument was that enormous obstruction (and even failure) were due to fragmented political structures and a lack of political leadership and co-ordination. According to Zevenbergen, the innovation process in the food and health sector is extremely complex. The challenges it faces exceed those of most other sectors, as not only economic success and social issues (impact on health system), but also ethical issues need to be taken into consideration.

This latter aspect was highlighted in a brief introduction on a novel field of research at Unilever. Before discussing two cases on innovation and – attempted – market introduction, Zevenbergen shortly described current developments in the food and health area that are based on "nutrigenomics" which is already subject to intensive debate and will certainly pose a major challenge for the policy process in the years to come. Nutrigenomics describes a science that enables customised products on the basis of individual genotyping. Its breakthrough would mean a paradigm change in food development, as not only additional functions would be engineered into food, but these functions would be tailored for each customer or for customer groups according to their genetic predispositions. Therefore, on top of the regular challenges faced in the food and health sector, the ethical issue comes into play, as the central question here is: how to organise genetic information as the basis of food engineering, who owns the genetic information, and how can this ownership be controlled effectively?

Zevenbergen discussed two cases. First, he reported on the attempt to introduce an improved margarine in Europe. After years of elaborating on the necessary deep scientific understanding, the product was ready for development, the proof of efficiency and effectiveness was made, market implementation was prepared. Very early on in the whole process, discussion with opinion leaders and consumers had started and worries had been taken into consideration. However, the regulatory process in Europe proved very long – 2 years as compared to 90 days in the USA – and in the course of this process obstacles came to the fore that rendered the market introduction impossible. In Zevenbergen's view, the process itself was not transparent and predictable and he had found an open dialogue with policy-makers very hard. The diversity of views on the issue across Europe exacerbated consensus decision-making enormously. Moreover, the claim approval process in Europe is still nationally organised which makes communication extremely complex and obstructs clarity on criteria for scientific substantiation. Despite attempts to integrate various stakeholders through a communication strategy, the overall process took 6 years, slowing down the innovation and implementation process enormously and thus diminishing the economic benefit of the innovation.

In his second case, Zevenbergen reported on a failed attempt to introduce genetically modified soja in Europe. He highlighted the role of public discourse in that sensitive area. As conflicting messages on the safety and the benefit to end consumers were sent and the media picked up the issue, labelling it "Frankenstein Food", it turned into a highly political issue. The resistance that built up was finally insurmountable for the industry.

Zevenbergen identified a set of lessons learned for the introduction of food. Given the extreme complexity in the area, close coordination with regulatory agencies is crucial. As in the case of nutrigenomics, public sentiment is much more sceptical towards modified food in Europe than elsewhere, it is extremely important to send clear messages about the net benefit for consumers and the ability to limit risks, and to integrate consumer groups very early on in the discussion process. All stakeholders involved need to be very cautious very early on as to what language to use and how the innovation is framed. Open and honest communication must clarify the scientific backing of the innovation. Most importantly as regards policy-makers, political authorities need to find a uniform position and even vision and must declare their will, under which conditions they back an innovation. On that basis, political leadership must be executed at all levels.

The discussion following Zevenbergen's contribution tackled very different issues. Most importantly, Zevenbergen was asked to explain the internal management of the complex innovation process that apparently has several dimensions and therefore several sets of rationales and norms. The key is a strategic and operative project management with a clear goal communicated to everybody in the company and a clear mandate from the board given to the operational level, the approach is leading through shared goals and visions.

In reaction to this, there was the view expressed from the audience that the major problem in the area for the implementation of innovations was, first, the legal and regulatory mess created in the multi-level and multi-departmental arena and, second, the lack of a clear common vision which must take into account the different language frameworks of the stakeholders involved. One might add that these two problems are inter-related, as the legal mess and the multiplicity of regulatory agencies can be interpreted as a reaction to the scientific and semantic complexity and the public uncertainty and fear, which in turn makes a clear vision extremely hard to formulate.

The second contribution within the health and food case hooked up on this vision building approach. *Jens Katzek*, Director of the German Association of Biotechnology Industries, stressed the necessity to formulate clear-cut national policy strategies with clearly defined responsibilities. As the major example Katzek refered to the Life Science Strategy for Europe which is an integral part of the European strategy developed in the Barcelona summit 2000 aiming at making Europe the number one knowledge-based economy in the world by 2010. While according to Katzekthe biotechnology industry shares this vision, the national implementation in Germany lacks the formulation of non-contradictory goals and sends conflicting signals to industry. For Katzek, the first step towards this ambitious European goal therefore was to formulate a coherent national strategy backed up by all relevant policy institutions. This led him to his second point, i.e. the definition of distinct administrative responsibilities in the context of research and innovation strategies. For example, the goal formulated in the Barcelona summit is pursued through actions and plans by federal ministries and coordinated by the head office of the chancellor, the result of which is not easy for industry to discern .

Katzek briefly mentioned four examples of the problems stemming from the lack of strategy and clear-cut responsibilities. First, he stated that the campaign to push start-up companies by the Federal Ministry for Economics (BMWi) was hampered by the tax systems as it was hostile to the innovation process and advanced financing schemes. Second, the allocation of public money for research in health-related aspects by the Federal Ministry for Education and Research was not backed up sufficiently by activities of the Ministry of Health to coordinate health insurance companies in order to make them buy products that resulted from this publicly financed research. Another example cited was the policy of the BMBF to finance a certain system for the safety assessment of plant biotechnology. In Katzek's perception, this was hampered by the Federal Ministry for the Environment which was not giving the necessary permits to the companies that developed the systems. Finally, Katzek complained about a mismatch between the high level statements of the German government labelling the biotech industry as a key industry for growth in the future and some programme administrators who – in the view of Katzek – rather bluntly oppose the development of a biotechnology industry in Germany.

The consequences for Katzek are obvious. Most importantly, he called for a re-design of indirect measures such as the tax system and the patent protection regime, in order to set incentives for industry that are in line with the innovation needs. Secondly, he asked for a comprehensive monitoring of all activities in order to enable coherent approaches. Finally, and in line with Zevenbergen, he asked for the definition of *binding* policy goals. Thus, his major demand for policy-makers was that they should permanently check if their programmes and activity match the overall policy goals and if the measures themselves are effective and efficient.

While the audience agreed with the main aspects of Katzek's analysis, there was some controversial discussion as to the role of clear visions and consensus. First of all, the view was expressed that goal setting itself must be responsive to societal needs, as it was the art of innovation policymaking to define goals that are operational for the administration and at the same time reflect a broad societal consensus.

Furthermore, the question was raised if a formulation of one clear vision could be dangerous as it might block diversity and alternative roads to innovation. In this perspective, internal contradictions are natural and even functional, they are necessary in order to make an effective "trial and error" approach possible.

National policy-makers confirmed these views, but differentiated even further. For them, there are issue areas with intensive conflicts and those with a high level of consensus. Policymaking should start by defining the interests involved and should adjust consensus-building and policy action accordingly. In their view, the prime task of policymaking, therefore, was the definition of policy goals in the face of conflicting interests and views. However, the policy-makers pointed to the problem of asymmetric cycles, as the relatively short-term legislative cycle in most issue areas was too short-term for the problems to be tackled.

A representative of the European Commission took a somewhat opposing view. For him coordination must function even in those areas where consensus cannot be reached, as in many cases consensus is just not conceivable; however, policy still must deliver.

4.2 Transportation

The second case presented and discussed was transportation. As the chair *Ruud Smits, University of Utrecht,* pointed out, this issue area is again characterised by a multitude of actors responsible for and directly effected by policy action. The interests involved in transport infrastructure projects are huge, and the conflicts over the modal mix and the check for external effects are driven by diverse rationales, such as economic considerations calling for efficient and fast mobility of persons and goods – not to mention the transportation sector itself – on the one hand, and concerns related to environmental and safety issues on the other. Moreover, transportation is a classical area in which by nature both the European level (trans-European networks, intermodality) and the local level, where the negative effects of national and European infrastructure projects are felt and opposed, play a crucial role.

Against this background, all speakers presenting their transportation cases stressed not only the current problem complex related to mobility and infrastructure, but also the growing pressure on the European societies stemming from rising transportation and related external effects. Innovation policymaking in this area therefore is challenged to meet the growing mobility needs by pushing developments of more effective and capable infrastructure and transport means, and at the same time ensuring environmental and safety standards (sustainability).

Claude van Rooten, Head of the Belgian Road Research Centre (BRRC) and President of the Forum of European National Highway Research Laboratories (FEHRL) presented the perspective of transportation researchers and engineers who are challenged to develop new technologies to meet the conflicting interests just mentioned. The BRRC is a contract research institute that is organised around its contract project work. Its research portfolio as well as its internal organisation show the complexity of the issue area. For example, the technological development of new road surfaces is embedded in environmental and safety concerns. Similarly, the safety aspects of road transportation are handled within a division that at the same time develops road management systems to make the infrastructure more effective and efficient.

The international dimension characterising infrastructure and mobility is reflected by a multitude of European (FEHRL, various EU Directorates General, CEN etc.) and other international organisations. Van Rooten presented – as one example – FEHRL, which was established in 1989 in order to stimulate European cooperative research in the field of highway engineering infrastructure and to provide advice to policymaking bodies at all

policy levels in Germany. The objectives of FEHRL mirror those of BRRC, i.e. FEHRL is a European Forum and coordinating body for institutes both delivering strategic intelligence to policy-makers and responsible for the development of new technologies. FEHRL therefore is a good example that the *form* (European coordination) of strategic intelligence follows the *function* (reconciliation of various conflicting interests and rationales, information of various policy levels) it has to deliver. Most importantly, FEHRL, together with industry and WERD (Western European Road Directors), has been part of an orchestration process that led to the development of the Strategic European Road Research Programme III (SERRP III). Through the close consultation of industry, research institutes and policy-makers, a research road map for European transportation research – providing both input for the policy discourse and concrete technological development – came into being. This road map includes the use of the new European policy tools such as Integrated Projects and Networks of Excellence that are perceived as an opportunity to intensify the integration that has been going on for many years by means of self-organised networks and transnational organisations.

The discussion on the organisation and mission of highway research centred around the ways in which stakeholders are integrated. Beyond the orchestration presented, in the case of the Belgian Road Research Centre (BRRC) there are two further major means of integration, first, the contract research being done on behalf of or in cooperation with industry, second, the internal organisation, as the technical committee also includes representatives of industry. In line with the strategic efforts of closer coordination in the whole sector, it is planned to increase the number of industrialists in the technical committee in the future.

In his presentation "Innovations in Transportation: Research and Policy Lessons of Recent Successful Cases" *Bert van Wee* based the short discussion of a selection of innovation cases with an analytical conceptual framework for the transport sector. Similarly to van Rooten, van Wee stressed the (increasing) importance, complexity and peculiarities of the transport area. To illustrate the complexity of policy, he presented a matrix of six policy-measures[3] impinging upon the five major determinants of transportation for environmental impacts. As environmental impact is only one dimension of transport policy, this matrix exemplified the magnitude of complexity in the area. Furthermore, van Wee discussed another policy matrix which combined the four policy levels (European, national, regional, local) and six policies that directly affect transportation (infrastructure, public transport, pricing, spatial, speeds, environmental).

Van Wee introduced the case studies as examples of incremental changes and adjustments in the transport sector. From his perspective, incremental change is the rule as radical innovations are hampered by the very characteristics of the sector, such as the number of actors with conflicting interests, persistent institutional barriers and dysfunctional organisational structures (fragmentation, departmentalisation), cumbersome multi-level imple-

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3 Restrictions, prices, land-use planning, marketing, information and infrastructure.

mentation, time needed for changes in land-use and planning and the magnitude of investment decisions.

For van Wee, one means to ease this situation and to deal with the complexity is to evaluate policy options with the help of research and evaluation. As fragmented administrations lack a holistic view on transportation issues, the Netherlands have introduced the OEEI (Dutch abbreviation for Research on Economic Effects of Infrastructure) guidelines in order to assess the impact of transportation measures ex ante and in a broad perspective, including non-economic aspects. This approach also facilitates the use of systemic instruments rather than individual, short-range measures.

Van Wee presented four case studies: the successful introduction of a park & ride system, the temporarily limited access to a route through a small town in order to reduce the burden to the inhabitants, reduction of emissions of motor vehicles by EU regulation and the development of porous pavements on motorways to reduce noise emission. Although in most cases the innovation itself was organisational rather than technological, these cases provided an overview of crucial success factors for innovation in the transportation area:

- involvement of those actors affected by the consequences of action (industry as well as users and those suffering from transportation side effects), and management of the interfacs between actors and institutions

- convincing mobilisation of support by
    - demonstrating the magnitude of the problem
    - articulating the demand for innovation
    - proving the cost-effectiveness and equity of a proposed solution and
    - defining clear goals

- use of ex ante research – preferably multi-disciplinary – to strengthen the case for action and the potential benefit (although the role of research has not been equally important for all cases)

- individuals or administrative units (e.g. dedicated municipalities) who function as policy entrepreneurs

Van Wee strengthened his argument by discussing the results of comparative case study research done by Cervero (1999). Besides adding new evidence, the discussion on Cervero stressed, above all, the importance of vision and visionaries as well as the mobilisation of entrepreneurial ethos for policy change.

The discussion following van Wee's presentation mainly responded to his claim that within systemic innovation policy those actors most affected should be involved and coordinated as directly as possible. It was argued that this was an important normative claim, but only to be fulfilled in local cases, while for national or European issues the coordination must take different forms and be much more indirect. Moreover, success of innovation policy that is driven by the involvement of affected groups often shows positive results only for

these groups, but does not take the overall social costs into consideration. A second aspect highlighted in the discussion was that van Wee showed impressively that many important, albeit "incremental", innovations are organisational rather than technological, and the analysis of innovation as well as the coordination necessary for innovation should take organisational change much more into focus.

The last contribution in the context of transportation was given by *Marnix Bruggemann*, a journalist and researcher. Bruggemann discussed one specific case, the successful development of a real-time public transport information service in the Netherlands, and he thereby presented a model case for a step-wise, integrative approach enabling demand-driven, technological innovation in the transportation sector. The system discussed guides travellers by providing real-time information on connections and most effective use of the various possible transport means. The origin of the system goes back to a small scale initiative by the Dutch government's Department of Transport which proposed a user's survey on the most pressing demand as regards transportation. To specify demand, the analysis of this survey was discussed with individual users, resulting in the translation into technological demand. On that basis the technological possibilities were analysed, including international benchmark studies on similar activities. One key recommendation from that research was to build up a broad consortium that included users (behavioural knowledge), technological experts (positioning, ICT), information service and network hardware providers, public transport operators and regional policy-makers. In order to raise awareness and interest even further, a public tender for a feasibility study was issued, mobilising over 50 companies and spreading the word to all relevant industrial actors in the field in the Netherlands. A small consortium with heterogeneous actors was picked which provided not only the technological capabilities but also the necessary coordination and interface management and a platform for standardisation of vehicle positioning.

Bruggemann identified four major reasons for success:

- government initiated and supported the projects in times of stalemates, but did not fully fund the whole development
- government functioned as a network broker
- early definition of a very clear and concrete aim
- support of a new and open cluster (neue Kombination) in absence of existing industrial consortia.

In 2002 the testing of the prototype system began, the consortium delivered.

5. Systemic Policy Measures and Processes: An International Comparison

The fourth session of the workshop was devoted to an international comparison of systemic policy measures and processes. In his key note presentation, *Erik Arnold, Technopolis,* introduced the major results of a study on the governance of research and innovation in eight countries (Boekholt et al. 2002).[4] The conceptual framework presented rests on the Innovation Systems Approach in its established form (as developed among others by Nelson, Edquist or Lundvall) and the concept of "governance". This combination led to a perspective on innovation policy[5] that highlights bounded rationality of policy-makers and stakeholders, path dependencies of policies, the importance of knowledge and learning for the process of policy development and implementation, and, above all, the meaning of networks and clusters (instead of individual actors).

In the context of *innovation policy,* Arnold defined the key dimensions as regards the analysis of governance as:

- identification of actors involved in decision-making

- ways in which these actors determine direction, priorities and volume of science, technology and innovation

- the structure of the government as co-determining the process of governance

- identification of change agents in the system

Emerging governance schemes are a consequence of changing context conditions and at the same time they need to respond to these changing conditions. For Arnold, the rationale for intervention is rooted in the system failure approach, according to which policy needs to respond to capability, institutional, network and framework failures rather than react solely to market failures.

In this perspective, the major drivers for governance change are the increasing meaning of mode 2 knowledge production, changes in the nature of technologies (dematerialising, convergent) and industrial organisation of knowledge production (globalised, modularised, de-integrated and accelerated). In addition, the relationship between science and society (and government) sets the condition for innovation policy, as the state is buyer of knowledge – which fosters departmentalisation of research as well – and patron of research –

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[4] The study was conducted by Technopolis and the University of Ottawa on behalf of the Dutch Ministry of Economic Affairs. The countries are Canada, Denmark, Finland, Ireland, Norway, Netherlands, Sweden and the United Kingdom. This summary not only draws on Erik Arnold's presentation but also on the final synthesis report of the study (Boekholt et al. 2002).

[5] We stick to the usage of the term „innovation policy" in its broad manner, including also governance for research and technology, while Arnold used both the term "innovation policy" and "governance of research and innovation".

which, in times of low budgets, has led to the overarching demand for "relevance" and "solutions" of publicly financed research.

The impact of all these changes on the governance of innovation policy are complex and still somewhat unclear. For Arnold, the key effects are as follows:

- Emerging global knowledge markets with

    - globally optimised research and monitoring capacities of companies

    - requiring research institutes to become global players (super-universities)

- the end of the linear ("three hump") model of research

- growing importance of intellectual property rights

- new forms of public private partnerships (enlarged, institutionalised, international)

Against this conceptual and contextual background Arnold presented a focused and selective overview of the empirical results as regards current development in the governance of innovation in eight countries. In face of the fragmented government structures, he introduced a set of examples of how governments try to organise coordination and knowledge integration.

It is beyond the scope of this report to discuss all examples in detail[6]. In most countries some kind of high-level structure and process have been implemented in recent years in order to cope with the challenges discussed. Although these challenges are obviously very similar, the design examples discussed were very different from each other, both in terms of their structure and in terms of their effectiveness. Most importantly, very diverse approaches have been taken related to the institutional scope of integration and coordination, some structures coordinating ministers, others concentrating on ministries and/ or agencies and others trying to integrate stakeholder groups and those performing R&D.

The Finnish Science and Technology Policy Council, for example, was presented as a very senior inter-ministerial institution that integrates five ministries and a set of key stakeholders from the knowledge system under the chairmanship of the Prime Minister. It functions as a referee in cases of priority conflicts, as an arena of debate and exchange and fosters horizontal coordination down to the working level. The major outcome are broad principles and guidelines that are endorsed by the whole knowledge system, the Council is rated to be highly effective and efficient. According to Arnold, there are indications that many countries converge towards the Finnish model.

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6   For a detailed analysis see Boekholt et al. (2003) (http://in3.dem.ist.utl.pt/master /03itt/lec_2_4.pdf). For additional information see also the more comprehensive report Arnold / Boekholt (2003) (http://www. technopolis-group.com/reports/352_Meta_030127.pdf).

Conversely, the interdepartmental Cabinet Committee on Science and Technology within the Irish government only existed on paper, ignored by the whole Irish knowledge system. A totally different approach was followed by the Norwegian government, which in the 1990s tried to simplify the whole knowledge system to ease coordination down to two major pillars, one being mainly responsible for industry and mainly organised by the Industry Ministry, one – The Research Council of Norway (RCN) – with a broader responsibility and organised mainly by the Ministry of Education. However, this coordination effort was struggling, not only because of problems in the micro-management, but also because of insurmountable cultural differences within the knowledge system.

The Danish government recently introduced a super-ministry of Science, Technology and Innovation and tried to pull all aspects relating to science and innovation governance together. This is the most radical attempt at coordination, the success of which – however – cannot be judged yet.

The study also found that the organisation and the conduct of strategic intelligence plays an important and increasing role in almost all countries. Again, the Finnish example, where the Science and Technology Policy Council takes up strategic intelligence and functions as its broker, has developed into a role model.

In sum, the task of coordination, of bridging the gap between science and innovation, between different ministries, between policy and other stakeholders, is a driving force for all governments, only few have proved successful. It is not the final structure for the coordination and integration, it is the dedication and commitment with which the actors in the system follow the objective of coordination that makes the difference. Ideally, this commitment is connected with extra money for coordination in the budget.

A final aspect presented by Arnold was the different ways of organising the allocation of research money to research topics. In most countries the ministry is assisted by some kind of intermediary research funder. This organisation is a good example of how the structure determines the governance, as the funding institutions and their composition and competencies decide about participation in the allocation process and therefore about the rationales and principles predominant in the research system.

Three ideal types were introduced: a *mono-functional* body only receives money from one ministry for one issue area and distributes it to relevant research organisations; secondly, a *multi-client* body that receives money from different ministries and allocates it to research organisations from different research areas. Finally, *umbrella* organisations combine the distribution of research money with a set of related economic or technological service functions. Each model has its strengths and weaknesses. For example, within the umbrella organisation, centre-division tensions tend to arise as divisions might be very specialised and memberships very disintegrated. Governance problems in the multi-client mode arise from competition between ministries as regards the service provided by the body. The overall feature for all funding agencies, however, is that their effectiveness rests on the

cooperation of the research institutes themselves, containing the dilemma that those who cooperate with the funding agencies on the planning level are likely to improve their position to get funds.

In his overall conclusion, Arnold stressed the fact that best practice relating to the governance of "research and innovation" is extremely hard to derive due to context embeddedness. In any case, the personal commitment of the head of government and the relevant ministries has proven a central key to success. Moreover, it pays off to provide structures that are able to deal with horizontal concerns. Governance schemes are the more robust and effective, the more they integrate strategic intelligence. It seems that multi-client and umbrella structures are becoming increasingly popular, which, despite functional advantages, runs the risk of lock-ins through the increasing role of those actors that receive research money. In closing with a good, proactive example, Arnold pointed towards the new Norwegian Research Council which on a very high level integrates research and innovation policies and puts – structurally – emphasis on taking advantage of strategic intelligence. However, after all the context dependency of governance in research and innovation renders the transferability of structures and approaches difficult.

This last conclusion was taken up by the audience in the discussion following Arnold's presentation. There was consensus on the context dependence of governance and government as regards research and innovation. But because of this, more elaboration on the categorisation of the context and the meaning of context variables for governance was asked for. In addition to the comparison of different countries, the analysis should try to extract more general conclusions on the meaning of context variables for innovation governance, thus conceptualising analysis and policymaking beyond single cases. Arnold agreed, and added that comparison is eased if one concentrated on the *functions* that are to be fulfilled rather than the underlying *structures*. Another point raised was the importance of the size of a country. It was argued that Arnold's analysis showed how smaller countries are better capable of governance change and systemic approaches, and that bigger countries and even the EU could very well learn from these approaches. Furthermore, the earlier discussion on a common strategy vision was taken up again. One participant argued that the *common strategy vision* was much more important as a prerequisite for functional and effective governance than the *organisation* of the governance process. From his empirical experience, Arnold wholeheartedly agreed.

6. Conclusions: A Round-table Discussion and the "Karlsruhe – Utrecht Principles for Horizontal and Systemic Innovation Policymaking"

6.1 Round Table on New Governance in Innovation Systems

The final discussion on „new governance on innovation" was organised as a round- able of invited participants, chaired by *Stefan Kuhlmann* (ISI and University of Utrecht), sharing their thoughts on innovation policy, followed by an open debate by all participants. This discussion not only reflected the debate of the workshop, but also the so-called "Karlsruhe-Utrecht Principles for Horizontal and Systemic Innovation Policymaking". This discussion paper had been distributed to the participants of the workshop beforehand in order to initiate debate and to prepare the resolution of such principles as a result of the discussion. Therefore, some speakers of the round-table referred not only to the previous discussion in the workshop, but also to these principles. After a summary of the roundtable discussion and some concluding comments by Frieder Meyer-Krahmer, head of the host organisation Fraunhofer ISI, this report will conclude with these principles as they have been reformulated *after* the conclusion of the workshop, taking into consideration the lively discussion they provoked.

As first speaker of the round-table, *Theo Roeland,* Ministry of Economic Affairs, Netherlands, described the innovation approach of his country as following the systemic model. The major challenge in the last years had been to bring together science policy, innovation policy and industrial policy, despite all existing departmentalisation. This integration was not tried with the help of a super-ministry model as the Danish government is trying it, but by coordinating the top-level of the various ministries and by enabling self-organisation of the system. Although the Netherlands have created a new organisation, for Roeland the major key is not re-organisation, but the commitment to a visible strategy and a clear priority-setting. Therefore, the definition of a clear strategy as major prerequisite for horizontal policymaking was his major criticism as regards the first draft of the Karlsruhe-Utrecht principles. Commenting on current developments at the European level, Roeland argued that the clustering of excellence throughout Europe was a good approach, however, the centres of excellence foreseen should be much broader and ambitious enough to challenge the leading global players like Stanford or MIT. Finally, Roeland pointed towards the importance of the very practical level, such as an effective European patent system, for the fulfilment of the European vision, to create ERA and to become a leading European knowledge economy,

Engelbert Beyer, German Federal Ministry for Education and Research (BMBF), Germany, in principle agreed with the theoretical analysis underlying the workshop[7]. However, he still could not see a satisfactory explanation as to why coordination often does not

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7   See chapter one and the following at the end.

work although he is convinced that many policy-makers meanwhile know and follow the innovation systems approach and try to think in holistic and systematic terms. In his view, analysis should focus more on bureaucracy and different societal interests. At the same time, the need for coordination should not be overstressed, especially not as regards formal organisation. Rather, Beyer called for coordination by consensus-building. Furthermore, he argued that the different actors in the system, e.g. agencies and institutes, should be given more freedom for self-organisation, including, for example, freedom of budget and strategy for research institutes. Beyer ended by pointing towards what he regarded as most important future areas of systemic policy: biotechnology, where the BMBF has achieved considerable success through clustering efforts; support for SMEs, which needs broad coordination given the multitude of funding possibilities; and finally venture capital, which for Beyer is an example of a successful coordination by a broad consensus of the viability of new financing instruments.

Rainer Jäkel, German Federal Ministry for Economics and Labour (BMWA), Germany, claimed that horizontal innovation policy was an approach that is deeply embedded in the culture of his ministry which followed a German policy model called "Ordnungspolitik", in essence a policy that stresses the importance of a regulatory framework in which the market economy can unfold and is checked. The problem for him was not the idea of the horizontal approach, but the existence of very strong vertical interests that cut across horizontal coordination. However, as the efforts as regards horizontal policy will continue, Jäkel strongly agreed with many of the previous speakers on the importance of visions and strategy. As regards organisational improvements, Jäekel called for much more flexible structures and processes within and between administrations. For example, rotation between ministries, and between ministries and industry should be facilitated, and programme managers should compete more among themselves. Finally, policy evaluation should not only focus on the content, output and outcome of policies, but also comprise the policy structures.

Finally, *Robin Miège,* who is now at the Joint Research Centre of the European Commission and who from 1984 to 1998 was responsible for innovation policymaking in various positions within the European Commission, shared his experience with innovation policymaking in the European Commission. He described the challenge of internal coordination in the course of issuing Commission action plans on innovation. For example, to issue the 1st Action Plan on Innovation in 1996, 150 EU administrators had to be coordinated. Another example was the organisation of a communication process in order to involve regions into the drafting of regional innovation policy schemes as early as 1994.

From his experience, Miège derived the major problems in innovation policymaking as being communicative, as innovation is not an easy message ready for headlines, and intra-organisational, as innovation means change within organisations that for many reasons resist it. Miège referred to the European Research Area (ERA) initiative as a positive example of coordination: there was a clear message rooted in a common intellectual framework and connected to a vision and a clear political will issued from the top level within

the Commission. The commitment that was communicated stirred up the whole community. Although there was – according to Miège – still resistance to ERA from national policy-makers for whom coordination – in the short term – would mean loss of autonomy, the whole process can be labelled as a success. In addition to the communication strategy, Miège traced the "success" of ERA also back to adjusted internal structures and processes within the Commission. As a consequence of massive criticism at the end of the 1990s, the Commission has become more accountable, more transparent and more flexible: fluctuation between Commission services is more common, Directorates General have been assessed and the communication of European policy initiatives are preceded by policy impact assessments, including impact cross-cutting different policy areas. In light of these interpretations of the ERA process, and despite existing pitfalls and problems, Miège demonstrated optimism as regards future coordination of innovation policy at the European level.

The round-table statements were followed up by intensive general debate. One major aspect taken up was the feasibility and consequences of *self-organisation*. While almost all speakers in the workshop had embraced this notion, some scepticism was raised as to the potential "coordination trap of self-organisation" (Kuhlmann) stemming from lock-ins of established interest and power structures. Similarly, it was emphasised that network structures of coordination can also be captured by strong lobbies, and analysts and policy-makers were asked to find solutions for that. In addition, various people pointed towards further prerequisites for self-coordination: self-coordinated networks need information about development in their environment, they need rules to function and they need strong mandates from the top of the structure (facilitated by a crisis or a relevant societal need). Referring to the example of sustainability, the possible dysfunctionality of self-coordination was demonstrated, as for reasons just mentioned, self-coordinated networks are rather short-term oriented, their perspective does not exceed the time-frame of the individual interest represented in the network. Or as one policy-maker put it: long term visions to coordinate a system are not "good to sell".

A second major aspect raised in the concluding discussion was the issue of a *common vision* for coordination. The perspective taken was a European one, and it was questioned if the demand for a common vision in face of the diverse governance and innovation cultures and traditions in Europe, increasing with enlargement, would be functional – and feasible. There seemed to be a dilemma here: with enlargement, the call for self-coordination could become louder as the complexity increases and hierarchical coordination would collapse. At the same time, a common vision and strategy to ease self-coordination is becoming more difficult to define. The European model called for, therefore, would be a right mix of long-term vision and framework, a set of clear rules and procedures ensuring a minimum of coordination and enough freedom for diverse models to compete.

In his closing remarks, *Frieder Meyer-Krahmer* resumed central aspects of the discussion and linked them to the "Karlsruhe – Utrecht Principles ". For him, there was a clear consensus visible as regards the *reasons* to have such principles, the driving factors for a horizontal policy coordination. It was less clear, however, what the criteria are for the selection

of the various solutions proposed in the workshop as well as in the Principles. Here he asked for further elaboration by policy and innovation analysts. In a third dimension, Meyer-Krahmer discussed possible *success factors* for policy coordination to take place. These included:

- principles of guidance (vision, leadership, orchestration of conflicting interests, self organisation)

- cultural fit of coordination schemes and trust

- design of appropriate organisation of coordination, avoiding best practice-trap and responding to specific contexts

- process-management and personal mobility

- reflexivity and appropriate distribution and organisation of intelligence

- taking into consideration the dynamics of government (development over time, radical changes outside the system)

Adressing the research community, Meyer-Krahmer finally called for further international comparison of *functions* (rather than structures) as regards governance of innovation and research, the condition and meaning of *culture and trust* for governance and finally more analysis as regards *incentive structures* and implications for coordination.

6.2 Karlsruhe Principles Karlsruhe-Utrecht Principles for Horizontal and Systemic Innovation Policymaking

Introductory remark: The principles presented on the following pages are a revised version of the first draft that was distributed before the workshop and discussed by the participants. The various comments and suggestions expressed were fed into this final draft. However, these Principles are not to be understood as a consensual result of the workshop, as there was no resolution. Rather, they represent the thoughts of the four authors named in the endnote.

„KARLSRUHE-UTRECHT PRINCIPLES FOR HORIZONTAL AND SYSTEMIC INNOVATION POLICYMAKING"*

Discussed at the workshop
„New Governance for Innovation? The Need for Horizontal Policy Co-ordination",

held at the occasion of the 30th anniversary of the Fraunhofer Institute Systems and Innovation Research (ISI), Karlsruhe/Germany, 14/15 November 2002,
organised in collaboration with the Dept. of Innovation Studies, Utrecht University,
and the „Six Countries Programme – the Innovation Policy Network" (http://www.6cp.net/)

Science, technology and innovations based thereon play a significant role today in the economies of the industrialised countries and are a driving force in their international competition. National and increasingly also regional governments and transnational agencies pursue, more or less explicitly, *„innovation policies"*, defined here as the entirety of all public initiatives regarding science, education, research, technological development and industrial modernisation, overlapping also with industrial, environmental, labour and social policies. Public innovation policy aims to strengthen the competitiveness of an economy or of selected sectors, in order to increase societal welfare through knowledge creation and economic success.

Schumpeter (1934) introduced the concept of innovation as „creative destruction" (of existing structures) and the establishment of „new combinations" leading to new structures. Innovation research revealed the genuinely social character of innovation processes: innovative artefacts and structures are socially constructed, i.e. „man-made", thus – almost by definition – shaped by bounded rationality evolving along historical trajectories (incremental innovation). At the same time innovation may emerge in a non deterministic manner, led by trial and error, inter-linking heterogeneous worlds, thus providing unknown opportunities (radical innovation). Innovation theory tries to cover the tension between the bounded and the non-deterministic character of innovation by introducing a system perspective on related actors, institutions and processes. The heterogeneity of (sub-)systems may hamper communication and thus block innovation, but may also feed it – if effective communication comes about and stimulates learning. How could *innovation policy turn heterogeneity productively?*

The following Karlsruhe-Utrecht Principles for Horizontal and Systemic Innovation Policymaking are a set of *valuing and normative statements* intended to stimulate debate and foster the development of fresh policy approaches.

Presently the governance of politico-administrative systems in general and public innovation policy in particular in most OECD countries is characterised by

- a high degree of departmentalisation, sectoralisation of the political administration, and low inter-departmental exchange and co-operation

- heterogeneous, un-linked actor and stakeholder arenas, which in turn often are caught by corporatist negotiation deadlocks

- failing attempts at restructuring responsibilities in government because of institutional inertia

- a dominance of a „linear model" of research and innovation in policy approaches, failing to enable new combinations of knowledge, demand and public interventions (the rise of „mode 2" knowledge production)

- a design of „innovation policy" as a very specific, narrowly defined field focusing on introduction of new technologies in small and medium sized enterprises, on intellectual property rights or on venture capital provision etc.

- a clash of medium- and long-term innovation issues and short-term policy cycles

- an emerging multi-level governance in the context of the European integration making the launching of horizontal and systemic policy approaches even more difficult.

New modes of governance – and relatedly: government – would require (1) a broader understanding of public policies for innovation, (2) a set of overarching goals, and (3) success factors facilitating the achievement of such goals.

(1) A *broader understanding* of public policies for innovation would be build on the following *ideas*:

- Horizontal and systemic concepts of innovation policymaking needs to start from the heuristic concept of *innovation systems*. Innovation systems encompass the „biotopes" of all those institutions which are engaged in scientific research, the accumulation and diffusion of knowledge, which educate and train the working population, develop technology, produce innovative products and processes, and distribute them. Policymaking occurs in multi-actor arenas characterised by inevitably differing and even contradictory problem perceptions, interests and values of actor groups.

- Organisation and content of governance has to take into account the *systemic and co-evolutionary nature of innovation*, including the notion of complex, non-linear interaction (e.g. stimulating multi-disciplinary research, fostering the debate on implications of „mode 2" for universities and other institutions in the innovation system, in particular with more regard to missions, culture, reward structures, relations between institutions, quality control, ...).

- A broader understanding of public policies for innovation presupposes *institutional reflexivity*, understood as the capacity to think in terms of the whole, to think in terms of problems and solutions, to anticipate future needs.

(2) Horizontal and systemic innovation policies would aim at the following overarching goals:

- There is a need for a holistic notion of innovation policy, keeping in mind and taking advantage of the *inter-dependence of specific policy measures* as well as the inter-relation of *different policy areas* (fostering cluster approaches, infrastructures facilitating the identification of and access to strategic intelligence, co-ordinating bodies with a real mandate, a parliamentary committee on innovation, …).

- In the light of the fusion of heterogeneous technologies, of the increasing integration of basic research, applied research and innovation, of high- and low-tech sectors, of old and new economies, of manufacturing and services, government and administration have to deal more proactively with the challenge of *moderating cross-sectoral linkages* and supporting the (re-)structuring of cross-sectoral networks (e.g. horizontal taskforces, sectoral councils, ...).

- Systemic concepts of innovation policy will foster a *co-evolution of techno-economic and socio-institutional transition processes*. Necessary transformations of traditional socio-technic infrastructures would be prepared in the light of systemic analyses, and would be developed with a careful orchestration of decisionmaking processes in multi-actor arenas.

- Systemic policy instruments have to be oriented towards *mid- and long-term future demand*: they would strive for a sustainable development, a better balance of push and pull, and would foster the involvement of users and future generations, e.g. by stimulating public discourse on innovation needs.

- In Europe, innovation policy requires more elaborated forms of institutionalised *co-ordination* between the *European* level on the one hand and the *national* and *regional* level on the other (e.g. initiating a political debate on a new multi-level governance and 'division of labour' between the various administrative levels, resulting in transparent decisions and strategies, furthering the development of networks of excellence, ...).

(3) Success factors facilitating the achievement of such goals of horizontal and systemic innovation policies would include:

- A continuous reflection and implementation of appropriate principles of guidance and governance, e.g. with respect to strong *leadership* on the one hand and *participatory* approaches on the other.

- Identification of situations of *system crisis*, providing historical *opportunities* for – often externally induced – radical changes of institutions and policies, whereas incremental adaptation to changing needs may well be achieved from inside institutions.

- In case of market-borne techno-economic transition processes: a start from *lead markets*.

- Creation and maintenance of a culture of *reliability and trust*, also between competing actor groups.

- Building an infrastructure for *strategic intelligence* by establishing, maintaining, and inter-linking sources (e.g. Technology Assessment, Foresight, Evaluation, Benchmarking), improving accessibility for all relevant actors (clearing house) and stimulating the development of the capacity to produce strategic information tailored to the needs of actors involved.

- *Platforms for learning* and experimenting: learning by doing, by using, by interacting, and learning at system level (= add value to the whole system).

- *Re-organisation of administrations* in a way that enables flexible horizontal co-ordination and exchange among formally divided entities (task-oriented mobility of staff, integrated teams, changes in reward systems that stimulate horizontal initiatives, new career tracks facilitating easy moving between industry, science, public administration ...).

- *A new breed of innovation policy-makers* necessitating related education and training programmes in higher education, combining e.g. administrative and legal aspects with economic, technological and social perspectives.

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