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**Governance of innovation:
Practice, policy, and theory
as dancing partners**

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Governance of innovation: Practice, policy, and theory as dancing partners

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By

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Mijnheer de Rector Magnificus Dames en heren

Wij hebben behoefte aan eigenstandige Wetenschaps-, Technologie-, en Innovatie-Studies om de ontwikkeling en besturing van wetenschap, technologie, en innovatie beter te begrijpen. Dat is het centrale voorstel van mijn oratie vandaag.

Ik hoop dat het goed is dat ik, omdat het Nederlands niet mijn eigen taal is, voor de rest van deze rede naar het Engels overschakel.

So once again:

We need dedicated Science, Technology and Innovation Studies in order to better understand the development and governance of science, technology and innovation! This is the central proposition of my talk today¹.

I will support this proposition by presenting five considerations. I will (1) begin with an illustration of why the governance of science, technology and innovation (STI) is an issue of concern, and that there are governance routes of different character and quality. Then I will (2) consider three aspects of the governance of STI of particular interest in this context: The (i) interrelationship between science, technology, and innovation in practice, the (ii) role of public policy, and (iii) the role of STI Studies, the field that I and my academic colleagues are concerned with, as ‘theory in action’.

In order to illustrate the mutual interaction of the three aspects I will offer you a metaphor: STI practice, policy and theory can be seen as ‘partners on a dancing floor’, moving to the varying music and forming different configurations² (see **Exhibit 1**). Take as a historical example of a dancing configuration the concept of ‘Big Science’, a fashionable term coined in the early 1960s, capturing a ‘new’ relevance of large facility based quasi-industrial research and the need for considerable public funding³.

At the time an elite of scientists, a new generation of science policymakers, and many science analysts agreed that there is a pressing need for supportive political arrangements. This rhetoric of ‘Big Science’ was very suggestive; in 1982 it even inspired the experimental musician Laurie Anderson who created one of the rare music pieces on ‘science’.

Taking a closer look at the dance floor we see

“Big Science. Hallelujah. Big Science. Yodelayheehoo. You know. I think we should put some mountains here. Otherwise, what are all the characters going to fall off of?”

(Laurie Anderson,
Big Science, 1982)

¹ I appreciate valuable comments and suggestions made by Arie Rip, Eva Eckel and Nelly Oudshoorn on earlier versions of the present text.

² The dancing metaphor has earlier been used by Arie Rip (1992) with respect to the relation of science and technology, inspired by Derek de Solla Price's discussion of this relation (1965).

³ The term was forward by Alvin Weinberg later and made popular by Derek Price (de Solla Price 1963); see the related discussion of conceptual fashions by Rip (2000).

how two of the dancers, STI practice and policy, argue and negotiate about the dance and music while the third, theory – not always, but often and to an increasing extent –, provides the other two partners with arguments and sometimes also with new music: Practice and policy increasingly have expectations vis-à-vis the contribution of social science based intelligence to their dance. Hence my third consideration: (3) STI Studies, by now a widely respected academic field of interdisciplinary knowledge and research, may experience a tension between participating in the dance and academic discourse at arm's length to practice. I will suggest that STI Studies can cope with this tension and in fact, make it a source of increased reflexivity. My fourth consideration will (4) exemplify some ways of deliberate interaction of STI Studies as theory in action, taking a closer look at 'fora' for the debate of STI issues. By way of conclusion, I will consider (5) what we, the STI Studies scholars at the University of Twente and beyond, can contribute towards a better governance of science, technology and innovation, through research, education and applied 'strategic intelligence'.

Exhibit 1: STI practice, theory, and policy as dancing partners



First consideration: Why 'governance of science, technology, and innovation'?

A better understanding of the governance of STI both in terms of driving forces and with respect to the room for manoeuvre in policymaking is in my view a precondition of successful practical attempts at shaping the character and direction of 'regimes' of STI or even changing them.

STI fields can be conceived as evolving 'regimes'. The term regime was first introduced by Nelson and Winter (1977) to characterize patterns in technical change such as the frameworks of engineers in an industry constituting the basis for their search activities. Van den Ende and Kemp (1999) define a technological regime "as the complex of scientific knowledge, engineering practices, production process technologies, product characteristics, user practices, skills and procedures, and institutions and infrastructures that make up the totality of a technology" (835). Rip and Kemp (1998) add to the 'grammar' of a regime explicitly the policies and actions of other technology actors including public authorities.

Regimes differ in terms of the character and quality of their *governance*. The notion of governance is used here as a heuristic, borrowed from political science, denoting the dynamic interrelation of involved (mostly organized) actors, their resources, interests and power, fora for debate and arenas for negotiation between actors, rules of the game, and policy instruments applied (e.g. Kuhlmann 2001; Benz 2006; Braun 2006). STI governance profiles and their quality and direction are reflected not at least in the character of public debates between stakeholders, policy makers and experts. Think of the debates on genetically modified organism (GMO), or – still more in status nascendi – debates on the governance of an emerging, cross-cutting STI field like 'nanotechnology'.

Recently, in a report of a EU Expert Group on 'Science and Governance' (Felt et al., 2007), Chapter 2 identified two basic types of 'regimes':

- *The regime of "Economics of technoscientific promise"*: Promises to industry and society, often far reaching, are a general feature of technological change and innovation, particularly visible in the mode of governance of emerging technosciences: biotechnologies and genomics, nanotechnologies, neurosciences, or ambient intelligence, all with typical characteristics: They require the creation of a fictitious, uncertain future in order to attract resources, financial, human, political, etc. They come along with a diagnosis that we are in a world competition and that we (Europe, the US, etc.) will not be able to afford our social model if we don't participate in the race and become leaders in understanding, fuelling, and exploiting the potential of technosciences. The regime "works with a specific governance assumption: a division of labour between technology promoters and enactors, and civil society. Let us (= promoters) work on the promises without too much interference from civil society, so that you can be happy customers as well as citizens profiting from the European social model" (Felt et al. 2007, 25). The recent European Aho Report on innovation policy (2006) is quite explicit about this mode of governance, saying inter alia: "Europe and its citizens should realize that their way of life is under threat but also that the path to prosperity through research and innovation is open if large scale action is taken now by their leaders before it is too late". Under this regime of technoeconomic promises politics, science and industry take the lead, while the innovation needs and expectations represented in

the society appear to remain in a rather passive consumer role.

- The second regime, “*economics and socio-politics of collective experimentation*”, is characterised by emerging or created situations which allow to try out things and to learn from them. The main difference with the other regime is that “*experimentation does not derive from promoting a particular technological promise, but from goals constructed around matters of concerns and that may be achieved at the collective level. Such goals will often be further articulated in the course of the experimentation*” (Felt et al. 2007, 26f). This regime requires a specific division of labour in terms of participation of a variety of actors, investing because they are concerned about a specific issue (see also Callon 2005). “Users matter” in innovation – that has been shown not in the least by our UT colleague Nelly Oudshoorn and her team (Oudshoorn & Pinch, 2003). Examples of such demand- and user driven innovation regimes include the information and communication sector (where the distinction between developers and users is not sharp), sports (e.g. von Lüthje et al. 2005) or the involvement of patient associations in health research (e.g. Rabeharisoa & Callon 2004; Boon et al. 2007) and pharmacogenomics (e.g. Moors et al. 2003). The concept of ‘open innovation’, debated around the user-driven development of non-patented Open Source software, and more generally in Hank Chesbrough’s influential book (2003), is largely overlapping with the collective experimentation concept. The governance of such regimes is precarious since they require long-term commitment of actors who are not always equipped with strong organizational and other relevant means, and there is always some room for opportunistic behaviour. Nevertheless, the promise is innovation with sustainable effects.

Another group, the EU ‘Lisbon Expert Group’ (Leon et al. 2007) tasked with an assessment of the ‘National Reform Plans’ of European Member States towards the innovation and growth targets of the “Lisbon Agenda”, found a number of underrepresented policy perspectives, coinciding to a considerable extent with the findings of the previous group, in particular in terms of the second, the collective experimentation mode of governance:

- Though there is evidence of growing interest in *demand-oriented research* and innovation policies and more facilitation of ‘*open innovation*’ environments in science, research and industrial innovation, so far one can find only few explicit public policies going in this direction.
- The same holds for an improved *governance* of research and innovation policy, in particular when it comes to a *better inclusion of stakeholders*. The report shows that the more successful countries are as measured in terms of science and innovation performance indicators, the more they dispose of a broader spectrum of experimental policy approaches and mechanisms for the inclusion of stakeholders in innovation regimes.

So there is reason to be concerned. The tone set by the Aho Report, the precarious governance of the experimentation regime, the missing emphasis on stakeholder inclusion and demand-oriented innovation policy found by the

Lisbon Group, they indicate that strategists and policymakers are running the risk of missing valuable opportunities offered through variety and experimentation in the development of regimes. How can we draw their attention to related insights of STI scholars? We, the scholars ourselves would have to understand our interactions with policy and practice better! This brings me to my second consideration.

Second consideration: Three inter-related aspects of STI governance and their dance

An analysis of the governance of STI has to cope with at least three major aspects:

First aspect: While since the 1950s in economics and sociology ‘science’, ‘technology’, and ‘innovation’ processes were plotted as a sequence of activities of institutionally and organisationally distinct units (‘linear approach’; Bush 1945) this has changed in the course of the 1980s and 90s. Today S, T, and I are conceived by most scholars as *overlapping fields of social practice*, forming a shared ‘space’ of interactivity, driven by knowledge dynamics, economic forces, and framed by inherited institutions. Most concepts and theoretical constructs emphasise the interactive character of idea generation, scientific research, development, and introduction of innovative products and processes into markets or other areas of use – take as a simplifying tag the pervasive concept of an alleged new „mode 2“ of knowledge production suggested by M. Gibbons et al. (1994). Eventually, the mode 2 perspective on knowledge production and innovation is building on a long strand of studies into the relation of science and technology (e.g. Zilsel 2003; De Solla Price 1965; Rip 1992; Weingart 1997; Roberts & Schaffer 2007) and, at least implicitly, alluding to older, more systemic concepts known already in the 19th and early 20th century⁴. The evolutionary approach of Nelson and Winter (1977), the innovation system tradition as inspired by Freeman (1987) and developed further by Lundvall (1992), Nelson (1993) and Edquist (1997), the concept of technological innovation systems (Carlsson et al. 2002; Hekkert et al. 2006), technological paradigms (Dosi 1982), techno-economic paradigms (Freeman and Perez 1988), sectoral systems of innovation (Malerba 2002), or “design spaces” (Stankiewicz 2000), as well as the cluster approach advocated by Porter (1990, developed further by Jacobs & de Man 1996), they all take on board an interactive, holistic understanding of the relation between S, T, and I. Also bodies of knowledge dealing with the broader embedment of innovation processes, as for instance the social construction of technology (Bijker et al. 1987), “system transitions” in socio-technical landscapes, related regimes, “innovation journeys” and niche management (see e.g. Geels & Schot 2007; Elzen & Wiczorek 2005; Visscher & De Weerd-Nederhof 2006; drawing on Van de Ven et al., 1999), technology assessment and its ‘constructive’ turn (Rip et al. 1995; Smits et al. 1995; Smit & van Oost 1999) and research after the role of users in innovation processes (Von Hippel 1988; Lundvall 1992;

4 Think of the works of A. Smith; K. Marx; F. List; J.v. Schumpeter (see e.g. Lundvall 2007) and of the reasoning of sociological constructivism of Berger and Luckmann (1966) and direct or indirect precursors like Schütz (1974), Weber (1988), or Simmel (1900).

Moors et al. 2003; Oudshoorn & Pinch 2003; van Oost 2003) – they all understand STI as a broad and varied, but interactive continuum.

Second aspect: If the ‘dynamics of S, T, and I are interwoven in practice, then what is “policy” and “governance” in a given STI field will reflect this heterogeneity⁵: Scope and variety of involved organised actors (such as science organisations, industries, governmental agencies, parliaments, non-governmental organisations) can be broad and heterogeneous, too. They have different interests, resources and power, and they negotiate in various inter-linked arenas on all kinds of rules and policy instruments. Political science studies have shown that the patterns of policy governance for science, technology, and innovation develop mostly in an incremental and only rarely radical way (Bozeman 2000; Larédo & Mustar 2001; Biegelbauer & Borrás 2003; Edler 2003). The organizations involved in policymaking and the arenas for the negotiation of options and decisions are mostly characterized by institutional inertia (e.g. Kuhlmann 1998). They evolve to path dependence, interwoven with historical STI regimes. This policy-oriented governance perspective deserves in my view more attention in STI Studies, and I intend to give it a more prominent role through my work here at the University of Twente⁶. One can analytically distinguish between two types of policy rationales in the context of STI (EPOM 2007)⁷: “Knowledge production policy rationales”, on the one hand, are built on causal beliefs, often derived from STI Studies’ insights, about the production of knowledge, providing a theoretical framework for the type of policy proposed, especially with socio-economic arguments. An advanced production rationale is characterized by the fact that knowledge is often tacit, partial, scattered and collectively distributed, and built through collective processes of creation, sharing, access, diffusion of knowledge, and more generally through learning processes. Recent policy debates and designs for new and emerging technologies such as nanotechnology can serve as an example of an advanced production rationale (Bozeman et al. 2007; Robinson et al. 2007). Here state public policy is supposed to facilitate learning or remedy cognitive failures. “Governance policy rationales”, on the other hand, reflect general causal beliefs in the political system about how the state should ‘govern’ (EPOM 2007). An advanced governance policy rationale is offered by a “decentralized multi-space model, with a growing importance of a large variety of public and scientific interest groups (public opinion, consumers, patients, NGO,...) willing to be associated into the policy design, with a high heterogeneity among them (in terms of level

5 Voß et al. (2006) have coined the notion of ‘reflexive governance’ (building inter alia on the concept of ‘reflexive modernisation’ as put forward by Ulrich Beck et al., 2003) taking into account that public policy and its reliance on policy instruments is itself embedded in, and constituted by, broader ongoing changes.

6 A major effort boosting the governance perspective in STI Studies has been made by the EU-funded PRIME Network of Excellence (Policies for Research and Innovation on the Move towards the European Research Area) assembling 49 institutions, 230 researchers and 120 PhD students from 16 European countries (www.prime-noe.org).

7 In the following I paraphrase arguments of a project of the PRIME Network of Excellence. The underlying report is unpublished; for a web-link see EPOM 2007.

of knowledge, means of expression, financial resources, representativity, etc.)” (EPOM 2007). Following this rationale, the actual policy choice and mixes depend on negotiation and learning processes in the development of a given ‘regime’: Whether the future governance of nanotechnologies, for example, will be driven mainly by techno-economic promises or by socio-political collective experimentation hinges not at least on the way how the involved heterogeneous actors in multi-space articulation processes will interpret the production rationales associated to nanotech.

Third aspect: Social science research, in particular STI Studies, can turn into “theory in action”: Given the variety and potential complexity of governance in the practice of STI as well as in related policymaking, actors tend to develop assumptions or ‘folk theories’ on governance, simplifying, guiding and stabilizing their action: Ask any scientist, innovator, or policymaker in our field about the constraints and room for manoeuvre for decision-taking: Most of them would know ‘rules of thumb’ based on experience, own analysis, or prejudice – or they would refer to and utilize expertise based on STI Studies. Using our concepts they don’t care a lot about academic concerns. Take for example the utilization of the ‘System of Innovation’ approach: This analytical concept, a heuristic developed by economists and innovation researchers since the late 1980s, has been increasingly utilized by policymakers around the world. Innovation systems⁸ have been conceptualised as 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; to this belong the relevant regulative bodies (standards, norms, laws), as well as the state investments in appropriate infrastructures. Innovation systems would extend over schools, universities, research institutions, industrial enterprises, the politico-administrative and intermediary authorities as well as the formal and informal networks of the actors of these institutions (Kuhlmann 2001 building on Freeman, 1987; Lundvall 1992; Nelson 1993; Edquist 1997). The innovation system concept turned out to appeal policymakers a lot, not at least because the systemic perspective provided an argument for a broadened scope and reach of public STI policy (Smits & Kuhlmann 2004). Many used it as a sort of programmatic device: Since a number of years, for example, the Swedish state office for innovation policy calls itself “Governmental Agency for Innovation Systems”. In other Scandinavian countries, too, and meanwhile also in the Netherlands or Germany, relevant policy initiatives and agencies draw justification from this notion. Actually, when taking a closer look, it turns out that the very concept of innovation systems while being designed by innovation researchers had at the same time been inspired and strongly supported by Scandinavian policymakers (see Carlsson et al. 2008) and by the OECD (Lundvall 2007) – the concept became ‘theory in action’. Of course, our Swedish academic colleagues could have tried to maintain academic distance to the lifting of their concepts and findings by policymakers or practitioners in STI – but they

8 The following characterisation is a paraphrase from my inaugural lecture at Utrecht University (Kuhlmann 2002).

chose to ‘pro-actively’ offer the policymakers information, heuristics, analysis and theory longing further than their ‘folk theories’. In other words, they danced with STI practice and policy and even jointly composed new melodies.

So I am returning to the metaphor of practice, policy, and theory as ‘partners on a dancing floor’, moving to varying music and exposing different configurations. I suggest considering the ‘regimes’ of STI and their evolution from the perspective of learning. The ideas, rationales, and instruments – finally the governance – of STI and related policy emerge as a result of *interactive learning*⁹ between actors involved in STI practice, intervention strategies and policies, and STI Studies and theory. Exhibit 1 (above) represented an attempt to characterise the dance of the three groups. In cultural history ‘dance’ generally refers to body movement used as a form of expression or social interaction, presented in a performance or in a spiritual setting. Practice, policy and theory can be conceived as dancing partners in a performance setting.¹⁰ I suppose that the three dancers observe each other, and react on the partners’ movements: They copy, comment, complement, counter-act, neglect, and thereby learn. In their interactive learning, they constantly create and change configurations. Sometimes STI practice is the driving force in a configuration, sometimes theory, sometimes public or private policy. The dancers may happen to bump into each other or may enjoy phases of harmony.

Learning on the STI policy dance floor may occur as first order or as second order learning. According to Argyris and Schön (1978) *first-order learning* links outcomes of action to organisational strategies and assumptions which are modified so as to keep organisational performance within the range set by accepted organisational norms. The norms themselves remain unchanged. *Second-order learning* concerns inquiries which resolve incompatible organisational norms by setting new priorities and relevance of norms, or by restructuring the norms themselves together with associated strategies and assumptions, hence escaping tunnel vision and crossing borders¹¹. In other words, while first order learning would help to improve the expression, harmony or elegance of an otherwise unchanged dance (or make a STI ‘regime’ more effective), second order learning would help to change the melody and the dance (or introduce new directions and modes of governance into a ‘regime’).

Taking a closer look at the dance we see how two of the dancers, STI practice and policy, argue and negotiate about the dance music while the third,

9 For the notion ‘interactive learning’ in innovation processes see Vandeberg & Moors 2007; Lundvall et al. 2002.

10 Whether or not to see them dancing also in a ‘spiritual’ environment is left up to the audience – there is quite some evidence that the nowadays widespread and sustained invocation of STI and related policy as the driving force of economic development and welfare is more like an incantation than rational choice.

11 For an application of the first/second order learning concept to the governance of emergent technology and innovation (here pharmacogenomics) see Boon et al. 2007.

theory, provides the other two with arguments and sometimes also new melodies. Having been involved for many years of my previous life, before I joined the University of Twente, in research-based consulting of public and private policy- and decision-makers I know that practice and policy have rising expectations vis-à-vis the contribution of social science based intelligence to their dance.

Third consideration: The potential of STI Studies as a dancing partner

This brings me to my third consideration, the potential of STI Studies as a dancing partner. Today, STI Studies are a respected academic field of interdisciplinary knowledge and research. Here is neither place nor time to give a comprehensive account of the overwhelming productivity of Science and Technology Studies¹² (STS, an acronym I extended to STI Studies in order to highlight the relevance of innovation processes). To keep it short, most of the enormous scope of topics covered by science and technology studies can be subsumed within two very general rubrics (Silbey 2006, 538): First, the *institutionalization, reception, and appropriation of STI* and, second, the *production of STI as a social process*. The first perspective is interested in the working of STI institutions, organizations, policies (expectations, rules, regulation, funding), strategy-making and planning, the assessment of potential developments and impacts of STI, and its constructive shaping (Constructive Technology Assessment, CTA). The other, second perspective of studies adopts an anthropological view on the working of scientists and engineers trying to reveal the intrinsic organization, culture and epistemology of social groups. The ambition is to understand STI not as a completely distinct realm of social action but like other social settings ruled by habits, rules, conflict, compromise, constructions, and narratives¹³ (Silbey 2006, 539). Consequently, this perspective concentrated rather on STI as social practice than on policy. In my view, this approach, nevertheless, had an important impact on policy concepts: It helped to understand that modelling the governance of 'science in the making' would fall too short if practice were conceptualised mainly in terms of functional and normative requisites (as put forward by Robert Merton, 1973) suggesting rather mechanistic designs of public policy for science ('mode 1'). Applying the constructivist approach not only to 'science in the making' but also to technological development and innovation as fields of social practice, strategists and policy-makers developed more and more sophisticated policy designs ('mode 2'). The above sketched 'production governance rationale' can be understood as a result of this new perspective.

In short, one can state that STI Studies contributed a lot to a better under-

12 For overviews see Silbey 2006; Hackett et al. 2007.

13 The science practitioners under observation, analysed like ants, were not always amused by the 'constructivist' interpretation of their work and did not feel like a dancing partner (as observer Bruno Latour notes [2005, 92]: "... our excitement in showing the 'social construction of scientific fact' was met with ... fury by the actors themselves!"), misunderstanding the sociological concept of 'social construction' of scientific insights.

standing of the driving forces of each of the two other dancers, STI in practice and policy, and became to some extent interwoven with them – sometimes very tightly, sometimes at some academic distance. I suggest that STI Studies cope with this tension and even make it a source of increased reflexivity and enlightenment for their own purposes. The reflexive potential of STI Studies arises from the combined perspective of the interaction of practice, policy, and theory: Observing the dance and getting involved into it, STI Studies hardly can avoid adopting a constructivist position and reflecting upon their own impact on the dance and the evolution of images and beliefs of the other partners. And – one step further – STI Studies cannot escape questioning the origins and dynamics of their own beliefs. To which extent are they driven by concerns of practice and policy? Could such a drift be pictured as second order learning, or are STI Studies scholars' beliefs sometimes also echoing the trends or fashions of their dancing partners or of the surrounding societal and cultural movement?

Obviously, STI Studies are not made up of one dominant theory; rather they appear as an assemblage of quite diverse intellectual strands, sometimes converging, sometimes diverting. Accordingly, innovation practice might prefer dances with other theory than public policy would like. Furthermore we know that different national political systems and related political elites revolve around different intellectual traditions and styles (Galtung 1981), hence expose marked preference for specific innovation theories¹⁴.

In sum, there is no single recipe for coping with the ambiguity of being involved in the dance with practice and policy. STI Studies scholars moving with some passion on the dancing floor can only try to keep a precarious balance, based on some distance through reflection. We should be aware of the *constructivist conditions of our own beliefs and actions*¹⁵. There is a need and a capacity for reflexivity of STI Scholars, moving on the dancing floor.

Fourth consideration: Dance in practice - Fora and Strategic Intelligence

I will now take a closer look at the dancing floor, introducing as an illustration two examples and the concept of pre-political “*fora*” for the debate of STI issues. Let me begin with the examples.

14 Think for instance of the dedicated preference of actors in innovation policy and practice in the US for (quantitative) economics-based analytical concepts (only recently re-emphasised in the “Science for Science Policy” initiative of the Administration and NSF) – compare this with the European tradition of sociology and evolutionary economics-based analysis of (public and private) institutions as shaping force of ‘innovation systems’, a notion of European origin, spread by OECD and received only with reservation in the US until today (Shapira & Kuhlmann 2003).

15 On the tensions at the interface of science and policy and the capacity to develop reflexivity see the ‘post-positivist’ concept of knowledge based policy advice; e.g. Hoppe (2005); Hoppe & Halfman (2005); Timmermans & Scholten (2006).

16 See for the following the 6CP website (www.6CP.net); part of the text is paraphrased from Edler et al. 2006. For more than 10 years I was the German member of the 6CP Steering Committee; I abandoned this position when joining the University of Twente in 2006.

Forum A: The Six Countries Programme (6CP) – the Innovation Policy Network

The Six Countries Programme (6CP) is an international network of experts, policy makers and practitioners engaged in research and policy making on innovation. It has been established as one of the first, maybe the first, forum of that kind. The network's major aim is to contribute to a better understanding of innovation processes, their impacts on the economy and society and the development of effective (public) innovation policies. The organisation was established in 1975 with four members: The Netherlands, Germany, France and the UK, followed soon by two other and later more European countries and beyond. Today there are 11 members; the name Six Countries Programme has been retained as a well known and appreciated 'brand name'.

The 6CP organizes conferences in the autumn and spring of each year. The objective of these events is to provide a forum for an open-minded exchange of information, reflection, and assessment of new developments in STI and the identification of 'new issues'. In particular, the 6CP tries to stimulate STI Studies experts to contribute findings from analytical and empirical research to the debates. It also seeks to motivate decision-makers in governments, companies and societal organisations to participate in multinational learning processes by establishing new networks and reinforcing existing ones. Themes covered in recent years include: 'User-producer relations in the innovation process'; 'Innovation policy and sustainable development'; 'New Governance for Innovation: The Need for Horizontal and Systemic Policy Coordination'; 'Crossing Borders - Venturing into the European Research Area'; 'Internationalisation of R&D'; 'Linking Defence and Security R&D to Innovation'; 'The Future of Research: New players, roles and strategies'; 'Innovation Policy Learning'.

Under the principle of an open discussion culture, the main effects are learning and the exchange of knowledge. The members stress the importance of the independent forum being a proper environment for completely open learning processes without any form of institutional obedience. This affects both individual members and also actions and rationales of the represented institutions and countries respectively. The open-mindedness of participants, the openness for issues and the stated intention not to influence innovation policy directly has allowed new, innovative, daring innovation policy issues. The forum was thus avant-garde. Meanwhile, the issues discussed tend to be more mainstream, although the non-instrumental nature of the forum and the rotating responsibilities for workshops to be organised still allow for discussions of issues not to be found in other transnational circles. The forum is thus still an instrument to transfer existing national debates onto a transnational level.

Over the years STI Studies experts used the 6CP quite often as a dancing

floor. They introduced and tested heuristics, theories and empirical findings in the debates; and they received questions and suggestions for improvement and further development of their concepts. The 'innovation system' approach, for instance, spread so quickly and widely not at least thanks to a number of 6CP conferences and publications. This holds also to the debates around the role of 'users' in technological innovation, or the concept of demand-oriented technology and innovation policy.

Forum B: Assessment Tools for Breakthrough and Emerging Science and Technology (ATBEST)¹⁷

The project ATBEST (funded by the European Commission, Programme NEST, 2004) aimed to communicate 'Assessment Tools for Breakthrough and Emerging Science and Technology'. It did so by combining scholarly research through interaction with practitioners. A thoroughly prepared one-off workshop was attended by experts involved in research practice and strategic research management, policy makers, and the ATBEST team members, i.e. STI Studies experts.

The starting point the workshop was that there is experience with assessment of emerging STI and there are unarticulated assessment practices. The purpose was to articulate existing assessment practices, enrich these with scholarly insights with respect to 'process-based assessment tools' and have scientists, research managers and policy makers go home with such tools. An underlying assumption was that other researchers might learn from existing, localized practices if these became more articulated and visible. This articulation can be aided by STI analysts. Their studies of breakthrough science and technology have shown that emerging STI areas are characterized by 'richness' in terms of discoveries to be made, and possibilities for their exploitation. In such areas, conventional approaches to assessing 'research value' and managing development ('picking the winners') may restrict many possibilities. Instead, the combination of great uncertainty and great potential requires a shift towards assessment of processes, including search, articulation and interactive learning ('process-based' assessments).

One of the project's conclusions was that one should not just improve technology assessments as such, refining analysis and assessment procedure, but discuss the contexts in which they will function, and the dynamics of research, research management, and STI policy. Given the variety of situations and actor-constellations, as well as differences between scientific and technological fields and their dynamics, it is not clear how general assessment approaches and tools can be. There is more work to be done, also in collating experiences of various actors involved in assessing new and emerging science and technology (representing a relevant part of the research agenda of STI scholars at the University of Twente). In sum, project and workshop offered a space for practitioners to exchange with and learn from

The following text is paraphrased from Edler et al. 2006. The project was run by an international team led by A. Rip, University of Twente.

STI Studies, and for STI Studies scholars to enrich their arsenal of assessment practices.

The 6CP Network and the ATBEST project are just two examples of 'fora' for the debate of STI issues on a 'dance floor', associating STI practice, policy and theory. I have borrowed the examples from a research project exploring the working of fora (Edler et al. 2006).¹⁸ *Why is there a need for such fora?* For a number of reasons the governance of science and innovation policy has become ever more complex: research and innovation processes themselves are subject of multiple forces and have become more uncertain; the number and heterogeneity of actors involved has grown, hence also the plurality of interests and values; and the borders between public and private spheres have become blurred. In order to cope with these challenges, actors seek to base their policy initiatives on increased interactivity, and often also on more evidence of actual or potential conditions, cost, impacts etc.. Interaction may be formally institutionalised and regulated, while in early phases interactivity may occur in emerging spaces, semi-institutionalised platforms, where policy-makers, public researchers and industry as well as experts meet, articulate their views, provide intelligence in order to inform the process, and make attempts to set the scene. One means of organising a policy-oriented discourse in semi-institutional environments are what we have called 'fora', *defined as institutionalised spaces specifically designed for deliberation or other interaction between heterogeneous actors with the purpose of informing and conditioning the form and direction of strategic social choices in the governance of science and technology* (see **exhibit 2**, and Edler et al. 2006).

Fora can be seen as a kind of dancing floor, a meeting place for innovation practice, theory and policy with two related effects: (1) Interactive learning of policy analysts, policy-makers and relevant stakeholders, and (2) improving the functioning of science and innovation policy and strategy. Fora can adopt several *governance functions on the dance floor*: They can offer a general, non-directed policy discourse (like the 6CP Network); they can offer policy information on specific issues (like the ATBEST workshop); they can prepare policy planning and development (visions, agenda, implementation); they can facilitate the resolution of conflict and the building of consensus; or they can improve the provision and application of policy intelligence (for examples see Edler et al. 2006).

In practice there are manifold variations of fora. A specific characteristic of the sort of forum I am alluding to is the prominent role played by 'Strategic Intelligence' (SI). SI has been defined as a set of sources of information and explorative as well as analytical (theoretical, heuristic, methodological) tools¹⁹ - often distributed across organizations and countries - employed to produce useful insight in the actual or potential costs and effects of public or private policy and management. Strategic intelligence is 'injected' and 'dige-

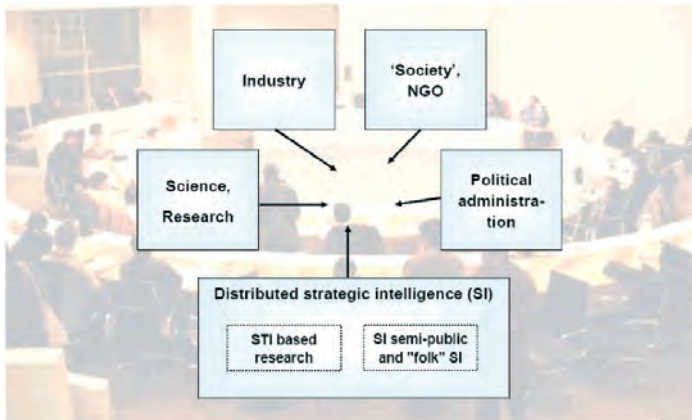
18 The Forum project was run in the context of the PRIME Network of Excellence (www.prime-noe.org), funded by the European Commission (Edler et al. 2006).

19 The definition was suggested by an international network of STIS teams coordinated by myself (Kuhlmann et al. 1999), and was subsequently taken up quite broadly in STI policy environments.

sted' in fora, with the potential of enlightening the debate.

SI can draw on semi-public intelligence services (such as statistical agencies), on 'folk' intelligence provided by practitioners, *and in particular on STI Studies*. Meanwhile, a number of formalised methodologies, based on the arsenal of social and economic sciences have been introduced and developed which attempt to analyse past behaviour ('Evaluation'; see e.g. Shapira & Kuhlmann 2003; OECD 1995), review technological options for the future ('Foresight'; see e.g. Martin 1995; van der Meulen & Löhnberg 2001; Cuhls et al. 2002), and assess the implications of adopting particular options ('Technology Assessment'; see e.g. Rip et al. 1995; Smits et al. 1995). Also, other intelligence tools such as comparative studies of the national, regional or sectoral 'technological competitiveness', or benchmarking methodologies etc. were developed and used. Furthermore SI can build on the broader methodological arsenal of STI Studies stretching from historical studies (e.g. Roberts et al. 2007) to action research (e.g. scenario workshops; see e.g. Hofman et al. 2004), and from techno- and scientometrics (e.g. Moed et al. 2004) to cultural studies.

Exhibit 2: Forum for debates of science, technology, and innovation issues



Providers of SI – including STI scholars – can play a number of roles in fora, often in combination: as a facilitator or moderator taking advantage of methodological capabilities; as an enabler or teacher supporting critical analysis and self-reflection (bird's eye view); as provider of issue expertise; or as entrepreneur using fora for advancing SI application in policy-making and for disseminating results (Edler et al. 2006). One can read the interactive learning of actors in fora, drawing on STI Study based SI, as a dance. Whether the dance is dominated by technoscientific promises or by collective experimentation depends largely on the involved actors from STI practice and policy, but to some extent also on the offers and the kind of involvement of STI Studies.

A number of colleagues in my new intellectual environment at the University of Twente, in particular the department of Science, Technology, and Health Policy Studies (STeHPS) and the Institute of Governance Studies (IGS), have contributed since many years, directly or indirectly, to the conceptual and practical development of fora for the ‘socio-politics of collective experimentation’ in science, technology and innovation. In this context, I am particularly interested in the further conceptualisation of public policy as dancer on STI dance floor – which brings me to my final consideration.

Final consideration: Research and education on the governance of science, technology, and innovation at and beyond the University of Twente

I started this talk with the proposition: *We need dedicated Science, Technology and Innovation Studies in order to better understand the development and governance of science, technology and innovation!* What can we, the STI Studies scholars at the University of Twente and beyond, contribute to vibrant dances towards a better governance of science, technology and innovation?

I have argued that STI Studies are more than an academic exercise; they are also a relevant dancer with direct or indirect impact on science and innovation practice and policy. And I made the claim that we should ‘dance’ with competence, attention, passion, and also reflection. So we would investigate, analyse, conceptualise, enlighten, teach, and we would even become involved in the shaping of socio-technical regimes. While doing so we would continue to learn. As Theodor W. Adorno said: “Nur wenn, was ist, sich ändern lässt, ist das, was ist, nicht alles”²⁰ (Adorno 1975, 391).

The study of the governance of innovation is at the heart of the specific profile of Twente as a university at the forefront of linking science, technology and research into social and political aspects of STI. This is a field of competence that in my view will gain ever more relevance and demand in the future – take as a marker the demand of societal organizations, of political actors, and also of large companies for concepts to cope with economic, social, or ethical implications of new and emergent technologies. This demand is visible in problem-oriented public research and innovation support programmes like BSIK in the Netherlands, or in the various social science subsets of the thematic technological funding strands of the European Commission’s 7th Framework Programme; FP7 offers even a specific programme on science, technology, and society issues²¹. Also in less developed countries has the interest in the shaping competence of STI Studies increased remarkably in recent years, here asking for genuine concepts adapted to the specific economic, social, political, cultural conditions of these societies, which in the mid term might even offer insights and concepts with relevance to the so-called advanced societies and their innovation potential.

The competences of the STeHPS group and the IGS, embedded in the broader

20 Only if one can change what is there, then there is more.

21 One could mention the recent launching of the ‘Science of Science and Innovation Policy Initiative (SciSIP)’ of the United States’ National Science Foundation.

context of the scientific, technological and managerial competences assembled within this university have quite something to offer to this demand: Ongoing and future research projects and teaching activities revolve around the development of socio-technical regimes, represented by (inter-) national actors, arenas and processes (articulation, decision-making, learning), mainly at a meso-level. In this context the research cluster 'Governance and assessment of science, technology and innovation' that I am representing aims at contributing to more reflexive practices of the governance of STI. Presently, there are two overlapping research areas: (1) 'Constructive technology assessment and reflexive innovation'; (2) 'Dynamics and governance of research and innovation systems'. In my view these fields undergo in the years to come incremental rather than radical evolution.

(1) 'Constructive technology assessment and reflexive innovation'. Here a number of projects study – partly in cooperation with technological research institutes (at University of Twente and beyond) – the dynamics and the impact of science and technological development, from a constructive and anticipatory technology assessment (CTA) perspective (e.g. Robinson et al. 2007). There are projects on the impact and ethics of nanotechnology (e.g. Swierstra & Rip 2007); on genomics and health care (e.g. Stermerding & Nelis 2006); on the articulation and societal regulation of morally contested science and technology (e.g. Stermerding & Swierstra 2006; Kirejczyk 2007); on socio-technical scenario development for transition management in the areas of mobility and energy production (e.g. Elzen 2006; Elzen & Wiecek, 2005).

The social shaping of new technologies is an area of research which, in recent years, I have been observing with great interest but also with some practical distance – since the main focus of my research and teaching from the early 1990s onwards was on governance and policy analysis in the field of STI. But actually had my career as a researcher and university teacher started with work on the social shaping of new technology, way back in the early 1980s: I was involved for many years in a variety of studies into the social implications of information technology (e.g. Brinckmann & Kuhlmann 1990; Kuhlmann 1985), and I did also my PhD in this field. Here at UT I intend to link-up with this tradition again. In addition, I will build on the experience with my part-time work as a professor of innovation policy from 2001 to 2006 at the Innovation Studies Group at Utrecht University (led by Ruud Smits), busy with research into the dynamics of innovation processes and systems, with a number of joint PhD projects with the UT STeHPS group.

Here at UT we intend to consolidate and deepen a running research programme in the field of CTA and societal aspects of nanotechnology and convergent technologies, initiated by Arie Rip and the MESA+ Institute a couple of years ago, embedded in the newly emerging international field of social, policy and ethical studies of new and emerging science and technology. In parallel I see a lot of synergy to be mobilized between our above mentioned research strand on the social shaping of health, environment, and technolo-

gy related regimes on the one hand and the other the strong working lines on the history of science, technology and innovation (represented by Lissa Roberts and colleagues); on health technology innovation and user-producer interaction in innovation (represented by Nelly Oudshoorn and colleagues); and on health related technological and organizational innovation (represented by Wouter van Rossum and Marten Ijzerman and colleagues).

(2) The other area of competence 'Dynamics and governance of research and innovation systems' is closely linked with what I have been busy with since the early 1990s, and there is a long tradition of research and teaching collaboration with colleagues here at UT (particularly Arie Rip and Barend van der Meulen) and other colleagues at my former main affiliation, the Fraunhofer Institute for Systems and Innovation Research in Germany. As I've said earlier in my talk, the governance perspective on STI, in particular the role of public policy, deserves continued if not increased attention. Our research starts from the assumption that the cognitive and organizational development of research and innovation is shaped by knowledge dynamics (local and global), international technological markets, inherited or newly evolving institutional environments (local, national, and global), and public policy initiatives (local, national, and transnational). There are projects on the governance of universities and the role of intermediary organizations (e.g. van der Meulen 2003; also joint research with the Centre for Higher Education Policy Studies, CHEPS); the inter-institutional research collaboration of across national public research systems (Heinze & Kuhlmann 2007); the Europeanisation of research practice, organization and policies (Larédo & Kuhlmann 2007). Research projects in this field contribute both to conceptual and methodological advancement and to the strategy and management needs of public and private policy.

In 2007 a three-year project "Governance of the collaboration of heterogeneous actors across national public research systems" started; the project is part of an international multi-site research programme "International Competitiveness and Innovative Capacity of Universities and Research Organizations - New Forms of Governance" funded by Deutsche Forschungsgemeinschaft. Beyond, STeHPS will together with a US team (Georgia Institute of Technology) run a project on "Measurement and Analysis of Highly Creative Research in the US and Europe", funded by the US National Science Foundation's SciSIP Initiative (building g on a preceding project funded by the European Commission; see Heinze et al. 2007). An international project collaboration on "Changing governance in European research 'configurations' – border-spanning shifts and integration (ERA Dynamics)", funded by the PRIME Network of Excellence started in 2006 and will run until end-2008. Last but not least, CHEPS and STeHPS intend to establish a collaborative research programme on the governance and the contribution of higher education institutions, in particular universities, for a sustainable supply of human resources disposing of advanced innovation capabilities.

Let me now turn to the other central mission of a university, education and teaching. If I am right about the strong if not growing demand in society, economy and policymaking for advice about the shaping of science, technology and innovation, then the other crucial contribution of STI Studies is the education of a next generation of engineers, policymakers, managers, scientists, and STI Studies scholars with a high level of reflexive understanding of the issues at stake and of the room for manoeuvre and shaping. The STeHPS group and its predecessors have been involved for decades in a considerable number of teaching activities, many of them in other faculties. Today the group is contributing to several Bachelor, Master, and Minor programmes. In my view this transversal provision of STI Studies knowledge is an excellent characteristic of the UT that should be maintained and continuously updated. I am looking forward to contribute to this effort.

The quality of this transversal teaching service was and is largely based on original research, not at least through a considerable number of PhD projects (many of them linked with the Dutch PhD School Wetenschap, Technologie, en Moderne Cultuur, WTMC). STeHPS receives qualified PhD candidates and young researchers from other high-level STI Studies education sites all over the world. To a relevant extent, nevertheless, we need also to grow our own seed. I am convinced that we should offer an International Master Programme on 'Governance and Management of Science, Technology, and Innovation'. This programme would make an effort to attract students from an international market, not at least from developing countries. I very much hope that we will be able to mobilize the necessary resources in order to set-up this programme and get it running soon.

Approaching the end of my talk, let me again return to the dancing floor: We have been participating and will continue to do so in a number of fora with public and private policymakers as an interface between theory, practice and policy. A related educational means with some prospects on a growing demand is professional courses for policymakers, strategists, etc. busy with the development of STI. Here, STeHPS has some experience and success, not at least with the longstanding international "R&D Evaluation Course", attracting research managers from all over the world. I had the pleasure to contribute to this experience for many years, starting long before I joined UT. Based on this experience we will consider the development of similar professional education formats for other audiences.

In sum, the dance goes on!

Many thanks for your attention!

Big Science. Yodellayheehoo.
Hey Professor! Could you turn
out the lights? Let's roll the
film. Big Science. Hallelujah.
Every man, every man for him-
self. Big Science. Hallelujah.
Yodellayheehoo
(Laurie Anderson,
Big Science, 1982)

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