

DIPLOMARBEIT

Titel der Diplomarbeit

The influence of societal challenges on
STI policy-making within the
European multi-level governance system:
The case of Joint Programming Initiatives

Verfasserin

Mag. Iris Wanzenböck

angestrebter akademischer Grad

Magistra der Philosophie (Mag. phil)

Wien 2012

Studienkennzahl lt. Studienblatt: A 300

Studienrichtung lt. Studienblatt: Politikwissenschaft

Betreuerin: MMag. DDr. Ursula Naue

Acknowledgements

At this point I would like to thank a number of persons, who have assisted and guided me throughout the whole process of this diploma thesis. Without their advice, support and patience, writing my thesis would not have been possible.

First and foremost, special gratitude is offered to Ursula Naue for the supervision of this diploma thesis. She offered me great effort and constant support in the form of valuable input and critical feedback. Particular thanks to Matthias Weber of the Foresight & Policy Development Department at the AIT Austrian Institute of Technology, who has supported me with his expertise throughout the whole project. Moreover, I would like to thank Thomas Scherngell (AIT) for motivating me to work on this thesis. This thesis has benefitted greatly from his efforts and suggestions. Special thanks are also offered to Klaus Kubeczko (AIT) for his support and useful comments. Further, I owe thanks to the Department of Foresight & Policy Development of the Austrian Institute of Technology (AIT) for the financial support of this diploma thesis. Last but not least, I offer my personal thanks to my parents, friends and colleagues, who have shown ongoing understanding and patience, even in stressful phases of this diploma thesis.

Content

Acknowledgements	i
List of Figures	iii
List of Abbreviations	iv
1 Introduction	1
2 STI policy-making in the context of societal challenges	5
2.1 Traditional rationales for STI policy intervention	7
2.2 Societal challenges as a new rationale for STI policy	13
2.3 The governance dimension in societal challenge-driven STI policy	16
3 Governance in a multi-level system: The European Union STI policy	34
3.1 Governance in the European Union: A general overview	34
3.2 The governance structures of the EU STI policy	41
3.3 STI policy coordination in the European multi-level system	50
4 STI policy-making in the European context: A shift towards ‘Grand Challenges’	55
4.1 Development and priority setting in EU STI policy	56
4.2 The focus on societal challenges in European STI policy	62
4.3 Strategic coordination in European STI policy-making: Past and present approaches	68
5 Joint Programming Initiatives (JPIs) to deal with European societal challenges: Policy coordination in two distinct JPIs	75
5.1 The Joint Programming Initiative (JPI) approach	76
5.2 Analytical framework for analysing two distinct JPIs	82
5.3 The Joint Programming Initiative Urban Europe	87
5.4 The EU Joint Programme Neurodegenerative Diseases Research	97
5.5 Comparative analysis and discussion	107
6 Conclusions	115
References	123
Abstract	137
Kurzzusammenfassung	138
Curriculum Vitae	139

List of Figures

Figure 1: The Joint Programming Cycle	79
---	----

List of Tables

Table 1: Major societal goals to which S&T may contribute	14
Table 2: Dimension of thematic coordination arising from societal challenge-driven STI policy	32
Table 3: Challenges for systemic policy coordination in European STI policy	54
Table 4: Evolution of the EU Framework Programmes (FPs)	61
Table 5: Analytical framework for the multiple case study strategy	83
Table 6: The multi-sectoral nature of the JPI Urban Europe	96
Table 7: Cross-case comparison of systemic policy coordination aspects	109
Table 8: Cross-case comparison of thematic policy coordination aspects	112

List of Abbreviations

AD	Alzheimer's Diseases
AGRI	Directorates General Agriculture and Rural Development
CAP	Common Agriculture Policy
CERN	European Organisation for Nuclear Research
CEU	Council of the European Union
CIP	Competitiveness and Innovation Framework Programme
COMP	Directorates General Competition
Coreper	Committee of Permanent Representatives
COST	European Cooperation in Science and Technology
CREST	Committee for Scientific and Technical Research
DG	Directorates General
EAC	Directorates General Education and Culture
EC	European Commission
ECFIN	Directorates General Economic and Financial Affairs
Ecofin	Council for Economic and Financial Affairs
EERA	European Energy Research Alliance
EIP	European Institute of Innovation and Technology
EMPL	Directorates General Employment, Social Affairs and Inclusion
ENTR	Directorates General Enterprise and Industry
ENV	Directorates General Environment
EP	European Parliament
ERA	European Research Area
ERAB	European Research
ERAC	European Research Area Committee
ERDF	European Regional Development Fund
ESPRIT	European Strategic Programme on Research in Information Technology
ESTAT	Directorates General Eurostat
ETAP	Environmental Technologies Action Plan
ETP	European Technology Platform
EU	European Union
EUREKA	European Research Coordination Agency
FP	Framework Programme
GPC	High-Level Group on Joint Programming
HLG	High-Level Group
ICT	Information and Communication Technology
INFO	Directorates General Information Society and Media
IP	Integrated Project

IPR	Intellectual Property rights
JLS	Directorates General Justice
JPI	Joint Programming Initiative
JPND	Joint Programme Neurodegenerative Diseases
JRC	Joint Research Centre
JTI	Joint Technology Initiative
MARKT	Directorates General Internal Market and Services
MFF	Multiannual Financial Framework
MOVE	Directorates General Mobility and Transport
ND	Neurodegenerative Diseases
NGO	Non-Governmental Organisation
NIS	National Innovation System
NoE	Networks of Excellence
NPM	New Public Management
OECD	Organisation for Economic Cooperation and Development
OMC	Open Method of Coordination
PPP	Public-Private-Partnership
R&D	Research & Development
R&I	Research & Innovation
REGIO	Directorates General Regional Policy
RTD	Directorates General Research and Innovation
S&T	Science & Technology
SAB	Scientific Advisory Board
SANCO	Directorates General Health and Consumers
SET	Strategic Energy Technology Plan
SFIC	Strategic Forum for International Science and Technology Cooperation
SI	System of Innovation
SME	Small and Medium-sized Enterprises
SRA	Strategic Research Agenda
STI	Science, Technology and Innovation
TAXUD	Directorates General Taxations and Customs Union
UE	Joint Programming Initiative Urban Europe
UEF	Urban Europe Forum

1 Introduction

In the recent past, Science Technology and Innovation (STI) policies have gained increasing importance in the policy mix of countries as well as supra-national entities, such as the EU (see, for instance, Lundvall and Borrás 2005), recognising the essential importance of STI for economic competitiveness and social welfare in the long-term. The *Europe 2020 Strategy* explicitly focuses on STI in order to achieve a new growth path leading to a smart, sustainable, and inclusive economy (EC 2010a). The realization of the European Research Area (ERA) – one of the main pillars of the *Innovation Union* that represents one so-called flagship of today's European STI policy – focuses on the promotion, guidance and coordination of research and innovation activities across Europe (see, for example, EC 2000a, 2007a and 2010b).

For this reason, the agendas of STI policy have to a considerable extent been transferred to the European level at which important impulses for strategic orientation and implementation of supranational as well as national or regional policy measures are being set. Thus, in a policy research and political science context, the organisation and priority setting in STI policy-making is of great current interest, in particular when it comes to the analysis of governance issues in a multi-level system (see, for instance, Kaiser and Prange 2004, Gassler et al. 2008). In the recent past, priorities of EU STI policy interventions have been shifted to societal challenges, i.e. transnational or global societal problems arising from societal conditions that can only be dealt with by multi-lateral cooperation, demanding innovative solutions in order to solve them sustainably, such as it is the case for the consequences of climate or demographic change (see, for example, Aho et al. 2006, EC 2007a, 2008a, 2010a and 2010b). In this context, the importance of new technologies and innovation to improve the quality of life and to enable a sustainable development of the society is particularly recognised, and also reflected in respective STI policy designs.

In contrast to conventional STI policy strategies, which are mainly driven by technological or economic rationales, legitimisation for recent policy initiatives increasingly arises from broad societal aspects (see, for instance, Gassler et al. 2008, Kubeczko and Weber 2009, Boekholt 2010). Traditional 'mission-oriented' approaches targeted to specific sectors have usually neglected the systemic nature of innovation as well as its societal aspects. According to Kubeczko and Weber (2009), a shift towards a 'new-mission approach' is recognisable, stressing the potential of innovation to provide appropriate solutions for far-

reaching societal problems. This re-orientation of current STI policy strategies imposes novel challenges for the governance of European STI policies, in particular the establishment of advanced multi-level governance structures for policy initiatives on the national as well as the European level. In relevant literature, three developments that induce a recognisable shift in governance and policy coordination mechanisms are particularly emphasised:

First, societal challenges are complex, uncertain and ill-structured since societal problems (see Rotman 2005) are usually situated at the intersection of different thematic policy fields, ranging from environmental policy, energy and transport to social or health policy. For this reason, the strategic and operative coordination of goals perceived, problems addressed and rationales pursued between STI policy measures and other sectoral policies is crucial in order to achieve field-overlapping policy goals (see, for instance, Smits et al. 2010). Given the properties of policy-making in modern societies (see, for example, Hajer and Wagenaar 2003, Benz 2004, Benz et al. 2007, Fischer et al. 2007), not only the number of actors involved and their interdependencies increase, but also their constitution and institutional background is getting more fragmented and diverse. Governance activities are now exercised by a number of interwoven actors (governmental, parliamentary or administrative actors as well as private actor groups from scientific or industrial communities or the civil society), whereas all of them at the same time deliver important impulses for STI policy-making (see, for example, Georghiou 2011).

Second, national or regional STI policies co-exist with the growing scale of EU STI supporting programmes. Hence, an increasing amount of relevant actors from the public as well as the private sector are jointly concerned with the governance of research and innovation activities on different levels (regional, national and supranational). Their interactions within a multi-level governance system (see Kaiser 2003, Kaiser and Prange 2004, Benz 2008 and 2010) lead to new modes and increasing complexity of governance structures at the EU level (see, for example, Héritier and Rhodes 2011). Thus, the coordination and cooperation between different actor groups from the regional, national and European level is of essential importance in European STI policy-making (see, for example, Kuhlmann 2001, Edler and Kuhlmann 2003).

Third, though STI policy issues have to a great extent been transferred to the European level, the majority of initiatives is still governed by member states. National funding

institutions develop and initiate their own STI policy programmes according to their individual national interests and priorities, lacking harmonisation and coordination between member states (see, for example, Muldur et al. 2006, Delanghe et al. 2009). Although national policy initiatives are still fragmented, awareness of the advantages to coordinate national actions increases, leading to the development of new modes of governance and new mechanisms for joint and coordinated national efforts at the European level (see, for example, EC 2008b, Jachtenfuchs and Kohler-Koch 2010).

The focus of this diploma thesis is on the influence of societal challenges on STI policy-making within the European multi-level governance system. The overall objective is to investigate in which way the formulation of societal challenges – considered as new form of STI policy rationales – influence policy coordination in the European multi-level governance system. The diploma thesis adopts a comparative case study strategy to provide – next to theoretical and conceptual considerations – empirical insight into respective policy coordination mechanisms at the programme level of STI policy-making using the example of the so-called Joint Programming Initiatives (JPIs) that explicitly address major European societal challenges by fostering multi-lateral coordination in the European multi-level governance system.

The diploma thesis aspires to provide a comprehensive picture on governance aspects related with societal challenge-driven STI policy approaches in general, and policy coordination in European STI policy-making in particular. This leads to a set of specific research-leading questions:

- What are the consequences of the change in STI policy orientation for policy coordination from a theoretical and conceptual perspective?
- Which influence has the formulation of thematic priorities in terms of different societal challenges on EU STI policy-making and policy coordination at the European level?
- In which form emerges societal challenge-driven policy coordination – distinguishing between aspects of ‘systemic’ and ‘thematic’ policy coordination – in JPIs as specific new EU STI policy designs?

To address these research questions and to elaborate the distinct theoretical and practical properties of policy coordination and multi-level governance mechanisms, the diploma thesis is structured as follows: The role of societal challenges as a new rationale for STI policy intervention will be discussed in some detail in *Section 2*. Based on a demarcation to traditional rationales for STI policy intervention, the section will further reveal from a

theoretical perspective which governance aspects become particularly important within such a STI policy orientation. To account for the influence on policy coordination, specific challenges and coordination mechanisms that are related with the interdisciplinary and field-overlapping nature, as well as the demand for enhanced societal responsiveness of STI policy are of particular interest. These mechanisms are referred to as ‘thematic’ policy coordination mechanisms throughout the diploma thesis. Then, *Section 3* highlights multi-level policy coordination mechanisms, referred to as ‘systemic’ policy coordination, resulting from the specific European governance structure as well as the diversity of regional and national innovation systems that are characteristic for European multi-level STI policy-making.

Afterwards, attention is shifted to the empirical perspective. *Section 4* analyses thematic priorities of previous EU STI policy from an historical perspective, and in further consequence, discusses the relevance of the upcoming recognition of societal challenges for current STI policy initiatives at the European level. In this section, special interest is given to the effects on governing and strategically coordinating national STI policies at the European level. After that, *Section 5* goes one step deeper by adopting a comparative multiple case study strategy disclosing the practical consequences of a societal challenge-driven STI policy on governance modes and policy coordination efforts in two distinct JPIs, namely JPI Urban Europe (UE) and JP Neurodegenerative Diseases (JPND). An analytical framework is derived from previous theoretical considerations comprising the aspects of systemic and thematic policy coordination. A cross-case comparison allows detecting how a specific problem is addressed, and whether governance structures and actors’ coordination mechanisms differ with respect to the thematic and scientific embedding of the initiatives. The case study approach will provide novel empirical indications on how the underlying societal problem influences governance and implementation of the respective STI policy measure, and how ‘thematic’ and ‘systemic’ policy coordination are interrelated in distinct JPI approaches.

The diploma thesis closes in *Section 6* with a summary of the main results, provides some implications in a European STI policy context, and re-examines the relevance of the results in the context of the actual scientific debate. Further it provides some directions and ideas for a future research agenda.

2 STI policy-making in the context of societal challenges

This section lays the theoretical and conceptual foundation on which later sections and particularly the empirical analysis of the diploma thesis build on. In order to address the question in which way the formulation of societal challenges as new form of STI policy rationale influence STI policy coordination in the European multi-level governance system, the notions of STI policy and societal challenges have to be clearly defined and stretched from different angles given in relevant literature. STI policy refers to political concerns addressing questions such as how technological development can be influenced politically, which opportunities do political actors have to support and facilitate innovation processes, or, how can the creation of scientific knowledge and technological solutions be accelerated in order to fulfil distinct societal and policy goals (see, for example, Weber 2009). Given the wide agreement on the crucial importance of STI for economic competitiveness and social welfare in the long-term, it seems natural that STI policies have gained increasing importance in the policy mix of regions, countries and supra-national entities in the recent past, and thus, are also of great current interest from a scientific perspective (see, for instance, Lundvall and Borrás 2005).

When decomposing the term STI policy, traditionally, science policy covers issues of basic and university research, intellectual property rights and education policy, whereas technology and innovation policy deals with private sector and industrial R&D. Technology policy focuses on technological aspects of R&D, while innovation policy refers to actions that influence the transformation of knowledge to its commercial application (Boekholt 2010)¹. The different policy fields cover different phases of the knowledge production chain. However, according to the nowadays perceived systemic and interrelated nature of innovation processes, the individual agendas of science policy, technology policy and innovation policy have gradually merged into an integrated policy field (OECD 2005a). This, however, is the result of an evolutionary process of changing innovation paradigms and theoretical rationales for public intervention alike (see, for example, Borrás 2003, Smits and Kuhlmann 2004, Boekholt 2010).

¹ Referring to the latter, innovation is often recognized as research- and technology-led and product-specific, but a broader conception of innovation policy takes account of e.g. process innovation, service innovation, non-technological innovations or organisational innovations (OECD 2005c).

Similarly, the design and objectives of concrete policy measures are influenced by their underlying rationales for public intervention (see, for example, Fischer et al. 2007). In an STI policy context, they are interpretable as tools public authorities use to implement distinct political strategies and priorities; more precisely, as government measures aiming to change the behaviour of actors involved in the innovation process, from generating new knowledge and ideas, to the development of solutions and the introduction to markets (Boekholt 2010). Further, public STI support programmes either follow a bottom-up approach, i.e. they are not targeted to a specific sector or technology, or are top-down designed in order to fulfil a governmentally predefined purpose. Thematic orientation in STI policy intends to channel research activities in thematic areas with advantageous sectoral, regional, and technological opportunities, but lacking market-driven investments, as for example in emerging technological fields (Steinmueller 2010).

In the recent past, the focus of STI policy measures has shifted to societal challenges. The notion of societal challenges refers to far-reaching societal problems that arise from societal conditions and go beyond national borders demanding advanced broadly-based scientific and innovative solutions (technological and non-technological) in order to solve them sustainably but in reasonable time (EC 2009a). Common examples mentioned in the literature are climate change, sustainable energy and environment, sustainable city life in terms of mobility, congestion, pollution, urban quality of life, ageing population and poverty (see, for example, EC 2009a, Smits et al. 2010). The most prominent recent example of EU-level STI policy are the Joint Programming Initiatives (JPIs), specifically designed to integrate national and regional research activities and policy programmes related to such societal problems. Thus, JPIs serve as empirical unit of analysis for addressing the research questions of the diploma thesis, analysed in a comparative case study strategy (see Section 5).

The change from traditional and mainly economic-driven to societal challenge-driven rationales for STI policy intervention will be discussed in some detail in the following. The subsection that follows elaborates on traditional rationales for STI policy intervention, before societal-challenge driven STI policy is stretched from a conceptual perspective in Subsection 2.2. To derive practical STI policy consequences, the Subsection 2.3 focuses on the specific governance dimension that becomes particularly prevalent in a societal challenge-driven STI policy approach.

2.1 Traditional rationales for STI policy intervention

STI policy measures are the final outcome of very specific interrelations between theoretical rationales for public interventions, on the one hand, and political practices and activities that become apparent throughout the policy-making process, on the other hand. This most notably refers to aspects of how and why distinct theories gain access, and how they are transferred and further processed by the multiple actors involved in policy-making (see, for example, Jann and Wegrich 2007). Having this in mind, the diploma thesis discusses the most influential theoretical arguments that legitimise specific types of intervention in innovation and knowledge generation derived from theoretical approaches focusing on the explanation of innovation and technological change (Chaminade and Edquist 2010), namely the *market failure* argument stemming from neoclassical economic theory, and the *system failure* argument introduced by evolutionary and systems of innovation (SI) approaches². The former has been the prevalent paradigm in the perception of the role of STI policy from the beginning of STI to become a specific policy field during the 1960s, mainly focusing on science policy. Since the early 1990s, new considerations on the changing character of the innovation process gradually led to the introduction of more comprehensive and complementary approaches, such as the system failure perspective.

In what follows, the main features of both arguments are discussed in some detail. Initially, it has to be noted in this context that both concepts do not contradict each other; rather they can be understood as complementary to each other. Both approaches highlight the importance of market mechanisms for innovation and legitimate public intervention only in those cases where ‚additionality’³, i.e. additional effects to private actions, can be achieved (Bach and Matt 2005).

Rationales following the market failure argument

From a theoretical perspective, justification for policy intervention in R&D processes goes back to the neoclassical paradigm of economic theory that legitimises political actions merely by the presence of market failures (see, for example, Nelson 1959, Arrow 1962). Market failures are, according to Arrow (1962), the result of basic factors hampering the

² Certainly, other theoretical frameworks and approaches may also provide legitimisation for STI policy interventions. However, regarding their significant influence on STI policy in practice, the scope of is limited to these two approaches.

³ For a compact overview on the different types of additionality see Wanzenböck et al. (2011).

efficiency of market mechanisms that can be traced back to the specificities of (technological) knowledge production. Such market inefficiencies are related with indivisibilities of inputs and outputs of knowledge production, externalities and the non-appropriability of outputs (i.e. the public good character of technological knowledge), and uncertainties inherent in the generation as well as appropriation of returns from R&D activities. As a consequence, market failures occur in the form that private rates of return from R&D are less than social rates of return would be, leading to allocative inefficiencies of market mechanisms and systematic private underinvestment in R&D (Nelson 1959, Arrow 1962). In other words, the market for knowledge does not provide adequate incentives for sufficient private R&D activities.

Thus, policy intervention in R&D and innovation processes in terms of the classical market failure approach is merely argued by the removal of the sources for such market failures. Policy measures following this rationale do not go beyond the provision of appropriate framework conditions (e.g. competition policy, intellectual property right regulations) in order to mitigate externalities or market power and create suitable conditions for knowledge creation (Steinmueller 2010). Financial incentives and direct subsidies of private R&D activities are only legitimised in cases where investments in R&D are less than socially desired from the perspective of economic theory (Lipsey and Carlaw 1998). Thus, active intervention or even public knowledge production focused primarily on basic research (Nelson 1959). In the case of basic scientific knowledge, economic market forces will produce less scientific knowledge than it is desired from a social perspective as the possibility for appropriation of R&D results is particularly low but uncertainty is notably high.

The market failure argument may still provide a theoretical frame for justifying large-scale policy measures with high externalities and significant entry costs (e.g. in fields of defence research or energy), but is too narrowly defined in light of new insights into how innovations are created (see, for example, Smith 2000, Chaminade and Edquist 2006). Critics on the neoclassical economic approach as a comprehensive rationale for STI policy intervention are manifold, ranging from very general critics on the underlying assumption of optimality and perfectly competitive markets (for an overview, see, for example, Metcalfe 2005), an oversimplified understanding of a linear innovation process (see, for example, Chaminade and Edquist 2010), to its too narrow focus on (technological) knowledge generation. Thus, the approach is not able to capture and explain innovation activities in general, and non-technological innovation such as social innovation in particular (see, for example, Rammert 2010). For these reasons, as

Chaminade and Edquist (2010) point out, policy implications following the market failure theory would be too simplistic in order to derive guiding principles for concrete STI policy designs, i.e. why, how and when to intervene in innovation processes. Although the theory might probably provide general policy implications for promoting basic science, it fails to capture the 'relational' and 'embedded' nature of R&D and innovation activities by overemphasizing the firm-level as the single locus where applied research takes place, and neglecting the systemic dimension of innovation processes (see, for example, Metcalfe 2005, Nelson 2009).

Rationales following the system failure argument

The system failure argument for STI policy intervention is based on new considerations during the 1990s shifting attention to the systemic character of innovation processes. This is widely reflected in the system of innovation (SI) approach that has emerged as a heuristic to analyse and explain the generation of innovation in a more comprehensive way, particularly taking into account globalisation and internationalisation tendencies as well as rapidly changing technologies leading to significant changes in innovation processes. It shifts attention from individual R&D performers to innovation as a collective phenomenon resulting from interrelations between different organisations and institutions⁴ (see, for example, Freeman 1987, Lundvall 1992, Edquist 1997). By this, the heuristic integrates evolutionary as well as institutional-based theories of innovation and technological change⁵ (see, for example, Nelson and Winter 1982, Bach and Matt 2005, Nelson 2009). Cumulative and interrelated innovation processes (see Kline and Rosenberg 1986) are the basis for a systemic understanding of innovation. At the heart of these interrelated innovation processes are knowledge flows between several types of actors, as well as knowledge spillovers within the innovation system and between different innovation systems, structuring and influencing the systems' overall knowledge stock, and thus, innovation capacity (see, Fischer 2001). From this perspective, innovation results from complex interactions and linkages between different types of actors as well as public

⁴ In general terms, the innovation system is perceived of components that are organisations and institutions, and their relations within distinct system boundaries (see, for example, Edquist 2005, Chaminade and Edquist 2006). In this context, important organisations might be innovation performing firms, research organisations, universities, funding agencies, policy actors, etc.; institutions in the context of SI refer to sets of routines, habits and practices, as well as norms and rules that regulate the interactions between different actors and organisations.

⁵ Evolutionary and institutional-based approaches substantially differ to neo-classical approaches of economic theory in the following major assumptions: Asymmetric information is crucial for novelty creation, variation and innovation; actors have bounded rationality; the various actors are characterised by diversity and heterogeneity, and innovation activity is path dependent, i.e. innovative actors learn from previous experiences (for an overview, see Woolthuis et al. 2005).

and private activities that are structurally interrelated throughout the whole innovation chain from knowledge development to the commercialisation and application of new products and services.

Dependent on the focus of analysis, different analytical conceptions of the SI approach have been discussed so far. They conceive the idea of an innovation system in spatial terms, such as National Innovation Systems (NIS) (see, for example, Freeman 1987, Lundvall 1992, Nelson 1993, OECD 1994) or Regional Innovation Systems (RIS) (see, for example, Cooke 2001), or put emphasis on distinct industrial sectors (e.g. transport, ICT) or technological (e.g. nanotechnology) areas that transcend territorial boundaries⁶. Despite the diversity of analytical focal points, the overall function of a system of innovation can be perceived as the creation, diffusion and usage of innovation (Edquist 2005). By this, the SI approach attempts to close the gap that neoclassical theory raises, implicitly assuming constant interlinkages of the knowledge production chain from scientific knowledge to the creation and commercialisation of innovation. To achieve this purpose, Edquist (2005) identifies the following set of activities to be important within a system of innovation (see also Wanzenböck 2010 for a compact overview):

- Creating new knowledge and providing R&D, especially in the fields of natural science and engineering,
- supply of resources in terms of financial and human resources,
- providing a platform for competence building, learning and experiencing in terms of human capital, education and training, production of skills and individual learning capabilities,
- guiding the direction of search processes towards identification, technological opportunities and problem solution ideas in particular areas, and providing incentives for innovation (e.g. IPR, standards and regulation, favourable political and legal framework conditions),
- knowledge transfer and diffusion through networks and interactive learning processes between different organisations involved in R&D and innovation,
- facilitating and stimulating the formation of markets for new and innovative products, services and processes, and enhancing applicability for innovation users.

⁶ For details on Sectoral Innovation System, see, for example, Breschi and Malerba (1997), Malerba (2002), while details on Technological Innovation System are given in Carlsson and Stankiewicz (1991).

In this context, the notion of system failure⁷ (Hauknes und Nordgrens 1999, Smith 2000, Woolthuis et al. 2005) points to insufficiencies in the inherent operation of those functions, ranging from infrastructural and investment problems, via lock-in and institutional problems, to network problems or capability problems, among others. The role of public policy is basically seen in remedying such flaws shifting attention to provide framework conditions that facilitate networking, knowledge transfer and collective learning between all relevant actors throughout the innovation chain. From the perspective of the SI approach, the boundaries of STI policy become reasonably blurred and increasingly interwoven with related policy fields. Different organisations, whether they are firms, universities, research organisations or other innovation-related actors, cannot be strictly assigned to a scientific, technological or innovation-related context anymore but closely interact at different levels of the innovation process (Bach and Matt 2005).

Although innovation processes are characterised as self-organising phenomena (see, for example, Metcalfe 2005) that provide little scope to assess or even determine their evolution, STI policy is seen as an inherent part of the innovation system that might play an active role in the generation and diffusion of knowledge (Bach and Matt 2005). However, STI policy should only intervene when systemic self-operation is disrupted (Chaminade and Edquist 2010). In this context, insufficiencies from a systemic point of view - in contrast to the market failure rationale – give not only broad legitimisation for governmental intervention, but may additionally constitute a practical guiding tool for the design of policy measures in terms of where to intervene, or which actors should be addressed (Woolthuis et al. 2005). Hence, the SI approach suggests a variety of STI policy instruments⁸ ('policy mix') and application fields for enhancing R&D and innovation capabilities that are adaptable to very different levels and areas – from a regional, over national to an European context, as well as to sectors or industrial areas.

From the above considerations, the SI approach also provides an important framework for transforming societal objectives and future challenges into a rationale for STI policy intervention. Three arguments are essential in this respect:

⁷ In recent literature, numerous categorisations of systemic inefficiencies have been introduced, pointing more or less to the same concepts. Another prominent example in this respect is the notion of 'systemic problems' as introduced by Chaminade and Edquist (2006).

⁸ For example, the work of Metcalfe and Georghiou (1998), Smith and Kuhlmann (2004), Boekholt (2010) and Steinmueller (2010) provide practical overviews of policy instruments in the field of science, R&D and innovation from different perspectives.

First, in the SI framework, legitimisation of policy intervention outreach a sole economic justification in terms of e.g. increase in productivity, industrial growth and competitiveness; policy intervention might also follow non-economic rationales by acknowledging cultural, social and environmental aspects of new technologies and innovation (Chaminade and Edquist 2006).

Second, the agendas of STI policy are much more extended compared to the market failure argument, partly overlap or even are merged with other fields that may also exert influence on the innovation system (e.g. education policy, environmental policy, industrial policy, etc.). In other words, various policy domains are integrated in a systemic perspective of STI policy, pointing to new rationales but also governance modes and instruments for STI policy-making.

Third, the notion of 'systemic failure' in its conception may also disclose future problems or opportunities emerging within the innovation system, providing potential for opening up STI policy to more strategic and anticipatory policies and problem-oriented instruments (see, for example, Boekholt 2010, Chaminade and Edquist 2010, Smits et al. 2010). Within the innovation system, however, problems are primarily assessed in direct relation with risk and uncertainties inherent in the generation of new technologies, and thus, system inherent reference to broader societal problems or challenges is rather weak. Resting upon this basis, however, public policy ought to take a more active role in articulating important societal challenges in areas such as health or environment.

However, there are some significant limitations of the SI approach for the derivation of STI policy intervention in the context of societal challenges. In the SI approach innovation is still conceived implicitly in technological terms while the changing nature of extended types like social innovation (see Rammert 2010) is not taken into account when rationales for STI policy interventions are deduced. Moreover, the peculiarities of service innovations see, for example, OECD 2005c) in contrast to physical goods are not fully captured. The ways in which they are generated, however, might differ substantially, as for example product variations, user intensity and consumer specificity are concerned. A demarcation between innovation user and producer is often not easy to draw.

Regarding the instrumental dimension of STI policy, another major drawback of the SI approach when considering the introduction of societal challenges as policy rationale, is its imbalance in emphasizing supply side in contrast to demand side policy measures (see, for example, Metcalfe 2005). It puts great attention to linkages of innovation

performers in early stages of innovation processes but lags somewhat behind in recognising the significant role that new ('lead') markets or user and consumer preferences might play for leveraging innovation. The rise of scholarly and practical debates on implementing strategic, demand- and problem-oriented instruments in the form of public procurement in socially highly relevant fields (e.g. public procurement for innovation in health care) might be regarded as attempt to address such shortcomings (see, for example, Edler 2010).

To put it in more general terms, the SI approach lacks of strategic orientation that is in line with a lack of capturing dynamics in innovation systems (see, for example, Smits et al. 2010). It lays strong focus on the operational level of policy-making that is the implementation of policy measures, but bears little ground for its interrelations with the strategic level of policy-making. In essence, strategic policies refer to policy processes that start with the detection and formulation of new strategic priorities, and subsequently generate new policies in order to set conditions for adapting the innovation system to strong environmental changes (Smits et al. 2010). Strategic STI policy-making combined with intelligent governance mechanisms, however, might be of particular importance to pursue serious and far-reaching societal challenges.

Despite these limitations, the SI approach provides several advantages and may serve as framework for societal challenge-driven STI policy legitimisation. In this context, the 'functional' approach of innovation system, or 'Complex Innovation System' approaches are examples for further developments of the SI approach that might be regarded as more suitable to derive societal legitimisation for policy intervention (Kubeckzo and Weber 2009).

2.2 Societal challenges as a new rationale for STI policy

Societal challenges are – as used in this diploma thesis – defined as far reaching societal problems demanding advanced and comprehensive technological and organisational innovations. Today, societal expectations on science, research and the development of new technologies are high (Muldur et al. 2006, EC 2009a). The opportunity perceived with scientific activities, and in this sense, with public promotion of scientific knowledge production has changed from the pure and objectless search for new knowledge to a focus that highly emphasises application and problem-solving capacity of knowledge production (Gibbons et al. 1994).

Moreover, new technologies and innovations will provide more comprehensive solutions in order to cope with changing, partly threatening environmental conditions. If existent solutions are no longer appropriate or do not correspond with what is required from a societal point of view, STI policy may be in a position to deliver impulses for targeted R&D and innovation activities. Table 1 shows major societal goals to which new technologies and innovation may deliver valuable contributions, ranging from economic and environmental to social challenges (Muldur et al. 2006).

Table 1: Major societal goals to which S&T may contribute

Quality of life, health, human development and knowledge

Education and diffusion of knowledge
 Personal and public health and safety
 Exploration and expansion of knowledge
 High standard of living
 Creation and maintenance of civic culture
 Cultural pluralism and community harmony
 Population stabilisation

A resilient, sustainable and competitive economy

Economic growth
 Full employment and workforce training
 International competitiveness
 Modernised communications and transportation
 International cooperation and action

Environmental quality and sustainable use of natural resources

Worldwide sustainable development
 Resource exploration, extraction, conservation and recycling
 Energy production and efficiency in use
 Environmental quality and protection
 Provisions for public recreation
 Maintenance and enhancement of productivity of the biosphere
 Maintenance of urban infrastructure
 Energy security and strategic materials

Source: adapted from Muldur et al. (2006, p. 20)

Typical examples of specific societal challenges in the political debate are climate change, sustainable energy and environment, sustainable city life in terms of mobility, congestion, pollution, urban quality of life, ageing population and poverty (EC 2009a). When addressing such societal challenges in an STI policy context, it is crucial to take into account that, according to Rotman (2005), societal problems are

- *complex* – they have multiple causes and consequences spanning across a wide range of societal domains, scales and levels, and they are deeply embedded in our societal structures and institutions,
- *uncertain* – there is no ready-made solution,
- *difficult to manage* – different actors at different levels and with diverse interests are involved,
- and *hard to grasp* – they are difficult to interpret and ill-structured.

From a societal point of view, policy intervention may be crucial when appropriate technologies or solutions suitable to deal with future societal challenges have, for example, not been developed yet, or existent technologies are still immature, and do not meet societal requirements. In practice, STI policy has therefore broadened its focal point, attaining legitimisation for intervention not only from market or system-inherent rationales, but also from a societal function expressed in generic and long-term policy goals, such as social balance, environmental sustainability or health. This will also be further reflected in the empirical part of the diploma thesis, focusing on the Joint Programming Initiatives (JPIs) that have been established at EU level to specifically deal with such challenges (see Section 5).

Although considerable progress has been made to give STI policy a profound theoretical base in economic or innovation-system inherent terms, research on the theoretical embedding of societal rationales and guiding tools for STI policy is still somewhat underdeveloped (Kubeczko and Weber 2009). In general, a societal-driven STI policy seeks for implementing market and system rationales of intervention combined with strategic aspects of policy-making. From the perspective of strategic STI policy, the following characteristics of societal challenges may serve as guiding principles for designing new sets of STI policies that better fit a changing societal context of extended scope⁹:

- Both, advancements in technological development and in basic science are needed to tackle societal challenges. At this, bridging the gap between institutionally diversified knowledge sources is important to provide a systemic integration of different scientific disciplines and technologies and to enhance interactive learning.

⁹ The itemisation is based on the considerations of strategic STI policy making in a systemic framework, as proposed by, for example, Smits et al. (2010).

- In fields with high societal relevance, externalities are probably high and incentives for private R&D efforts may be limited.
- Societal needs are still latent and private demand is not yet fully articulated. Although final demand might be vast, it is fragmented and subject to various national regulations and standards.
- Thus, effective policy intervention comprises a combination of supply-side, regulatory and demand-side measures geared to strategic, coordinated and long-term priorities.
- However, sustainable solutions quite certainly have a backlash on social co-existence, implying a distinct re-organisation of society that may be also reflected in continuous social and organisational innovations.

Thus, the spectrum of potential policy instruments on which STI policy can draw on is broadened in contrast to traditional rationales (see, for example, Bórras 2009), ranging from economic and financial supply-side R&D and technology policy measures in terms of financially supporting research activities, education and training of high-skilled workers, to generic innovation policy instruments or regulatory and demand-side measures to foster innovation-friendly markets and spur the uptake of innovations¹⁰. Given the interactions of potential STI policy instruments, the strategic level of policy-making gains importance in STI policy-making in order to define and coordinate a broad set of policies needed to tackle societal challenges. Thus, so-called ‘meta-instruments’ (Bórras 2009) in the form of innovation indicators, policy benchmarks and technology foresight¹¹ are increasingly applied for designing STI policy measures, complementing the instrument range of STI policy.

¹⁰ For European STI policy, a fraction of the wide array of policy instruments to tackle societal challenges is given in Section 4.

¹¹ According to Martin (2001) "Foresight is the process involved in systematically attempting to look into the longer-term future of science, technology, the economy and society with the aim of identifying the emerging generic technologies or the underpinning areas of strategic research likely to yield greatest economic and social benefits." (Martin 2001, p. 7). Foresights are participative processes that involve a number of different private and public actors in order to identify and structure common ideas and visions for the future. They have come into wide use to support decisions on and implementation of STI policy measures.

2.3 The governance dimension in societal challenge-driven STI policy

As discussed in the previous subsections, different theoretical considerations on the role and nature of research and innovation activities have been highly influential for legitimating STI policy interventions. It was further revealed that changes in the cognitive apprehension of the role that STI might play for future societal resilience lead to a shift in theoretical considerations on STI policy. However, the political implementation of a societal challenge-driven approach calls for a transformation of prevalent practices in STI policy-making that go beyond mere modifications of the existing policy instruments applied. According to Hall (1993) long-term policy changes involve changes in the policy paradigms¹² that is the “framework of ideas and standards that specifies not only the goals of policy and the kind of instruments used to attain them, but also the very nature of the problems they are meant to be addressing” (Hall 1993, p. 279; as cited by Grin and Loeber 2007, p. 206).

Against that background, this section turns to the political process of STI policy-making, and by this, highlights requirements for STI policy coordination that become increasingly demanding in light of a societal challenge-driven STI policy. As far as societal challenges are concerned, STI policy follows a thematic prioritisation that cuts across various policy domains and integrates a number of actors, shifting political governance issues on top of the STI policy research agenda. A recent OECD project on ‘Governance of Innovation’ (OECD 2005a) emphasises the role of strategic intelligence, policy-learning and the development of comprehensive coordination mechanisms between multiple policies and actors for an integrated and coherent STI policy (see, for example, Braun 2008). Thus, important guiding tools for a STI policy that encompasses a number of societal actors and policy domains have been proposed in the recent past (see, for example, OECD 2005a, Remøe 2008, Boekholt 2010).

This section employs a practical perspective on STI policy and relates a societal challenge-driven STI policy to major governance challenges that might arise with such an approach. After a brief introduction to general prepositions of the governance concept and its consequences for the political governance of STI activities in the following, this

¹² While such changing paradigms refer to the notion of ‘third order learning’, he further introduces two other (lower-level) types of learning, namely ‘first order learning’ that refers to changes in the relevance of a policy instruments and ‘second order learning’ that concerns changes in the choice of policy instruments (for an overview, see, for example, Bandelow 2003). Policy-learning implications for STI policy-making will be further discussed in Subsection 2.3.2.

subsection focuses on relevant governance mechanisms that need to be developed in terms of thematic prioritisation in form of societal challenges. The practical implementation of thematic coordination mechanisms as well as their reflection in current policy strategies and instruments designed to tackle societal challenges will be analysed in the empirical part of the diploma thesis, taking the Joint Programming Initiatives (JPIs) as objects of study.

2.3.1 The governance concept in the context of STI policy-making

As noted by Pierre and Peters (2000, p. 37) the notion of governance is used in multiple contexts. Governance – as a particular scientific concept – has entered theoretical and empirical literature in different scientific disciplines. In political sciences, the notion of governance is used in different contexts ranging from analyses in international relations to specific policy analysis (Benz 2004). Therefore a uniform and comprehensive definition can hardly be found, and is – depending on the subject and purpose of analysis – used with different meanings, and in different scientific ways, namely both as normative as well as analytical concept¹³ (see, for example, Benz 2004, Benz et al. 2007).

Generally speaking, the notion of governance refers to alternative modes of organisation, regulation and coordination of social activities beyond hierarchy of the state and self-organisation of markets. By this, governance lays special emphasis on the institutional conditions structuring these processes of interaction (see, for example, Rhodes 1997, Benz 2004, Benz et al. 2007, Tömmel and Verdun 2009, Héritier and Rhodes 2011). From a political perspective, governance points to alternative forms of interactions in the political process in order to shape and coordinate ('govern') economic and social interactions.

Political sciences shifts attention to network structures in which public and non-public actors cooperate in order to jointly fulfil specific governmental functions, traditionally in the sole responsibility of public authorities (see, for example, Hajer and Wagenaar 2003). Such cooperative arrangements may range from the definition and implementation of policies to the provision of public goods and services. For this reason, governance has to be delimited from traditional meanings related to the notion of government or governing (see, for example, Rhodes 1997, Pierre 2000). It refuses the per se superiority of public

¹³ As Rhodes (1997) points out, depending on the subject and purpose of analysis, "the concept of governance is used with at least six different meanings: the minimal state, corporate governance, new public management, good governance, social-cybernetic systems and self-organised networks" (Rhodes 1997).

authorities, but recognises that the role of governments is decentralised in cooperative institutional arrangements¹⁴ across different levels (sub-national, national, European or international) of a political system, across various types of public or private actors, and across different segments of the society (see, for example, Benz et al. 2007). Noteworthy in this context, however, are the multiple dimensions of governance as it shapes not only institutional structure (Mayntz 2004), but emphasises their close relation with particular steering instruments implemented by public authorities (Héritier 2002), or changing political processes of agenda- and priority setting (Kohler-Koch 1999). Having this in mind, complex institutional arrangements of policy-making as well as rising societal challenges are of particular interest when taking a governance perspective¹⁵.

From an empirical point of view, the notion of governance is highly related with the transformed conception of the 'state', its functions and the role of governments to guide societal activities during the 1990s in democratic countries of the western hemisphere (see Rhodes 1997, Pierre 2000). With the emergence of New Public Management (NPM) approaches, efficiency norms have increasingly been applied for the organisation of the public sector and the provision of public goods. Referring to the latter, private actors, agencies or joint arrangements in the form of public-private-partnerships are increasingly installed in order to conduct traditional governmental functions (Mayntz 2004). Efficiency and effectiveness arguments, however, do not only apply to the provision of public services, but also hold for the policy-making process itself due to the growing importance of external knowledge and information sources for the preparation of collective binding decisions.

¹⁴ In this context, the notion of 'policy networks' gains increasing attention in public policy analysis in the recent past (see, for example, Mayntz 1993, Rhodes 1997; for an overview see also Fischer et al. 2007), causing a number of different analytical perspectives on the influence of such arrangements on policy-making processes. According to Mayntz (1993), policy networks point to structural interorganisational relationships between public and private actors that are characteristic for modern governance processes. Closely related with policy networks are the notions of 'policy communities' (for an overview see Miller and Demir 2007) or 'issue networks' (Hecklo 1978), each of them emphasising (informal) arrangements between different groups of interrelated policy actors that share a common interest on distinct political matters. According to Rhodes (1997), policy communities show the highest degree of integration, while issue-networks are loosely-integrated forms of policy networks.

¹⁵ In this context, Hajer and Wagenaar (2003) emphasise that with the governance perspective "a new range of political practices has emerged between institutional layers of the state and between state institutions and societal organizations" (Hajer and Wagenaar 2003, p. 1) leading to "new sites, new actors and new themes" (Hajer and Wagenaar 2003, p. 3) in policy-making. JPIs as new approach for STI policy-making in the EU (see Section 5 of this diploma thesis), may serve as a characteristic example for such changing policy spheres, arenas and actors.

Further, responsibilities in policy-making have been gradually more intensively shared between different spatial levels, especially involving the tendency of shifting national responsibilities towards inter- or supranational levels (see Rhodes 1997). These developments give rise to the establishment of advanced governance mechanisms that are efficient and appropriate instruments to coordinate activities at multiple levels. In particular in the context of far-reaching challenges contemporary societies and economies are facing, direct public intervention is replaced or even supplemented by strategic measures intending to guide and coordinate rather than hierarchically steer activities of various actors and levels in the medium or long run. In this regard, instruments offering strategic intelligence gain growing recognition in policy-making (Smits and Kuhlmann 2002, Weber 2009).

In the context of this diploma thesis, the notion of governance refers also to changes in policy processes, in particular in terms of interaction patterns and instruments to coordinate the activities of several public and private actors:

First, traditional governmental structures are transformed throughout the entire policy cycle (see, for example, Hajer and Wagenaar 2003); various political actors are working on the preparation, formulation, adoption as well as implementation and control of decisions in joint collaboration with different institutions, transnational organisations, expert committees, unions or civil societies. In this context, Pierre (2000) points out that this does not necessarily erode the role of the state, but rather is an increasing possibility to adapt to external changes. In doing so, new actors may bring in new and enhanced types of information, and by this, may initiate a transformation of strategies and objectives, as well as values and preferences in order to achieve societal goals and resolve societal problems.

Second, new governing mechanisms and practices of interactions gain importance, replacing traditional patterns of hierarchical steering in favour of 'soft' steering instruments and horizontal arrangements in the form of networks to intermediate interests, exchange resources or reach mutually acceptable decisions by deliberation, negotiation and cooperation (see, for example, Kohler-Koch 1999).

Third, on the basis of such new organisational arrangements, governance is thought to enhance public governing processes, in which policy coordination makes up a substantial part (Braun 2008). Through increased interaction between administrative units and policy makers of different fields, mutual understanding and cooperative learning may be

fostered, but also policy segregation, lacking coordination and duplication of policy measures may be reduced (Heritier and Rhodes 2011).

These observations point to a general trend towards an increasing diversified and complex coordination in policy-making; be it – as mentioned above – between multiple actors from the public and private sector, between different spatial levels ranging from the regional, to the national or supranational level, or between multiple sectors or policy fields. In many cases, it is an efficiency argument in terms of avoidance of duplication, overlapping and policy inconsistencies that give rise to novel policy coordination efforts. In addition, and at least as important in the recent past, the systemic understanding of policy-making strives for an encompassing governance perspective in contrast to particularistic and sectoral perspectives, making coherence, cohesion, and agreed setting of priorities inevitable (see, for example, Braun 2008).

Thus, under the heading of the governance concept, a number of new conceptual and theoretical considerations about policy coordination have been introduced in the recent past dealing with the different types and degrees of policy coordination (see, for example, Remøe 2008, Braun 2008, Whitelegg 2009). Braun (2008) identifies a set of five stages ranging from weak to strong coordination, proposing the following types and their characteristics (see also EC 2009b):

- i) *No coordination* means that mutual adjustment between actors is absent.
- ii) *Negative coordination* involves mutual adjustment of actors through the exchange of information (e.g. by interdepartmental committees, or inter-service consultations), but is not based on encompassing and predefined coordination efforts or cohesive action.
- iii) *Positive integration* means that actors explicitly cooperate in order to reach a common but distinct and impermanent objective (e.g. by common White Papers, joint management of a policy programme, etc.).
- iv) *Policy integration* strives for the active coordination of final goals.
- v) *Strategic coordination* is the most far-reaching type of coordination aiming at the joint development of encompassing common visions and strategies for the future upon which political actions are based.

In this regard, Braun (2008) further assigns the distinct degrees of coordination to different stages of the policy-making process¹⁶. *Negative coordination* and *positive coordination* refer to the administrative level of policy-making, i.e. policy implementation. In this regard, these two degrees are summarised under the heading ‘administrative coordination’, referring to commonly agreed-upon policy goals by a number of political actors, while an encompassing policy is still absent. The degrees *policy integration* and *strategic coordination* denote coordination already at the stage of policy formulation, i.e. at the political level of policy-making (‘policy coordination’).

From the perspective of STI policy, *strategic coordination* refers to an overall agreement on objectives and strategic goals provided to be the precondition for an integrated and multi-sectoral STI policy (OECD 2005a). In this perspective, the field of STI promotion has developed to a generic policy area, where a number of policy areas matter and strategic and coordinated actions are needed. Such an approach pays particular attention to the institutional structure and processes of STI policy-making. Thus, the governance dimension in strategic and operational terms takes centre stage in new STI policy approaches (Bórras 2009, Boekholt 2010).

2.3.2 Societal challenges as governance challenges for STI policy-making

As discussed in the Subsection 2.2, societal challenges are thematic policy targets that span across policy fields encompassing a wide array of actor types and knowledge sources to tackle them on a broad base. They may give thematic orientation for aligning and implementing a set of policy instruments around a predefined objective.

From the perspective of STI policy, a societal challenge-driven approach cuts across different policy boundaries and operational levels (Boekholt 2010); the scope of such an approach is much broader and complex than the goals perceived in traditional approaches imposing high requests on policy makers at the strategic and operative level (OECD 2005a, Boekholt 2010, Smits et al. 2010). Governance challenges for a societal challenge-driven STI policy, for example, refer to the way of political identification and selection of problems (i.e. the societal challenges) to be addressed by political

¹⁶ In the perception of the diploma thesis, policy-making is an interactive process comprising the analytical dimensions (‘stages’) of agenda-setting and vision building (problem identification), policy formulation, policy implementation, and finally policy evaluation. The advantages and flaws of the policy cycle as a tool to analyse the development of distinct policies is widely discussed in political science (see, for example, Parsons 2005, Fischer et al. 2007). For the purpose and scope of this diploma thesis, the four-stage process, as defined herein, is regarded as a sufficient framework for analysing policy-making and coordination in the European STI policy.

intervention, to practices applied in order to define the specific priorities and objectives to tackle them, or to mechanisms for integrating and coordinating the policy-related activities of the range of (public and private) actors most affected, most interested or most professional in an issue. In the following, major challenges and consequences for the organisation of STI policy resulting from a societal challenge-driven focus are discussed from a theoretical point of view, while the case studies in Section 5 will reveal how such governance modes and coordination patterns appear in political practice for distinct JPIs.

i) Interrelations between strategic and operational dimension of STI policy-making

A societal challenge-driven STI policy includes both a strategic and an operational level of policy-making (as proposed, for example, by Smits et al. 2010). At the strategic level of policy-making, complex societal challenges and a dynamic environment calls for an institutional transition of the whole policy regime by pursuing an open, systemic, resort overreaching, coordinated and integrated strategy. Issues of science, research, technology and innovation policy should be better coordinated or even strategically integrated in other policy domains, which is also reflecting in adjustments of traditional governance processes between STI and adjacent fields (OECD 2005a). This refers to reflexive and strategic governance structures that are related with the competencies, knowledge and ability to reflect on changing conditions and redefine governmental missions (see, for example, Remøe 2008, Weber 2009).

While the strategic dimension will enable effective governance on the basis of commonly agreed priorities and aligned expectations in the innovation system, political visions and priorities also have to be reflected in the operational dimension, i.e. in the implementation of policy instruments (Bórras 2009). Given the scope of societal challenges, a number of instruments have to be implemented in parallel (see Subsection 2.2). Especially in the case of demand-side instruments such as public procurement or environmental or health regulations they are primarily in the responsibility of other sectoral policy areas. Thus, the coordination of objectives perceived, problems addressed and rationales pursued between STI policy and other sectoral measures is crucial to pursue sufficiently broad and long-term goals set at the strategic level. On the one hand, this refers to improved mechanisms for horizontal policy and administrative coordination as well as to the involvement of various stakeholders in the policy-making process. On the other hand, 'strategic intelligence' and 'willingness to learn' on part of policy makers facilitates assessing and responding to current and future societal requirements (Smits and Kuhlmann 2004; Edler 2010; Smits et al. 2010).

ii) *Strategic selection of thematic STI policy priorities*

Notably with the upcoming systemic understanding of innovation in the 1990s, thematic policies focusing on a narrow sector or technology field have severely been brought into question. Centralised priority selection may bear high risks of government failure (EC 2009a). Thus, main arguments identified against strong thematic prioritisation may still remain today.

From a STI policy perspective, one crucial argument is that thematic funding efforts often refer to the precompetitive area in which neither the public hand nor firms have a clear idea of the application of research output (Steinmueller 2010). A strong governmentally defined focus on uncertain technologies bears the risk of too narrow and less flexible technological specialisation, and guiding into unfavourable technological directions creating ‘lock-in’ effects in certain technologies. This may subsequently have negative structural effects, making the national economy more jeopardised for external shocks.

Societal challenge-driven STI policies focus not exclusively on the development of radical innovations, but recognise the role of incremental and non-technological innovation, putting innovation uptake and final demand by a large target group at its core (EC 2009a). In many cases, the aim is to accumulate and facilitate demand articulation, for example, by means of strategic public (pre-commercial) procurement, in order to overcome innovation barriers associated with technology uncertainty and lacking prospects on adoption and use of new technologies (EC 2009a). Consequently, such thematic policy designs require the ability to sufficiently specify the priority as well as the scope of the programme. A too narrow programme design runs the risks of hampering innovative private initiatives by ‘overspecifying’ the themes (Steinmueller 2010). A market-driven selection of specific technologies is thus often regarded as more suitable to detect new and successful innovation possibilities, favouring the implementation of generic policies (see, for example, Boekholt 2010).

In contrast to prior mission-led approaches (for an overview, see, for example, Gassler et al. 2008, Boekholt 2010), the identification of priorities in current thematic STI approaches is not centralised at governmental units, but involves a variety of social actors and R&D performers. Moreover, detail-orientation and scope of technological predefinition is restrained. In the case of societal challenges, only the evaluation of societal needs and problems as well as common guidelines to address them with specifically designed policy measures are at the core of the political level, while the selection of distinct technologies

and design should occur bottom-up (EC 2009a). Thus, the aim is to provide orientation rather than politically predefine technological evolution. The analysis of JPIs in this context (see Section 5) will provide empirical evidence on how such bottom-up processes are organised in practice, laying particular attention on participatory aspects of objective and research priority definition.

iii) Creating strategic intelligence and policy-learning

A number of literature streams dealing with the ability of policy makers to adjust their actions and decisions to distinct experiences have emerged in public policy theory (see, for example, Bandelow 2003). Despite of differing views on the decisive sources of policy-learning¹⁷, they build on the common ground that the implementation of policies, their design as well as changes in policy strategies are determined by (active and passive) learning activities on part of actors involved in policy-making. Furthermore, ongoing evaluation activities are usually implemented throughout the entire policy process (see Wollmann 2003). They intend to provide knowledge and support policy decisions in questions of how and whether a programme should be further continued, or should it be re-designed or even terminated. The implementation of pilot programmes is a prominent example in this regard, as the limited introduction of a newly established measure provides policy makers with first evidence on appropriability, and at the same time may serve as practical test in terms of its societal uptake (Jann and Wegrich 2007).

In light of a societal challenge-driven STI policy, strategic intelligence and policy-learning refers to scientific and evidence-based capacity building throughout the whole policy-making process, referring to decision-making and administration of STI policy alike (Smits 2001, Braun 2008, Boekholt 2010, Smits et al. 2010). The institutionalisation of strategic intelligence and policy-learning methods may ensure effective systematic responsiveness to societal challenges by indicating the way in which STI can contribute to solve distinct problems, and thus, bridge the gap between new technological developments and responsive STI policy-making. First practices of strategic intelligence have evolved with the perception of complex innovation processes (Smits and Kuhlmann 2004). Attempts to institutionalise policy-learning and strategic intelligence structures have been further

¹⁷ Grin and Loeber (2007) distinguish in their overview on policy-learning theories between theories that focus on learning processes between policy domains encompassing lessons-drawing approaches (see, for example, Rose 1991) and theories on policy transfer (see, for example, Stone 1999 or Dolowitz and Marsh 1996), and learning processes within a particular domain that are mainly driven by ideas and arguments, such as in the case of policy-oriented learning (see Sabatier and Jenkins-Smith 1993) or societal learning (see, for example, Hall 1993).

developed with the growing importance of policy in guiding and managing innovation system activities.

From a governance perspective, strategic intelligence refers to discursive and knowledge-based practices that enable an opening up of STI policy-making to a wider range of actors (Smits 2001, Georghiou 2011). Concerning the multi-sectoral nature of current STI policy approaches, awareness building, training and reinforced communication and discourse between respective policy fields and administrative units may be fostered by strategic intelligence (Edler 2010). Distinct instruments provide support to the creation of strategic governance and policy-learning. Problem and need analyses, processes for stakeholder involvement, technology assessment or foresight studies may be appropriate instruments to foster strategic intelligence in STI policy-making (Smits 2001, Boekholt 2010). In addition, constant evaluations and monitoring systems of STI policy and their measures are the essence of policy-learning (OECD 2005a) and should accompany the overall policy-making process. They aim at facilitating and improving effectiveness of decisions at different levels of policy-making, regardless of whether priority setting, strategy formulation, or design and management of distinct programmes are concerned (Boekholt 2010).

The importance of strategic intelligence and policy-learning for the governance of an integrated and multi-sectoral STI policy is therefore twofold: First, to enhance responsiveness to broad societal challenges in general and assess future scientific and technological opportunities in this regard, and second, to build up awareness and competencies within governmental institutions for a strategic integration of STI policies agendas into other policy domains.

iv) The challenge to integrate science, technology and innovation policy

Having in mind the complex character of societal challenges in that they involve knowledge that go beyond scientific discipline-centred basic research (see Subsection 2.2), it is assumed that neither basic scientific activities nor technological R&D on their own can deliver sufficient inputs to tackle them. This poses several integration challenges as knowledge production has to be collective in several ways: Cooperation or even integration of scientific disciplines; making use of knowledge inputs from natural as well as social sciences; interlinking scientists, researchers, engineers with industry, businesses and the society as a whole.

In this context, Gibbons et al. (1994) describe a new form of knowledge production that is networked, problem- or application-oriented, transdisciplinary and reflexive. Not only universities, but also private and public research laboratories, industry as well as consultants or societal organisations may deliver inputs and impulses for scientific and technological knowledge production and innovation. In conjunction with societal challenges, this might imply high-quality basic research combined with application- and problem-related R&D in order to produce new solutions in societal significant areas combined with pervasive channels to spur societal co-production and facilitate innovation application by users.

Thus, in an integrated STI policy, a broadened understanding of the various types of innovation and their different generation processes needs to be ensured. In combining science and technology-related agendas with innovation policy, the risk is high to overemphasise technology-led innovations by neglecting the importance of other, non-technological types of innovation (see Subsection 2.1 and Subsection 2.2). For STI policies directed to societal challenges, the benefits arising from service innovations or social and organisational innovation but also their peculiarities in contrast to technological innovations may be of particular importance to tackle them sufficiently.

Moreover, it is as often as not clear-cut where problems start and where their solutions end. Societal challenges are to a high degree shaped by societal conditions and needs, implying knowledge inputs and problem-oriented research from both natural as well as social scientists in order to tackle them (EC 2009a). A multi-disciplinary approach accounting for distinct scientific disciplines and connecting various knowledge sources may be needed in order to adequately respond to multi-faceted problems.

v) Multi-sectoral coordination challenge

STI is supposed to be a promising tool for delivering contributions to reach various sectoral policy goals (see, for example, Remøe 2008, Edler 2010, Boekholt 2010). However, in most European countries the wide range of issues related with STI is not integrated into a single policy area and managed under one departmental roof (Braun 2008) giving rise to several coordination challenges with a STI policy that cuts across various policy fields:

First, societal aspects such as health care or climate change issues have increasingly been implemented in STI funding policies, leading to overlapping and horizontally fragmented responsibilities for STI policy agendas across various ministries and agencies. In such cases, however, labour division might be inefficient, as an overall and coordinated strategy is lacking (Boekholt 2010). Second, in the diverse case, other fields might be less aware about their position they have in leveraging R&D and innovation, such as it is the case for environmental regulations and public demand or procurement for sustainable and innovative solutions (Edler 2010). As promoting STI activities is insufficiently integrated in complementary policy agendas at both the strategic and operative or instrumental level, the potential of leveraging STI activity is not fully recognised by other sectoral policies and synergies between complementary policy fields might remain unexploited. Third, further multi-sectoral coordination problems might arise when policy actors lack awareness of the supporting role that research and innovation might play for the execution of their own tasks, such as for example the promotion of new technologies for enhancing environmental sustainability, or the application of ICT-based technologies in public sector activities. In such cases, STI as an instrument to tackle policy field-specific concerns might be underrated leading to insufficient demand articulation for innovation- or technological-related inputs from public actors (Remøe 2008).

If STI policy is targeted to tackle far-reaching and sector overarching societal challenges, further inefficiencies might arise from the segmented organisation of the public sector: As different ministries or public authorities are responsible for sectoral areas (Remøe 2008), policy intervention targeted to distinct societal issues are still segmented in different departmental responsibilities and not aligned in their formulation, design as well as modes of implementation. Traditionally, specific societal needs are directly related with a distinct policy field or sector, as for example the health department take overall responsibilities for issues of public health, while the environment department headed policy initiatives on environmental sustainability. This is the result of strong efficiency norms that have been applied to the organisation of the public sector (OECD 2005a, Braun 2008). However, a narrow and sectoral division of labour is more likely to induce particularism, duplications and inefficiencies (Braun 2008).

Moreover, it is increasingly recognised that policy areas still retain on specific modes of governance and favour specific instruments (Héritier and Rhodes 2011) that may be historically rooted in the steering culture of that particular field, such as regulations in environmental policy or direct funding or tax incentives in R&D policy. In light of the proliferation of interest on targeted R&D and innovation promotion across policy fields in

the recent past, this fact might be particularly relevant for implementing STI policy measures. By this, possibly conflicting general views, rationales and objectives (environmental sustainability in contrast to economic growth) but also differing and rigid institutional routines and cultures might appear as particularly challenging (Remøe 2008). A trend towards decentralisation and ‘agencification’ (OECD 2005a, Remøe 2008, Weber 2009) and related efforts of outsourcing the management and implementation of support programmes to designated private agencies may cause additional fragmentation problems. Encompassing strategies and institutional coordination along common objectives between governmental areas, but also between public and private actors, is expected to be a key in this regard.

For strengthening the cross-cutting understanding of STI policy, a coherent policy of how STI activities can be commonly promoted to tap their full societal potential at a particular issue is of crucial importance. Further, demonstration and awareness rising of the role that STI might play to tackle complex and multi-sectoral challenges are equally important elements. For that reason, the multi-sectoral coordination challenge comprises mechanisms on the strategic level encompassing strategic and long-term priority identification and agenda setting. Vision building on the future role of STI might loosen particularistic and short-term sectoral perspectives. Further, commonly agreed-upon needs, potential solutions and ordered intervention priorities at the highest level of policy-making might induce orientation and higher consistency also in a top-down way. Networked and participative measures for a joint formulation of common goals might additionally enhance awareness of institutionalised and sector-specific rationales and practices, working as a catalyst for all subsequent efforts and lower levels of policy-making (Braun 2008). Policy coordination also penetrates the operative level in a similar way, involving horizontal formal and informal coordination mechanisms to ease institutional boundaries and facilitating interdepartmental communication and coordination by the formation of network structures (Remøe 2008). This might give rise to systematic and more profound cross-department measures by jointly developing and managing cooperative instruments and policy programmes between complementary fields.

iv) Responsiveness and multi-actor coordination challenge

Despite some common characteristics outlined in the previous subsection, societal challenges are unique in their structure and hard to compare in terms of tackling them in practice. Appropriate solutions for an ageing population will very likely differ substantially from those for climate change, irrespective of scientific and technological input required or

adaptation in daily life is concerned. Thus, not only research on societal challenges needs to be responsive but also STI policy-making needs to take account of policy field-related characteristics and relevant actors outside the policy sphere.

In this regard, consulting and mobilising multiple actors may be particularly relevant in order to enhance the responsiveness to society, i.e. what citizens – particularly those affected – research communities, firms and industry really need. In this regard, private R&D efforts can only be mobilised if public incentives take account of business behaviour and rationales for investment (EC 2009a). Moreover, as far as radically new solutions and new technological developments are concerned, reluctances of users may be high (Edler 2010). However, societal challenges can only be tackled in full extent if the need for innovations, whether if social, organisational or technological, is widely tangible among several segments of the society. For these reasons, societal involvement in the entire policy-making processes is crucial in order to assess needs, preferences, threats and expectations in advance.

Conceptions and views on which problems should be resolved, appropriate perceived solutions as well as respective demands for political action might differ considerably between various independent actors; so, experts that take a professional perspective on a specific issue might have differing appreciations of ‘the’ appropriate policy solution than those persons directly affected with a specific problem, adding complexity to the form of policy-making. In addition, in the case of far-reaching problems in modern society, such as climate change, food security or ageing population, it is increasingly challenging to draw the line between those people directly affected with a specific problem and the many others who might have particular interest in finding a solution. Thus, public policy is confronted with the search for new of participation patterns that go beyond the integration of private actors directly affected in policy formulation or implementation (Hajer and Wagenaar 2003).

Although current governance and decision-making processes have become much more complex and decentralised, already relying on information and practical experience from different public and private actors, private actor involvement nevertheless varies considerably, ranging from consultation and hearing at a minimal level, to full and equal involvement at the highest level of decision-making (see, for example, EC 2002b, BKA 2009). In the case of societal challenges it is widely recognised that new participative and more inclusive forms of the decision-making processes are needed in order to respond to societal needs (see, for example, Könnölä 2009, Georghiou 2011). As a consequence of

the directly traceable societal dimension, opening up the entire STI policy process to private actors by engaging a variety of stakeholders in priority setting, policy formulation as well as the implementation of distinct programmes is regarded to be particularly relevant. Actors from the scientific community, industry or societal actor groups (NGOs, etc.) may bring in their experiences in order to adapt policy measures more efficiently to individual societal problems and needs.

Especially in the identification of priorities at the highest political level, widespread responsiveness to current and future societal needs is crucial (see, for example, Georghiou 2011). However, responsiveness of STI policy in this regard should go beyond the needs brought in by large and dominant stakeholder groups. When it comes to predefining or formulating distinct policies, also full consideration of problem- and field-specific characteristics is crucial. To assess the potential as well as the contributions that STI can make to tackle societal challenges, the involvement of experts with technological as well as market-related knowledge may also be necessary.

Although expert consultation is a characteristic element in modern policy-making processes in nearly all policy areas, scientific and technical advice-giving has a particularly long tradition for preparing and planning STI-related policy decisions (see Fischer 2003). The increasing complexity and uncertainty of today's policy issues intensified these information requirements, especially in themes that are of great public interest, such as environment or health issues. Professionals and experts provide policy makers with knowledge on present or potential future problems by delivering information and evidence on the related risks or the solutions needed to solve specific dilemmas¹⁸. Numerous theoretical and empirical analyses on public policy reveal that experts, or groups of experts, are important determinants of political processes. They actively participate in very different - formal and informal, firmly or loosely-integrated - institutional arrangements, from context-specific policy communities, issue networks (see Heclo 1978, Rhodes 1997; see also Miller and Demir 2007) or epistemic communities (see Haas 1992)

¹⁸ As Fischer (2003) points out scientific knowledge and information provided by experts is far from value-neutral. It is not only the selective interest-driven consultation on part of policy makers, but also the specific (self-) interests, domain-specific appreciations of science and selective views of certain issues represented by experts that may exert considerable power on shaping policy processes. Closely related with the dominance of values and interests in policy-making is the notion of 'belief systems' (see Sabatier and Jankins-Smith 1993) - a set of fundamental values, causal interests and distinct perspectives on problems - as introduced in the Advocacy Coalition Approach (for an overview see Weible and Sabatier 2007).

to think thank (see Stone 2007) or advisory boards installed for the purpose of giving (permanent) policy advice¹⁹.

In this regard, new types and platforms aiming at enhancing expert engagement and public-private-communication via the mobilisation of different stakeholders (e.g. industry, scientists, NGOs) become apparent in new EU STI policy designs addressing societal challenges (see EC 2008b). Prominent examples are the implementation of advisory boards, networking platforms, or discussion forums that should provide possibilities for more participative and open definition of policy priorities. The JPI approach that will be analysed in Section 5 of this diploma thesis, in principle, involves such participation and integration platforms aiming at a closer discourse between policy makers, scientific communities as well as citizens, social organisations or industrial stakeholders. Thus, the comparative case study strategy (Section 5) will devote special attention to the different patterns of societal participation in JPIs, and by this, focuses on the different forms of private actor engagement and the relevance of (scientific and social) knowledge in setting the objectives of the respective initiative. Table 2 summarises the governance challenges identified for societal-challenge driven STI policy, providing a reference for the establishment of coordination mechanisms in distinct thematic policy programmes.

Table 2: Dimension of thematic coordination arising from societal challenge-driven STI policy

Dimension of thematic coordination	Characteristics of societal challenges
Strategic level of policy-making	<ul style="list-style-type: none"> • High degree of complexity • Strategic and long-term policy priorities
Interdisciplinary STI approaches	<ul style="list-style-type: none"> • Involve scientific, technological and innovation input • Need for inter- and transdisciplinary knowledge production
Policy-field overlapping goals	<ul style="list-style-type: none"> • Cross-cutting policy themes • Major concern in several policy areas – impact of other policy activities
Societal responsiveness	<ul style="list-style-type: none"> • Social embedding - solutions rooted in the organisation of society • Major concern for a range of (public and private) actors

¹⁹ In the context of policy coordination to tackle societal challenges, the notion of epistemic communities as introduced by Haas (1992) is particularly interesting. On analysing intergovernmental policy coordination in environmental issues, he identifies a specific network of transnational professionals and experts with particular domain-specific knowledge but shared principals and beliefs that have been crucial for the political course, jointly developing solutions for complex trans- or international problems.

As the focus of this diploma thesis lays on the influence of societal challenges on European STI policy-making, the following section shifts attention to governance aspects of STI policy in the complex political system of the EU. Also in current EU strategies, STI is regarded as a key element and strategic driver for sustainable socio-economic development and growth throughout Europe (EC 2010a). In this regard, one of the major targets is to activate the collective production and diffusion of knowledge throughout Europe, fostering innovation, and thus, supporting Europe's standing in the global innovation competition. Joint policy endeavours, such as the JPI approach (see Section 5 for details), between multiple levels – regional, national and European – to pool research and financial resources throughout Europe and to create new arrangements for interlinking national activities are currently regarded as a promising approach to tackle future societal challenges (see, for example, EC 2007a). Thus, differing national innovation activities give rise to additional efforts to coordinate STI policy in Europe. 'Systemic' coordination mechanisms related with the political system of the EU will be elaborated in the following section.

3 Governance in a multi-level system: The European Union STI policy

After the general characterisation of STI policy-making in the context of societal challenges in the previous section, this section discusses the EU STI policy dimension that is crucial in the context of the research focus of the diploma thesis, particularly with respect to the empirical analysis on the Joint Programming Initiatives (JPIs) (see Section 5). In the EU, agendas for STI policy are shared between regions, member states and European institutions imposing considerable challenges for the governance of STI activities across Europe. Fragmentation of R&D efforts as well as diversity in STI policy schemes in member states give rise to efforts for better coordinating STI policy for which important impulses are set at the European level. In this context, however, the complex institutional structure of the EU, notably in terms of shared competencies in STI policy-making between multiple levels, multiple EU institutions as well as the increasing influence of multiple actors lead to additional difficulties in organising STI policy. For this reason, the multi-level governance system of the EU is at the centre of attention. First, it is necessary to provide an overview on the institutional structures of the EU in general in Subsection 3.1. Subsection 3.2 reflects on governance structures relevant for EU STI policy, before the consequences for STI policy coordination referring to the notion of 'systemic coordination' are introduced in Section 3.3.

3.1 Governance in the European Union: A general overview

In what follows, a brief overview on influential governance approaches that have emerged in relation with the particularities of the EU governance system as well as the general characteristics of the governance system of the EU is discussed. Both are regarded as highly influential for the distinct nature of European STI policy-making, especially as far as STI policy coordination in the European multi-level system is regarded.

3.1.1 Governance approaches of the European Union

As Hix (1998, p. 39) points out, the governance system of the EU is characterised by “a unique set of multi-level, non-hierarchical and regulatory institutions, and a hybrid mix of state and non-state actors”. For this reason, numerous studies in the recent past intend to disclose the most striking features of European governance in terms of patterns,

processes and actor constellations most distinctive for EU policy-making (see, for instance, Eising and Kohler-Koch 1999, Hooghe and Marks 2001, Héri-tier and Rhodes 2011).

When speaking about European governance, the notion of multi-level governance has come into fairly wide use. It is one prominent example particularly emphasising that decision-making authority is shared among multiple actors on different territorial levels (Marks et al. 1996, Hooghe and Marks 2001). The multi-level governance approach puts emphasis on the vertical dimension of coordination. Although recognizing the power of nation states, multi-level governance stresses the importance of interdependencies of local, regional, national and international actors. Further, supranational institutions act autonomously and exert individual influence on policy-making (Hooghe and Marks 2001). Further, policy networks – hybrid arrangements of actors that share an interest in a given policy sector (Peterson 2003) – are the main vehicles in order to pool resources and competencies from all levels and directly link sub-national with supranational concerns (Héri-tier and Rhodes 2011).

Although quite similar in their conception of the EU's multi-level nature and the influence of non-governmental actors, the concept of 'network governance' (Eising and Kohler-Koch 1999, Kohler-Koch 1999) highlights the type of interaction, and by this, particularly the horizontal dimension of policy-making in the EU. It turns away from governmental-centric approaches, emphasising the growing importance of non-governmental and private actors and their relations with the public sphere in policy processes. Having this in mind, the role of the 'state' is perceived to turn from an 'authoritative allocator' or 'steerer' to an 'activator' or 'mediator' (Kohler-Koch and Rittberger 2006). It is assumed that the emergence and diffusion of network formations is particularly distinctive for the governance system of the EU. Public and societal actors interlink each other in issue-specific or problem-specific arrangements at the European level in order to deliberate and align their positions, leading to an increasingly blurred demarcation between the private and public sphere (Börzel 2005).

Besides research streams focusing on the institutional and actor structure of the European governance system, other streams deal mainly with modes and instruments of political steering in the EU (see, for example, Héri-tier 2002, Tömmel and Verdun 2009, Héri-tier and Rhodes 2011). Growing references to 'new modes of governance' in EU Studies signalise the proliferation of the governance concept in its instrumental dimension, particularly emphasising the changing styles and instruments of coordination and political

steering employed by the EU²⁰. New modes of governance²¹ are characterised by their contrariety to the traditional Community method of legislation, their varieties in design and the predominance of 'soft law' over traditional 'hard' legislative acts, such as the deployment of recommendations, guidelines or benchmarks (Kohler-Koch and Rittberger 2006). This has become considerably recognisable since the establishment of the Open Method of Coordination (OMC) in the year 2000 (see, for example, Bórras and Jacobsson 2004 for details).

The notions of governance in general and 'new' modes of governance in particular have also entered the European political sphere as a normative concept or distinct political model. With the release of the White Paper on European Governance in 2001, the European Commission initiated a debate on 'good governance' in the EU. It seeks to renew the modes of governance and coordination between the EU institutions, member states, sub-national levels up to the civil society by fostering accountability, participation and openness to civil concerns²², on the one hand, and increase coherence in European policy-making, on the other hand (EC 2001). Consultation of expert groups prior to EU decision-making may be regarded as an additional attempt to enhance legitimisation of policy actions²³. The number of expert groups and advisory committees installed for providing advice in the field of research policy as discussed in the next subsection are a characteristic example in this regard.

3.1.2 Characteristics of the EU governance system

Several strands of literature discuss the governance system of the EU, notably in terms of the separation line between the European and the national sphere. Earlier attempts to classify the EU rely on integration theories (see, for example, Holzinger et al. 2005, Pollak and Slominski 2006), ranging from supranational approaches particularly focusing on the

²⁰ Tömmel and Verdun (2009) refer to 'innovative' modes of governance in this context.

²¹ As the notion is frequently used in recent European Studies literature, also the diploma thesis relies on this term. However, it is acknowledged that those instruments are not particularly 'new' in their design; the term should rather emphasise their scale and scope of implementation (see also Héritier 2002).

²² Non-governmental actors should gain better and sooner access to policy processes, either directly in the form of advisory committees, or more indirectly through institutionalised public consultation procedures. This is believed to be a response to compensate the democratic deficit claims often associated with the EU, but also to incorporate priorities or reluctances on part of the society already in the phase of policy formulation (EC 2001). However, numerous scholarly critics result from the release of the White Paper claiming that the goals related with increasing public participation are too ambitious to reach them, notably in light of the principle lack of democratic legitimisation of EU Institutions (Radermacher 2002).

²³ Induced by increasing critics regarding lacking transparency and openness of European policy processes, the EU defined common principles (EC 2002) that attempt to lay the involvement as well as the influence of expert advisory groups and committees on decision-making more open.

supranational aspects of the EU and institutions to intergovernmental views emphasising the still predominant role of member states to decide on public policy via their domestic political systems.

From these variations in theoretical conceptions on the EU and its degree of integration, it becomes clear that one of the most prominent characteristics of the EU is its bipolar constellation. This bipolarity finds expression in the EU institutions, on the one hand, and the member states with their national governments, on the other hand (Tömmel 2008, Jordan and Schout 2006). In contrast to European integration theories, the governance approach recognises that the supranational and national politics are not excludable from each other. They emphasise that the interrelations and dependencies of the European and the national sphere create a synthesis, becoming evident in a complex institutional setting structuring the relationships of actors.

According to Tömmel (2008), the system of the EU must be considered in the context of two underlying principles, an 'European' as well as a 'national principle', arising from a vertical dimension between the European and the national level and a horizontal dimension between European institutions. The former refers to the multi-level nature and the interactions between central European institutions, in particular the European Commission (EC), the Council of the EU (CEU) and the European Parliament (EP), and the governments of individual member states. The latter particularly appears in the institutional arrangements of the EC – acting in support of the Community as a whole – and the Council – representing the member states.

The EU governance system is characterised by the specific institutional structure that determines the division of competencies between the EU and member states, on the one hand, as well as the EU-internal relations between EU institutions and between public and private actors, on the other hand. The main institutional characteristics are the following:

i) Distribution of competencies between the EU and member states

On the basis of the structural relations between the EU and its member states, the most distinct characteristics of European policy-making are the following²⁴:

²⁴ Certainly, this list is far from finite; the items selected, however, are considered as the most fundamental and most noteworthy in light of the aim of this diploma thesis.

- Although European policy-making attempts to induce changes in economic and societal behaviour, numerous measures taken at the European level do not directly address citizens and economic actors, and thus, have rather indirect impact on economic and societal activities. Instead, legislative decisions are often directed to national or regional policy makers, and need to be transposed into domestic measures (Holzinger et al. 2005), or directly aim at regulating or guiding the member states activities by the implementation of common and coordinated strategies (e.g. Europe 2020 strategy or OMC).
- According to the Treaty of Lisbon (2007), the constitution of the EU follows a sectoral logic; competencies and power for entirely autonomous action at the EU level is limited to only a small fraction of domains. In most policy fields, competencies of the European and the national level are interwoven; they are either shared, or do not reach beyond a supportive or supplementary function on part of the EU, leading to a complex web of different strategies and policy measures on the national and European level rising the need to coordinate activities.

ii) *Distribution of competencies between EU institutions and institution-internal relations*

The horizontal distribution of power in the EU is to a high degree shared among the basic European institutions, leading to the fact that neither institution has single authority in executing their governmental functions (Pollack 2010). In general terms, law-making and policy implementation functions are shared between the European Council, the EC, the Council of Ministers, and the European Parliament (EP). Formal processes of cooperation are thought to take account of the different segments making up the EU, i.e. the EU as a whole, member states as well as European citizens (Hix 2005).

The tasks of agenda-setting and proposing policy initiatives are divided between the European council and the EC. Concerning long-term matters and political orientation of the EU, the European Council sets the major impulses for the overall strategic direction (Europa 2011a). In contrast, the EC exerts considerable influence on the short-term decision-making process and has the monopoly for agenda setting and proposing legislations (Hix 2005). Similarly, law-making functions are shared between the directly elected European Parliament (EP) and the Council of Ministers, passing legal acts by co-decision in nearly all policies and issues (Europa 2011a).

As a consequence of the shared competencies in the vertical and the horizontal dimension, lengthy negotiation procedures are characteristic for EU policy-making (Scharpf 1999). Formal and informal negotiations via institutionalised committees or rather informal networks usually precede final decisions on distinct policies. European institutions organise different kinds of committees, in which an inter-institutional consensus is negotiated and effectiveness of decision-making within and between the institutions should be enhanced (Christiansen and Larsson 2007). For example, inter-service consultation processes among different Commission departments, in which other departments have to give their approval for proposals of lead DGs, precede the adoption of an EC proposal.

Concerning bureaucracy and administrative work within EU institutions, similar to national ministries and their sub-units, each institution is highly segmented and tightly organised in the form of specialised branches and committees, such as education, environment or economic affairs, featuring weak coordination structures in their internal organisation (Hix 2005). Further, diversified institutional and organisational cultures and structures may have led to a gradual development of distinct routines, impeding a regular exchange of information and resources that cut across sectoral boundaries within one institution (Gornitzka and Sverdrup 2007). Although the division of labour in sectoral sub-units may facilitate negotiations between the different EU institutions, it may hamper the development of coordination and exchange mechanisms across sectoral policy fields.

iii) Influence of a wide range of actors

From an actor-based point of view, one central feature is that European policy-making encompasses a wide range of actors that go beyond the European and national public sphere, including regional and local authorities (Marks et al. 1996). Although public authorities still have a prominent role in decision-making, emphasis has shifted from an exclusive governmental view to the recognition of collective policy-making activities of private or non-state actors in different institutional settings. Policy networks formed by administrative staff, experts, stakeholders and civil societies influence policy-making from the policy initiative, over the decision-making to the policy implementation phase, and in doing so, execute information and consultative functions or even are responsible for the development, definition or implementation of policies and distinct programmes (EC 2001, Richardson 2006, Christiansen and Larsson 2007). In addition, in many cases external experts are called upon to monitor or evaluate current programmes on their achievements

and impacts, and in this way improve the quality and sustainability of public measures (Gornitzka and Sverdrup 2007).

3.1.3 Policy coordination in the EU as a specific mode of governance

EU policy-making encompasses a variety of different policy modes. Dependent on the policy field related competencies, they range from the classical Community ('supranational') method, as it is the case for the common trade policy, to regulative (e.g. legal regulation in environmental, health and consumer protection domain, competition rules) or distributional modes of governance (e.g. EU spending via structural funds in regional policy, or the Framework Programmes (FPs) in the research and development domain) (Wallace 2010).

In this respect, policy coordination is an extenuated mode of governance, intending to complement the traditional forms of law-making and aiming at developing common European standards to bind nationally rooted policies (Héritier and Rhodes 2011). According to Wallace (2010), the EC is the driver of such coordination mechanisms. Outputs of such deliberative arrangements take the form of 'soft' and declaratory commitments (Wallace 2010). They are based on voluntarism, i.e. non-binding agreements and flexible targets, rather than on hierarchical enforcement. Although the EC oversees their compliance, it does not have any formal sanction mechanisms at its disposal (Héritier 2003).

As soft law measures provide a higher degree of autonomy for member states, employing policy coordination mechanisms are considered as a means to combat member states reluctances to transfer further competencies to the EU level, but nevertheless promote 'horizontal coordination' across member states (Benz 2004). Member states can adjust measures and instruments in order to reach their defined targets on an individual basis. However, soft governance instruments may be seen as further centralisation instruments among national or subnational actors (Kaiser and Prange 2004). Thus, reference to the subsidiary principle is very significant in these arrangements since it defines the EU's leeway of action and hinders not to interfere with member states or regional competencies.

The Lisbon Strategy in 2000 has delivered impulses to anchor policy coordination by specifically designed mechanisms. The Open Method of Coordination (OMC) has been employed with the aim to ensure coherence in policy fields where delegating power of the

Community is limited, but convergence of member states' policies is regarded as more efficiently to reach the basic objectives of the EU (Eising and Lenschow 2007). Moreover, the increasing recognition of cross-country variations in social conditions and economic performance has been a driving force for such instrumental arrangements (Wallace 2010), providing at the same time mechanisms for horizontal policy learning between member states. The fields of education policy, macroeconomic policies as well as STI policies are common examples in which the EC promotes strategic coordination by means of comparison, benchmarks and best practices.

3.2 The governance structures of the EU STI policy

European STI policy-making is – as for the EU policy-making in general – characterised by shared competencies between the centralised EU level and the member states. As a consequence, the policy strategies and individual instruments are either set up at the EU-level or under national frameworks. Although a considerable degree of STI funds and support programmes is still provided at the national level, the EU seeks to provide coherence and strategically coordinate EU and national policies. At EU-level, a number of institutions are involved in the political decisions regarding STI policy, but also in the design of actual EU STI policy programmes. The European Commission – with its different administrative departments – is the most central actor in this regard, having major responsibilities for the initial formulation as well as implementation of EU initiatives, and by this, may deliver major impulses for the course of STI policy. While the next subsection provides a brief introduction into the main principals of competencies division in the European multi-level system, the following subsections deals in some detail with the array of political EU institutions, their administrative units as well as non-EU actors influencing STI-relevant policy-making.

3.2.1 Institutional background of European STI policy-making

The institutional structure of the EU leads to shared responsibilities in the execution of STI policy between the centralised EU government and governments of the EU member states. In the field of R&D, the competencies of the EU are regulated in Art. 2 of the Treaty of Lisbon (2007), stating that “in the areas of research, and technological development, the EU shall have competence to carry out activities, in particular to define and implement programmes; however, the exercise of that competence shall not result in member states being prevented from exercising theirs” (Art. 2 of the Treaty of Lisbon).

Referring to EU activities, the most prominent example are the EU Framework Programmes (FPs) supporting collaborative R&D across Europe since their inception in 1984²⁵. At the national level, countries pertain to implement their own STI policy programmes, ranging from basic research to different thematic country-specific priorities.

The legal basis for the EU research policy is Art. 179-190 of the Treaty of Lisbon, encompassing research and technological development and space. It provides the legal basis for the EU FPs, the concept of the European Research Area (ERA) and for joint activities between the EU and national policies. Further, it defines the frame for coordination activities in order to provide coherence between policies at different spatial levels. However, the agendas of innovation policy are assigned to the area of industry policy in which exclusive EU competencies are even more restricted. In this area, the EU has only supporting competencies, and thus, can only coordinate and supplement member states' policies (Art. 2 of the Treaty of Lisbon).

In areas of shared or supportive competencies, the principles of subsidiarity and proportionality are important reference points for justifying the scope of EU level actions. The subsidiarity principle restricts actions at the EU level "in so far as the objectives of the proposed action cannot be sufficiently achieved by the member states, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at Union level." (Art. 3 of the Treaty of Lisbon). This implicitly indicates that policy formulation as well as the implementation of policies is subject to the lowest authority level (national, regional or even local). Thus, policies performed at the EU level need to be legitimised in terms of effectiveness and appropriateness. In the field of STI, legitimisation is given only in cases where economies of scale and cross-border spillovers or externalities of STI policies can be expected (Radošević et al. 2008). Further, according to the principle of proportionality, the selected measures and instruments have to be proportional to their policy objectives (Art. 3 of the Treaty of Lisbon). In contrast, heterogeneity of national policy objectives as well as diversity in national preferences and circumstances may limit the scope of EU actions and restrain EU-led initiatives (Radošević et al. 2008).

²⁵ The EU FPs as main STI policy instrument have been attracted burst of attention in empirical research in the recent past, in particular concerning their contribution to the realization of ERA (European Research Area) (see for instance, Breschi and Cusmano 2004, Scherngell and Barber 2009 and 2011, Scherngell and Lata 2012).

3.2.2 Governing bodies of EU STI policy

In what follows, the central STI policy bodies are introduced, including different EU institutions, governing and advisory bodies as well as expert groups. Their main characteristics and their positions in the STI policy-making process are discussed in some detail below.

The European Commission (EC)

The EC is the main administrative organ of the EU. In addition, it has major political responsibilities that range from initiative, executive and representative powers to management and supervision duties (Hix 2005). At the level of EU-internal governing bodies, it has the right to initiate the short-term law-making process by proposing and drafting legislation, but also may propose priorities and distinct strategies for the development of the EU in the medium-run.

The EC as a political institution consists of a College of 27 Commissioners, one per each member state. Each commissioner, however, conducts the political leadership in the formulation of policies in one specific strategic area. Although commissioners are nominated by national governments, they have to execute their power independently and in the sole interest of the Community (Wallace 2010). A cabinet supports each commissioner, fulfilling advisory and inter-commissioner coordination functions (Hix 2005).

The EC as an administrative institution consists of 33 departments or directorates-general (DGs) and eleven services accomplishing the bureaucratic and operational tasks (Europa 2011b). Each DG is directly subordinate to a distinct commissioner and responsible for the tasks related to a particular policy field. Their main functions range from policy development, preparation and initiation of legislation, policy management to the provision of support and advise (Hix 2005). They fulfil the groundwork and provide the respective commissioner with the relevant information that is needed to carry out its political mandate. Although each DG leads a particular policy topic, most of the issues are interdisciplinary and relate to several DGs. Thus, the several DGs need to work closely together and coordinate the implementation of political decisions as well as the preparation of legislation proposals.

The DGs are responsible for executing the work programme as well as developing measures according to the political decisions (Hix 2010). Thus, the EC is the main

executive body of STI policy at the European level. In this regard, DG research and innovation (RTD) is the prime unit concerned with the implementation of the EU STI policy. By this, its main task is to conduct the EU FPs as well as to coordinate national and regional research and innovation support programmes (EC 2011a). By this, it holds overall responsibility for all issues regarding the creation and promotion of the European Research Area (ERA), ranging from enabling a free movement of researchers across Europe to the development of intergovernmental research programmes and infrastructure. In doing so, it fulfils a supportive function for other EU policies in the fields of e.g. health, energy, environment or regional development.

Thematic STI policies, especially those implemented under the EU FPs, are closely related with key tasks of other DGs (for example, in the fields of biotechnology, agriculture, food, health, industrial technologies, transport, environment or energy). Thus, various departments may exert influence on direction, scale and scope of such initiatives, demanding major interdepartmental coordination efforts of individual perspectives, interests and preferences related with the development and execution of thematically targeted R&D programmes.

Besides DG RTD, the following DGs are directly in charge of research and innovation support for both, policy formulation and implementation (see Anvret 2010):

- DG Enterprise and Industry (ENTR) is responsible for all activities related to the promotion of industrial innovation and runs the flagship initiative ‘Innovation Union’ (EC 2011b).
- DG Information Society and Media (INFSO) runs large-scale programmes to promote research on as well as the uptake of Information and Communication Technologies (ICT) and to better connect researchers across Europe (EC 2011c).
- DG Mobility and Transport (MOVE), supports research and innovation projects in the field of sustainable transport technologies and systems (EC 2011d).
- DG Environment (ENV) is in charge of activities related to the promotion of energy technologies, and thus, is highly involved in the EU FPs and responsible for the development of the SET Plan, the European Strategic Energy Technology Plan (EC 2011e).
- DG Economic and Financial Affairs (ECFIN) holds overall responsibility for public procurement schemes, and thus, the uptake of innovative solutions in the public sector (EC 2011f).

- DG Education and Culture (EAC) is responsible for all activities in relation with education, skill development and training of high-skilled workers, students and young researchers, and runs, for example, Marie-Curie Actions for researcher mobility across Europe (EC 2011g).
- DG Joint Research Centre (JRC) is responsible for providing reference on science and technology and policy support in EU policies (EC 2011h).

Additional funds or indirect support of research and innovation are given by cross-cutting policies (Anvret 2009), such as

- DG Regional Policy (REGIO) through promoting innovation activities of regions by financial means of the European Regional Development Fund (ERDF),
- DG Employment, Social Affairs and Inclusion (EMPL) through promoting skill development and employment by the European Social Fund (ESF), and
- DG Agriculture and Rural Development (AGRI) through funds from the Common Agricultural Policy (CAP) as well as its activities to research projects in food, agriculture and fisheries, and biotechnology knowledge-based-bio-economy.

On accounting for retroactive aspects and indirect impacts from other policy areas, the following DGs additionally need to be mentioned (Anvret 2010):

- DG competition (COMP) in the form of regulations concerning state aid,
- DG Internal Market and Services (MARKT) through their initiatives in public procurement, promotion of an internal market for services and the standardisation of intellectual property rights (IPR),
- DG Health and Consumers (SANCO) for the setting of health and safety regulations,
- DG Taxations and Customs Union (TAXUD) through fiscal incentives,
- DG Eurostat (ESTAT) for gathering and providing statistics and,
- DG Justice (JLS) with regard to third country researchers and high-skilled workers.

From the extensive list above, it becomes obvious that STI policy matters are highly complex and interrelated with other policy fields. Given the fact that STI policy has evolved to an 'umbrella policy' (Bórras 2003), research and innovation feeds into almost all areas, while, in turn, major impulses may also come from other policy domains, leading

to considerable complexity in the organisation and implementation of STI policy measures (OECD 2005a, Boekholt 2010).

The Council of the European Union (CEU)

The Council of the European Union (often referred as Council of Ministers or Council) is, together with the European Parliament (EP), the main legislative body of the EU. The Council is composed of the respective 27 national ministers for a specific thematic field, but depending on the functional policy domain under consideration, meets in different configurations (Pollak and Slominski 2006).

It is headed by the Presidency, which is held by a member state's government and rotates every six months. It has significant control over the agenda and may be a considerable driving-force for the direction of policy-making in the EU. As the member state holding Presidency have distinct leeway to select the EC's proposals to be discussed in the Council, they may influence the priorities of legislation by promoting national preferences during the term of office (Hix 2005)²⁶.

As the Council is the forum for national governments at the European level, a lot of preparation and coordination work needs to be done at the level of national administrations (Wallace 2010). The elaboration of national positions lies in the responsibility of federal civil servants. In this respect, consulting and collecting the positions of other relevant governmental and public branches, as well as NGOs and private organisations are a considerable part of their tasks. The Council is the European institution in which member states' interests are most directly and most influentially represented (Hix 2005, Wallace 2010). The tight relations between the national and European level may lead to conflicts of interests and considerable pressure on the national ministers. On the one hand, they ought to bear the interest of the entire EU in mind; on the other hand, they are directly accountable to the national level, and are assigned to act according to national interests.

²⁶ The Committee of Permanent Representatives (Coreper) is subordinate to the Council and responsible for preparing the meetings, but also for agreeing on a majority of the items beforehand (Pollak and Slominski 2006). The Coreper seeks to build broad consensus at the diplomatic level before the legislature is passed to the Council configurations. The ministers themselves discuss only a small fraction of decisions personally; only those which could not be resolved in advance and are in need of a compromise at the political level (Wallace 2010). In this context, the thematically specialised working groups or committees play an important role. They assist the Coreper and exercise the groundwork for the Council by negotiating proposals of the EC in order to build an informal consensus already at the administrative level (Christianson and Larsson 2007).

Considering the agendas of science, research and innovation, most of the relevant decisions are made in the configuration of the Competitiveness Council. It is responsible for the issues related to internal market, industry, research and space (CEU 2011). Working groups with a potential research or innovation component are the Working Party on Research, the Joint Working Party on Research/Atomic Questions, the Working Party for Establishment and Services, the Working Party on Public Procurement, the Working Group on Competitiveness and Growth, the Working Group on Competition as well as the Working Group on Technical Harmonisation.

Due to the considerable amount of expenditures distributed through the EU FPs²⁷, also the Council for Economic and Financial Affairs (Ecofin) plays a considerable role for STI policy-making. In addition, the broadening of STI policy in general, as well as the thematic extension of the FPs makes Council configurations of Employment/Social Policy/Health/Consumer Affairs and Education/Youth/Culture/Sport as well as Agriculture and Fisheries, Transport/Telecommunications/Energy and Environment increasingly important. Consequently, the different branches involved have to work together and coordinate their issues already at the working group and permanent representative level in order to enable a fast and efficient decision-making process at the highest level of the Council. Since in most of the cases the Council merely agrees on the decisions made at lower levels, the most important aspects of STI policy-making processes take place in the working groups or Coreper (Committee of Permanent Representatives).

The European Council

The European Council is the platform for the member states' Heads of State or Government, meeting usually twice a year with the President of the European Council, the President of the EC and the representatives of the EU for foreign affairs and security policy. Its major task is to define common guidelines for the general political direction of the EU. For this reason, European Council conclusions may provide important impulses for the development of common political strategies. In the matter of STI policy, for example, with its agreement on the Europe 2020 strategy in March 2010, the European Council emphasises the significance of research and innovation for the further development of the EU and gives an additional sign for STI policy to be on top of the political agenda (see European Council 2010)

²⁷ The currently running 7th FP accounts for more than 50 bn Euros for the period 2007 to 2013 (Europa 2011c).

The European Parliament (EP)

The EP is the directly elected institutional representation of European citizens in the EU consisting of 736 delegates. Due to gradually increased power with major Treaty revisions, the EP has major functions in adopting – together with the Council in co-decision – European legislatures as well as deciding upon the EU budget (Europa 2011). Moreover, it is responsible for controlling the EC in exerting their executive function. The EP is organised in several standing committees. The Committee on Industry, Transport, Research and Energy (ITRE) is the most important for the agendas of STI policy, advising the EP on EU STI policy matters in general, and decisions on the EU FPs in particular. Through its budget authority the EP may exerts major influence on the overall financial EU resources devoted to research and innovation as well as the amount assigned to specific priorities (Hix 2005).

Other supportive bodies in European STI policy

Various other supportive EU bodies accomplish important operational functions in overall European STI policy-making. Expert groups of the EC are a prominent example in this regard. Besides internal studies and ad-hoc hearings, expert groups provide the EC with domain-related expertise and scientific knowledge on a rather permanent basis. The consulted members might be individuals representing either their personal views or the interest of stakeholders in a particular field, organisations like companies, trade unions, NGOs, scientific or research institutes, or civil servants and national / regional / local authorities (Larsson and Murk 2007).

Given the prominence of R&D and innovation for the overall strategy of the EU, DG Research and Innovation and its subunits very frequently rely on external advice and the establishment of permanent committees and temporary expert groups (Gornitzka and Sverdrup 2007). Scientific and industrial research-related knowledge and policy advice is believed to compensate for the lack of an adequate internal knowledge base. Further, recourse to external information is essential in establishing common priorities and coherent strategies, streamlining existing programme designs, and managing numerous co-existing programmes efficiently. Continuous monitoring and evaluation activities might further contribute to enhanced legitimisation of research funds provided by the EU.

Further, a consultation of member states opinions and experts in the policy development phase might be an attempt to pull together national and European activities, increase acceptance and accelerate implementation on part of member states. In this context, expert groups provide an additional forum to coordinate and connect tasks with member states and stakeholder interests, and are often regarded as a means for individuals and stakeholder communities to feed the EC's administrative and political issues with scientific and societal aspects (Gornitzka and Sverdrup 2007).

In STI policy, the European Research Area Board (ERAB) is one of the most important examples regarding external advisory bodies or expert groups. It has been established as an independent consultative body in all policy issues related to the creation and promotion of the European Research Area (ERA). By this, it assists the EC in the preparation of legislative proposals as well as in the formulation of policies. Expert advice is given in the form of recommendations and reports on current strategic STI policy issues. The ERAB has been installed in 2008. As an advisory board it is composed of 22 experts from science, research, business and industry (ERAB 2011).

In the recent past, the EC has convened additional advisory or experts groups on very specific topics. The most prominent and influential examples are the expert group on 'Creating an innovative Europe' chaired by Esko Aho in 2006, the expert group 'Challenging Europe's research: Rationales for the European Research Area (ERA)' chaired by Luke Georghiou in 2008, and that chaired by Luc Soete in 2009 on 'The role of community research policy in the knowledge-based economy'. In addition, the number of advisory groups for FP7 reflects the significance of the EU FPs coordinated by DG Research and Innovation.

The European Research Area Committee (ERAC)²⁸ has an outstanding position as supportive body. It is a specific committee attributed to the Competitiveness Council, but has been initially set up in order to strategically advise both the Council as well as the EC in matters related with research and innovation policy development. With the ambition to create an integrated European Research Area, ERAC was reoriented and has gained increasing importance in the STI policy-making process. The committee has attained a new task in enhancing the governance of the overall European STI policy and aligning national and European policies in this context (EC 2011i). In addition to the ERAC, ad hoc working groups may be established, as it has been already the case for the High Level

²⁸ With the ambition to enhance the governance of ERA, the former CREST (Scientific and Technological Research Committee) has attained new tasks and has been renamed in ERAC in 2009.

Group on Joint Programming (GPC)²⁹ or the Strategic Forum for international S&T Cooperation (SFIC)³⁰.

3.3 STI policy coordination in the European multi-level system

Governing STI in a multi-level and multi-actor system faces a number of challenges in terms of policy coordination. As outlined above, European STI policy is by far not only subject of distributional governance via the provision of funds in the EU FPs, but it has developed to a field in which European-led coordination activities between multiple levels are becoming increasingly important on a multi-lateral basis.

In general, rationales for European wide cooperation in STI policies are avoidance of duplication, pooling of limited resources, joint building up of expensive infrastructures, exchange of good practices and better opportunities to tap expertise and knowledge outside the national sphere (see, for example, Svanfeldt 2009). However, mutual adjustment of national STI policies would not go far enough to reach ambitious goals related with enhancing complementarities and overcoming fragmentation, but strategic alignment of STI policy directions between countries – but also in a vertical dimension between the national and the European level – is needed. Today, one of the main tasks assigned to European STI policy therefore is to implement mechanisms in order to frame individual approaches and provide strategic coherence between the different territorial levels (see, for example, Bórras 2003, Kaiser and Prange 2004).

Strategic coordination seeks to provide consistency in developing and pursuing goals, strategies and policies along several phases of policy-making from agenda-setting, to policy formulation and finally to the implementation of certain policy measures (Braun 2008). In European STI policy-making, however, a central question in this context is the division of labour and responsibilities for designing and implementing own policies among vertical levels (EC 2009a). Moreover, the diversity in the member states' innovation systems poses additional requests to the comprehensive STI policy coordination (Kaiser and Prange 2004). Based on challenges Europe's STI policy is currently facing, central mechanisms for policy coordination in a multi-level system are to be identified in the

²⁹ The aims and mission of the High Level Group for Joint Programming (GPC) are discussed in more detail in Section 5.

³⁰ The objective of SFIC is to enhance the international orientation of ERA by preparing and coordinating joint research-related activities with third countries. The EC as well as member states delegate representatives to the SFIC (EC 2011i).

following. These mechanisms refer to both multi-level and multi-lateral coordination, and additionally take into account the emergence of new governance patterns between public and private actors. Thus, recent European STI policy coordination efforts are often related with 'soft' governance instruments based on voluntary national commitment, i.e. they reflect the EU's complex institutional structure and the shift in governing styles.

3.3.1 Challenges for systemic coordination in the European multi-level system

Certainly, societal, economic and technological benefits of joint STI programmes and measures are the ultimate goal of STI policy intervention. However, such politically induced joint STI activities are structurally embedded in the overall multi-level governance system providing the frame for the success of coordinated approaches. In this regard, the European governance system bears considerable structural challenges for consistent STI policy approaches:

- i) *Fragmentation of R&D efforts and structural diversity of innovation systems:* A first set of rationales for enhanced coordination can be subsumed under the heading of fragmented R&D efforts (Muldur et al. 2006) and structural diversity of innovation systems across Europe (see, for example, Kaiser and Prange 2004). National innovation systems are still heavily dominated by sectoral patterns of specialisation, also reflected by local institutional framework conditions, the education system, the concentration of firms, as well as preferred types of public intervention (Boyer 2009). These characteristics point to systemic challenges related to the pooling of STI resources, linking researchers, providing common standards and frameworks and establishing networks across Europe (see, for example, Svanfeldt 2009).
- ii) *Shared responsibilities and competencies in policy-making across multiple levels:* According to the Treaty of Lisbon (2007), competencies and responsibilities to formulate and implement policies in the field of STI are shared between different governing bodies at different levels (see Subsection 3.2). Overlapping authority between member states and centralised EU governing bodies leads to a huge variety of individual support strategies and programmes that are running parallel at different organisational levels (Muldur et al. 2006, Delanghe et al. 2009). However, the majority of support programmes are conducted at the national level (Muldur et al. 2006). As individual member states hold overall responsibility, in both development and operation, they are primarily designed to address own priorities with weak reference to policies at higher levels. In addition, the role of the local and regional

level in acting as an efficient hub for R&D and innovation is increasingly recognised in STI policy (see, for example, Cooke 2001) leading to a proliferation of region-specific instruments that are in some cases also under full regional authority. Consequently, responsibilities to govern STI policies are further divided within national boundaries. In addition, EU level responsibilities complement national initiatives when a 'European added value' is observable or the scope of the programme would outreach national capacities (Bórras 2003). Thus, a clear delimitation of distinct responsibilities for strategic policy-making and policy implementation functions is hard to draw. In practice, multiple levels have become gradually and increasingly interwoven (Bórras 2003). Although the subsidiarity principle was intended to systematically structure the division of STI policy responsibilities between the different territorial levels, it does not work as an appropriate coordination mechanism in practice (Kuhlmann and Edler 2003). Its ambition is primarily based around a principle of selecting an optimal level of policy-making (Radošević et al. 2008), and by this, the vertical coordination mechanisms implicitly involved might probably be too weak.

- iii) *Fragmented implementation and a variety of funding channels*: Due to the multi-layer architecture, the very specific competencies and the limited budgetary resources at the EU level, a variety of support channels for research and innovation co-exist (Bórras 2003). Currently, specific measures are centrally managed by the EC (such as the FPs, the Competitiveness Programme (CIP) or the Structural Funds), fully organised at the national level or even conducted at individual regional levels. In addition, joint national programmes in the form of intergovernmental agreements co-exist with joint programmes between the EU and the national level. Taking all these measures together, this leads to the fact that STI funding is not systematically structured and harmonised across Europe but fragmented into a number of supporting channels working at different levels. This fact refers to what is called a 'governance gap' in European STI policy-making (Kuhlmann and Edler 2003, Muldur et al. 2006). In this respect, consistency of policies within and across levels is needed in order to reduce duplication and fragmentation of support, mutually exploit synergies and ensure greater consistency across policies at the local / regional, national or European level.
- iv) *Disparities in national strategies and priorities*: Member states' efforts are subject to individual strategies and diverse targets, and they are defined within national borders, often lacking intergovernmental or transnational coordination (Svanfeldt 2009). Furthermore, regional measures customised to specific regional conditions are

additionally appearing. Thus, the importance for ensuring long-term commitment and aligning strategies among the national and / or regional level – notably in terms of underlying visions and priorities – increases (Muldur et al. 2006). Moreover, national policy initiatives often do not reach beyond national borders and are only accessible for national entities, such as domestic universities, research organisations and firms. Due to weak linkages and resistance to mutual agreements between countries, they often lack openness to transnational initiatives (Svanfeldt 2009). National policies are less aware of potential benefits and cross-border spillovers that might arise from joint programmes (Radosevic et al. 2008).

In the EU, multi-level coordination is widely considered as essential, especially in light of the ERA goals as one of the top priorities in current STI policy-making (see, for example, Delanghe et al. 2009). The structural obstacles of the European STI funding landscape give rise to the need for closer aligning STI activities and policies on a multi-level (between multiple territorial levels) and a multi-lateral (between member states) basis. In this regard, joint programming, i.e. the design and implementation of cross-border public STI programmes within a common strategic framework, constitutes a major step towards opening up individual programmes leading to a higher level of coordination and cooperation between countries (Pérez et al. 2010).

However, evaluations of previous cross-border efforts show that within large-scale and long-term joint endeavours additional obstacles might arise (for an overview see, for example, Horvat et al. 2006) that might also be crucial for the successful implementation of JPIs. These obstacles have been closely related with the general systemic challenges, such as country specific research priorities, regulations, public funding principles or STI competencies, but also refer to different interests in conducting the joint programme, reflected in diverse perceptions on timing, management and funding of the initiative. In addition, hampering factors have become gradually higher, when private actors from the scientific, research or industrial sphere are brought into the management of the joint initiatives (Svanfeldt 2009). For this reason, efforts to better align specific STI policy measures need to take account not only of the technological benefits arising from closer coordination, but also need to assess complementarities in stakeholder interests and objectives between multiple levels and actors.

The JPI approach, which is at the core of this diploma thesis (see Section 5), is a prominent example for advanced cooperation efforts between European countries that are supported and coordinated at the EU level. Generally speaking, JPIs follow a common

strategy with jointly agreed priorities and are set up for the purpose of tackling societal challenges that are of mutual interests for the participating members of the initiative. The empirical investigation in Section 5 will provide insight into how systemic coordination challenges are considered and dealt with in the JPI approach. For this purpose, Table 3 summarises the above-mentioned challenges according to their multi-level and multi-lateral dimension. The analytical framework that will be derived for the empirical analysis (Subsection 5.2) will – in addition to the dimensions of thematic coordination as derived in Section 2 – include these general systemic coordination challenges, while their practical appearance and relevance in distinct JPIs will be explored in more detail by means of a comparative case study strategy presented in Subsection 5.3 and Subsection 5.4.

Table 3: Challenges for systemic policy coordination in European STI policy

Dimension of systemic coordination	Characteristics of systemic coordination challenges
Multi-level coordination	Shared responsibilities and competencies in policy-making across multiple levels
Multi-lateral coordination	Fragmentation of STI capabilities and disparities in national STI strategies and priorities
Multi-level and multi-lateral coordination	Variety of funding channels and STI support programmes

4 STI policy-making in the European context: A shift towards ‘Grand Challenges’

This section shifts attention to the empirical part of the diploma thesis by investigating STI policy-making in a European context, laying special emphasis on the shift towards societal challenge-driven STI policy-making at the EU level in terms of the so called ‘Grand Challenges’. Such ‘Grand Challenges’ are regarded as major societal or environmental problems of pan-European nature that require STI input to tackle them. They first entered the political debate on EU STI policy with the recognition that lacking political governance has been one of the main hampering factors for a closer integration of the European research and innovation landscape. Since previous EU STI policy efforts to closer coordinate fragmented STI activities have not brought the expected results, placing an increased focus on such EU-wide societal problems, as it has been proposed, should not only deliver valuable contributions to tackle such problems by STI input but also enhance multi-lateral cooperation and coordination of research and innovation efforts throughout Europe. The focus on ‘Grand Challenges’ also provides the conceptual foundation for the establishment of the Joint Programming Initiatives (JPIs) explicitly designed to deal with such societal challenges by integrating regional and national research activities addressing a specific societal challenge across Europe. Thus, two JPIs are analysed – given the research focus of the diploma thesis – according to the practical consequences of societal challenge-driven STI policy in Section 5.

To get started with the empirical analysis of STI policy-making in the European context, initially the historical development of STI policy orientation and priorities will be discussed in Subsection 4.1. By this, the evolution of the EU Framework Programmes (FPs) – considered as the most important STI policy measure of the EU – illustrates that EU STI policy has passed through several phases since their implementation in 1984, pointing to remarkable re-orientations in the priorities of EU STI policy until now. Subsection 4.2 concentrates on the recent shift of EU STI policy-making towards ‘Grand Challenges’ by elaborating on the evolution and consequences of an EU STI policy that is increasingly societal challenge-driven. Finally, Subsection 4.3 focuses on the development of coordination efforts from the traditionally multi-lateral and fragmented nature to a strategic coordination at EU level.

4.1 Development and priority setting in EU STI policy

Development and priority setting in EU STI policy-making has been to a large extent dominated by the establishment and design of the EU Framework Programmes (FPs). In essence, the FPs have been the sole institutionalisation of EU level STI policy for a long time, constituting a major vehicle for the integration of national STI activities and policy programmes. Their design reflects the evolution of thematic priorities in EU policy-making as well as the respective innovation paradigm. In this respect, the programme is in empirical terms considered as an illustrative case that reveals the shift from technology-led rationales, via economic- and innovation-based rationales to the approach of 'Grand Challenges' as a new cornerstone of EU STI policy.

In what follows, the development of thematic priorities and policy instruments in EU STI policy since the early 1960s is discussed in some detail, mainly devoted to the EU FPs from their implementation in 1984. It is generally recognised that thematic priorities and STI policy instruments are strongly interlinked with the perception and theoretical models of innovation processes (see Subsection 2.1) in a certain time period (see, for example, Bach and Matt 2005, Boekholt 2010). However, STI policy-making in an EU context is not only the single result of theoretical models but also the outcome of dynamic institutional structures and interrelations in political processes between member states and the EU.

Development of thematic priority setting and EU STI policy instruments from the early 1960s to 1984

Recognising the important role of technological change as engine of economic growth in the early 1960s, several attempts at the European level were made to develop cross-national STI policies, mainly focused on science policy addressing basic research. The country-specific governments inclined to accept a loss in competencies on STI activities only in 'mission-oriented' initiatives that attempt to shape and support very specific technological paradigms and trajectories, such as in the fields of nuclear energy or military-based technologies (Gassler et al. 2006). Public authorities demanded for scientific knowledge and new technologies in sectors with huge financial and infrastructural requirements. For this purpose, governments established nationally or intergovernmentally managed laboratories in which all central parts of research activities were conducted. Private R&D efforts of e.g. industrial firms played a rather minor role in such programmes. Thus, the funding principle of 'mission-oriented' programmes was in line with a 'science-push' understanding of innovation processes, referring to knowledge

creation through basic research that is subsequently taken up by engineers and applied researchers in specific laboratories (see also Subsection 2.1). Science policy was therefore the main driver for policy intervention, and also for thematic priority setting in European STI policy.

During the 1970s, policy changed in face of critical economic situations and the emerging 'technology gap' between Europe and its main competitors, the US and Japan. Attention was shifted to the industrial usage and applicability of technologies, often referred to as key technologies that were regarded as crucial for economic growth, leading to a closer integration of science or technology policy and industrial policy concerns (Boekholt 2010). Emphasis was laid on the application and diffusion of such key technologies and 'strategic' industrial sectors (e.g. ICT, biotechnology) by directly promoting or subsidising activities of private firms operating in these technological areas. In this context, economic rationales or typical industrial policy conceptions in the form of economies of scale or the presence of spillovers and externalities provided legitimisation for STI policy making (Gassler et al. 2008). Although such initiatives have become to a large degree application- and industry-oriented, they still followed the science and technology push principle, based on the linear model of innovation. At the same time, they have almost entirely concentrated on the supply-side of R&D. In Europe this shift in STI policy has brought an increasing acceptance of EC engagement on behalf of the member states, leading to the establishment of the DG Research, Development and Employment (1973) and the constitution of CREST, the committee for scientific and technical research (1974) (see, for example, Prange 2003, Guzzetti 2009, Tindemans 2009). Both the aim of industrial competitiveness and the expansion of EU competences has led to the establishment of the first entirely EU-led funding initiative - the European Framework Programmes (FPs) in 1984, placing emphasis on supporting R&D in key technologies.

The shift towards pre-competitive collaborative R&D promotion (1984-2000)

Based on new models describing the innovation process as interactive collaborative process (see Subsection 2.1) – leading to a systemic perspective for European STI policies – policy programmes implemented at the EU level during the 1980s followed such advanced theoretical indications by shifting attention to the promotion of pre-competitive collaborative research. From an instrumental perspective, this period was characterised by the strengthening of the European-level in STI policy making. The cornerstone in this context constituted the creation of the first EU FP for Research and Technological Development (FP1, 1984-1987). By this, the previously perceived role of the EC in terms

of coordinating exclusively huge and strategically important STI programmes (examples are cross-border programmes such as the European Strategic Programme on Research in Information Technology (ESPRIT), or the centrally organised Joint Research Centres – JRC) was augmented with the autonomously managed allocation of EU funds to pre-competitive R&D projects in strategic areas of common European interest (e.g. ICT, material technologies, energy, environment) (see, for example, Prange 2003). Besides the principle that public funds should not intervene into market forces, it was stipulated that the FPs should serve as complementary instrument to national funds. Thus, early FP funds were based on the principles of ‘non-substitution’ and ‘additionality’ of the European level and therefore relatively small in scale compared to national R&D expenditures (Bórras 2003).

During the 1990s, EC support in terms of funds increased remarkably. Funds allocated doubled with FP4 (1994-1998). Further, European level competencies expanded with the Treaty revisions of Maastricht (1992) and Amsterdam (1999) (Prange 2003). From that time on, the EU was allowed to take actions that would ensure effective coordination between member states’ and EU activities in STI policy. Further, decision-making procedures in the Council were loosened with regard to the FPs, facilitating to surmount difficulties related to member states’ resistances in distributing EU budgets for R&D activities. Institutional changes and expansion of FPs were also triggered by the rising gap in innovation performance and competitiveness to the US observed in the early 1990s, in particular in high technologies such as ICT or Biotechnology (Boekholt 2010).

However, evaluations of previous funding principles pointed to central weaknesses in terms of the transformation of new technological knowledge into innovative products. Further, lacking horizontal coordination between DGs of the Commission and vertical coordination between territorial levels were regarded as major shortcomings of the European STI funding system, giving rise to new European STI policy strategies in subsequent policy designs (Bórras 2003, Prange 2003). The EC was the driving force in re-orienting EU STI policies in the mid 1990s, releasing a Green Paper on Innovation (EC 1995) as well as a first Action Plan for Innovation (EC 1996). This resulted in the restructuring of FP5 (1998-2002) with a reorientation on thematic ‘key’ areas, on the one hand, and the implementation of horizontal or generic programme lines, on the other hand. Such generic programmes particularly focused on the perceived structural weaknesses of European R&D and innovation activities (Prange 2003), such as the low level of science-industry collaboration or R&D activities by small and medium enterprises (SMEs). Promoting science and industry collaborations or funding specific SME or

entrepreneurial activities were regarded as promising tools to overcome barriers to knowledge transfer; and by this, to contribute to economic competitiveness and growth.

The Lisbon Strategy as major impulse for European STI policy coordination

The Lisbon Strategy and the initiative of the European Research Area (ERA, see also Subsection 2.1), launched in the year 2000, is intended to bring new impulses for European STI policy making by fully incorporating the 'systemic approach' and gearing towards interaction, coordination and collective knowledge production across Europe (Bórras 2003). Henceforth, systemic and multi-level coordination has been perceived as one of the key roles of European STI policy making (see, for example, Delanghe et al. 2009).

While previous FPs mainly aimed at funding collaborative R&D activities between universities, research agencies and companies, i.e. cooperation at the project level, FP6 (2002-2006) has changed the focus of STI promotion patterns by emphasising coordination of national and regional R&D programmes, i.e. at the programme level of STI policy (Muldur et al. 2006). In experiencing a considerable augmentation of financial resources in contrast to its predecessors, FP6 has been regarded as major vehicle for realising ERA, giving rise to a number of new policy instruments (Bórras 2003). New network-based instruments that envisage pooling of research capacities and resources (e.g. Networks of Excellence (NoE) and Integrated Projects (IP)), as well as coordinating member states' research programmes with those at European level (e.g. Art. 169 Initiatives, ERA-NET scheme, etc.) are expected to deliver appropriate mechanisms for boosting horizontal and vertical coordination (Dratwa 2009). The exchange of information and experiences and the mutual opening of national support programmes are considered as key elements in tackling major systemic shortcomings that hampered prior progress towards a unified European research system (EC 2004). With the European Technology Platforms (ETPs) additional mechanisms that aim at intensifying interactions of actors particularly interested in the development of specific technologies have been established. In such platforms notable industrial stakeholders should be brought together to coordinate their interests and define a common Strategic Research Agenda (SRA) in a specific technological field, categorised to broader thematic areas, including energy, ICT, bio-based economy, production and processes and transport.

In principle, enhanced efforts to coordinate national and regional STI policy programmes by means of FP budgets have sustained also in FP7 (2007-2013) that still preserves on the major coordination instruments introduced in FP6, such as ERA-NETs or Art. 185 measures (former Art. 169 measures) (EC 2011a). In general, FP7 is an umbrella for four specific programme lines, financially supporting precompetitive and transnational collaborative R&D projects in ten thematic key areas (programme *cooperation*), scientific excellence and frontier research via the newly established European Research Council (programme *ideas*), international researcher mobility (programme *people*) and general R&D and innovation infrastructure and capacity building in regions, businesses and society (programme *capacities*). While promoting multi-level coordination has been already an important element in previous programmes, FP7 is the first programme featuring instruments that particularly focus on R&D activities of high societal relevance and support coordination efforts with financial EU resources. The newly established public-private initiative Joint Technology Initiatives (JTIs) is the most prominent example in this regard.

To sum up, the main objectives pursued with the specific FPs reflect the thematic orientation in several phases of European STI policy making (see, for example, Muldur et al. 2006). Table 4 provides an overview of the evolution of the FPs and its main priorities. While the launch of FP1 was determined by the perceived technology gap in the 1980s, FP2 was intended to strengthen industrial competitiveness through the promotion of certain strategic sectors. FP3 has to be seen in light of enhanced European integration and efforts for realising the single European market. Economic values such as growth, industrial competitiveness and employment as promoted in the White Paper (EC 1993) influenced the development of FP4, while socio-economic values of R&D and innovation gained increasing recognition in FP5 for the first time. In contrast, FP6 and FP7 have been fully dedicated to the vision of ERA that is characterised by networking, collective knowledge and innovation generation, and a better systemic coordination of STI policy programmes across multiple levels. Referring to the latter, the objectives have been particularly driven by the conception of 'knowledge-based economy' (see, for example, OECD 1996), in which knowledge is regarded as the central component for future economic growth and welfare (Edler 2003)³¹.

³¹ The conception of the 'knowledge-based economy' has also been crucial for the increasing interest in coordinating national STI policies and activities (see Subsection 4.3 for details).

Finally, the structure for Horizon 2020 – the new financial instrument of the EU combining the Framework Programme for research and innovation (FP8), the Competitiveness and Innovation Framework Programme (CIP) and the European Institute of Innovation and Technology (EIT) running from 2014 to 2020 – will partly reflect a thematic approach featuring sustainable development to its overarching objective and societal challenges as essential elements (EC 2011I). The proposal for Horizon 2020 schedules to make – besides scientific excellence and industrial leadership – the so called ‘Grand Challenges’, referring to such societal challenges, to one of its key priorities.

Table 4: Evolution of the EU Framework Programmes (FPs)

Periods	Main objective	Main priorities	New actions
FP1 (1984-1987)	Coordination of Community RTD actions	Energy and ICT oriented	Environment, international cooperation, human capital and mobility
FP2 (1987-1991)	Information society	ICT oriented	Biotechnologies, marine resources, dissemination
FP3 (1990-1994)	Industrial competitiveness	Multiple priorities	-
FP4 (1994-1998)	Industrial competitiveness	Multiple priorities	Transport and social sciences
FP5 (1998-2002)	Innovation and social needs oriented	Multiple priorities	Nanotechnologies
FP6 (2002-2006)	Instrument for ERA	Multiple priorities	New network instruments (e.g. NoE, IP, ERA-NET, ETP)
FP7 (2007-2013)	Instrument for ERA	Multiple priorities	New instruments (e.g. JTIs)
Horizon 2020 (2014-2020)	Instrument for Innovation Union (Societal challenges, Excellent science and Competitive industries)	Multiple priorities	Combine research and innovation funding (FP, CIP and EIT)

Source: adapted from Muldur et al. (2006, p. 96)

4.2 The focus on societal challenges in European STI policy

Societal challenges, or ‘Grand Challenges’ as they have been referred to in the EU STI policy conceptions, have led to a refocusing in the political discourse on the role that STI policy might play (see Subsection 2.2), which is also reflected in overall EU priorities deeming research and innovation as most important drivers for ‘smart, sustainable and inclusive growth’ (EC 2010a). In this spirit, recently introduced STI policy instruments explicitly reflect such broad societal purposes in their objectives. This subsection discusses the most important strategies and instruments to tackle societal challenges employed at the EU level.

Development of the societal challenge concept

As mentioned in Subsection 3.2, the ERA Expert Group ‘Rationales for the European Research Area’ is the most important reference point for the EU STI policy to focus on societal challenges, initiating a broad political discourse in Europe on ‘Grand Challenges’ that are rooted in economic, social or scientific goals (EC 2008a). The Expert Group proposes a set of criteria applicable for the identification of ‘Grand Challenges’, which are defined as follows (EC 2008a, p. 46):

- “Relevance demonstrated by contribution to European added value through transnationality, subsidiarity and the need for a minimum critical effort;
- a research dimension to ensure the buy-in of the research community and the potential to induce improvements in efficiency and effectiveness;
- feasibility as an economic or social investment in terms of research and industrial capability and a viable implementation path”.

The Expert Group distinguishes between three broad categories of Grand Challenges³² that have somewhat different focal points and consequences for field-specific as well as external coordination efforts with other policy fields:

- Social and environmental challenges – as discussed in the sense of societal challenges in Section 2 – point to the societal function of science, technology and innovation in issues of supranational or even global nature that can only be dealt

³² As stated in the report, it is “artificial to separate economic, social and environmental opportunities [...] for convenience of discussion we could categorise them by their centre of gravity” (EC 2008a, p. 36).

with by collective strategic action. Hence, political commitment at the highest strategic level of policy-making – from the EC, to the European Council and the European Parliament – as well as broadly based coordination ambitions between member states and stakeholders to bundle their resources are regarded as particularly essential in this context.

- Economic challenges as identified in the expert group report arise from the transformation of scientific and research results into marketable products and the development of innovation friendly markets. They refer to an integrated STI policy involving coordination efforts that strengthen the innovation chain and bridge the gap from knowledge generation to market; the challenge for STI policy in this regard is to facilitate interactions between users and suppliers of STI by supporting their activities with a mix of policy instruments that combine supply-side and demand-side measures (see also Aho et al. 2006). Joint Technology Initiatives (JTIs), lead-market initiatives or pre-commercial public procurement are examples for recently established instruments aiming at strengthening the linkages between the research and market dimension of innovation.
- A third type identified as ‘Grand Challenge’ is rooted in the sphere of science and technology in itself, referring to frontier science and the provision of resources in key technologies such as nanotechnology, on the one hand, as well as to the role of social sciences and humanities, on the other hand. Social sciences are regarded as a bridge between basic research results and societal needs, leveraging the societal contribution of research and innovation by triggering societal efforts.

Although the notion of societal challenges prevails over the notion of ‘Grand Challenges’ in the subsequent political discourse, the Expert Group report provides major impulses for bringing the role of research and innovation for specific social concerns at the highest level of policy-making (see, for example, ERAB 2009, EC 2009a, von Sydow et al. 2009, Pérez et al. 2010). The promotion of innovation in fields of major social concern is regarded as particularly promising for reaching the aims of an eco-efficiency-based and inclusive European society (see, EC 2010b), however, always against the background of driving European economic growth³³ (see, for example, Swedish Presidency 2009, EC 2010a). Thus, the EC and the member states incorporate the notion of societal challenges

³³ For details on the Europe 2020 Strategy – the current growth strategy for Europe – see Section 4.3.2.

in their long- to medium-term STI strategies, making it a catchword for loosely defined issues regarding climate change, food and energy security or the ageing society.

With the proposal for the Horizon 2020 initiative (EC 2011I)³⁴, the Commission focused on an inter-disciplinary and problem-oriented definition of thematic priorities in the prospective EU STI policy, and restricted the wide array of societal challenges to the following priority fields (EC 2011I):

- *Health, demographic change and wellbeing*, aiming at life-long health with particular respect to economically affordable health-care systems. Main objectives are disease prevention through the development of preventive and screening tools, health and disease surveillance systems, effective data- sharing as well as bridging the gap between basic research results and clinical trials.
- *Food security, sustainable agriculture, marine and maritime research and the bio-economy*, aiming at food quality and security as well as the transition to bio-based, resource-efficient and carbon-saving production processes in European industries, fishery, agriculture and forestry systems. Main objectives are to transform industrial production processes as well as to develop integrated tools for an enhanced use of biomass by recycling biowaste and industrial by-products.
- *Secure, clean and efficient energy*, aiming at the development of sustainable and reliable energy systems to tackle problems related with climate change, scarce resources and increasing demand for energy. Main objectives are technological development of systemic solutions for intelligent, environmental-friendly and renewable resource-based production and storage of energy, as well as to support markets for innovative products that are based on bio-energy, low-carbon, hydrogen and fuel-cell elements.

³⁴ According to the ex-ante impact assessment of Horizon 2020 (EC 2011I), the following criteria have been applied to define the selected set of societal challenges: '(1) corresponding to the major challenges facing Europe as identified in Europe 2020 and the MFF Communication on the basis of sectoral policy analyses, and lending clarity and visibility to EU intervention; (2) corresponding to the concerns of Europe's citizens and being understandable by them; (3) corresponding to demands expressed by member states as well as other public and private actors of the European R&I system; and (5) balancing continuity and change, investing in areas of strength and investing in areas of relative weakness where Europe has to catch up (i.e. European R&I weakness with regard to competitors), alignment and complementarity with the priorities of the member states. Thus, this identification builds on the interim and ex-post evaluations of Community interventions, and on analyses of the strengths and weaknesses of European R&I across disciplines and S&T domains, and is set in the context of the Europe 2020 strategy' (EC 2011I).

- *Smart, green and integrated transport*, focuses on minimising the environmental impact of the European transport system. EU support should enable the technological development of resource-efficient and environmentally friendly transport systems, as well as the establishment and management of intelligent, secure and integrated freight and passenger traffic infrastructure across Europe.
- *Climate action, resource efficiency and raw materials*, addresses climate change mitigation and focuses on eco-innovative technologies products and services, in particular with regard to their interaction with the society. Aims are to enhance understanding for climate change mitigation measures and evoke societal changes by social innovation and innovative mitigation policies. Further, objectives are the development of knowledge and competencies for advanced data pooling and monitoring activities regarding the management of natural resources and raw materials.
- *Inclusive, innovative and secure societies*, aiming at the reduction of inequalities and segregation in a globalised world as well as combat serious crime, terrorism and digital crime. In terms of STI, the objectives are to stronger involve citizens in STI by user-driven innovation, enhance digital public services and support other EU policies to ensure individual and societal security.

From the perspective of STI policy legitimisation, the aims related with the concept of societal challenges fits into the approach of 'new missions' for STI policy intervention, i.e. to strengthen the societal function of research and innovation (Gassler et al. 2008, Kubeczko and Weber 2009). Although no clear definition, nor a comprehensive framework for addressing such challenges have been provided yet, the increasing reference to societal challenges in important strategic documents points to a shift from traditional economic-centred (lack in economic competitiveness) or structural-centred (fragmentation and structural weaknesses in European Research system) to societal challenges-driven approaches in European STI policy-making. The most important EU strategies and respective policy instruments in this context, the Joint Programming Initiatives (JPIs), will be examined in the following section as part of the comparative case study strategy.

Societal challenges and thematic coordination

The role of STI, especially research and technological development, and their supportive function for reaching sectoral policy objectives in energy, environment, regional development, or health, among others, is widely recognised at the EU level (Muldur et al. 2006). From the perspective of thematic coordination, the respective policy areas are closely involved in the joint development of the thematic areas of the FPs³⁵, constituting an important policy coordination mechanism between STI policy and other policy fields at the programme level of policy-making³⁶. Isolated multi-sectoral coordination efforts between STI policy and other policy fields can be found at the strategic level of policy-making in the form of strategic technology action plans, for example in the field of environment (Environmental Technologies Action Plan - ETAP) or energy (Strategic Energy Technology Plan - SET) (EC 2008a). However, such strategic efforts are sector or technology specific and not structured around a specific theme.

A societal challenge-driven STI policy – in contrast to traditional STI policy approaches – involves an enhanced governance dimension that evokes a number of challenges for STI policy-making (see Subsection 2.3). It integrates a number of policy fields, and thus, calls for common reference points in the form of shared goals and jointly agreed-upon priorities defined at the highest political level. Recently launched strategic approaches directly address a set of quantitative and qualitative objectives that should serve as common multi-sectoral policy goals for all EU policies. In this regard, research and innovation is recognised as an integral part of the European economy (see, for example, EC 2010a), and is expected to provide major contributions to the social and economic development of the EU in the medium- and long-run. The most important strategic approaches for European STI policy-making are the following:

Proposed in the year 2010, the *Europe 2020 Strategy* follows the Lisbon Strategy and constitutes the overall long-term strategy for ‘smart, sustainable, inclusive growth’ of the European economy (EC 2010a). In general, the strategy defines EU-average quantitative targets for the level of education, social inclusion, R&D investment, resource-efficiency,

³⁵ For example, the thematic programmes of FP7 are: Health; Food, Agriculture, Fisheries and Biotechnology; Information and Communication Technologies (ICT); Nanosciences, Nanotechnologies, Materials and New Production Technologies; Energy; Environment (including Climate Change); Transport (incl. aeronautics), Socio-Economic Sciences and the Humanities; Space; Security (EC 2011a).

³⁶ There are also other thematic coordination mechanisms that work on a programme or project basis, such as joint undertakings or specific themes of coordination instruments (ERA-NETs, ERA-NET Plus, Art. 185 Initiatives, JTI, ETPs).

and employment that should lead to overall economic competitiveness and growth, and further, to a certain societal development. Further, each member state has adopted its individual targets and action plans, which should reflect the country-specific economic and social conditions. In this regard, knowledge and innovation is seen as one of the key drivers for future societal development. Concerning investments in R&D, the target of investing 3% of the GDP in research and innovation still serves as major quantitative EU benchmark to be reached until 2014.

One flagship initiative of the *Europe 2020 Strategy*, the *Innovation Union*, particularly deals with STI policy goals in terms of improving conditions for financing research and innovation in Europe and facilitating the market uptake of innovative products and services. The flagship initiative proposes a new STI policy instrument specifically designed to tackle societal challenges (EC 2010b). European Innovation Partnerships (EIP) should be established in order to integrate and align the wide array of supply-side (research and technology) and demand-side (innovation and market-related) instruments, covering the entire innovation chain from development to the uptake of innovations and new technologies in specific societal challenges. For this reason, such partnerships should go beyond traditional STI funding principles and ensure that respective sectoral policies in terms of public procurement, regulations or standardisation measures are equally considered and aligned towards common objectives. The multi-level dimensions of European STI policy is covered by the integration of public and private actors at the EU as well as the national and regional level. A Pilot for European Innovation Partnerships has been launched in the field of Active and Healthy Ageing in 2011.

In general, the concept of societal challenges provides additional opportunities for the strategic coordination of European policies (EC 2008a). As problems go beyond the scope of STI policy involving a number of different policy fields, actors and initiatives across Europe, societal challenges might provide a reinforced lever for policy coordination efforts that are centred on a specific theme, i.e. 'thematic' coordination. The 'Rationales on ERA' Expert Group proposed to "focus continued effort on ERA by engaging with a series of Grand Challenges that capture the political and public imagination and connecting ERA with these challenges", and thus, "capture the imagination of the research community and its stakeholders" (EC 2008a, p. 36). However, this refers not only to multi-level or multi-lateral coordination between member states and the EU, but also to the alignment and institutionalisation of policy coordination in an integrated and multi-sectoral sense. With the focus on a common societal problem, the cross-cutting nature of STI policy and the multi-sectoral interrelations may become noticed more strongly, and thus, might have

additional structuring effects on joint policy endeavours. In this regard, Section 5 will analyse the Joint Programming Initiatives (JPIs) – one of the few recently implemented instruments directly related with societal challenges – in the context of the comparative case study strategy, elaborating on how these theme-specific interrelations appear in an initiative that, in essence, follows the ideas of enhancing multi-lateral coordination across EU member states. Beforehand, however, the next subsection focuses on the development of strategic coordination approaches in EU STI policy.

4.3 Strategic coordination in European STI policy-making:

Past and present approaches

While the previous section elaborated on the evolution of thematic priorities in European STI policy-making, this section shifts attention to the development of coordination efforts, beginning from multi-lateral coordination to the current focus on strategic coordination. Early multi-lateral STI policy coordination efforts between member states were quite fragmented either project- or ‘mission’-based, and lacking a systemic approach and broad commitment at the EU level until the launch of the ERA initiative. Further, the ‘coordination’ function of the EU – especially in the context of FPs – was mainly perceived in terms of facilitating collaborative STI activities across Europe. However, with proceedings of the ERA initiative, governance aspects of promoting cross-border STI activities have gained importance (see EC 2007 and 2009c), leading to a reinforced institutionalisation of ‘systemic’ coordination mechanisms in European STI policy-making. In contrast to previous approaches, the JPIs (see Section 5) involve strong strategic elements constituting a major development step in the coordination of national STI policies. The following gives a brief overview on the development of coordination strategies and instruments.

Historically, member states pursued very different strategies in STI policy intervention imposing difficulties to align national actions or to centrally coordinate them (see, for example, Guzzetti 2009, Tindemans 2009). Member states’ reluctances to transfer competencies to the EU level traditionally had been high, leading to the support of European-wide collaborative initiatives – as mentioned above – only in cases of resource-intensive and large-scale research projects in which cooperation was of strategic importance. Strategic cross-border coordination efforts were conducted on an intergovernmental basis, i.e. they were obligatory and not coordinated by EU efforts (see, for example, Bórras 2003, Delanghe et al. 2009). Excellent and large pan-European

scientific and research facilities such as CERN (European Organisation for Nuclear Research), or multi-lateral programmes such as COST (European Cooperation in Science and Technology) or EUREKA (European Research Coordination Agency) are prominent examples in this regard.

With the Maastricht Treaty (1992), European STI policy has received a new pillar for coordinating national policies. Henceforth, coordination efforts have been primarily based on the subsidiarity principle (Guzetti 2009). However, the strategic role of the EU had not been fully perceived and promoted before the launch of the Lisbon Strategy and the ERA initiative in the year 2000. In essence, the following sources have influenced the expansion of the EU's coordinative and strategic role:

- *First*, the 'knowledge-based economy' perspective (see, for example, OECD 1996, Muldur et al. 2006) has gained attention, regarding the generation and diffusion of knowledge as the most central element for economic growth. Thus, the provision of framework conditions that enable the effective generation, diffusion and application of knowledge are considered as the main policy missions (Edler 2003). This perspective is explicitly reflected in the Lisbon Strategy, approaching to 'become the most competitive and dynamic knowledge-based economy in the world ...' (European Council 2000, p. 2), providing reference for the establishment of ERA in terms of coordinating national STI policies and country-specific STI policy programmes.
- *Second*, systemic innovation approaches that have emerged in the 1990s reinforced the request for strengthening the vertical and horizontal integration of knowledge actors in Europe to enable the effective generation and diffusion of knowledge (Edler 2003).
- *Third*, from a governance perspective, the broader acceptance of the European level may also be related with the advancing division of labour in STI policy-making, especially when the strategic and operational dimension is considered (Gassler et al. 2008, Bórras 2009). While the majority of STI policy instruments have still been managed at the national or regional level, EU level competencies have mainly been legitimised with the 'added value' potential of strategic coordination through the intensified use of coordinative governance modes based on networking, interaction and communication. 'Soft' and coordinative governance

instruments have been broadly institutionalised for the first time with the launch of the Lisbon strategy and the ERA process.

The EC can be regarded as the most 'central actor' in this transformation process (Edler 2003, Guzzetti 2009), playing an active and pivotal role by setting forth major steps for the integration of national policies. In the sense of the coordinative mode of policy-making, it has launched a number of strategies, action plans or formal targets that should serve as enablers for the alignment and integration of national STI policy efforts. Most notable examples in this context are the required formulation of European and national policy action plans to reach a European wide R&D investment intensity of 3% of GDP, or the application of the Open Method of Coordination (OMC) to research related fields in the year 2003.

From a multi-level perspective, the ERA initiative can still be regarded as one of the most important strategies and political visions for the coordination efforts in European STI policy (see, for example, Delanghe et al. 2009). As previously outlined, it aims to establish a 'common European market' for research and innovation (EC 2000), by coordinating national research activities, ensuring more inclusive network building and knowledge sharing between firms, researchers and research institutions as well as facilitating free movement of researchers. In terms of coordination efforts in European STI policy, it is of special importance as it is explicitly intended to reduce fragmentation in STI policies across Europe. Fragmentation is mainly conceived in terms of investment and execution of R&D activities, i.e fragmentation between member states and regions, and fragmentation between types of actors (universities, research organisations, firms, SMEs) and sectors (scientific, technological and industrial).

However, practical progress in removing barriers for integration was modest after a few years the ERA initiative has been launched. Slow integration is not considered as result of poor research capabilities or lacking resources, rather than shortcomings in the political governance of ERA, related to the fragmentation in STI policy programmes and policy instruments between member states and regions³⁷ (EC 2007).

³⁷ "National and regional research funding (programmes, infrastructures, core funding of research institutions) remains largely uncoordinated. This leads to dispersion of resources, excessive duplication, unrealised benefits from potential spillovers, and failure to play the global role that Europe's R&D capability would otherwise allow, notably in addressing major global challenges. Reforms undertaken at national level often lack a true European perspective and transnational coherence" (EC 2007, p. 7).

Thus, with the Green Paper on ERA and its new perspectives (EC 2007), the EC provides impulses for a re-structuring of ERA by shifting coordination of fragmented research efforts on top of the political agenda. In this regard, strengthening the strategic level of STI policy making is regarded as key to stimulate integration of the European research and innovation system (Dawenta 2009). The 'Ljubljana Process' addresses this governance dimension by aiming at the development of encompassing strategic visions between the EU level, member states and stakeholders (CEU 2008b). As a consequence, an ERA vision for 2020 (EC 2009c) with five strategic initiatives ('partnerships') has been launched in 2008. Such strategic partnerships should strengthen the ties between the EC, member states and stakeholders in priority areas defined as careers and mobility of researchers, the creation of research infrastructures, the transfer of knowledge and cooperation between public research and industry, international science and technology cooperation as well as the joint development and operation of research programmes (see EC 2009c).

As already discussed in more detail in Subsection 2.3, a new pillar for legitimising EU-level STI policy efforts and give member states' a stronger impetus to align their activities is related to the establishment of the ERA Expert Group report 'Rationales for the European Research Area' (EC 2008a). With their suggestions regarding the political concept of 'Grand Challenges' as additional cornerstone of the ERA initiative, the promotion of ERA and the coordination of national STI policies received additional legitimisation through European societal purposes (see, for example, EC 2010b and 2011l).

Current EU initiatives for systemic STI policy coordination

Given the above considerations, the EU STI policy has developed towards a comprehensive coordination platform between national innovation systems and their policies in the recent past, inducing the creation of 'new' and specific instruments for the coordination of multi-level policy action, on the one hand, and the integration of actors that are beyond European and national authorities, on the other hand (Héritier and Rhodes 2011). Such instruments are utilised at the strategic and political level or at the level of implementing policies and programmes. They are often accompanied by tools that provide strategic intelligence for strategic coordination laying additional emphasis on periodic and systematic monitoring, evaluation and peer review efforts (Bórras 2009).

The Open Method of Coordination (OMC) has been introduced into research policy agendas in 2003 in order to reach the strategic Lisbon and Barcelona targets (3% Action Plan). It is currently one of the most prominent examples of 'soft governance' instruments aiming at stimulating consistency and policy-learning between voluntarily participating member states (Bórras and Jacobsson 2004, Kaiser and Prange 2004, Héritier and Rhodes 2011). In the field of research, the instrument of OMC-NET should complement the OMC in their role to achieve better STI policy coordination by offering financial support to national (or regional) policy makers for their policy-learning, transfer or coordination activities via FP funds (EC 2011i). The OMC is organised in biannual cycles divided into several priority topics for which individual expert groups are regularly established. The European Research Area Committee (ERAC) has been assigned to review the progress of OMC (EC 2011i), and, in addition, High-Level Groups (HLG) of national R&D policy representatives have been implemented to assist the EC in coordinating and planning. Coordination within the OMC framework is a stepwise process: While the EC is responsible for setting up common European guidelines and providing framework conditions for the adjustment of member states' STI policies, member states are encouraged to subsequently transfer those targets to the regional level and implement their own mechanisms for country-internal coordination.

Evaluations of the OMC, however, show diverse results (EC 2009b). From a multi-level governance perspective, the OMC process almost utterly involves European and national policy makers and officials focusing on mutual coordination at the member state level; regional and local actors are not directly involved in target formulation at the European level (Kaiser and Prange 2004). While the OMC has brought considerable progress in cross-country policy learning and experience sharing, it failed in providing a sustainable instrument for long-term coordination, but is rather restricted to spontaneous mutual adjustment without a pre-defined strategy (EC 2009). Moreover, the diversity in national innovation systems as well as institutional structures and cultures of multi-level governance between member states might limit the transferability of best practices and benchmarks across all member states (Kaiser and Prange 2004). Structural diversity, lacking depth effects and reluctance to strategic coordination are thus argued as serious hampering factors for the OMC to become a thoroughly successful coordination mechanism in STI policy making.

While the instruments of the OMC mainly comprise coordination at the strategic level of policy-making, other instruments have been developed to promote a coordinated design and implementation of policies, i.e. the operational level of policy making³⁸. One of the most far-reaching examples in the European STI policy is the ERA-NET scheme launched under FP6 and continued under FP7 aiming at a closer cooperation between national (or regional) authorities responsible for research programme implementation or management by establishing platforms for joint and transnational activities in selected topics (Horvat et al. 2006). ERA-NET is an umbrella for specific forms of voluntary public-public partnerships that focus on higher coordination between member states in a thematically 'bottom-up' manner (Svanfeldt 2009, EC 2011j). By this, networking activities are rather based on information exchange, benchmarking and mutual learning than on full integration or harmonisation of member states' policies. Nevertheless, ERA-NETs additionally provide mechanisms for opening up national or regional programmes towards joint transnational activities via joint project calls that will be financially assisted by the EC. Beyond that – in selected cases where 'European added value' is considerably high – single transnational calls between various national (or regional) programmes may be augmented by EU funds, referring to the ERA-NET Plus scheme (EC 2010c). ERA-NET Plus points towards a reinforced coordination mechanism by joint funding between the EU and national level, but nevertheless is implemented on a less-strategic basis. However, preliminary evaluations of the ERA NETs reveal that participation of regions and regional representatives is underdeveloped (see, for example, Horvat et al. 2006).

'Art. 185 Initiatives' provide the highest degree of policy coordination of national programmes, but also between the national and the European level (EC 2011j). This specific type of Public-Public partnerships currently run under FP7 and follow the logic of an integrated European STI policy in strategic management as well as financial terms. Voluntarily participating member states build up a joint implementation structure in order to integrate large-scale research efforts in a selected area. On the basis of Art. 185 of the Treaty of Lisbon (2007), the EU obtains a mandate to participate in these joint initiatives by providing additional funds³⁹.

³⁸ In this regard the EC recently adopted a Communication on 'Partnering in Research and Innovation' containing several forms of networking and partnership instruments currently run at EU level, divided into Public-Public Partnerships and Public-Private Partnerships (EC 2011j).

³⁹ As set out by the EC (2011k), the following criteria have to be met: 'The relevance to EU objectives, clear definition of the objective to be pursued and its relevance to the objectives of the FP, presence of a pre-existing basis (existing or envisaged research programmes), European added value, critical mass, with regard to the size and the number of programmes involved and the similarity of activities they cover, efficiency of Art. 185 TFEU as the most appropriate means for achieving the objectives.' (EC 2011k).

The next section focuses on the Joint Programming Initiatives (JPIs) as a new instrument for policy coordination that, in essence, follows the ideas of an integrated ERA, but is combined explicitly with a societal challenge-driven approach. How ‘systemic’ coordination – in terms of multi-level and multi-lateral alignment of EU and national policies as well as across Member States – relates with ‘thematic coordination’ in light of distinct societal goals will be discussed by the means of a comparative case study strategy focusing on two JPIs, namely the JPI Urban European (UE) and the JPI Neurodegenerative Diseases (JPND).

5 Joint Programming Initiatives (JPIs) to deal with European societal challenges: Policy coordination in two distinct JPIs

At this point of the diploma thesis, attention is shifted to the empirical investigation of how societal challenges influence STI policy-making within the European multi-level governance system, directly addressing the research questions outlined in Section 1. The analytical approach used takes – based on the theoretical and conceptual considerations from the previous sections – the Joint Programming Initiatives (JPIs), a specific European policy program derived from current societal challenges in Europe, as empirical unit of analysis. By means of a comparative case study strategy, novel empirical insight into the relationship of societal challenge-driven STI policy-making and policy coordination in a multi-level and multi-actor governance context is gained.

Joint endeavours for conducting STI activities in a more coordinative way among European countries have already been initiated in early 1960s. While previous efforts have mostly been based on intergovernmental agreements, i.e. without EU engagement, the ongoing ERA process gives rise to new coordination approaches at EU-level (see Subsection 4.3). The degree of EU involvement in such joint activities between member states ranges from the direct and active participation (Art. 185 Initiatives) to the provision of financial funds (ERA-NET plus and partly ERA-NET) or to a supportive and coordinative role in joint projects (ERA-NET) between member states (EC 2011j).

The rationales for partnering in STI policy coordination are manifold, involving STI inherent necessities in light of complex and collaborative innovation processes (see also Section 2), the need for knowledge exchange between national research systems, and the mutual interest of countries in specific research projects or the joint usage of research facilities. Furthermore, a more efficient organisation of public STI support by reducing duplication and pooling of financial resources is an additional motivation for the establishment of joint activities of European countries.

In the recent past, the crucial role of various societal challenges requiring joint specification and implementation of research activities has been stressed by political stakeholders as well as by the scientific community. It is considered as an essential STI policy element in order to tackle transnational or global challenges such as energy shortages, demographic change, climate change or threatening diseases more effectively. The key policy initiatives launched at EU-level in this context are the Joint Programming

Initiatives (JPIs). JPIs are a new and comprehensive approach that aims at coordinating and integrating national public research programs on a strategic basis, supplemented with high-level political commitment for jointly addressing particular societal challenges. As described in Section 2, societal challenges are unique in nature, and thus, require individual approaches imposing distinct consequences on STI policy-making.

This section intends to analyse in which way distinct societal challenges influence policy coordination efforts within JPIs by employing a comparative case study strategy. Subsection 5.1 gives a brief overview on the general characteristics of JPIs with particular regard to policy coordination aspects, while Subsection 5.2 introduces the analytical framework for the empirical investigation. Two different JPIs are investigated in this respect in order to gain insights on how the underlying societal challenge influences policy coordination efforts. Subsection 5.3 focuses on the JPI Urban Europe (UE), while Subsection 5.4 analyses the JPI Neurodegenerative Diseases (JPND). The two cases are investigated using a wide range of policy documents, programme descriptions, and official documents that summarise communication, discussions and presentations in official JPIs related meetings and workshops of policy makers as well as stakeholders. By means of detailed content analysis of these numerous documents, relevant aspects in terms of the research focus of this diploma thesis are picked up, summarised and reflected on the basis of the analytical framework. The analysis reveals distinct policy coordination aspects in the JPIs by laying special emphasis on the interrelations of a specific thematic priority (i.e. societal challenge) and the respective policy coordination mechanisms. Finally, Subsection 5.5 provides a comparative analysis of the two cases focusing particularly on differences and similarities in a policy coordination context.

5.1 The Joint Programming Initiative (JPI) approach

The Joint Programming Initiatives (JPIs) are explicitly designed at EU-level to address particular societal challenges of crucial importance in the near future for the development of European society. Two selected JPIs form the basis for an empirical investigation of this approach, and provide novel insights into the question of how societal challenges influence STI policy-making in Europe. Before the analytical framework for the empirical analysis is discussed in some detail in the subsection that follows, the JPIs approach is introduced in this subsection, mainly focusing on systemic and thematic policy coordination issues.

JPIs are a new policy approach for coordinating STI activities across member states established in response to the Green Paper of the Commission (EC 2007). The overall objective is to remedy fragmentation and inefficiencies of national research programs addressing major societal challenges (see EC 2008b)⁴⁰. The EC (2008b) has proposed – based on remarkable impetus from the European Council expressed in its spring council in 2008 – a new coordination approach that should explicitly focus on strategic EU priorities referring to particular societal challenges, such as climate change mitigation or disease prevention. Subsequently, the JPIs have been established with the launch of the pilot initiative on Neurodegenerative Diseases (including Alzheimer’s Disease) by the end of 2008 (CEU 2008a). Further JPI areas were established in 2010, including the following themes:

- Agriculture, Food Security and Climate Change
- A Healthy Diet for a Healthy Life
- Cultural Heritage and Global Change
- Antimicrobial Resistance (Human Health Challenge)
- Clik'EU (Connecting Climate Knowledge for Europe)
- More Years, Better Lives (Challenges of Demographic Change)
- Urban Europe (Global Challenges, Local Solutions)
- Water Challenges
- Healthy & Productive Seas and Oceans

These themes have been identified on the basis of the following guiding principles (CEU 2008c):

- A theme to be selected for a JPI is intended to address a pan-European or even global socio-economic or environmental challenge;
- The theme should be specified in terms of manageable, clear and realistic objectives in which public support in the form of financial funds for research is needed, and clear added value of joint member states’ action is conceivable, i.e.

⁴⁰ Although a number of policy efforts have been established for reducing fragmentation among European STI funding schemes and realising an integrated ERA (see Section 4.2 for details), an Expert group report on ‘Optimising research programs and priorities’ expressed the need for “more strategic, sustainable and efficient transnational programming and coordination” approaches, within which member states should “develop a common vision with priorities for transnational research, encompassing regional, national, intra-European and Community funding’ and establish ‘a common set of principles and operating guidelines to optimise the implementation of existing and new ERA-structuring mechanisms” (EC 2008c, p. 41).

pooling financial resources and capabilities of individual member states in order to tackle a common challenge.

- Further, joint action is based on sufficient and effective commitment of member states concerned.
- Relevant stakeholders from the regional, national and European level, as well as appropriate private stakeholders from scientific communities or funding bodies have been involved in the identification of the area.
- Moreover, JPIs should contribute to disseminate the research output to European citizens, enhance European competitiveness and foster efficient and effective public R&D funding by pooling key funding schemes in the respective area.

Member states have been consulted to identify areas that would satisfy these criteria, and thus, might be of particular interest for further JPIs. Elaborated on the basis of foresights and national consultation procedures (ERAC GPC 2010), specific member states delivered their priority areas. After review and classification of proposals by the GPC, the Council has identified a set of three priority areas in which JPIs actually have been launched in October 2010 ('first wave'). In a 'second wave' six further JPI themes have been proposed.

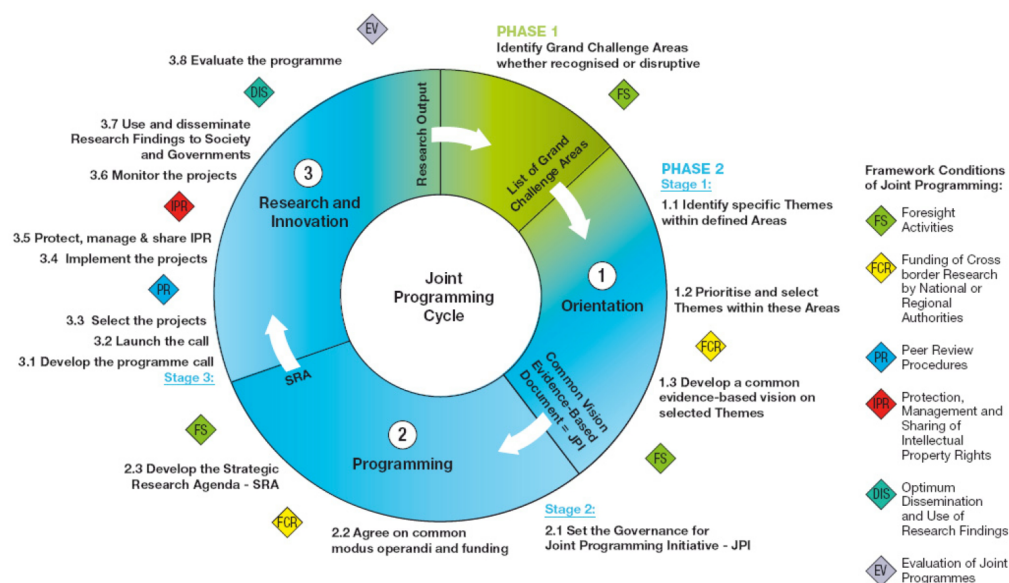
JPI policy coordination: Main characteristics

JPIs are voluntary member-state led efforts to coordinate national STI activities more efficiently, especially national R&D support programs, aiming at reducing redundancies in European research activities. JPIs complement the set of public-public partnerships in STI (EC 2011j) by explicitly addressing political EU priorities in terms of societal challenges, on the one hand, and their clear focus on a more strategic approach to reduce the fragmentations of the European research funding system, on the other hand. Thus, JPIs are – in terms of the focus of this diploma thesis – specific policy coordination measures that are subject to broad-based political commitment at the national as well as the EU-level.

In this regard, JPIs focus on present or future societal requirements calling for an encompassing set of targeted and coordinated activities. The latter comprises the exchange of information on national programs, the development of a common strategic plan, pooling of research resources and infrastructures, collectively selecting appropriate funding instruments as well as joint monitoring and evaluation activities (EC 2008b).

JPIs encompass an individual governance and management structure, and thus, are not to be understood as an individual top-down policy instrument in the traditional sense, but rather as a comprehensive approach that involves strong strategic elements and also operational aspects of STI policy-making. The approach comprises a number of joint STI policy activities that are similar to previous coordination instruments, such as for example the organisation of workshops and conferences, the establishment of shared research infrastructure or specific researcher mobility programs, or the individual launch of single projects calls. However, the joint formulation of common strategies and the long-term alignment of respective activities demarcate JPIs from previous coordination initiatives established at the EU-level.

Figure 1: The Joint Programming Cycle



Source: ERAC GPC (2011, p. 24)

According to a set of predefined voluntary framework conditions⁴¹ for the operation of JPIs (ERAC GPC 2011), the approach follows a stage cycle, referred to as the 'Joint Programming Cycle', as illustrated by Figure 1. It shows certain resemblances to the traditional policy-making process from agenda-setting, to policy formulation and implementation, and finally to policy evaluation.

⁴¹ The framework conditions have been set up by the GPC in order to facilitate the implementation processes of individual JPIs, entailing guiding principles for their governance in terms of the usage of foresight activities, the development of peer review, monitoring and evaluation procedures as well as handling of intellectual property rights (IPR) or dissemination of research results (ERAC GPC 2011).

From the perspective of strategic policy-making, the three stages involve the following activities (EC 2008b):

- *First*, emphasis is laid on developing a shared problem perception, i.e. a future societal challenge that is politically encouraged by all participating member states and the European level alike. This most notably involves a comprehensive assessment of societal problems and requirements, future trends in science and technology as well as the development of respective sectors and markets for innovative solutions by means of e.g. foresight activities and stakeholder engagement. As stated in EC (2008b), vision development for a respective area should be based on evidence from multiple stakeholder groups, ranging from regional and national public authorities to scientific and industrial communities, and complemented by long-term objectives that are politically encouraged and defined by experts.
- *Second*, on the basis of a common vision, a concrete Strategic Research Agenda (SRA) for the JPI is to be specified by the definition of common research objectives that are specific, measurable, achievable, realistic and time-based (SMART) (EC 2008b). This should take into account all relevant research competencies in the respective field across Europe.
- *Third*, the implementation phase focuses on the definition of the SRA requiring the alignment of all relevant R&D support schemes ranging from national and regional research programs, intergovernmental research initiatives and collaboration schemes to research infrastructures and researcher mobility schemes. In addition, individual support measures in the form of joint projects and calls or specific measures to leverage research solutions in terms of societal uptake across Europe could be implemented within the JPI frame.

Systemic policy coordination aspects

The pan-European orientation of JPIs justifies the inauguration of EU-level competencies for setting up and supporting joint actions between member states (CEU 2008c). Based on the principle of subsidiarity, the EU is authorised to ensure and stimulate coordination between member states' STI policies and activities (Art. 181, Art. 185 and Art. 187 of the Treaty of Lisbon). However, participating member states bear the main responsibility for

providing financial resources for the JPIs, whereas specific EU FP calls may serve as additional channel for co-funding (ERAC GPC 2010).

While European institutions (EC and CEU) finally adopt the strategic key areas and launch selected JPIs, member states are the ones who identify and shape the themes of interest. They are responsible for designing and implementing the distinct JPIs. In doing so, national consultation procedures are supplemented by cross-border arrangements for exploring topics of mutual interest. Thus, the individual procedures for identifying and selecting thematic JPI priorities largely follow national practices (Pérez et al. 2010).

Although member states take the lead in establishing JPIs, the set up and operation is supported by EU-level involvement. The EC is the central actor in this regard by either directly supporting the internal governance of JPIs in terms of management and strategic planning activities, or advising them on opportunities and potential links to complementary STI policy initiatives and funding instruments at EU-level, such as for example thematically related JTIs, ETPs or ERA-NETs.

Thematic coordination in the Joint Programming Process

Besides their explicit efforts to better coordinate national policies by means of strategic coordination, JPIs show important thematic STI policy coordination aspects in order to promote problem-oriented research activities more sufficiently. While systemic aspects of policy coordination focus on the strategic alignment of various national and EU-level policies and activities, thematic coordination mechanisms are governance modes and instruments that address the variety in problem-centred research and innovation approaches and stress the societal embedding of these STI activities providing new inroads for a variety of scientific and social knowledge sources in the JPI process (see also Section 3 and Section 4).

Thus, thematic coordination is understood as a set of coordination mechanisms that focus on the strategic development of STI-based responses to distinct societal challenges. In essence, inputs from various knowledge sources and interdisciplinary research activities are combined, and at the same time, a wider range of scientific, political as well as social actors is closer integrated in the strategic design and operation of the JPI. Although the political level predefines and finally adopts the broad JPI themes in the form of distinct societal challenges from top-down, the JPI process basically provides mechanisms to formulate strategies and decide on the appropriate measures in a bottom-up way by

specific cooperation arrangements between public authorities (e.g. public EC or national representatives) and private actors (e.g. field-specific experts, social organisations, industrial stakeholders). Such arrangements shape the implementation and operation of distinct JPIs, especially with regard to the priorities selected, the objectives defined and the instruments applied. Thus, JPIs are thematically embedded in very different STI contexts and communities, policy fields as well as stakeholder interests which might lead to manifold forms and instruments of policy coordination across distinct JPIs.

5.2 Analytical framework for analysing two distinct JPIs

In what follows, the analytical framework for the empirical analysis of two distinct JPIs – derived from the theoretical and conceptual considerations, and from the overall properties of JPIs – is introduced. The framework is intended to explicitly link the different dimensions of societal challenge-driven policy-making with concrete empirical observations, and by this, to shed light on the policy practices apparent to deal with coordination and integration of multiple actors in the multi-level governance system of European STI policy.

Table 5 presents an overview of the analytical framework to be used, reflecting in which way the JPI approach tries to cope with different policy coordination challenges in general. These challenges are derived from the theoretical consideration of a societal challenge-driven STI policy in the European multi-level system as discussed in Section 2 and Section 3. The empirical analysis is conducted in form of a comparative multiple case study strategy that is further introduced below (see, for example, Yin 2003a and 2003b). It aims to disclose the influence of underlying societal challenges on policy coordination in distinct JPIs, and by this, it will shed light on the distinct nature and relevance of systemic coordination strategies and instruments as well as thematic coordination mechanisms. The question of how these coordination modes and instruments differ with regard to the targeted societal challenges will be considered in more detail in the comparative analysis. Of particular interest in this context are differing instruments and modes for shared vision building, priority selection or implementation of specific measures.

Table 5: Analytical framework for the multiple case study strategy

Challenges for STI policy coordination in JPIs	Aspects of policy coordination to be analysed in the cases
<i>Systemic coordination</i>	
Shared competencies between EU and national level	Division of labour between member states (lead) and EU (support)
Disparities in national STI capabilities, strategies and priorities	Pan-European perspective of strategic research goals
Variety of funding channels and STI support programs	Internal coordination mechanisms (instruments)
<i>Thematic policy coordination</i>	
Strategic policy-making	Mechanisms (instruments) for challenge-led strategic vision building
Inter-disciplinary STI approaches	Mechanisms (instruments) for combining research approaches / knowledge sources
Societal responsiveness	Mechanisms (instruments) for societal participation
Policy field overlapping goals	Relations to other policy fields; Mechanisms to integrate several policy fields

As can be seen from Table 5, the framework specifically considers the special role of JPIs as new STI policy approach that addresses challenges arising from the multi-level character of European STI policies, in particular challenges that arise from fragmented member states' efforts. In terms of *systemic coordination* aspects, three crucial challenges are considered in this context: shared competencies between the EU and national level, disparities in national STI capabilities, strategies and priorities, and the variety of funding channels and STI support programs. Further, the orientation on societal challenges involves – as discussed in some detail in Subsection 2.3 – additional governance challenges in the implementation of JPIs, calling for advanced modes for joint strategic vision building, research priority selection, and coherent implementation of measures. These dimensions of governance challenges are taken into account in the empirical framework when analysing how the selected cases deal with these challenges in practical terms. Concerning *thematic coordination*, the dimensions of interest refer to strategic STI policy-making in the selected cases, the degree of interdisciplinarity, societal responsiveness and overlaps between policy fields.

Furthermore, the framework implemented explicitly puts emphasis on the mechanisms and scope of stakeholder involvement, as the JPI approach, in its general conception, calls for more participation of relevant stakeholders considering especially more

comprehensive elements of technical and societal participation in governance and decision-making, for example in terms of evidence-based and expert-led problem definition and enhanced stakeholder consultation procedures⁴². Thus, different stakeholder groups gain increasing importance in formulating priorities and concrete objectives within the JPI framework, leading to multi-actor governance structures and processes that shape the actual form of implementation and operation of JPIs. Empirical observations in this context particularly refer to the dimensions *strategic policy-making* as well as *societal responsiveness* in the empirical framework (see Table 5).

Methodological approach and selection of cases

The diploma thesis pursues a comparative multiple case study strategy (see, for example, Yin 2003a and 2003b) that allows for achieving empirical insights into distinct forms of societal challenge-driven policy coordination aspects in current STI policy designs. Case studies have come into fairly wide use in social sciences, such as policy research, also for the analysis of STI policy programmes and the study of governance issues in innovation systems (see, OECD 2005b, as one major international example). Despite limitations of case studies concerning generalisation and reliability, they are widely recognised as promising tool to get in depth explanations and a deeper understanding of social behaviour (see Gillham 2005). In light of the research design of this diploma thesis, the approach is particularly appealing since problems of generalisation do not occur, having in mind that the two cases are investigated with respect to the question whether different governance modes appear in these cases, related to different underlying societal challenges.

In the investigation at hand, the empirical cases to be analysed are two JPIs, namely the JPI Urban Europe (UE) and the JPI Neurodegenerative Diseases (JPND) that are examined according to their distinct policy coordination aspects as given by the analytical framework (see Table 5). While the JPND has been launched as a pilot initiative for the JPI process in 2008, UE was part of the ‘second wave’ of JPI themes launched in 2010. Following the previous theoretical consideration with particular regard to the characteristics of an societal challenge-driven STI policy, it is assumed that within ‘one’ policy measure, namely the JPI, major variations in their governance and policy coordination patterns as well as implementation instruments can be conceived, and that

⁴² See Subsection 2.3 of the diploma thesis for a detailed discussion on the governance challenges involved in a societal challenge-driven STI policy.

these variations are particularly traceable to the very specific thematic background (i.e. the societal challenge) in which they are embedded.

Having selected the cases to be explored in terms of a specific research question, the next step is to specify the methodological approach in which way the cases are analysed. This can be only one method or a set of diverse methods, ranging from content and textual analysis to quantitative data analysis and modelling approaches. Given the research questions, this diploma thesis sticks to an in depth content analysis of various kinds of documents that contain – implicitly or explicitly – relevant information according to the analytical framework presented above. Thus, information has to be gathered, structured and summarised – i.e. to be made explicit – in the case study analysis so that respective conclusions on different aspects of governance in JPIs can be drawn.

Furthermore, in this diploma thesis the comparative perspective between the cases under consideration is crucial, leading to a comparative multiple case study strategy (see, for example, Yin 2003a and 2003b). The strategy is realised in a two-step procedure, following the cross-case synthesis technique as proposed, for example, by Yin (2003a): First, it introduces the main characteristics of the individual cases by laying special emphasis on the presence and shape of the distinct systemic and thematic policy coordination aspects and instruments. By this, a uniform analytical framework – based on theoretical propositions – provides the structure for the analysis of the single cases. For each of the two JPIs under consideration, the different aspects of policy coordination are identified and assigned to the categories provided by the analytical framework (see Table 5). For this purpose, word tables are created, displaying the data drawn from the individual cases for each category. On that basis, secondly, the most pivotal differences and similarities in the appearing mechanisms are identified in order to draw cross-case conclusions and disclose the links between the underlying thematic context of the JPI and the surfacing multi-level and multi-actor coordination patterns. Individual case study reports (Subsection 5.3 and Subsection 5.4) present the most striking results for each case in more detail, while the most significant findings from a cross-case comparison perspective and the respective word tables are given in Subsection 5.5.

Considering the individual thematic and scientific background, UE is a long-term oriented, forward-looking and research-based initiative that seeks to grasp the number of uncertainties in future urban development, ranging from broad societal and economic to more specific ecologic, energy- or transport-related challenges for European cities. In contrast, JPND mainly focuses on scientific, medical and health-related challenges

caused by the presently lacking knowledge on treatment methods for neurodegenerative diseases (ND). In awareness of the estimated disease expansion in the near future, it particularly aims at speeding up the generation of new research discoveries.

As each JPI passes distinct stages of the schematic JPI cycle (see Figure 1), a comparison of the selected cases with regard to the research question appears adequate and practicable. Due to the novelty of the JPI approach, only the initial phases of UE and JPND are analysed in more detail, particularly addressing the process of priority selection and objective specification for the respective Strategic Research Agenda (SRA). Thus, observations enclose the period from the launch of the respective JPI theme up to the end of 2011. Remarks on activities and instruments are based on either the analysis of already implemented measures, or clear ambitions to implement them in the ongoing JPI process. However, note in this context that the emergence of specific societal challenges on the political agenda, in particular with respect to the motivations for the initial identification of JPI themes at the national or EU-level, is not addressed in the investigation at hand. Thus, issues concerning, for instance, the questions why certain themes have gained special attention as societal challenges at the political level, or who was the driving force behind these developments, or why certain approaches to tackle them have been preferred over others are outside the scope of this diploma thesis, providing much potential for further empirical research.

As mentioned above, information on the respective JPIs is mainly drawn from the content analysis of publicly available policy documents. In more detail, this includes official EC and CEU communications, preambles and terms of reference of the respective JPIs, meeting minutes, project reports, implementation plans and working programs as well as documentations of meeting presentations. Official JPI homepages constitute additional important information sources. While information on the UE is mainly available in the form of project descriptions and written reports, the analysis of JPND relies on official EU documents, specific meeting minutes and presentation documentations.

5.3 The Joint Programming Initiative Urban Europe

This case study focuses on the JPI Urban Europe (UE) that has been launched in 2010⁴³ as a response to the trend of increasing societal challenges related to urbanisation and urban concentration in order to gain essentially novel insights into critical issues for future urban development affected by globalisation, climate change, demographic transformation, energy and resource shortages, social segregation, safety and security requirements or air pollution and congestion (see, for example, Seiser et al. 2010, Menninga et al. 2011, JPI UE 2011b). The major aim of UE is to coordinate individual research actions in urbanism in order to develop systemic, long-term, technology-based and sustainable urban management strategies on the basis of socio-economic research initiatives.

UE has already established its governing and management structure⁴⁴ and is presently in the first implementation phase – the so-called ‘Pilot Phase’ – comprising the elaboration of framework conditions for joint activities as well as the final and detailed definition of future research needs and planned programs that should be reflected in the Strategic Research Agenda (SRA) scheduled for 2014-2020. Of particular interest in terms of analysing governance structures is the pilot phase of the JPI⁴⁵. It is characterised by establishing essential governance related structures such as internal communication and consultation processes (between the stakeholder bodies such as the Urban Europe Forum (UEF), the Scientific Advisory Board, and the governing and management bodies of UE). In what follows, the case is characterised by a structured – according to the empirical framework – content analysis to draw relevant information from public case materials. These materials cover a wide range of policy documents, referring to programme descriptions, but also official documents on relevant meetings where decisions on the governance structure of the JPI were made.

⁴³ At present, 14 EU member states and associated states have decided to work together in the JPI Urban Europe (JPI UE 2011i). Under the leadership of Austria and the Netherlands, the governments of Denmark, Germany, Finland, France, Ireland, Italy, Malta, Spain, Sweden, Switzerland and Turkey have given their firm commitment to participate in UE, while further countries already showed interest to join at a later stage. During the development phase (2010-2011), the participating countries were asked to support the JPI in the form of in-kind (hosting meetings, workshops, communication activities) as well as financial contributions (management fees).

⁴⁴ The governance structure of UE consists of a Governing Board (GB), being the main decision-making body and holding the overall responsibility for the strategic orientation, a Management Board (MB) charged with the executive and operational tasks of Urban Europe, and two advisory units, the Scientific Advisory Board (SAB) providing scientific expertise and the Urban Europe Forum (UEF) intended to be a platform for various stakeholders (JPI UE 2011b, 2011c, 2011d and 2011e).

⁴⁵ The second implementation phase is expected to run from 2014-2019, which also involves the launch of own research initiatives in order to reach the strategic research objectives as set out in the SRA.

Thematic background

The overall objectives of the UE are primarily dedicated to the societal purpose of urban research in terms of creating sustainable urban areas with high quality of life for European citizens⁴⁶ (see, for example, JPI UE 2011b). UE addresses a number of challenges arising from increasing urbanisation⁴⁷. In addition, economic objectives such as future global economic competitiveness of Europe, and the economic importance of European urban areas in a globalised world, especially with regard to the growing importance of Asian mega-cities (JPI UE 2011m), have also been decisive reasons for establishing a STI policy initiative in the form of UE. This already shows the multi-faceted thematic embedding of UE that is – as will be discussed below – clearly reflected in the respective governance and coordination patterns, specifically designed given this thematic background.

Furthermore, not only intra-urban conditions but also the relations between European cities play an important role, stressing the need for greater cooperation and interconnectivity and the establishment of ‘city networks’ of European or even global scale⁴⁸ (JPI UE 2011m). The thematic multi-dimensional approach (‘multi-faceted’ and not restricted to ‘disciplinary-oriented research activities’) of UE is explicitly built around four pillars comprising *ecological* (e.g. climate change, environmental degradation, energy scarcity, water management), *transport-related* (e.g. air and noise pollution through traffic density, parking space, commuting and long-distance travel, new logistic concepts) challenges as well as *societal* (e.g. ageing population; transformation in living, mobility, consumption and social interaction behaviour; migration and cultural-ethical tensions, ghettoisation) and *economic* challenges (e.g. economic agglomeration in cities, urban areas as innovation hubs, increasing competition but simultaneously increasing collaboration between cities) (see JPI UE 2011a, Menninga et al. 2011).

⁴⁶ Right at the outset, the UE Vision states: “The aim is to create attractive, sustainable and economically viable urban areas, in which European citizens, communities and their surroundings can thrive.” (JPI UE 2011b, p. 8)

⁴⁷ Structural changes are mainly conceived with increasing share of population living in urban areas. The EC (2011k) recognises that “by 2050 nearly 70 percent of the global population will live in cities, up from around 50 percent today. The figure for Europe is higher: some 83 percent of the population (nearly 557 million) are expected to live in cities by 2050” (EC 2011k, p. 2).

⁴⁸ UE addresses not only individual metropolitan areas but seeks for grasping their interrelations (‘European urban system’) and the interaction between cities (‘systemic and transnational nature’).

Given this multi-dimensional orientation of the JPI, it seeks to grasp the interfaces of ecology, economy, society and transportation in the future constitution of cities, mainly driven by a social science perspective (see JPI UE 2011a, Menninga et al. 2011). By this, it lays special emphasis on systemic and interdisciplinary research approaches that may enable the development of new technological assessment and monitoring tools as well as governance and policy concepts for efficient and effective management of urban transformations in the long run. While the importance of technological R&D for urban development is recognised and stressed, UE focuses on socio-economic research initiatives aiming to raise public awareness and acceptance for future urban needs, and to enhance societal uptake of technological breakthroughs by the civil society, the economy or policy makers rather than directly supporting technology and research-led innovations (no ‘technology-oriented research approach’) (JPI UE 2011b). Thus, UE aims at bridging the gap between technological R&D in terms of generating new technological solutions for smart energy grids, recycling, waste recuperation or transport systems, society in terms of societal needs of urban citizens, and urban policy makers who are responsible for managing and planning urban areas and the provision of public services.

Systemic policy coordination aspects

From the perspective of systemic policy coordination, the complexity of urbanism and the influence that the development of European cities will have on the well-being of European society in general is considered as the essential arguments to launch an EU-wide initiative in this research field (see, for example, EC 2011m). The pan-European dimension producing specific requirements for systemic policy coordination is also reflected by research themes explicitly addressed in UE, such as the *interconnectivity and networks of cities across Europe*.

In essence, one of the major aims of UE in terms of systemic policy coordination is to provide a transnational platform for research and interaction by pooling and coordinating a number of individual regional, national and European research initiatives as well as different theoretical research approaches in urbanism. Referring to the former, a wide array of programs provides potential to coordinate the JPI with such measures. Since UE sees itself as a networking and interaction platform, collaborations and the exploitation of synergies between other European stakeholder platforms (such as urban field-specific JTIs, ETPs, ERA-NETs, etc.) and organisations (such as the European Energy Research Alliance (EERA)) are of particular importance (see JPI UE 2011b). Collecting information on such organisational arrangements and their classification was a crucial part of UE’s

development phase in order to gain a first overview on potential field-related capacities, strategies and priorities (JPI UE 2011g). With regard to European initiatives, member states closely cooperate with the EC in order to receive information on potential synergies with other EU research and innovation schemes or related JPI themes. Although a number of European and national initiatives provide links to urban issues and / or the research priorities of UE, the encompassing thematic coverage as well as the broad time horizon demarcates UE from most of the existing research programs that are either technology or infrastructure-centred⁴⁹, or focusing on network building or concept and tool development for urban research⁵⁰ (see JPI UE 2011b, Menninga et al. 2011).

In terms of policy instruments, the development of networks and platforms for knowledge and information exchange is one of the most important tools for UE (see, for example, JPI UE 2011b and 2011j). Shared physical infrastructure such as comprehensive transnational databases should serve as tools to pool national information, share individual experiences with new technologies and innovative solutions and establish new concepts and models in urban-related issues (Seiser et al. 2010). New data preparation systems for mapping and handling comprehensive data sets on urban-related issues are expected to provide an opportunity for linking fragmented research activities across Europe more closely to the interdisciplinary interest of UE. The necessary steps for preparing such networking platforms are part of the current pilot phase (JPI UE 2011b).

Joint calls as well as *targeted research projects* should be prepared in the first implementation phase (JPI UE 2011b) leading to joint funding and implementation of demonstration projects (‘living labs’) in selected cities (application-orientation), or large scale and transnational projects to connect geographically dispersed researchers, urban experts and industrial actors in order to promote fundamental knowledge generation (scientific research-orientation). In initial phases of the JPI process, preparatory work concentrates on *assessing already existing urban-related instruments and research programs* across Europe, while especially in later stages of the JPI process, the launch of

⁴⁹ The ‘Smart City Initiative’, a industrial-led initiative that is part of the SET Plan focuses on technology-oriented issues to ensure energy security for future European cities and provides particular potential for coordination efforts. Also the proposed European Innovation Partnership on ‘Smart Cities’ that integrates energy and mobility issues is expected to provide valuable links for UE (JPI UE 2011b).

⁵⁰ In addition, a number of thematic FP programs may support R&D and innovation activities relevant for the research orientation of UE, such as in socio-economic sciences and humanities, transport, energy, environment, ICT, security or health. Regional innovation activities funded under the EU Structural Funds that particularly focus on urban and regional development, cohesion as well as networking between European regions may be of additional relevance for UE. However, the links to technology-oriented direct European R&D and innovation funding schemes have not been explicitly considered in the screening of the activities (see JPI UE 2011b).

joint research programs (bilateral and trilateral) is expected to be the main instrument for implementing the common UE strategy and aligning national research and innovation programs. In this context, UE will support initiatives by providing appropriate framework conditions, best practice examples and strategic guidelines (JPI UE 2011b).

It is worth noting that the argument of dispersed or duplicative national and EU-level efforts – as often applied for the promotion of coordinating actions within the ERA framework – seems to play a rather minor role in the set up of UE. Likewise, the variety and disparity of national research strategies and priorities is less relevant. However, in many cases the related national and European programs are disciplinary or technology-oriented and may therefore provide links only for distinct sub-topics or specific research objectives of UE. Therefore, the advantages of the transnational approach taken by UE are rather seen in its integrated and encompassing thematic coverage that calls for coordination and pooling of different knowledge sources and theoretical research approaches within the UE platform.

Thematic policy coordination aspects

Future urban development is expected to entail a number of challenges that may be of economic, technological, ecological and societal nature, all of them in the focus of UE. Thus, urbanism in general and the approach of urban development as perceived by UE in particular encompass a number of research and scientific disciplines. As a consequence of the broad focus of UE ('umbrella theme'), just as much policy fields and stakeholders from different levels and different institutional backgrounds may have interest in the themes, objectives and activities covered by the JPI. For that reasons, it involves the dimensions of thematic policy coordination given in the empirical framework (see Table 5) in the following form:

Mechanisms for challenge-led strategic vision building

UE is explicitly built on future orientation in terms of long-term trends (ecological, social, demographic and economic) and scenarios for urban development. In the initial phase of UE, long-term visions ('urban images' for 2050)⁵¹ have been created on the basis of main

⁵¹ These schematic 'urban images' with the related thematic 'cornerstones' are Entrepreneurial City 2050: economic vitality and innovation (economy and innovation); Connected city 2050: smart logistics & sustainable mobility (mobility, infrastructure, communication); Pioneer City 2050: social participation & social capital (society); Liveable City 2050: ecological sustainability (ecology) (see, for example, Menninga et al. 2011).

focal points ('cornerstones' of UE), and are expected to offer the stylised orientation needed for the systemic and strategic research approach of UE. On the basis of these images, operational research areas and issues⁵² have been selected and specified that will be included in the SRA and guide all subsequent research activities.

At the stage of strategic vision building, joint activities are mostly related with the *organisation of workshops and conferences* in order to consulate and interlink policy makers and stakeholders with researchers and experts from several fields and disciplines for the assessment of long-term urban development scenarios, technological trends and societal needs (see JPI UE 2010a, Menninga et al. 2011). Due to the long-term focus of UE (up to 2050), *foresight activities* comprise a major tool for the JPI, as they are expected to provide specific and future-oriented knowledge on urban demands and developments (JPI UE 2011b). This holds especially true for the initial phases of the JPI where multiple scenarios for long-term urban development are conceivable but common images and structured visions on future targets with a selected set of research priorities need to be defined. Besides the implementation of foresight activities in overall strategic mission and vision building of the JPI, targeted foresights are the most important instruments for selecting and specifying the research topics⁵³ (JPI UE 2011b). In principle, foresights, technological assessments, and simulation activities are one of the most important research tools for the *socio-economic research approach* UE focuses on, and thus, are crucial research instruments for realising the SRAs in the entire JPI process.

Mechanisms for combining research approaches and knowledge sources

Thematic coordination aspects related to the combination of research approaches and different knowledge sources directly arise from the *interdisciplinary and integrated research approach* UE explicitly focuses on. This involves the coordination and integration of a number of scientific disciplines, from fundamental research to applied research or from socio-economic sciences to technology-oriented disciplines, but also concerns the multiple dimensions of innovation, i.e. from the uptake and commercialisation of research

⁵² These research issues are: Urban megatrends (demographic, economic and technological megatrends); Urban networks and connectivity (mobility, logistic and land use development); Socio-ecological sustainability of city systems (ecological and social constellations in order to shape sustainable and balanced long-run urban developments) (see, for example, JPI UE 2011b and 2011g).

⁵³ A screening of already conducted foresight activities in urban and city-related issues (e.g. sector- or technology-specific foresights, challenges, trends and drivers for urban / regional development) reveals that the time horizon of these foresights was much shorter than the strategic focus of UE, raising additional need for the execution of individual UE foresight activities (see, for example, Kubeczko et al. 2011).

and technology-led innovations to the strong focus on social and organisational innovations⁵⁴. However, it is explicitly noted that UE does not adopt technology-led research activities (JPI UE 2011b), but is rather interested in the uptake and implementation of new technologies and technology-led innovations (e.g. in the energy, infrastructure and transport system) as well as in new urban management concepts.

Due to its focus on societal problems, one major aim of UE is to strategically integrate the societal purpose and societal uptake of new technologies and innovations in its own research activities (JPI UE 2011a and 2011b). As policy makers, public or private firms and organisations are expected to trigger knowledge and technology diffusion, the creation of knowledge networks is of high importance in order to exploit potential synergies and create new combinations of already existing pieces of knowledge, in particular when combining this knowledge with industrial demands and needs. Thus, *networks and exchange platforms facilitating the combination of knowledge sources* with research needs in urban-related issues are major tools for the JPI, not only to bring together individual national R&D actors and support programs but also to achieve a broader, multi-dimensional and problem-oriented research focus.

The research activities conducted within the JPI framework should consequently *integrate social, economic and ecological aspects* of urban development (see, for example, JPI UE 2011a). Such an approach does *not* directly aim to create radical (technological) innovations per se, but to deliver inputs for the future development of technological solutions and the diffusion of innovative city concepts in light of future urban needs. Thus, research and innovation activities in UE also target the active integration of innovation users that are mainly urban policy makers, urban citizens or the economy directly affected from new urban management concepts.

Mechanisms for mobilising and integrating experts, stakeholders and civil society

Given the overall mission of UE, a range of individual needs and expectations need to be taken into account in the definition of concrete research objectives. As mentioned above, instruments like Foresight provide the opportunity to assess long-term developments and trends. Foresight processes have been an integral part in the implementation phase of UE in order to assess long-term societal developments in urban regions and to define a set of strategic research topics. The involvement of UE representatives as well as researchers,

⁵⁴ The research activities of the JPI are expected to “contribute to the entire innovation cycle from basic research up to commercialisation with a strong focus on social innovation” (JPI UE 2011b, p. 18).

companies, public authorities and policy makers was intended to ensure broad stakeholder participation and societal responsiveness in the definition of strategic research objectives (see JPI UE 2011b).

However, societal responsiveness might not only be expressed in the societal function of the strategic research objectives of the JPI, but is also to be understood in terms of degree, influence and variety of private stakeholder involvement in the operation and decision-making within a distinct JPI. For this reason, the ways in which experts and private actors are consulted as well as the constitution of distinct advisory bodies provide reference points to describe the degree of societal involvement in the set-up and implementation of the respective JPI.

In case of UE, urban-related scientific research communities (such as universities, research organisations as well as industrial companies) as well as national and regional policy makers and public authorities, municipal representatives, governmental agencies, civil society organisations (NGOs), other European stakeholder platforms and networking arrangements are regarded as the most important stakeholder groups that may have direct interest in the activities of the JPI (see, for example, Menninga et al. 2011). Differing stakeholder interests on research and long-term urban development have already been taken into account in the development phase of UE in the form of workshops and conferences ('Policy Vision Workshop') (see also JPI UE 2010a). Such platforms should provide the opportunity to generate awareness on UE and to closer interconnect societal and stakeholder concerns with the JPI representatives at the initial phase of the JPI.

Besides the efforts aiming at stakeholder integration at a rather broad, informal and voluntary basis during the development phase, another important governance instrument to integrate stakeholder interests has been established in form of a stakeholder forum that provides a formal inroad for societal concerns throughout the ongoing JPI process. The Urban Europe Forum (UEF) represents a network for all national and EU-level urban communities, and intends to enhance discussion, sharing of experience and information as well as ensuring dissemination of best practices (JPI UE 2011e). Emphasis is laid on the integration of other platform organisations for urban-related research and technologies, industrial members as well as civil society organisations and cities in general. The UEF should provide the governing bodies of the JPI with stakeholder-oriented recommendations in the set up of specific research projects and in this way enhance the societal relevance and impact of UE's research activities. It is also concerned with external relations to other national, European and international initiatives.

As the importance of expert advice and active involvement is particularly stressed in the general JPI approach, the governance structure of UE comprises a Scientific Advisory Board (SAB)⁵⁵ that should assist the governing bodies with particular regard to the scientific research approaches applied in the thematic orientation of the SRA (JPI UE 2011d). Moreover, they should provide scientific input for defining specific thematic research programs and monitor the ongoing JPI process from a scientific perspective. At present stage, however, the distinct role and composition of the SAB is still to be clarified.

Furthermore, declarations of intention indicate that the interdisciplinary approach of UE should also be reflected in the composition of the board. Thus, the selected members should cover a range of different research fields such as geography, urban and regional science, demography, urban economics, urban sociology, urban transport and mobility research, land use, urban energy management, building planning and design, urban planning and design, urban technology and environment, innovation and sustainability research (JPI UE 2011e).

Relations to other policy fields and mechanisms to integrate them

UE has a strong focus on the policy dimension in its research activities in terms of seeking comprehensive governance models for sustainable urban planning and management. However, urban development is a cross-cutting policy field that integrates core aspects of a variety of other policy fields. Thus, the efforts of UE are not exclusively related with STI policy issues but rather interconnect a number of policy fields that influence sustainable and integrated urban development. This is also reflected in the four-dimensional research focus ('cornerstones') of the JPI. The policy fields transport and energy, enterprise and business or environment hold the most important thematic linkages to research activities in the JPI (see, for example, Menninga et al. 2011, JPI UE 2011a), but connections to other policy fields are just as important with regard to the JPI's strategic objectives. Table 6 provides an overview on the relations between the agendas and goals of different policy fields and the research focus of UE.

⁵⁵ The Scientific Advisory Board (SAB) should consist of individual members from the urban-related scientific research sphere selected by a specially established search committee on the basis of distinct predefined criteria and appointed by the Governing Board (JPI UE 2011e). The members should hold high reputation in their specific research field as well as show experience in interdisciplinary research. The criteria for the SAB composition are not clearly defined yet but should take particular regard to balancing the four main focal points of UE topics as well as represent European and international experts.

Table 6: The multi-sectoral nature of the JPI Urban Europe

Policy field	Relations to UE
Energy	<ul style="list-style-type: none"> • Energy consumption of urban housing and infrastructure • Urban energy supply systems
Transport	<ul style="list-style-type: none"> • Intra-urban and inter-city transport systems • Eco-friendly and efficient transport services
Environment	<ul style="list-style-type: none"> • Problems related with pollution, green house gas emission and resource consumption intensity in urban areas
Enterprise and business	<ul style="list-style-type: none"> • Spatial concentration of firms and innovative entrepreneurs in cities • Urban areas are the main drivers for economic development
Research policy	<ul style="list-style-type: none"> • Cities are 'living labs' for urban research activities • Most of the research facilities are located in cities; agglomeration and urbanisation as a driver for knowledge creation
Regional policy	<ul style="list-style-type: none"> • 'Local/regional' embedding of cities and urban areas – land-use • Cities are vital for the regional economy • Urban areas are hubs for innovation, knowledge generation, production and wealth creation
ICT	<ul style="list-style-type: none"> • ICT-based city infrastructure and public services • Communication in and between cities • Interconnectivity of cities – 'network of cities'
Employment and social affairs	<ul style="list-style-type: none"> • Cities provide the majority of jobs and other social services • Urban agglomeration – problems and tensions related with unemployment, migration, demographic transformation and social exclusion
Health	<ul style="list-style-type: none"> • Healthcare systems in cities • Demographic change and consequences for health management in urban areas

Source: own elaboration on the basis of UE research objectives (see, for example, Seiser et al. 2010, Menninga et al. 2011, JPI UE 2011b)

The multi-sectoral nature of UE is also reflected in the composition of the Governing Board⁵⁶, mainly comprised of representatives from the member states⁵⁷. The majority of country delegates have direct STI background as they perform leading functions in federal ministries or public-related organisations with science, technology and innovation focus. They are national delegates from departments with technology- or innovation agendas or have institutional background in the field of transport, energy or environment. In this

⁵⁶ A list of Governing Board Members including the home institution and function is given in JPI UE (2011b).

⁵⁷ The Governing Board holds overall responsibility for the implementation of the JPI. It sets down the long-term orientation, and has the final decision power over all relevant strategic, political and financial matters. The Governing Board consists of one member from each country participating in UE. Each participating country has a vote in the Board and for this reason nominates a representative who has the authority to make decisions and act on behalf of its country. Moreover, a representative of EC participates in regular meetings, but has no voting right in contrast to the representatives of member states. The same applies to the Executive Director and Vice Directors of the Management Board, Chair and Vice Chairs of the Scientific Advisory Board, Chair or Vice Chair of the Urban Europe Forum, members of the Service Platform/Secretariat, which may attend meetings on request of the Chair and at least one Vice Chair of the Governing Board (JPI UE 2011c).

regard, members with direct or closer relations to social sciences are rarely represented. Further, delegates that are directly responsible for the agendas of regional / urban development in their home institutions are also barely represented in Governing Board of the JPI.

Overall, it can be noticed that – with the broad focus on long-term and sustainable urban development – a number of policy fields are directly or indirectly related with the research activities conducted in UE. This leads to different interests in the focal points and types of research activities and complicates decision-making at the governing level. The assessment of how and to what extent the multi-sectoral focus of UE influences the implementation of the SRA, also in terms of achieving strategic goals, is subject to more detailed evaluations and need to be conducted at a later stage of the initiative.

5.4 The EU Joint Programme Neurodegenerative Diseases Research

This case study focuses on to the policy coordination mechanisms prevalent in the JPI Neurodegenerative Diseases Research (JPND). As for UE, it analyses – according to the analytical framework given in Subsection 5.2 – the applied STI policy strategies and instruments for aligning problem-specific research activities across Europe in face of the policy coordination challenges related to systemic and thematic policy coordination. As for UE, JPND is explored by depicting and filtering relevant information in form of a structured content analysis of numerous materials available on JPND, described and interpreted in terms of the research focus of the thesis.

JPND has been launched in 2008⁵⁸ (CEU 2008a), stimulated by the rising challenges and societal problems related with the increasing number of diagnosed cases of neurodegenerative diseases (ND) and Alzheimer's Disease (AD)⁵⁹ in its different forms in the context of Europe's ageing population (EC 2009d, Alzheimer Europe 2010). Given the

⁵⁸ During the French Presidency of the European Council in the second half of the year 2008, France took a leading role in promoting a JPI in ND (see Amouyel 2009b).

⁵⁹ Alzheimer's Disease in its different forms is the most common form of ND and accounts for 50-70 % of all dementias (EC 2009f, Alzheimer Europe 2010). Other prevalent NDs are Parkinson's Disease, Amyotrophic Lateral Sclerosis, and Huntington's Disease. For the year 2008, it was estimated that direct and informal care of dementia patients imposes financial costs of approximately 130 billion Euros for the EU-27 (see Alzheimer Europe 2008). Due to the fact that ND are one of the main causes for disability in advanced age (approximately 70 % of Alzheimer's patients are aged 75 and over), the estimated rise of the proportion of Europe's population aged over 65 from 16 % today to 25% in 2030 will cause considerable social costs for the EU society (CEU 2008a).

expected doubling of persons affected in the next 30 years (see, for example, Amouyel 2010), the major problems of ND are perceived in terms of increasing social burdens for patients, relatives and carers as well as financial costs for the European healthcare system.

It is assumed that the expansion of disease patterns poses a number of challenges for the EU society as a whole and European research on ND in particular (see, for example, CEU 2008a, EC 2009d). Besides social concerns related with an ageing European population and the care of dementia patients ('social challenge'), or economic aspects in relation with the resulting consequences for the European health care and pension system ('economic challenge'), ND feature a paramount STI dimension. They require advanced scientific and technological input in order to find appropriate cure, prevention and treatment methods that are unknown or still underexplored to this day. For these reasons, the major aim of the JPND⁶⁰ is to improve Europe's research capabilities in terms of exploring the causes of ND and developing new forms of prevention, treatment and patients' care by strategically coordinating European-wide research efforts and research funding programs⁶¹.

Until now, the initiative has established their governance and management structure⁶², recently launched its first joint call (pilot call) and is about to announce the SRA for the following ten years in early 2012 (JPND 2011a and 2011b). A specifically launched ERA-NET project ('JUMPAHEAD') supports the implementation of JPND by providing additional financial resources for the management, coordination and development of the SRA in the first three years of existence of JPND.

⁶⁰ The scope of JPND covers the following forms of ND (Moody 2011): Alzheimer's Disease and other dementias; Huntington's Disease; Motor Neurone Diseases; Parkinson's Disease and PD-related disorders; Prion disease; Spinal muscular atrophy (SMA); Spinocerebellar Ataxia (SCA). It explicitly excludes targeted research on multiple sclerosis; Age-related macular degeneration; conditions where the primary lesion is not neurodegenerative; loss of function or cell death due directly to cancer, oedema, haemorrhage, trauma; poisoning and hypoxia; and co-morbid conditions.

⁶¹ JPND endeavours in this regard particularly concern to (i) identifying research needs and opportunities from a scientific point of view, (ii) systematically exploring existing strategies and research efforts across Europe and detecting gaps and barriers for progress, (iii) developing common short and long-term research priority areas and strategic objectives for participating countries, (iv) specifying the required research infrastructure and technologies, and (v) specifying need and potential for cross-border research activities (see Amouyel 2009a, 2009b, 2009c and 2010, Rossor 2011, Maggi 2011a).

⁶² The internal governance and management structure of the JPND comprises a management board that is the decision-making body of JPND, a scientific advisory board (SAB) that will provide the management board with scientific advice, and an executive board as well as a secretariat responsible for preparing and implementing concrete actions on the basis of the decisions made by the management bodies (JPND 2011a, Amouyel 2009c and 2010).

Thematic background

Although previous research activities in the field of ND brought progress in the treatment of disease symptoms, appropriate methods and therapies for the different forms of ND are not developed yet (see, for example, EC 2009d and 2009e, Alzheimer Europe 2010). Thus, the urgent need for new methodological approaches in this direction is particularly stressed in the objectives of JPND. Systemic, transdisciplinary and translational research approaches should enhance the time to market of new care, treatment and prevention strategies or early diagnostic tools that are based on fundamental basic research findings.

Concerning the JPND research framework, a threefold challenge is highlighted that is also reflected in the three major research focal points (Amouyel 2009a and 2010): First, the overall and ultimate aim of research on ND is to enhance the understanding of the causes and the course of the diseases from a scientific point of view ('scientific challenge'⁶³). Second, JPND involves also a medical dimension regarding the improvement of diagnostic tools and skills of medicines that should ensure more effective prevention, facilitate the recognition of symptoms and enhance possibilities to treat the disease already at early stages ('medical challenge'⁶⁴). Third, JPND also addresses research that is targeted to medical and social care systems with particular regard to the utilisation of smart technologies ('ethical and social challenge'⁶⁵).

To tackle these challenges, JPND is built around three domains, namely basic research, clinical research, and health and social research (see JPND 2011d, 2011e and 2011f). Each individual domain lays emphasis on the importance of creating scientific excellence and the development of fundamental scientific breakthroughs in ND targeted research. Furthermore, translational research activities should facilitate the development of new technological solutions and research-led innovations in order to improve the diagnosis of ND by new medical devices, provide better opportunities for a targeted cure of patients

⁶³ The scientific challenge comprises research on genetic susceptibility; developing competitive animal models; basic research on pathophysiology; development of new imaging technologies and new biomarkers; studying early onset forms of Alzheimer's Disease and related dementia; development of new treatment strategies; coordinate biobanks for blood samples; CSF and brain tissues; launching or integrating large population cohorts or registries (Amouyel 2009c).

⁶⁴ This may involve early diagnosis using multidisciplinary approaches, the use of prevention to reduce the burden of dementias, publicly-funded clinical trials, standardization of diagnostic criteria and diagnostic instruments, among others (Amouyel 2009c).

⁶⁵ Ethical and social challenge involves research on comparison of different systems and identification of best practice; technological development for home automation, smart homes and domotics as well as social research, for example, in ethics and health economics (Amouyel 2009c).

and patient care. A focus on training and education of clinical scientists, practitioners as well as healthcare professionals will complement the JPND approach.

Overall, the JPND framework should provide better conditions for applying new methodological approaches and establishing interdisciplinary links between several research activities around the common societal problem of ND (see Moody 2011). A strategically coordinated approach should enhance the overall knowledge on ND from causes and consequences to the treatment of persons affected by pooling several knowledge sources, research capacities and skills throughout Europe.

Systemic policy coordination aspects

From a systemic policy coordination perspective, the European research landscape on ND and AD is characterised by lacking coordination of dispersed research resources and competencies as well as fragmented research support strategies that are recognised as ineffective, especially in light of the urgent need for comprehensive and appropriate solutions (see, for example, EC 2009a and 2009c). Several countries have launched individual national initiatives and plans for fighting against ND or AD in the recent past. However, they are characterised by very different strategies, research priorities as well as funding policies (see EC 2009d and 2009e for an overview). The same holds true for a number of ambitious but isolated EU initiatives that either formulate general strategies for the development of ND (EU health strategy, European Pact on Mental Health and Well-Being), address collaborative research activities by FP funding or support specific network or large-scale project arrangements (e.g. EADC – European Alzheimer’s Disease Consortium) (EC 2009e). Thus, systemic policy coordination in the JPND framework should reduce fragmentation and increase efficiency of R&D funding schemes across Europe. Above all, however, increased coordination is expected to lead to faster generation of research results in light of the urgency for scientific progress in ND research.

For these reasons, various instruments aiming at a broad coordination of public support programs and funding channels for ND-related research activities have already been applied in JPND. Most notably in this context are the extensive mapping efforts of national and European research initiatives conducted in the starting phase of JPND (see Creely 2011). The basic objective of that comprehensive and survey-based screening method was to gain a first picture of the European-wide research landscape in ND and AD, its main strategies, existing initiatives and dominant research funding channels. In further

consequence, this should also facilitate the detection of distinct knowledge gaps in the research domains of JPND. Respective evaluations reveal that there is remarkable potential for integrating these existing national strategies in the JPND framework (EC 2009e, Creely 2011). Further, the establishment of close relations with other European research initiatives or networking platforms that focus on specific research topics of JPND is regarded as promising for coordinating and structuring European efforts more strategically.

In order to improve effectiveness of R&D in ND, exploiting national and EU instruments for creating a critical mass of skills and knowledge on ND, but also pooling of financial resources devoted to respective research activities is a clear priority of JPND. If, however, targeted cross-border actions are regarded as particularly beneficial for a specific research objective, new initiatives and research objectives might be launched in the form of coordinated joint transnational calls⁶⁶ or more integrated research networks and excellence centres that would allow each JP member a voluntary participation (Amouyel 2009a and 2010).

Additional attempts to create a more integrated research system on ND throughout Europe emphasise the development of new ways for conducting large-scale clinical studies or establishing far-reaching population cohorts on a transnational basis. Requirements for joint infrastructural facilities are therefore expressed in the form of pan-European databases and patient registries that should provide the foundation for enhanced knowledge, information and data exchange throughout Europe (EC 2009d). Thus, JPND actively promotes standardisation activities enabling the utilisation of harmonised data assessment methods as well as diagnostic criteria for research purposes (see, for example, Amouyel 2009b, Curtius 2011). Databases that feature comprehensive but coherent, reliable and comparable information should provide a transnational platform for knowledge and best practices exchange across Europe.

In general, JPND stresses the importance of strategically coordinating already existing research activities across Europe in order to tackle the far-reaching and demanding problems of ND. Ambitions for joint activities in ND result from the increased awareness that appropriate solutions for addressing the negative consequences of ND involve huge

⁶⁶ Given the urgency for research progress, JPND has decided to launch a first joint call just before its final SRA implementation (JPND 2011b). Thus, the first joint call on the optimisation of biomarkers and harmonisation of their use between clinical centres has been launched in May 2011 and financed by financial contributions of 20 participating countries.

financial investments. These should be employed more coordinated across Europe. In addition, JPND lays emphasis on a combination of different research capabilities, skills and knowledge sources in order to sufficiently take into account the wide spectrum of ND-related research domains.

Thematic policy coordination aspects

Tackling huge societal problems coming from increasing ND prevalence by means of STI are the cornerstone of JPND, covering a wide spectrum of research activities from causes, diagnosis and treatment of ND in natural and clinical sciences, to the consequences and dealings with ND from a social sciences perspective (see EC 2009d, Curtius 2011, Maggi 2011a). In what follows, the thematic aspects of policy coordination for combating ND are introduced, and in doing so, insights on how the different research approaches are coordinated in pursuing problem-oriented research objectives are provided. Further, it is described in which way scientific, political and societal stakeholders are involved in the formulation and definition of specific research priorities.

Mechanisms for challenge-led strategic vision building

In JPND it is emphasised that scientific knowledge for a deeper understanding of the causality in ND is still underdeveloped at present (see, for example, EC 2009d, JPND 2011d). This is also the case concerning therapies and methods to cure patients, calling for further significant and thematically coordinated research efforts in the near future (JPND 2011e). Joint future research needs in the JPND framework are mainly related to this lack of critical knowledge, stressing the urgent need for appropriate solutions in light of pessimistic prospects for the evolution of the disease. This is widely agreed across the European stakeholders pointing to a first shared vision on future research needs and demands in the field of ND.

In practice, the concrete definition of short- and long-term research opportunities and priorities of JPND was based on existing national and European research portfolios (see, for example, Creely 2011). Structural gaps in European research activities in the field of ND have been identified on the basis of the initially conducted mapping of currently running national programs, strategies and initiatives. In addition, selected research experts have been consulted in order to assess the most critical knowledge gaps in the field as well as to identify important barriers for research progress (see, for example, Rossor 2011).

For this reason, three academia-led thematic workshops covering the main research domains of JPND (basic, clinical and health and social research) have been held to assess various expert opinions on scientific opportunities and emerging themes in the field for the next decade (see JPND 2011d, 2011e and 2011f). A final workshop was organised to bring together previous findings in order to provide an integrated roadmap for future JPND activities (see JPND 2011g). Thus, scientific expert-based expectations and perceptions for near and long-term developments in research on ND provide the main inputs for the final specification of the concrete research priority topics by the scientific advisory board of the JPND.

Mechanisms for combining research approaches and knowledge sources

As mentioned above, research activity in JPND is built around three major research domains, namely basic, clinical and health research (see, for example, Amouyel 2009b, Maggi 2011) covering a wide spectrum of different scientific disciplines that ranges from natural science-based fields such as biology, to scientific fields with high application-orientation such as clinical laboratory sciences or medical sciences. Social sciences address health economic aspects, particularly in relation with research on current and future healthcare systems. In each of the individual domains, scientific excellence and the development of domain-specific research capacity and knowledge are regarded as major keys for accelerating progress in ND research (see JPND 2011d, 2011e and 2011f). Therefore, JPND explicitly and almost exclusively focuses on frontier research activities that are expected to deliver appropriate discoveries to prevent the expansion of the diseases, disburden patients directly or indirectly affected and lessen the negative consequences for the entire European society. Thus, JPND also integrates aspects related with field-specific education in its objectives, such as training and capacity building, especially in terms of enhancing capacity for collaborative and interdisciplinary research activities.

Although natural and clinical sciences are the focal points of JPND, scientific input from social sciences is also stressed (see JPND 2011f). Health and social research activities should facilitate technological development targeted to ease and enhance living conditions for ND patients, such as for example in the case of new technologies for smart homes and home automation.

Efforts to enhance translational research activities are a major concern in JPND (see JPND 2011c, 2011e and 2011f), which provides opportunity to better link and integrate individual research disciplines, especially with regard to basic and clinical science. Promoting the targeted transformation of basic discoveries into specific drugs under the roof of JPND is seen as a promising approach for faster developing ND therapies. Measures that focus on combining several research approaches might comprise the establishment of new and specifically targeted research networks and centres of excellence, intending to promote more integrated and collaborative research activities. Further, active utilisation and participation of existing networking platforms is aspired by JPND⁶⁷. The aim of spurring the translation of basic research results might also be achieved by particular measures that focus on closer academia-industry cooperation⁶⁸.

Mechanisms for mobilising and integrating experts, stakeholders and civil society

The main stakeholders of JPND are scientists (public as well as industrial researchers), policy makers (in particular health policy makers) from the national or EU level, public and private research funding agencies, healthcare professionals, and service providers as well as patient interest groups (Mitchell 2011). Although all these stakeholder groups might have some kind of interest on JPND's activities, their influence in form of actual involvement and consideration of their views in formulating research priorities and specifying concrete activities differs considerably.

Due to JPND's focus on research and scientific knowledge production, knowledge input in the form of domain-specific research expertise played a decisive role for setting the SRA. The governance structure of JPND comprises a scientific advisory board (SAB) consisting of 15 high-level experts from the academic sphere, five for each research domain (JPND 2011a). The expert committee provides the decision-making bodies with scientific advice and recommendations throughout the entire JPI process, in particular with regard to ensure evidence-based and effective specification of concrete research objectives. Thus, it is heavily involved in the identification and selection of research priorities, exerting major influence on the bottom-up formulation and specification of JPND's long-term research

⁶⁷ For example, the recently founded Centres of Excellence in Neurodegeneration (COEN), a joint initiative of research organisations world-wide, supports collaborative, cross-border projects in ND and will complement the activities of JPND (JPND 2011a).

⁶⁸ The need for close academia-industry cooperation and public-private partnerships was a major concern in a targeted workshop with industrial researchers (JPND 2011c).

objectives. Further, the committee appoints academic-based workshops that provide the key foundations for the formulation of the JPND's SRA.

In addition, focused consultation procedures (see JPND 2011c and 2011h) conducted after the formulation of strategic priorities provide an ad-hoc platform for stakeholder groups outside the academic sphere for bringing in their views on the research objectives. Small-scaled meetings specifically convened for public authorities at EU-level, European patient and carer organisations as well as industrial stakeholders should supply the decision-making and advisory bodies of JPND with general recommendations and additional appraisals on previous research barriers and future research opportunities. Further, such consultations should provide the opportunity for identifying different stakeholder priorities regarding future JPND activities (JPND 2011a).

Concerning industrial consultation, one particular objective was to assess the future potential for academia-industry collaborative arrangements and public-private partnership funding models, especially with regard to joint drug development for ND⁶⁹. For this purpose, important enterprises in the biotechnology and pharmaceutical sector have been the main targets of such industrial consultation procedures. Further input in the form of suggestions for the progression of JPND has been derived from broad based online consultations addressing an extended set of stakeholders, notably with respect to persons directly-affected by ND. To capture more in-depth insights in the healthcare perspective, interviews with (mostly) private professionals in fields of health care services and assisted, ICT-based living have been conducted via telephone conferences (see JPND 2011a for further details).

To sum up, it can be noted that scientific experts have experienced broad integration in the development of JPND, while other stakeholder groups (industrial researchers, policy makers, patient and carer organisations, etc.) have been consulted to pass their opinions after the specific research objectives have been set. Due to the strong scientific and very specific research focus of the initiative, the selection of strategic research priorities was based on scientific advice that has been rendered by selected expert committees, either initiative-internal via the SAB or external via thematically-focused workshops.

⁶⁹ Details on the participants, aims and major outcomes of industrial consultation meetings are given in JPND (2011c).

Relations to other policy fields

Given the scientific focus and the societal challenge behind JPND, the initiative is mainly embedded in research policy agendas. However, the initiative shows strong thematic linkages to the health policy domain. Due to the ultimate aim of JPND, namely to find appropriate research-led solutions for achieving good health conditions for ND affected persons, research activities in JPND are of particular relevance for health policy agendas. These direct relations are also reflected in the composition of the decision-making bodies of the JPND that partly consists of public authorities from national research and health-related ministries, but also includes representatives from universities, science foundations, or specific research councils that might have more practical experience in research on ND⁷⁰.

Besides scientific- or health-related challenges, ND in general and the estimated increase of the diseases in particular induce economic challenges for Europe's society that are especially stressed in the goals of JPND (see, for example, EC 2009d). Thus, relations with financial policy affairs concern JPND's potential contributions to reduce the financial burdens for European health care systems that might result from further prevalence of ND. On taking particular account of the social consequences for people affected, research progress in age-related ND might also deliver contributions to increase social and working life participation and reduce social segregation of ND patients. Subsequently, this might lead to a more inclusive society in the long run. Social inclusion and high levels of employment are goals traditionally related with the policy field of employment and social affairs (see, for example, EC 2011n).

Considering the research objectives of JPND that are closely related with the development of medical devices and assisting-technologies for dementia patients (see, for example, JPND 2011e and 2011f), in particular ICT-based tools, public support in the field of ICT may have considerable influence on ND-related research issues. Furthermore, measures of other policy fields might spur research activities in the field of ND and therefore might exert distinctive impact on the research progress in JPND. Examples in this regard could be the implementation and standardisation of regulations that should be research-friendly but nevertheless take account of ethical concerns, in particular patients protection.

⁷⁰ JPND (2011a) provides a list of the appointed management board members.

Moreover, education policy initiatives that enhance general scientific research capacity, as well as targeted skill development measures for health professionals or medical professionals on dementia and ND might play an important role for tackling the numerous challenges of the disease.

5.5 Comparative analysis and discussion

This section shifts attention to the comparative analysis of the JPI UE and the JPND addressing the differences and similarities between the two cases under consideration, particularly regarding their policy coordination mechanisms. In terms of the comparative multiple case study strategy employed here (see Yin 2003a and 2003b, see Subsection 5.2), this subsection concerns the second step of the two-step procedure adopted, i.e. after relevant characteristics of the two individual cases have been extracted by means of structured content analyses of numerous public material on the cases (see Subsection 5.3 and Subsection 5.4), the most pivotal differences and similarities in the appearing mechanisms are identified in the following in order to draw cross-case conclusions. Given the research question of the diploma thesis, the focus is on distinct forms of societal-challenge-driven policy coordination, and how they are dealt with from a multi-level and multi-actor perspective. By this, the analysis will provide novel empirical insight into the question how the specific formulation of societal challenges – given their distinct thematic properties and embedding in basic and applied research – influence coordination patterns in the implementation of European STI policy design.

As discussed in some detail in Subsection 5.1, JPIs are a particular EU-level STI policy instrument designed and implemented to bundle national STI policy activities in concrete areas that are regarded to be of crucial importance for the future development of European society. While the political level decides on the broad JPI themes in accordance with current EU priorities, each JPI has individual implementation structures and mechanisms that determine the targeted objectives and priorities as well as the actual measures. This produces distinct patterns of operational coordination in JPIs that are driven, first, by multi-level and multi-actor aspects arising from a diverse set of stakeholders involved at the regional, the national and the EU-level, second, by the inter- and transdisciplinary character of the research areas corresponding to a specific societal challenge, and, third, by the specific scientific embedding of a societal challenge to be addressed in basic and applied research. The two case studies on the JP UE (see Subsection 5.3) and the JPND (see Subsection 5.4) reveal that both JPIs show such specific coordination patterns in their implementation. However, it becomes evident that –

given the distinct scientific embedding of the two topics, namely urban development in Europe and issues of ND – different approaches and internal mechanisms for assuring problem-oriented and consistent actions are adopted in the two cases.

In what follows, the most notable differences and similarities of policy coordination mechanisms are identified and discussed according to the analytical framework (see Section 5.2). Noteworthy is the fact that the thematic context-specific analysis delivers valuable empirical indications for explaining differing JPI designs, in particular governance patterns and coordination mechanisms. From an analytical perspective, systemic coordination mechanisms comprise efforts that basically aim at coordinating and pooling the diversity of fragmented - national and European – resources, strategies and approaches, while thematic coordination mechanisms particularly arise from the societal challenge-driven approach of JPIs and reflect the scientific characteristics of the JPI theme. For this reason, different forms of thematic coordination aspects have been considered in the analysis, pointing, first, to distinct modes for developing a common societal challenge-led strategy, second, to distinct instruments for pursuing such an inter- and transdisciplinary research strategy, third, to the mechanisms for enhancing societal participation and integrating public and private interest groups, and, fourth, to the specific policy field embedding of the JPI theme. Before thematic policy coordination aspects are discussed from a comparative perspective, dissimilarities concerning systemic policy coordination mechanisms are elaborated on in the following.

Comparison of systemic policy coordination mechanisms

In principle, both JPIs under consideration strive for a more efficient exploitation of national research capacities in the respective research areas by enhancing *systemic coordination* at the European level (see Table 7). In doing so, member states agree on a voluntary basis to devote national financial resources to the strategic implementation of joint endeavours that are supported by the EU. Nevertheless, motivations of member states for joining the JPIs as well as the way in which the distinct goals are pursued differ considerably in the two initiatives. In JPND, coordination efforts are mainly driven by the unsatisfactory progress of previous research, notably in light of the alarming predictions about the upcoming proliferation of ND. Deficiencies are mainly seen in isolated research efforts, dispersed European and national strategies and public support programs as well as unequal standards (for e.g. diagnosis and data assessment) that are increasingly perceived as significant impediments for the exchange of knowledge and best practices. Promoting a coherent ‘European research system’ on ND allowing for harmonised

research procedures and more effective usage of existing research capabilities is therefore regarded as particularly promising for advancing knowledge generation in ND. Hence, JPND as pilot initiative of the JPI approach is still closely related with the primary ERA idea, namely to remove national and institutional barriers, and better exploit the already available research potential in order to accelerate the research outcome for tackling ND.

Table 7: Cross-case comparison of systemic policy coordination aspects

Aspects of systemic policy coordination	JPI Urban Europe	JPI Neurodegenerative Diseases
Division of labour between member states (leader) and EU (support)	<ul style="list-style-type: none"> • Member states-led initiative based on national consultations and multi-lateral coordination • National financial and in kind contributions • EU (EC) has supportive function in the operation of JPI by e.g. advising on additional funding and cooperation possibilities 	<ul style="list-style-type: none"> • Member states-led initiative with great EU commitment (pilot initiative) • National financial resources supplemented by EU-FP funds for implementation of JPND (ERA-NET) • EU (EC) assists with the provision of data and information
Pan-European perspective of strategic research goals	<ul style="list-style-type: none"> • 'European urban system' and 'network of cities' • Competitiveness of European cities in a globalised world • Lack of comparable national strategies and approaches 	<ul style="list-style-type: none"> • Similar disease prevalence throughout European countries • Pan-European urgency for knowledge generation on ND-related issues • Coordination and integration of individual national initiatives, plans and strategies
Internal coordination mechanisms (instruments)	<ul style="list-style-type: none"> • Screening national and European research activities • Joint knowledge infrastructure (pan-European data base with standardised indicators) • Platform for sharing best practices • Joint transnational calls and research projects 	<ul style="list-style-type: none"> • Mapping of national and European research portfolios: Country surveys; Screening of EU initiatives • Coordinated population cohorts and large-scale clinical studies • Standardisation/harmonisation of patient samples and documentation for data and best practice sharing • Pan-European joint infrastructure (research networks, centres of excellence) • Exploiting existing national and EU instruments • Joint transnational calls and research projects

In contrast, UE follows a somewhat different purpose. It attempts to develop a new research perspective with joint transnational forces that is based on merging different research approaches, but as such is unique in the European research landscape on urbanism. This, most notably, applies to the specific research focus on an integrated 'European urban system'. Thus, UE lays particular emphasis on providing a transnational platform for interaction and best practice exchange enabling pooling of knowledge and information on European cities and facilitating the assessment of future urban needs.

The different approaches to exploit or coordinate national activities clearly indicate the influence of the specific societal challenge, i.e. the distinct thematic backgrounds of European urban development vs. ND, on coordination efforts in distinct JPIs. Although other factors that have not been directly analysed in this study might also influence coordination patterns in practice, the remarkable differences in the way the common strategy has been developed and how it is pursued underscore the impact of the distinct thematic embedding on governance modes and coordination activities of the two initiatives.

Comparison of thematic policy coordination mechanisms

In terms of thematic policy coordination (see Table 8), for both JPIs, *strategic vision building* is crucial in the initial development phase. It determines the path for further implementation of the JPI and specifies the common near to long-term research needs in a bottom-up way. Against the background of the targeted societal challenge, the vision development process involves technical experts or stakeholder consultations in both JPIs. However, significant differences in the challenge led strategic vision building can be observed in the two cases under consideration. The forms of expert advice and therefore the range and type of experts involved differ according to the thematic foci of both JPIs. UE addresses a variety of societal challenges that might have impact on long-term future urban development ('umbrella theme') and seeks to contribute to long run, sustainable urban transformations. Due to the broad orientation and large time-horizon of UE, different stakeholders (academia, industry, policy makers, etc.) jointly engage in foresight activities in order to combine different views on research needs and gain systemic knowledge on potential future developments. While UE seeks to comprehend external uncertainties from a systemic perspective, JPND is confronted with specific research inherent uncertainties, notably as far as the unknown path of research progress as well as the time to real breakthrough is regarded. JPND mainly focuses on problems that are related to lacking specific knowledge on cause and treatment of the diseases. Because of the basic

research focus of the theme, mainly academic experts were entrusted with the identification of domain-specific knowledge gaps, providing the basis for research priorities as specified by JPND's scientific advisory board.

The distinct research focus of the two JPIs (systemic, interactive and inter-disciplinary approach in UE vs. scientific excellence with particular importance of translational aspects in JPND) is also reflected in the way *different research approaches are combined*. Moreover, the *societal participation* by means of *integrating research-based and non-scientific societal knowledge sources* varies considerably across the distinct research approaches. Since JPND mainly strives for tackling the societal problems of ND by advancing discipline-oriented scientific progress, also in terms of facilitating its translation, it particularly stresses the importance of scientific capacity building in specifically designed facilities and network arrangements. In contrast, UE pronounces an interdisciplinary and socio-technological approach that integrates multiple research perspectives on urbanism, and lays strong emphasis on promoting social innovation. In doing so, UE explicitly aims at bringing together scientific actors, civil society as well as policy makers in the course of research, involving elements of scientific research activities in the traditional sense, but also emphasises the collaborative development of new urban management strategies and concepts. Thus, UE pursues a networking purpose that enables higher interaction and knowledge exchange between the urban research communities but also between society and policy makers, while knowledge exchange and coordination in JPND is limited to translational aspects of domain-specific research activities.

Moreover, both JPIs feature elements pointing to *societal participation* in objective formulation and decision-making, although the scope of private actor involvement varies across the two JPIs. For JPND, the strong scientific focus is also reflected in the patterns of stakeholder participation, implying that only scientific experts via the scientific advisory board are actively integrated in the operation of the initiative. Although other research-related (industrial research) and societal stakeholder groups (patients- or health professionals organisations) are addressed via the execution of specific (partly standardised) consultation procedures, JPND's governance structure does not yet provide a formal inroad for their active participation in the ongoing JPI process. In contrast, UE features, besides the scientific advisory board, an additional advisory platform that is open for different stakeholders. Since one major aim of UE is to bridge the gap of research and new technology-led innovations relevant for urban areas and their uptake in urban governance concepts, the stakeholder platform is designed to feed the decision-making

bodies with recommendations that are of high practical significance in urban living and policy-making.

Table 8: Cross-case comparison of thematic policy coordination aspects

Aspects of thematic policy coordination	JPI Urban Europe	JPI Neurodegenerative Diseases
Challenge-led strategic vision building	<ul style="list-style-type: none"> Uncertain challenges: Identifying and specifying largely intangible future needs and demands of cities Creation of stylised 'urban images' for 2050 <p>Instruments / activities:</p> <ul style="list-style-type: none"> Organisation of broad based stakeholder workshops and conferences Foresight to specify priorities 	<ul style="list-style-type: none"> Tangible problem: Expansion of ND but lacking knowledge on causes and underdeveloped treatment methods Identification of existing knowledge gaps <p>Instruments / activities:</p> <ul style="list-style-type: none"> Organisation of domain specific ad-hoc expert groups and academia-led workshops in priority research fields SAB sets research priorities
Combining different research approaches / knowledge sources	<ul style="list-style-type: none"> Systemic, interactive and social science driven 'human-centred approach' Integrating multiple dimensions in research activity: economy, ecology, transport, society Integration of existing technological innovations Striving for social innovation (new urban management concepts) <p>Instruments / activities:</p> <ul style="list-style-type: none"> Providing platforms for interaction and knowledge exchange between scientific research domains, policy and urban society Developing urban profile indicators Targeted foresight activities, technological assessments Living-labs, demonstration projects 	<ul style="list-style-type: none"> Creating scientific excellence in three individual research domains (basic, clinical, and health and social research) Applying new methodologies Education, training and capacity building in research domains Enhance linkages between research disciplines and domains Facilitating translation of research and technological development <p>Instruments / activities:</p> <ul style="list-style-type: none"> Scientific collaboration: Create networks and centres of excellence Enhance academia-industry research collaboration
Societal participation: Integrating experts, stakeholders and civil society actors	<ul style="list-style-type: none"> Focus on bridging new technologies with society and policy for urban management Policy makers as prime target group for new governance solutions Integrating and interacting with multiple stakeholders in ongoing JPI process <p>Instruments / activities:</p> <ul style="list-style-type: none"> Conferences / workshops SAB Urban Europe Forum – stakeholder platform and additional advisory body 	<ul style="list-style-type: none"> Strong focus on expert advice <p>Instruments / activities:</p> <ul style="list-style-type: none"> SAB (high influence on research objective definition) Focused consultation of key stakeholder groups after specifying research priorities (e.g. industrial consultation, patient-based workshops)
Relations to other policy fields	<ul style="list-style-type: none"> Cross-cutting theme with direct relations to numerous other policy fields 	<ul style="list-style-type: none"> Supportive function of research policy to achieve other policy goals (e.g. health) Potential impact of other policy fields

However, policy coordination to tackle societal challenges does not only refer to aspects of multi-actor participation, but also comprises the interrelations with other *policy fields*, in particular with regard to policy field overlapping goals of both JPIs. In principle, both initiatives aim at tackling societal challenges that span across several policy fields and are closely related with other sectoral goals. However, JPND particularly highlights the supportive role of research for achieving other policy goals that are located, for example, in the health domain or refer to financial or social affairs. Although distinct measures in other policy fields might support the overall research progress of JPND, the scientific-centred objectives of JPND limit the potential impact of other policy field measures as compared to UE. The latter takes a systemic perspective on urban development, and by this, more explicitly addresses ‘cross-cutting’ and policy field overlapping goals. Thus, UE may deliver valuable contributions to achieve the overall goal of sustainable European development, but a number of complementary actions that are beyond STI policy have potential impact on the future urban situation.

Concluding remarks and discussion of findings

In conclusion, the comparative analysis provides empirical evidence that distinct societal challenges highly influence governance and coordination patterns in the implementation and operation of European STI policy designs. In close relation with these findings is the fact that governance practices that involve a wide array of specific experts and stakeholders are prevalent in designing current STI policy programmes, leading to a reinforcement of thematic embedding effects. In particular, this refers to the appraisal of different knowledge sources for policy design influencing the way in which different expert and social actors are addressed as well as the role they play for selecting and formulating specific policies. Thus, for the JPIs under consideration, the comparative case study strategy reveals that the specific research approach selected to tackle these challenges is at least as important when explaining the different coordination patterns and instruments that become apparent.

In essence, this pertains both to *systemic policy coordination*, as well as to *thematic policy coordination*. In terms of *systemic policy coordination* the mechanisms applied for coordinating national activities varies considerably between the cases under consideration, for instance related to the relevance and design of internal coordination instruments. In terms of *thematic policy coordination*, the specific societal challenge-driven influence can be seen clearly in the form of how scientific, technical and societal knowledge is integrated, particularly with regard to private actor participation in building a

strategic vision and setting the research priorities, as well as the distinct problem-oriented inter- and transdisciplinary integration of different research streams and disciplines, and the relation to other policy fields.

At an operational level, tackling ND involves scientific input that is both financial and human resource intensive, inducing JPND to promote an integrated European research system on ND by drawing on already existing national activities. The strategic formulation of research needs and priorities provides a common reference for national efforts, on the one hand, and enables coordination of different research domains that are decisive for tackling ND, on the other hand. In contrast, tackling urban-related societal challenges involves a number of different inputs that are of scientific and technological nature, but also societal- and urban policy-based. Thus, the research perspective of UE requires much more initial effort for developing and specifying the concrete research needs. While the interactive aspects between research activity, policy and society in the UE approach are also reflected in its broader integration of social actors, JPND is primarily based on expert advice for setting the research priorities reflecting the relevance and urgency of scientific progress in ND. Thus, integration and influence of multiple actors on priority-setting and decision-making in the distinct JPI designs is highly dependent on the research focus.

6 Conclusions

Today it is widely recognised that Science, Technology and Innovation (STI) are the main drivers for economic growth, and at the same time deliver major contributions for sustainable social development, placing STI policies in a key position in the policy mix of regions, countries and supra-national entities, such as the EU (see, among others, Lundvall and Borrás 2005). In this sense, the influence STI policy might exert to promote knowledge production and innovation processes is of great current interest in innovation policy research and public policy analysis alike.

From a historical perspective, varying theoretical and conceptual frameworks have been used to legitimate STI policy intervention since its explicit inception as a specific policy field after the Second World War, usually related to different perceptions of the innovation process (see Fagerberg 2005, Boekholt 2010). During the 1980s, the 'systems of innovation' approach has come into fairly wide use as conceptual frame for STI policy interventions, pointing to the crucial importance of the interactive character of the innovation process, and by this, emphasising the provision of framework conditions that facilitate networking, knowledge transfer and collective learning between all relevant actors throughout the innovation chain.

However, in the recent past, significant criticism has occurred that purely 'systems of innovation' driven STI policy approaches are too narrowly focused on technological and economic rationales (see, for instance, Kubeczko and Weber 2009, Smith et al 2010, Chaminade and Edquist 2010), neglecting the social dimension of STI. In this context, theoretical considerations for STI policy intervention increasingly emphasise the potential of STI for providing solutions for far-reaching societal problems. Furthermore, the nature of scientific activities, and therefore also the public promotion of scientific knowledge production, have changed from a rather pure and less objective-driven search for new knowledge to a focus that highly emphasises application and problem-solving capacity of knowledge production. In this sense, the implementation of STI policy measures has gradually turned away from narrowly focused scientific, technological or economic aims towards broader goals related with the social benefits directly resulting from STI activities. This gives rise to the notion of societal challenges as driver for STI policies.

Taking a European perspective, STI policy makers at both the national and EU-level increasingly emphasise the potential of knowledge and innovation creation for resolving complex problems facing the European societies, such as climate or demographic change, and in doing so, refer to the notion of societal challenges that are apprehended as pan-European societal problems demanding advanced and comprehensive innovations in order to tackle them sufficiently (see EC 2010a and 2010b). In a European STI policy context, the need for enhanced policy coordination efforts between the EU and its member states dominates the current political debate on tackling such pan-European societal challenges, also appearing as so-called 'Grand Challenges' in the political communication (see EC 2008a). These facts might point to a shift in the political governance of STI in the EU that is reflected in changes of the overall STI policy goals pursued, the specific thematic priorities and approaches selected for targeted intervention as well as the reinforced importance of aligning policy activities of various policy fields at different territorial (see also OECD 2005a).

The focus of this diploma thesis was on the influence of societal challenges on EU STI policy-making, emphasising governance modes particularly in the form of different kinds of policy coordination patterns. To investigate in which way the formulation of societal challenges – considered as new rationale for science, technology and innovation (STI) policy intervention – influences policy-making and policy coordination in the European multi-level governance system from a theoretical as well as empirical point of view, the diploma theses theoretically stretches potential influences from different angles of the governance literature, in particular with regard to STI policy and EU policy-making. In addition, it provides novel empirical insight by using information on concrete recent EU STI policy programmes intended to address such societal challenges, namely the Joint Programming Initiatives (JPIs). Three specific research questions guided the research process, namely (i) what are the consequences of the change in STI policy orientation for policy coordination from a theoretical and conceptual perspective; (ii) which influence has the formulation of thematic priorities in terms of different societal challenges on EU STI policy-making and policy coordination at the European level; (iii) in which form emerges societal challenge-driven policy coordination in JPIs as specific new EU STI policy designs.

Given the multi-level nature of the European governance system (see, for example, Benz 2010), JPIs have to be understood in light of the two most striking driving forces for current STI policy initiatives at EU-level: Enhancing strategic coordination of dispersed national research policies and activities, referring to *systemic policy coordination*, and

tackling distinct societal challenges by spurring aligned problem-oriented, inter- and transdisciplinary knowledge and innovation generation, referring to *thematic policy coordination*. The JPI approach integrates both elements in its conception, featuring interesting multi-level and multi-actor coordination aspects. For the empirical analysis, thus, a comparative case study strategy has been adopted, investigating two different JPIs, namely the JPI Urban Europe (UE) and the JPI Neurodegenerative Diseases (JPND), in order to gain insights on how the underlying societal challenge influences policy coordination efforts. The two cases have been examined according to an analytical framework derived from theoretical and conceptual considerations on societal challenge-driven policy coordination, reflecting their specific coordination patterns and governance modes in terms of systemic policy coordination and thematic policy coordination.

The foundations for the empirical analysis have been laid by a comprehensive theoretical and conceptual elaboration on STI policy governance and societal challenges, and their potential influence on policy coordination mechanisms from a multi-level perspective (see Section 2 and Section 3). In doing so, first, the consequences of such an societal-challenge driven STI policy approach for the governance of STI have been analysed from an theoretical perspective (Section 2), providing the theoretical fundament for investigating in which way the shift of thematic STI policy priorities influences governance modes and coordination patterns in practice. Regarding research question (i), it is crucial to take into account that societal challenges are complex in nature, have multiple causes and consequences, span across a wide range of societal domains, scales and levels, and are deeply embedded in our societal structures and institutions. This leads to advanced requirements for the political governance of STI activities, regarding practices to politically identify societal challenges and related problems, to define the specific priorities and objectives to tackle them, or to specific mechanisms for integrating and coordinating policy-related activities. In this regard, *thematic coordination* requirements for a societal challenge-driven STI policy particularly arise from the fact that societal challenges span the entire knowledge chain encompassing inter- and transdisciplinary research, cut across policy fields and require multi-actor coordination of a wide array of actors with diverse interests.

Considering prevalent governance structures and modes of STI policies in the EU, the importance of multi-level coordination (between different territorial levels) and multi-lateral coordination (between different member states) becomes evident, leading to additional challenges for the strategic coordination of STI efforts in the European multi-level governance system. Such systemic coordination challenges particularly arise from the

structural diversity of innovation systems, disparities in national STI capabilities, strategies and priorities and the specific division of responsibilities in STI policy-making between the EU, its member states and their regions that are accompanied by a variety of different funding channels and STI support programmes across Europe (see Section 3).

In view of the practical influence of the formulation of societal challenges on STI policy-making at the EU level, the initial policy focus on so-called ‘Grand Challenges’ is expected to provide a new drive for progress towards an integrated European Research Area (ERA) by elevating governance and strategic coordination issues of national STI activities to the highest political level. These ambitions grow particularly apparent in the implementation of the notion of societal challenges in new EU strategies and approaches, leading to the following important consequences for – systemic and thematic – policy coordination efforts at EU level that are closely related with the increasing recognition of the societal function of STI policy (research question (ii)):

First, the European research landscape has always been characterised by high fragmentation and loose integration of national STI activities (see Section 4). Thus, the formulation of societal challenges have brought a new political impetus for structuring regional, national as well as European research efforts, and at the same time enhance strategic coordination of member states’ STI policies in order to deal with distinct transnational challenges more effectively. The Joint Programming Initiative (JPI) is the main recent example in this context, aiming at the strategic coordination of EU-wide research efforts for tackling problems that are of high societal and political relevance.

In this context, the empirical analysis shows that JPIs are member-states led initiatives that explicitly focus on transnational collaboration and the systemic coordination of multiple levels (in particular the EU and national level). Furthermore, JPIs reflect the increasing awareness in policy-making that far-reaching societal problems cannot be solved independently, but require commitment to joint action and problem solution. Given the distinct peculiarities of the European multi-level governance system (see Section 3), the JPI approach points to the currently prevailing ‘new’ modes of governance (see, for example, Héritier 2002) in the EU attempting to increase coherence and consistency of national and European STI policies in at least three different ways: (i) the strategic involvement and supportive function of the EU as well as the implementation in the form of collaborative partnerships between member states should enhance multi-lateral STI policy coordination and consistency with EU priorities; (ii) the flexible and voluntary basis regarding member states participation allows for considering different member states’

interests and priorities, particularly as far as the presence of distinct research and innovation priorities are regarded; (iii) JPI should achieve increasing efficiency demands related with the usage of public budgets, namely to distribute individual public STI funds more effectively and efficient by coordinating STI support across Europe.

Second, the promotion of STI activities in fields of major social concern is regarded as particularly promising for reaching the current EU aims of economic growth that should be based on environmental sustainability and an inclusive European society. Thus, the EU incorporated the notion of societal challenges not only in its overall long- to medium-term strategies, but also in its prime STI policy instruments – the FPs, making it a catchword for loosely defined issues regarding climate change, food and energy security or the ageing society. This leads to an increasing emphasis on the promotion of research activities that should be interdisciplinary and problem-oriented, making use of various (scientific and social) knowledge sources.

In light of modern policy-making processes (see, for example, Sabatier 1993 and 2007, Hajer and Wagenaar 2003, Jann and Wegrich 2007), the more directly perceivable social relevance of STI policy leads to a wider range of political, societal and scientific actors that might exert considerable influence on the strategic formulation and specification of such research priorities. Having this in mind, JPIs are a further characteristic example for the diluting unity of the policy-making process within governmental institutions, on the one hand, and the increasing resistance to utterly centralised top-down determination of research priorities, on the other hand. While the societal challenges to be addressed are broadly conceptualised at the highest political level – the EU – in a top-down way, the actual strategies, scientific research approaches and objectives of JPIs to achieve these political aims are set bottom-up, involving different forms of network-based arrangements that span across multiple levels and integrate public and private actors with a mutual interest on a distinct issue. In addition, the governance structures in JPIs include scientific advisory boards as well as stakeholder forums to provide advice to political decision-makers and monitor the course of action. In this regard, the comparative case study strategy (see Section 5) constitutes the core of this diploma thesis, directly aiming to provide empirical evidence on how distinct broadly formulated societal challenges influence the development of problem-oriented STI-based responses and policy coordination in the multi-level and multi-actor setting of JPIs (research question (iii)). The two case studies refer to the JPI Urban Europe (UE), and the JPI Neurodegenerative Diseases (JPND) that have been explored using a wide range of policy documents, programme descriptions, and official documents by means of detailed content analysis,

picking up relevant aspects of the analytical framework that reflects the relevant dimensions of systemic and thematic policy coordination. The thematic and scientific embedding of the two JPIs have been analysed in order to reveal the crucial aspects that shape the designs as well as the governance modes and coordination mechanisms in JPIs.

The case study analysis provides interesting insights into the implementation and operation of new EU STI policy approaches, in particular with regard to issues of ways to select specific research strategies. The results of the comparative case study (see Subsection 5.5), summarised below, further show clearly that the thematic and scientific, societal challenge-related, embedding indeed shapes the nature of coordination mechanisms and governance practices that become prevalent in the distinct JPIs:

JPND focuses on combating ND by paying particular attention to scientific excellence in order to find advanced treatment methods for ND-related problems on a rapid path. It stresses the supportive function of research to achieve health or financial policy goals. Besides clinical and health care system-related research, it places a strong emphasis on basic research that is driven by the apprehension that scientific knowledge on the causes are lacking and appropriate treatment methods are underdeveloped. Thus, academia- and expert-based identification of future research needs, mainly determined by a scientific expert committee – the Scientific Advisory Board (SAB) –, intends to make the problems related with lacking knowledge on ND more tangible, and to provide the ground for the strategic coordination of further research activities on ND. Of major relevance in this regard is the promotion of an integrated European research system on ND by making use of already existing national activities, on the one hand, and the coordination of different research domains selected for tackling ND, on the other hand.

In contrast, UE takes a systemic and social science-driven perspective on issues around urbanisation and long-term urban development by emphasising interactions between STI, policy and society. Urban development is a cross-cutting theme with a high degree of interwovenness with other policy fields, integrating economic, social, ecological as well as transport-related aspects. The lack of comparable research initiatives in Europe in conjunction with the multi-dimensional research focus as well as the long-term perspective make the development of a common vision, the identification of future demands in cities and the specification of UE's research objectives more challenging. In this regard, UE lays emphasis on open workshops and conferences as well as foresight activities in the initial phase of the JPI process, involving different scientific, industrial or political actors.

From this, it can be concluded that the specific research approach selected to address distinct societal challenges in JPIs influences (i) the role existing national initiatives play for pursuing the research objectives as well as the relevance of internal mechanisms to coordinate them (systemic coordination) (ii) the way joint future research needs and priorities are specified (participative workshops and foresight activities in UE vs. scientific expert advice in JPND), or (iii) practices of social participation in terms of access possibilities and integration of different stakeholder groups (distinct advisory boards involving either scientific experts, or industrial communities, public actors from different levels, social organisations, etc.) throughout the JPI process.

To sum up in the light of the overall aim of this diploma thesis, namely to investigate in which way the formulation of societal challenges influences EU STI policy-making, the analysis has revealed that the uptake of societal challenges in EU STI policy agendas in general, and the implementation of the JPI approach in particular, has to be seen in light of the increasing demands for strategic coordination of national STI policy initiatives at the EU level. Further, the higher orientation towards societal challenges brings new governance aspects into the centre of STI policy-making. In general, this refers to the strategic prioritisation of research approaches that should be increasingly interdisciplinary and geared to a specific problem or theme. In this regard, however, the thematic prioritisation of far-reaching societal problems that require joint STI policy action to solve them is based on political commitment at the highest level, while, at least as far as JPIs are concerned, the specification of the research approach occurs in various arrangements encompassing a range of actors with different institutional backgrounds. The call for enhancing evidence-based policy-making and the utilisation of different knowledge sources for policy design intensifies the crucial role of experts and social actors in selecting and formulating the specific research priorities. Thus, the prevalent governance practices of STI policy-making involve a wide range of stakeholders that exert potential influence on the design of current STI policy programmes. Finally, the two case studies provide interesting insights into issues of which ways have been chosen to select specific research strategies, and who influences their selection or what is the relevance of scientific, technical or societal knowledge to pursue the aims.

However, the diploma thesis leaves unexplored why selected societal challenges gain increasing attention on the political agenda while others are neglected, why distinct research approaches and priorities are preferred over others, or why a very specific perspective on a problem prevails, raising a number of relevant issues for future research in this direction. Moreover, the question whether the shift in STI policy orientation towards

tackling societal challenges will be appraised as successful in terms of satisfying the related expectations and, in further consequence, will bring sustainable changes in the rationales for STI policy intervention remains a crucial point for a future research agenda.

References

- Alzheimer Europe (2008) Dementia in Europe. Yearbook 2008. Available at: http://ec.europa.eu/health/ph_information/reporting/docs/2008_dementiayearbook_en.pdf (accessed 10 November 2011)
- Alzheimer Europe (2010) Alzheimer Europe position July 2010 - European Commission communication on a European initiative on Alzheimer's disease and other dementias (COM(2009) 380). Available at: www.alzheimer-europe.org (accessed 20 December 2011)
- Amouyel P (2009a) Towards joint programming in research: A pilot initiative on combating neurodegenerative diseases, in particular Alzheimer's disease. Article for Republique Francaise. Plan Alzheimer 2008-2012. Available at: www.plan-alzheimer.gouv.fr%2FIMG%2Fpdf%2Farticle-septembre_09.pdf&ei=QoUYT_LTK4Sr-gaC5vG2Cg&usq=AFQjCNG9KnKTYH_SHoTAKTYvcpyHqfFzQ&cad=rja (accessed 10 November 2011)
- Amouyel (2009b) The pilot joint programming initiative on neurodegenerative diseases, notably Alzheimer's, state of play. Presentation held at the 2th GPC Meeting, 15 April 2009. Available at: <http://www.era.gv.at/space/11442/directory/11614/doc/11996.html> (accessed 10 November 2011)
- Amouyel (2009c) JPND = A pilote initiative on combating neurodegenerative diseases, in particular Alzheimer's disease. Presentation held at the 4th GPC Meeting, 4 December 2009. Available at: <http://www.era.gv.at/space/11442/directory/11614/doc/11996.html> (accessed 10 November 2011)
- Amouyel P (2010) A pilote initiative on combating neurodegenerative diseases, in particular Alzheimer's disease. Presentation held at the GPC Meeting, 16 September 2010. Available at: <http://www.era.gv.at/space/11442/directory/11799.html> (accessed 10 November 2011)
- Anvret M, Graniere M and Renda A (2010) A new approach to innovation policy in the European Union. Innovation Policy: Boosting EU competitiveness in a global economy. CEPS Task Force Report
- Aho E, Comu J, Georghiou L and Subirá A (2006) Creating an innovative Europe. Report of the Independent Expert Group on R&D and Innovation appointed following the Hampton Court Summit. Office for Official Publications of the European Communities, Luxembourg
- Arrow KJ (1962) Economic welfare and the allocation of resources for invention. In: Nelson RR (ed.) The Rate and Direction of Inventive Activity: Economic and Social Factors. Princeton University Press, Princeton, NJ, 609-625
- Bach L and Matt M (2005) From economic foundations to S&T policy tools: A comparative analysis of the dominant innovation paradigms. In: Llerena P and Matt M (eds.) Innovation Policy in a knowledge-based Economy. Theory and Practice, Springer Verlag, Berlin Heidelberg, 17-42
- Bundeskanzleramt (BKA) (2009) Standards der Öffentlichkeitsbeteiligung. vom Ministerrat beschlossen am 2. Juli 2008. Available at: www.partizipation.at/standards_oeb.html (accessed 15 January 2012)
- Bandelow NC (2003) Policy lernen und politische Veränderungen. In: Schubert K and Bandelow NC (eds.) Lehrbuch der Politikfeldanalyse. Oldenbourg, München, Wien 289-331

- Benz (2004) Governance – Regieren in komplexen Regelsystemen. Eine Einführung. VS Verlag für Sozialwissenschaften, Wiesbaden
- Benz A (2008) Entwicklung von Governance im Mehrebenensystem der EU. In: Tömmel (ed.) Die Europäische Union. Governance and Policy Making. Politische Vierteljahresschrift 40/2007, Sonderausgabe, VS Verlag für Sozialwissenschaften, Wiesbaden, 36-57
- Benz A (2010) Multilevel Governance – Governance im Mehrebenensystem. In: Benz A and Dose N (eds.) Governance - Regieren in komplexen Regelsystemen. Eine Einführung. 2nd Edition, VS Verlag für Sozialwissenschaften, Springer, Wiesbaden, 111-136
- Benz A and Dose N (2010) (eds.) Governance - Regieren in komplexen Regelsystemen. Eine Einführung. 2nd Edition, VS Verlag für Sozialwissenschaften, Springer, Wiesbaden
- Benz A, Lütz S, Schimank U and Simonis G (2007) (eds.) Handbuch Governance. Theoretische Grundlagen und empirische Anwendungsfelder. VS Verlag für Sozialwissenschaften, Wiesbaden
- Boekholt P (2010) The evolution of innovation paradigms and their influence on research, technological development and innovation policy instruments. In: Smits R, Kuhlmann S and Shapira P (eds.) Theory and Practice of Innovation Policy. Edward Elgar Publishing, 333-358
- Borrás S (2003) The Innovation Policy of the European Union. From Government to Governance. Edward Elgar, Cheltenham
- Bórras S and Jacobsson K (2004) The open method of co-ordination and new governance patterns in the EU. Journal of European Public Policy 11(2), 185-208
- Bórras S (2009) The widening and deepening of innovation policy: What conditions provide for effective governance? CIRCLE Electronic Working Paper Series 2009/02, Lund University
- Börzel TA (2005) European Governance - nicht neu, aber anders. In: Schuppert GA (ed.) Governance Forschung - Vergewisserung über Stand und Entwicklungslinien. Nomos, Baden-Baden, 72-94
- Boyer R (2009) From the Lisbon Agenda to the Lisbon Treaty: National research systems in the context of European integration and globalization. In: Delanghe H, Muldur U and Soete L (eds.) European Science and Technology Policy. Towards Integration or Fragmentation?, Edward Elgar Publishing Limited, Cheltenham, 101-126
- Braun D (2008) Organising the political coordination of knowledge and innovation policies. Science and Public Policy 35(4), 227-239
- Breschi and Cusmano (2004) Unveiling the texture of a European Research Area: Emergence of oligarchic networks under EU Framework Programmes. International Journal of Technology Management 27(8), 747-772
- Carlsson B. and Stankiewicz R (1991) On the nature, function, and composition of technological systems, Journal of Evolutionary Economics 1, 93-118.
- Chaminade C and Edquist E (2006) From theory to practice. The use of the systems of innovation approach in innovation policy. In Hage J and de Meeus M (eds.) Innovation, Science and Institutional Change. A Research Handbook, Oxford University Press
- Chaminade C and Edquist E (2010) Rationales for public policy intervention in the innovation process: A systems of innovation approach. In Smits R, Kuhlmann S and Shapira P (eds.) Theory and Practice of Innovation Policy. Edward Elgar Publishing

- Christiansen T and Larsson T (2007) Introduction: The role of committees in the policy-process of the European Union, In: Christianson T and Larsson T (eds.) The Role of Committees in the Policy-Process of the European Union Legislation, Implementation and Deliberation. Edward Elgar Publishing, Cheltenham, 1-11
- Cooke (2001) Regional innovation systems, clusters, and the knowledge economy. *Industrial and Corporate Change* 10(4), 945-974
- Council of the European Union (CEU) (2008a) Council conclusions concerning a common commitment by the Member States to combat Neurodegenerative Diseases, particularly Alzheimer's. September 2008, Brussels
- Council of the European Union (CEU) (2008b) Council conclusions on the launch of the "Ljubljana Process" - towards full realisation of ERA. 10231/98, Brussels, 3 June 2008
- Council of the European Union (CEU) (2008c) Council conclusions concerning joint programming of research in Europe in response to major societal challenges, December 2008, Brussels
- Council of the European Union (CEU) (2009) Council conclusions concerning the joint programming of research in Europe. 17226/09, Brussels, 8 December 2009
- Council of the European Union (CEU) (2011) Competitiveness Council. Available at: <http://consilium.europa.eu/policies/council-configurations/competitiveness?lang=en> (accessed 15 November 2011)
- Creely C (2011) JPND mapping exercise. Presentation held at the patient and carer consultation meeting 26 May 2011, Brussels. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/consultations/patientcarer/> (accessed 20 December 2011)
- Dratwa J (2009) Analysing community policies. In: Delanghe H et al. (eds.) *European Science and Technology Policy. Towards Integration or Fragmentation?*, Edward Elgar Publishing Limited, Cheltenham, 78-99
- Delanghe H, Muldur U and Soete L (eds.) (2009) *European Science and Technology Policy. Towards Integration or Fragmentation?*. Edward Elgar Publishing Limited, Cheltenham
- Dolowitz D and Marsh D (1996). Who learns what from whom: A review of the policy transfer literature. *Political Studies* 44, 343-357
- Eckhart C (2011) Joint programming initiative on neurodegenerative diseases. State-of-play. Presentation held at the GPC meeting, 15 March 2011. Available at: <http://www.era.gv.at/space/11442/directory/11799.html> (accessed 10 November 2011)
- Edler J (2010) Demand-based innovation policy. In: Smits R, Kuhlmann S and Shapira P (eds.) *Theory and Practice of Innovation Policy*. Edward Elgar Publishing, Cheltenham
- Edler J and Kuhlmann S (2003) Changing governance in European research and technology policy. In: Edler J, Kuhlmann S and Behrens M (eds.) *Changing Governance of Research and Technology Policy: The European Research Area*. Edward Elgar Publishing, Cheltenham
- Edler J, Kuhlmann S and Behrens M (eds.) (2003) *Changing Governance of Research and Technology Policy: The European Research Area*. Edward Elgar Publishing, Cheltenham
- Edquist C (ed.) (1997) *Systems of Innovation: Technologies, Institutions and Organizations*. Pinter, London

- Edquist C (2005) Systems of innovation. Perspectives and challenges. In: Fagerberg J, Mowery DC and Nelson RR (eds.) The Oxford Handbook of Innovation. Oxford University Press, Oxford, 181-208
- Eising R and Kohler-Koch B (1999) Introduction. Network governance in the European Union. In: Kohler-Koch B and Eising R (eds.) The Transformation of Governance in the European Union. Routledge, London, 3-13
- Eising R and Lenschow A (2007) Europäische Union. In: Benz A, Lütz S, Schimank U and Simonis G (eds.) Handbuch Governance. Theoretische Grundlagen und empirische Anwendungsfelder. VS Verlag für Sozialwissenschaften, Wiesbaden, 325-339
- Europa (2011) EU Institutions and other bodies. Available at: http://europa.eu/about-eu/institutions-bodies/index_en.htm (accessed 15 November 2011)
- Europa (2011b) About the European Commission. Departments and services. Available at: http://ec.europa.eu/about/ds_en.htm (accessed 15 November 2011)
- Europa (2011c) Seventh Framework Programme (2007 to 2013). Available at: http://europa.eu/legislation_summaries/energy/european_energy_policy/i23022_en.htm (accessed 3 December 2011)
- European Commission (EC) (2000a) Towards an European Research Area. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM (2000) 6, Brussels
- European Commission (EC) (2001) European Governance. A White Paper. COM (2001) 428, Brussels
- European Commission (EC) (2002) Improving the knowledge base for better policies. Communication from the Commission on the collection and use of expertise by the commission: Principles and guidelines. COM(2002) 713, Brussels
- European Commission (EC) (2002) Towards a reinforced culture of consultation and dialogue - General principles and minimum standards for consultation of interested parties by the Commission. COM(2002) 704, Brussels
- European Commission (EC) (2004): Background document coordination of national research programmes. DG Research, 10.11.2004. Available at: ftp://ftp.cordis.europa.eu%2Fpub%2Fcoordination%2Fdocs%2Fcoordination_of_national_programmes_101104.pdf&ei=MaAAT96EH5GbOojsldcl&usq=AFQjCNFFS5sHx0KwJ4cwQsnVSoRKXVJFhQ&cad=rja
- European Commission (EC) (2007a) The European Research Area: New Perspectives. Green Paper, 4th April, Brussels
- European Commission (EC) (2008a) Challenging Europe's Research. Rationales for the European Research Area, Report of the EC High-Level Expert Group, Brussels
- European Commission (EC) (2008b) Towards joint programming in research: Working together to tackle common challenges more effectively. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM (2008) 468, Brussels
- European Commission (EC) (2009a) The role of community research policy in the knowledge-based economy Expert Group Report, October 2009, Office for Official Publications of the European Communities, Luxembourg

- European Commission (EC) (2009b) The open method of coordination in research policy: Assessment and recommendations. Office for Official Publications of the European Communities, Luxembourg
- European Commission (EC) (2009c) The European Research Area Partnership. 2008 Initiatives. DG Research, November 2011, Office for Official Publications of the European Communities, Luxembourg,
- European Commission (EC) (2009d) Proposal for a council recommendation on measures to combat neurodegenerative diseases, in particular Alzheimer's, through joint programming of research activities. COM (2009) 379, 22 July 2009, Brussels
- European Commission (EC) (2009e) Commission Staff Working Document accompanying the proposal for a council recommendation on measures to combat neurodegenerative diseases, in particular Alzheimer's, through joint programming of research activities, SEC(2009) 1039, 22 July 2009, Brussels
- European Commission (EC) (2009f) Communication from the Commission to the European Parliament and the Council on a European initiative on Alzheimer's disease and other dementias. COM(2009) 380, 22 July 2009, Brussels
- European Commission (EC) (2010a) Europe 2020 A European strategy for smart, sustainable and inclusive growth. Communication from the European Commission, COM(2010) 2020, Brussels
- European Commission (EC) (2010b) Europe 2020 Flagship initiative Innovation Union. Communication from the European Commission, COM (2010) 546, Brussels
- European Commission (EC) (2011a) Research and Innovation DG. Available at: <http://ec.europa.eu/research/index.cfm?pg=dg> (Accessed 17 November 2011)
- European Commission (EC) (2011b) Enterprise and Industry DG. Available at: http://ec.europa.eu/enterprise/index_en.htm (Accessed 17 November 2011)
- European Commission (EC) (2011c) Information Society and Media DG. Available at: http://ec.europa.eu/dgs/information_society/index_en.htm (Accessed 17 November 2011)
- European Commission (EC) (2011d) Mobility and Transport DG. Available at: http://ec.europa.eu/enterprise/index_en.htm (Accessed 17 November 2011)
- European Commission (EC) (2011e) Environment DG. Available at: http://ec.europa.eu/dgs/environment/index_en.htm (Accessed 17 November 2011)
- European Commission (EC) (2011f) Economic and Financial Affairs DG. Available at: http://ec.europa.eu/dgs/economy_finance/index_en.htm (Accessed 17 November 2011)
- European Commission (EC) (2011g) Education and Culture DG. Available at: http://ec.europa.eu/dgs/education_culture/index_en.htm (Accessed 17 November 2011)
- European Commission (EC) (2011h) Joint Research Centre DG. Available at: <http://ec.europa.eu/dgs/jrc/index.cfm> (Accessed 17 November 2011)
- European Commission (EC) (2011i) European Research Area. Available at: http://ec.europa.eu/research/era/index_en.htm (Accessed 17 November 2011)
- European Commission (EC) (2011j) Partnering in research and innovation. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2011) 572, Brussels

- European Commission (EC) (2011k) Cordis. About Article 185 TFEU (ex Article 169 TEC) Initiatives. Available at: http://cordis.europa.eu/fp7/art185/about-185_en.html (accessed 12 December 2011)
- European Commission (EC) (2011l) Horizon 2020 - The Framework Programme for Research and Innovation. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2011) 808 final, Brussels
- European Commission (EC) (2011m) Commission recommendation on the research Joint Programming Initiative "Urban Europe - Global Urban Challenges, Joint European Solutions". COM(2011) 7406, 21 October 2011, Brussels
- European Commission (EC) (2011n) DG Employment, Social Affairs and Inclusion. About us. Available at: <http://ec.europa.eu/social/main.jsp?langId=en&catId=656> (accessed 17 January 2012)
- European Council (2010) Conclusions, EUCO 13/10, 17 June 2010, Brussels
- European Research Area Board (ERAB) (2009) Preparing Europe for a new renaissance. A strategic view of the European Research Area. First Report of the ERAB, European Commission, DG Research, Brussels
- European Research Area Board (ERAB) (2011) European Research Area Board (ERAB). Available at: http://ec.europa.eu/research/erab/index_en.html (accessed 17 November 2011)
- European Research Area Committee High Level Group for Joint Programming (ERAC-GPC) (2010) Joint programming in research 2008-2010 and beyond. Draft report of the High Level Group on Joint Programming to the Council. ERAC-GPC 1311/10, Brussels
- European Research Area Committee High Level Group for Joint Programming (ERAC-GPC) (2011) Voluntary guidelines on framework conditions for joint programming in research 2010. Publications Office of the European Union, Luxembourg
- Fagerberg J (2005) Innovation: A guide to literature. In: Fagerberg J, Mowery DC and Nelson RR (eds.) The Oxford Handbook of Innovation. Oxford University Press, Oxford, New York, 1-26
- Fischer MM (2001) Innovation, knowledge creation and systems of Innovation. The Annals of Regional Science 35, 199-216
- Fischer F (2003). Reframing Public Policy. Discursive Policy and Deliberative Practices. Oxford University Press, Oxford
- Fischer F, Miller GJ and Sidney MS (eds.) (2007) Handbook of Public Policy Analysis: Theory, Methods, and Politics. CRC Press, Boca Raton
- Freeman C (1987) Technology Policy and Economic Performance: Lessons from Japan. Pinter, London
- Gassler H, Polt W and Rammer C (2008) Priority setting in technology policy: Historical developments and recent trends. In: Nauwelaers C and Wintjes R (eds.) Innovation Policy in Europe. Measurement and Strategy. Edward Elgar Publishing, Cheltenham, 203-224
- Georghiou L (2011) From priority-setting to societal challenges in future-oriented technology analysis. Introduction. Futures 43, 229-231
- Gibbons M, Limoges C, Nowotny H, Schwartzman S, Scott P and Trow M (1994) The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies. Sage, London

- Gornitzka A and Sverdrup U (2007) Who consults? Expert Groups in the European Union. In: Egeberg (ed.) *Institutional Dynamics and the Transformation of Executive Politics in Europe*. CONNEX Report Series Nr. 3, Mannheim, 191-230.
- Gillham B (2001) *Case Study Research Methods*. Continuum, London, New York
- Grin J and Loeber A (2007) Theories of policy learning: agency, structure, and change. In: Fischer F, Miller GJ and Sidney MS (eds.) *Handbook of Public Policy Analysis: Theory, Methods, and Politics*. CRC Press, Boca Raton, 201-219
- Haas PM (1992) Introduction: Epistemic communities and international policy coordination. *International Organization* 46, 1-35
- Hajer M and Wagenaar H (2003) Introduction. In: Hajer M and Wagenaar H (eds.) *Deliberative Policy Analysis. Understanding Governance in the Network Society*. Cambridge University Press, Cambridge, 1-31
- Hall PA (1993) Policy paradigms, social learning and the state: the case of economic policy-making in Britain. *Comparative Politics* 25, 275-296
- Hauknes J und Nordgren L (1999) Economic rationales of government involvement in innovation and the supply of innovation-related services. STEP Working Paper, Oslo
- Héritier A (1993) Policy-Netzwerkanalyse als Untersuchungsinstrument im europäischen Kontext: Folgerungen aus einer empirischen Studie regulatoriver Politik. In: Heritier A (ed) *Policy-Analyse. Kritik und Neuorientierung*. Politische Vierteljahresschrift 34 (24), 432-447
- Héritier A (2002) New modes of governance in Europe: policy making without legislating? *Reihe Politikwissenschaft* 81, Political Science Studies, Institute for Advanced Studies (IHS), Vienna
- Héritier A and Rhodes M (2011) *New Modes of Governance in Europe. Governing in the Shadow of Hierarchy*. Palgrave Studies in European Union Politics, New York
- Heclo H (1973) Issue networks and the executive establishment. In: King A (ed.) *The New American Political System*. American Enterprise Institute for Public Policy Research, Washington, 87-124
- Hix S (1998) The study of the European Union II: The 'new governance' agenda and its rival. *Journal of European Public Policy* 5(1), 38-65
- Hix S (2005) *The Political System of the European Union*. 2nd Edition, Palgrave Macmillan, Houndmills/Basingstoke
- Holzinger K, Knill C, Peters D, Rittberger B, Schimmelfennig F and Wagner W (2005) *Die Europäische Union. Theorien und Analysekonzepte*. UTB. Paderborn
- Horvat M, Guy K, Demonte BV, Engelbrecht J and Wilken R (2006) *ERA NET Review 2006*. Report of the Expert Review Group, December 2006
- Jachtenfuchs M and Kohler-Koch B (2010) Governance in der Europäischen Union. In: Benz A and Dose N (eds.) *Governance - Regieren in komplexen Regelsystemen. Eine Einführung*. 2nd Edition, VS Verlag für Sozialwissenschaften, Springer, Wiesbaden, 69-92
- Jann W and Wegrich K (2007) Theories of the policy cycle. In: Fischer F, Miller GJ and Sidney MS (eds.) *Handbook of Public Policy Analysis: Theory, Methods, and Politics*. CRC Press, Boca Raton, 43-63

- Jordan A and Schout A (2006) The Coordination of the European Union: Exploring the Capacities for Networked Governance. Oxford University Press, Oxford
- Joint Programming Initiative Urban Europe (JPI UE) (2010a) Workshop minutes JPI Urban Europe. Workshop „Stakeholder Involvement“, 4 March 2010, and Workshop „Getting off the ground“, 5 March 2010. Available at: <http://era.gv.at/space/11442/directory/13047/doc/19016.html> (accessed 20 December 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2010b) 2nd Governing Board Meeting. Summary Conclusions. 16 and 17 December 2010, Stockholm. Available at: <http://era.gv.at/space/11442/directory/13047/event/21778.html> (accessed 10 November 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2011a) Guidelines JPI Urban Europe. Preamble Draft, 15 April 2011. Available at: <http://www.jpi-urbaneurope.eu/> (accessed 10 November 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2011b) Report for EC Assessment. April 2011. Available at: <http://www.jpi-urbaneurope.eu/> (accessed 20 September 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2011c) Adopted terms of reference Governance Board. 15 April 2011. Available at: <http://www.jpi-urbaneurope.eu/> (accessed 10 November 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2011d) Adopted terms of reference Management Board. 15 April 2011. Available at: <http://www.jpi-urbaneurope.eu/> (accessed 10 November 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2011e) Adopted terms of reference Scientific Advisory Board. 15 April 2011. Available at: <http://www.jpi-urbaneurope.eu/> (accessed 10 November 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2011e) Guidelines Urban Europe Forum. 15 April 2011. Available at: <http://www.jpi-urbaneurope.eu/> (accessed 10 November 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2011f) 3rd Governing Board Meeting. Summary conclusions. 21 to 22 Feb 2011, Rome. Available at: <http://era.gv.at/space/11442/directory/13047/event/22491.html> (accessed 10 November 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2011g) 7th Governing Board Meeting. Summary conclusions. 24 to 25 October 2011, Copenhagen. Available at: <http://era.gv.at/space/11442/directory/13047.html?page=1&> (accessed 10 November 2011)
- Joint Programming Initiative Urban Europe (JPI UE) (2011i) <http://www.jpi-urbaneurope.eu/>
- JPND research (JPND) (2011a) JPND Research EU Joint Programme Neurodegenerative Disease Research. Available at: <http://www.neurodegenerationresearch.eu/> (accessed 20 September 2011)
- JPND (2011b) Call for proposals for “Neurodegenerative Diseases - a call for European research projects for the optimisation of biomarkers and harmonisation of their use between clinical centres”. Available at: <http://www.neurodegenerationresearch.eu/> (accessed 20 September 2011)
- JPND (2011c) JPND industry stakeholder consultation meeting: key outputs report. 16 May 2011, Milan. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/consultations/industry/> (accessed 20 December 2011)

- JPND (2011d) JPND basic research workshop: Final report. 22 March 2011, Madrid. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/workshops/basic-research/> (accessed 20 December 2011)
- JPND (2011e) JPND clinical research Workshop: Final report. 4 March 2011, Paris. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/workshops/clinical-research/> (accessed 20 December 2011)
- JPND (2011f) JPND healthcare research workshop: Final Report. 31 March 2011, London. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/workshops/healthcare/> (accessed 20 December 2011)
- JPND (2011g) JPND Final SRA Workshop: Rome, 20 June 2011. Report – Key Outputs. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/workshops/final/> (accessed 20 December 2011)
- JPND (2011h) Patient stakeholder consultation meeting: Key outputs report. 26 May 2011 Brussels. Available at: <http://www.neurodegenerationresearch.eu/> (accessed 20 December 2011)
- Kaiser R (2003) Innovation policy in a multi-level governance system. In: Edler J, Kuhlmann S and Behrens M (eds.) *Changing Governance of Research and Technology Policy: The European Research Area*. Edward Elgar, Cheltenham, 290-310
- Kaiser R and Prange H (2004) Managing diversity in a system of multi-level governance: The open method of co-ordination in innovation policy. *Journal of European Public Policy* 11, 249–266
- Kline SJ and Rosenberg N (1986) An overview of innovation. In: Landau R and Rosenberg N (eds.) *The Positive Sum Strategy*, National Academy Press, Washington, 275-305
- Kohler-Koch B (1999) The evolution and transformation of governance in the European Union. In: Kohler-Koch B and Eising R (eds.) *The Transformation of Governance in the European Union*. Routledge, London, 14-35
- Kohler-Koch B and Rittberger B (2006) The 'Governance Turn' in EU Studies. *Journal of Common Market Studies* 44, 27-49
- Könnöä T, Smith J and Eerola A (2009) Introduction, future-oriented technology analysis - impacts and implications for policy and decision making, *Technological Forecasting and Social Change* 76, 1135–1137
- Kubeczko K and Weber M (2009) Proaktive Legitimation FTI-politischer Intervention: Jenseits von Markt- und Systemversagen. In: Leitner KH, Weber M and Fröhlich J (eds.) *Innovationsforschung und Technologiepolitik in Österreich. Neue Perspektiven und Gestaltungsmöglichkeiten*. Studien Verlag, Innsbruck
- Kubeczko K, Ravetz J, van der Giessen A and Weber M (2011) Screening urban foresights and studies supporting forward looking activities. What can we learn for a JPI-Urban Europe 2050+ Foresight? Results from the EFP policy workshops (April 2011, Brussels; November 2011, Vienna), December 2011. Available at: <http://www.foresight-platform.eu/events/event-reports/> (accessed 4 January 2012)
- Kuhlmann S (2001) Future governance of innovation policy in Europe - three scenarios. *Research Policy* 30, 953–976

- Larsson T and Murk J (2007) The Commission's relations with expert advisory groups. In: Christianson T and Larsson T (eds.) *The Role of Committees in the Policy-Process of the European Union Legislation, Implementation and Deliberation*. Edward Elgar Publishing, Cheltenham, 64-95
- Lipsey RG and Carlaw K (1998) Technology policies in neo-classical and structuralist-evolutionary models. *STI Review* 22, 31-73
- Lundvall BÅ (ed.) (1992) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. Pinter, London
- Lundvall BÅ and Borrás S (2005) Science, technology and innovation policy. In: Fagerberg J, Mowery DC and Nelson RR (eds) *Innovation Handbook*, 599-631, Oxford University Press, Oxford
- Maggi A (2011a) Introduction to JPND. Presentation held at the industry consultation meeting on 16 May 2011, Milan. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/consultations/industry/> (accessed 20 December 2011)
- Maggi A (2011b) Outcomes of the thematic workshops. Presentation held at the industry consultation meeting on 16 May 2011, Milan. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/consultations/industry/> (accessed 20 December 2011)
- Marks G and Hooghe L (2001) *Multi-level Governance and European Integration*. MD: Rowman and Littlefield, Lanham
- Marks G, Hooghe L and Blank K (1996) European Integration and the state: Multi-level versus state-centric governance. *Journal of Common Market Studies* 34(3), 341-378
- Martin B (2001) *Technology Foresight in a Rapidly Growing Economy*. Brighton: University of Sussex
- Mayntz R (1993) Policy-Netzwerke und die Logik von Verhandlungssystemen. In: Heritier A (ed) *Policy-Analyse. Kritik und Neuorientierung*. Politische Vierteljahresschrift 34 (24), 39-56
- Mayntz R (2004) Governance im modernen Staat. In: Benz A (ed.), *Regieren in komplexen Regelsystemen. Eine Einführung*, VS Verlag für Sozialwissenschaften, Wiesbaden, 65-75
- Mayntz R (2006) From government to governance: Political steering in modern societies. In: Scheer D, Rubik R (eds.) *Governance of Integrated Product Policy*. Greenleaf Publishing, Aizlewood Mill, 18-25
- Menninga H, Nijkamp P, Noll M and Polt W (2011) JPI Urban Europe status report. March 2011. Available at: <http://www.jpi-urbaneurope.eu/> (accessed 10 November 2011)
- Metcalfe JS and Georgiou L (1998) Equilibrium and evolutionary foundations of technology policy. *STI Review* 22, 75-100
- Metcalfe JS (2005) Systems failure and the case for innovation policy. In: Llerena P and Matt M (eds.) *Innovation Policy in a knowledge-based Economy. Theory and Practice*, Springer Verlag, Berlin Heidelberg
- Miller HT and Demir T (2007) Policy communities. In: Fischer F, Miller GJ and Sidney MS (eds.) *Handbook of Public Policy Analysis: Theory, Methods, and Politics*. CRC Press, Boca Raton, 137-148

- Mitchell D (2011) Next steps and future plans. Presentation held at the patient and carer consultation meeting 26 May 2011, Brussels. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/consultations/patientcarer/> (accessed 20 December 2011)
- Moody C (2011) Developing the SRA. Presentation held at the industry consultation meeting on 16 May 2011, Milan. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/consultations/industry/> (accessed 20 December 2011)
- Muldur U (ed.) (2006) A New Deal for an Effective European Research Policy. The Design and Impacts of the 7th Framework Programme. Springer, Dordrecht
- Nauwelaers C and Wintjes R (2008) Innovation policy, innovation in policy: policy learning within and across systems and clusters. In: Nauwelaers C and Wintjes R (eds.) Innovation Policy in Europe. Measurement and Strategy. Edward Elgar Publishing, Cheltenham, 225- 268
- Nelson RR (1959) The simple economics of basic scientific research. Journal of Political Economy 67, 297-306
- Nelson RR (ed.) (1993) National Innovation Systems. A Comparative Analysis. Oxford University Press, New York, Oxford
- Nelson RR (2009) Building effective innovation systems versus dealing with market failures as ways of thinking about technology policy. In: Nelson RR (ed.) The New Economics of Technology Policy, Edward Elgar Publisher, Cheltenham
- Nelson RR and Winter S (1982) An Evolutionary Theory of Economic Change. Belknap Press, Cambridge, MA
- OECD (1994) National Systems of Innovation: General Conceptual Framework. DSTI/STP/TIP 94(4), OECD, Paris
- OECD (1996) The Knowledge-based Economy. OECD Publishing, Paris
- OECD (2005a) Governance of Innovation System. Volume 1. Synthesis Report. OECD Publishing, Paris
- OECD (2005b) Governance of Innovation Systems, Vol. 2: Case Studies in Innovation Policy. OECD, Paris
- OECD (2005c) Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd Edition, OECD Publishing, Paris
- Parsons W (2005) Public Policy. An Introduction to the Theory and Practice of Policy Analysis. Edward Elgar, Cheltenham
- Pérez SE, de Dominicis L and Guy K (2010) Developing the European Research Area: Opening-up of national R&D programmes and joint R&D policy Initiatives. JRC Scientific and Technical reports 59085. Joint Research Centre, Institute for Prospective Technological Studies, Publications Office of the European Union, Luxembourg
- Peterson J (2003) Policy Networks. Political Science Series 90, IHS Institute for Advanced Studies, Vienna
- Pierre J (2000) Introduction: Understanding governance. In: Pierre J (ed.) Debating Governance Authority, Steering and Democracy. Oxford University Press, Oxford
- Pierre J and Peters BG (2000) Governance Politics and the State. Palgrave Macmillan, Hong Kong

- Pollack MA (2010) Theorizing EU Policy-Making. In: Wallace H, Wallace W, Pollack MA (eds.) Policy-Making in the European Union. 6th Edition, University Press, Oxford, 15-44
- Pollak J and Slominski P (2006) Einführung in die EU. WUV/UTB, Wien
- Radermacher L (2002) The European Commission's White Paper on European Governance: The Uneasy Relationship Between Public Participation and Democracy. German Law Journal 3. Available at: <http://www.germanlawjournal.com/index.php?pageID=11&artID=12>
- Radosevic S, White M and Furlani A (2008) Complementarities between regional, national and EU support instruments, Pro Inno Europe Learning Platform Report, June 2008
- Rammert W (2010) Die Innovationen der Gesellschaft. In: Howaldt J and Jacobsen H (eds.) Soziale Innovation. Auf dem Weg zu einem postindustriellen Innovationsparadigma. VS Verlag für Sozialwissenschaften, Wiesbaden, 21-52
- Richardson J (2006) Policy-making in the EU interests, ideas and garbage cans of primeval soup. In: Richardson J (ed.) European Union. Power and Policy-making. 3rd edition, Routledge, Abigdon
- Remøe SO (2008) Innovation governance in dynamic economies: Lessons from the OECD MONIT project. In: Nauwelaers C and Wintjes R (eds.) Innovation Policy in Europe. Measurement and Strategy. Edward Elgar Publishing, Cheltenham, 139-170
- Rotman J (2005) Societal innovation. Between dream and reality lies complexity. Inaugural Addresses Research in Management Series, Erasmus University Rotterdam, Rotterdam
- Rhodes RAW (1997) Understanding Governance. Policy Networks, Governance, Reflexivity and Accountability. Open University Press, Buckingham and Philadelphia
- Rose R (1991) Lessons-Drawing in Public Policy. A Guide to Learning across Time and Space. Chatham, New York
- Rossor M (2011) Outputs from Expert Workshops. Presentation held at the patient and carer consultation meeting 26 May 2011, Brussels. Available at: <http://www.neurodegenerationresearch.eu/initiatives/strategic-research-agenda/consultations/patientcarer/> (accessed 20 December 2011)
- Sabatier PA (1993) Advocacy-Koalitionen, Policy-Wandel und Policy-Lernen. Eine Alternative zur Phasenheuristik. In: Héritier A (ed.) Policy-Analyse. Kritik und Neuorientierung. PVS Sonderheft 24, Westdeutscher Verlag, Opladen, 116-148
- Sabatier PA and Jenkins-Smith HC (1993) Policy Change and Learning. An Advocacy Coalition Approach. Westview Press, Boulder
- Sabatier PA (2007) Theories of the Policy Process. 2nd Edition, Westview Press, Boulder
- Salmenkaita JP und Salo A (2002) Rationales for government intervention in the commercialization of new technologies. Technology Analysis and Strategic Management 14(2), 183-200
- Scharpf FW (1999) Regieren in Europa. Effektiv und demokratisch? Campus, Frankfurt am Main and New York
- Scherngell T and Barber M (2009) Spatial interaction modelling of cross-region R&D collaborations: Empirical evidence from the 5th EU Framework Programme. Papers in Regional Science 88(3), 531-546

- Scherngell T and Barber M (2011) Distinct spatial characteristics of industrial and public research collaborations: Evidence from the 5th EU Framework Programme, *The Annals of Regional Science* 46, 247-266
- Scherngell T and Lata R (2011) Towards an integrated European Research Area? Findings from Eigenvector spatially filtered spatial interaction models using European Framework Programme data, *Papers in Regional Science* [forthcoming]
- Seiser C, Schädler I and van Ommen A (2010) Joint Programming Initiative Urban Europe Global Challenges – Local Solutions. Final proposal to be delivered to the GPC. April 2010. Available at: <http://era.gv.at/space/11442/directory/13047/doc/19645.html> (accessed 20 September 2011)
- Seiser C, Schädler I and van Ommen A (2010) Joint Programming Initiative URBAN EUROPE: Global Challenges – Local Solutions. Summary, 16 March 2010. Available at: <http://era.gv.at/space/11442/directory/13047/doc/19016.html> (accessed 10 November 2011)
- Smith K (2000) Innovation as a systemic phenomenon: Rethinking the role of policy. *Enterprise & Innovation Management Studies* 1, 73-102
- Smits R (2001) The new role of strategic intelligence, strategic policy intelligence: Current trends, the state of play and perspectives. IPTS Technical report Series, December 2001
- Smits R and Kuhlmann S (2004) The rise of systemic instruments in innovation policy. *International Journal of Foresight and Innovation Policy* 1, 4-32
- Smits R, Kuhlmann S and Teubal M (2010) A system-evolutionary approach for innovation policy. In: Smits R, Kuhlmann S and Shapira P (eds.): *Theory and Practice of Innovation Policy*, Edward Elgar Publishing, 417-447
- Soete L (2008) Innovation policy in a post-Lisbon Europe: some reflections. In: Nauwelaers C and Wintjes R (eds.) *Innovation Policy in Europe. Measurement and Strategy*. Edward Elgar Publishing, Cheltenham, 269-285
- Steinmueller WE (2010) Economics of technology policy. In: Hall BH and Rosenberg N (eds.) *Handbook of the Economics of Innovation*. Volume 2, Elsevier B.V., Amsterdam, 1182-1218
- Stone D (1999) Learning lessons and transferring policy across time, space and disciplines. *Politics* 19, 51–60
- Stone D (2007) Public policy analysis and think tanks. In: Fischer F, Miller GJ and Sidney MS (eds.) *Handbook of Public Policy Analysis: Theory, Methods, and Politics*. CRC Press, Boca Raton, 149-157
- Svanfeldt C (2009) A European Research Area built by the Member States? In: Delanghe H, Muldur U and Soete L (eds.) *European Science and Technology Policy. Towards Integration or Fragmentation?*. Edward Elgar Publishing Limited, Cheltenham, 44-63
- Swedish Presidency (2009) The Lund Declaration. Europe must focus on the Grand Challenges of our time. Declaration from the research conference in Lund: European research must focus on the Grand Challenges. July 2009. Available at: http://www.se2009.eu/polopoly_fs/1.8460!menu/standard/file/lund_declaration_final_version_9_july.pdf (accessed 20 December 2011)
- von Sydow B, Casingena Harper J, Cattau M, Münz R, Timmerhuis V, Torok A and van Pottelsberghe B (2009) A Knowledge intensive future for Europe. Expert Group Report. DG Research, Brussels

- Tindeman P (2009) Post-war research, education and innovation policy-making in Europe. In: Delanghe H, Muldur U and Soete L (eds.) *European Science and Technology Policy. Towards Integration or Fragmentation?*. Edward Elgar Publishing Limited, Cheltenham, 3-23
- Tömmel I (2008) Governance und policy-making im Mehrebenensystem der EU. In: Tömmel (ed.) *Die Europäische Union. Governance and Policy Making. Politische Vierteljahresschrift* 40/2007, Sonderausgabe, VS Verlag für Sozialwissenschaften, Wiesbaden, 13-35
- Tömmel I and Verdun A (eds.) (2009) *Innovative Governance in the European Union: The Politics of Multilevel Policymaking*, Lynne Rienner Publishers
- Wallace H (2010) An institutional anatomy and five policy modes. In: Wallace H, Wallace W and Pollack MA (eds.) *Policy-Making in the European Union*. 6th Edition, University Press, Oxford, 69-105
- Wanzenböck I and Scherngell T (2010) How do behavioural effects of public R&D subsidies differ across specific firm characteristics? Empirical evidence from a binary regression analysis. AIT Working Paper Series, No. 2010/31
- Wanzenböck I, Scherngell T and Fischer MM (2011) How do distinct firm characteristics affect behavioural additionalities of public R&D subsidies? Empirical evidence from a binary regression analysis. 51st European Congress of the Regional Science Association, 30th August - 3rd September 2011, Barcelona, Spain
- Weber M (2009) FTI-Politik im Spiegel von Theorie und Praxis: von Planung über Steuerung zu Governance. In: Leitner KH, Weber M and Fröhlich J (eds.) *Innovationsforschung und Technologiepolitik in Österreich. Neue Perspektiven und Gestaltungsmöglichkeiten*. Studien Verlag, Innsbruck, 230-254
- Weber M, Gassler H, Polt W, Dachs B and Streicher G (2004) Ansätze und Schwerpunktsetzung in der österreichischen Forschungs- und Technologiepolitik. *Wirtschaftspolitische Blätter* 3, 405-418
- Weible CM and Sabatier PA (2007) A Guide to the Advocacy Coalition Framework. In: Fischer F, Miller GJ and Sidney MS (eds.) *Handbook of Public Policy Analysis: Theory, Methods, and Politics*. CRC Press, Boca Raton, 123-136
- Whitelegg K (2009) Horizontale Politikkoordination – österreichische Spezifika und Lösungen eines europäischen Problems. In: Leitner KH, Weber M and Fröhlich J (eds.) *Innovationsforschung und Technologiepolitik in Österreich. Neue Perspektiven und Gestaltungsmöglichkeiten*. Studien Verlag, Innsbruck, 215-228
- Wollmann H (2003) Kontrolle in Politik und Verwaltung: Evaluation, Controlling und Wissensnutzung. In: Schubert K and Bandelow NC (eds.) *Lehrbuch der Politikfeldanalyse*. Oldenbourg, München, Wien, 335-360
- Woolthuis RK, Lankhuizen M and Gilsing V (2005) A system failure framework for innovation policy design. *Technovation* 25, 609-661
- Yin RK (2003a) *Case Study Research: Design and Methods*. 3rd Edition, Applied Social Research Methods Series, Vol 5, Sage Publication, Thousand Oaks
- Yin RK (2003b) *Applications of Case Study Research*. 2nd Edition, Applied Social Research Methods Series, Vol 34, Sage Publication, Thousand Oaks

Abstract

Climate change or ageing population are prominent examples for pan-European societal problems that call for strategically coordinated science, technology and innovation (STI) input in order to deal with them sustainably, putting societal challenges and policy coordination on top of the current EU STI policy agenda.

This diploma thesis focuses on how the formulation of societal challenges influences EU STI policy-making. The aim is to analyse how this shift in thematic prioritisation of STI policy affects the prevalent policy coordination practices in the EU by particularly accounting for the specific nature of a multi-level governance system. The empirical investigation of two Joint Programming Initiatives (JPIs) by the means of a multiple-case study analysis provides new insights into governance and coordination aspects arising in new STI policy approaches that explicitly address major European societal challenges by fostering multilateral coordination of STI efforts. It explores the practical implications resulting from the political prioritisation in terms of broadly formulated societal challenges for the development of specific problem-oriented STI-based responses in the multi-level and multi-actor setting of JPIs. The analysis focuses on the thematic and scientific embedding of the two JPIs - ranging from explicit goals and research objectives to the array of actors that exert influence on selecting such objectives - in order to reveal the crucial aspects that shape the factual designs as well as the governance modes and coordination mechanisms predominant in JPIs.

The study reveals that increasing demands to strategically coordinate national STI efforts at the highest political level have remarkably driven the first uptake of the notion of societal challenges in EU STI policy agendas in general, and the implementation of the JPI approach in particular. The case studies provide further evidence that a societal challenge-driven STI policy brings new governance aspects into the centre of STI policy-making, pertaining to issues of ways to strategically select and coordinate research approaches that are interdisciplinary and oriented towards a distinct problem. In light of increasing demands for evidence-based policy-making, specific institutional arrangements involving different scientific experts and stakeholders are crucial for determining the objectives of JPIs.

Kurzzusammenfassung

Gesellschaftlichen Herausforderungen wie zB Klimawandel oder die alternde Bevölkerung sowie der Ruf nach politischer Koordinierung von Forschungs-, Technologie und Innovationsaktivitäten (FTI) zur nachhaltigen Bewältigung dieser bestimmen derzeitige FTI politische Bestrebungen auf europäischer Ebene. Die vorliegende Arbeit analysiert wie sich bestimmte gesellschaftliche Herausforderungen als explizites FTI politisches Ziel auf die Politikgestaltung in der EU auswirken. Hierbei soll, unter besonderer Bezugnahme der Charakteristika des Europäischen Mehrebenensystems, genauer untersucht werden, wie sich diese thematische Schwerpunktsetzung in den vorherrschenden FTI politischen Governance- und Politikkoordinierungsformen widerspiegelt. Anhand von zwei Fallstudien werden Joint Programming Initiativen (JPI) - neue FTI politische Ansätze auf EU-Ebene welche auf verstärkte multilaterale Koordinierung von FTI Aktivitäten setzen, um zukünftige gesellschaftliche Herausforderungen zu bewältigen - näher untersucht. Dies bringt neue Aufschlüsse über das Wechselspiel zwischen Schwerpunktsetzung auf politischer Ebene, und der praktischen Ausgestaltung von unterschiedlichen Governance- und Koordinierungsmechanismen zur Auswahl bestimmter Forschungsstrategien auf Programmebene. Ein besonderes Merkmal von JPIs stellt die aktive Mitwirkung einer Vielzahl an Akteuren, welche auf unterschiedlichen Ebenen agieren, dar. Die spezifische thematische und wissenschaftliche Einbettung der untersuchten JPIs, vor allem hinsichtlich der Einbindung von unterschiedlichen Akteuren zur Festlegung von Forschungszielen, bilden den Fokus der Analyse um in weiterer Folge wichtige Determinanten interner Koordinierungsprozesse sowie deren unterschiedliche Ausformung zu identifizieren.

Die Diplomarbeit zeigt, dass der neue FTI politische Schwerpunkt auf gesellschaftliche Herausforderungen sowie die Einführung von Joint Programming Initiativen stark durch den Ruf nach verstärkter strategischer Koordinierung von nationalen FTI Aktivitäten auf EU Ebene angetrieben wurde. Die Fallstudien deuten weiters darauf hin, dass mit dieser Re-Orientierung neue Governanceaspekte ins Zentrum FTI politischer Gestaltung rücken. Dies bezieht sich vor allem auf die strategische Auswahl von interdisziplinären Forschungsansätzen sowie deren Koordinierung zur Bewältigung von bestimmten sozialen Problemen. Unterschiedliche wissenschaftliche und gesellschaftliche Akteure nehmen Einfluss in die Zielbestimmung von JPIs, was vor allem auch vor dem Hintergrund der Forderung nach evidenzbasierter und problemlösungsorientierter Politikgestaltung zu betrachten ist.

CURRICULUM VITAE

Mag. Iris Wanzenböck

Wohnort:	Wien
Geburtsdatum	23. September 1986
	Neunkirchen, NÖ
Staatsbürgerschaft	Österreich
Familienstand	ledig

Ausbildung

2000 - 2005	Bundeshandelsakademie Wiener Neustadt Niederösterreich, Reifeprüfung mit ausgezeichnetem Erfolg
2005 - 2010	Diplomstudium Volkswirtschaft, Wirtschaftsuniversität Wien Schwerpunkte: Innovationsökonomie, Wirtschaftsgeographie Abschluss: Dezember 2010 (Mag. rer. soc. oec.)
2005 - 2012	Diplomstudium Politikwissenschaft, Universität Wien Schwerpunkte: Policy Analyse, Internationale Politik, Politische Theorie
08 / 2008 - 01 / 2009	School of Economics, Business and Law Göteborg, Schweden, ERASMUS Programm

Sprachkenntnisse

Englisch	C1
Französisch	Schulniveau
Schwedisch	A2

Publikationen (veröffentlicht oder zur Veröffentlichung eingereicht)

Wanzenböck, I., Scherngell, T. und Lata, R. (2012): Embeddedness of European regions in EU funded R&D networks: A spatial econometric perspective. Paper presented at the first Eurolio European Seminar on Geography of Innovation, 26-28 January 2012, Congress Center, Saint-Etienne, France

Wanzenböck, I. (2011): Firm-specific drivers of behavioural additionality. IEV PhD- & Master-Theses Series Vol. 8, 2011, Wien

Wanzenböck, I., Scherngell, T. und Fischer, M.M. (2011): How do distinct firm characteristics affect behavioural additionalities of public R&D subsidies? Empirical evidence from a binary regression analysis. Submitted to Technovation [status: under review]

Wanzenböck, I., Scherngell, T. und Fischer, M.M. (2011): How do distinct firm characteristics affect behavioural additionalities of public R&D subsidies? Empirical evidence from a binary regression analysis. Paper to be presented at the 51th Congress of the European Regional Science Association (ERSA), 30 August - 3 September, University of Barcelona (Spain), 2011

Dachs, B. und Wanzenböck, I. (2011): Policies towards Innovation in Services and ServPPINs. ServPPIN Project Report

Dachs, B., Hyvönen, J., Toivanen, H., Wanzenböck, I. und Weber, K.M. (2011): Lead Markets. INNOVA Sectoral Innovation Watch Report.

Wanzenböck, I. und Scherngell, T. (2010): How do behavioural effects of public R&D subsidies differ across specific firm characteristics? Empirical evidence from a binary regression analysis. AIT Working Paper Series, No. 2010/31