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Embedding foresight in transnational research programming

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The complexity of transnational research programming and the requisite large-scale stakeholder engagement set a major managerial challenge: how to prepare, run and evaluate such activities in an effective, efficient and appropriate as well as transparent, open and inclusive manner. To address such co-ordination challenges we specify dimensions of transnational, vertical, horizontal and temporal co-ordination and apply them to three cases of foresight processes in connection with transnational research programming. This provides some evidence on a potentially significant role for foresight in facilitating and integrating different functions of programming but also shows major challenges in foresight design and management, which we address by way of elaborating guiding foresight principles of scalability, modularity and flexibility. We also consider the potential role of foresight in joint programming in Europe and in transnational research programming elsewhere.

Keywords: transnational research co-operation; foresight; joint programming.

1. Introduction

Science and scientists have crossed the national borders of individual states for many years. International research collaboration has become a daily business together with the pace of globalisation. In this respect, more collaboration in research programming across borders makes sense in terms of avoiding duplication, reaching a critical mass and detecting gaps, while too much co-ordination may lead to a decrease in competition. In Europe, a lot of room exists for increasing collaboration between the research funding activities of Member States. Around 85% of all civil public research in Europe is still programmed, financed, monitored and evaluated at national level (European Commission 2008). Another driver for more collaboration is the increasing pressure in Europe[1] and other parts of the world[2] for research and innovation to both support competitiveness[3] and offer solutions to global and local societal challenges. However, despite clear drivers for collaboration, there are also major challenges and barriers. In this paper we address such challenges and examine some recent European experiences using foresight as a co-ordination tool embedded in the facilitation of transnational research collaboration.

In Section 2 we look more in detail at the challenge of co-ordinating transnational programming and propose a co-ordination approach to address this challenge. Section 3 applies the approach to some empirical observations on recent cases of transnational programming. From there, possible foresight principles in the context of transnational research programming are discussed, as well as the role foresight can play as an integrator of programming functions. The paper also looks at the implications for transnational programming in Europe and elsewhere. Finally, it draws conclusions for foresight in transnational research programming.

2. Co-ordination of transnational programming

The co-ordination of cross-national public research involves a set of challenges in bridging potentially

Table 1. Tensions in transnational research priority setting between science and policy-making, based on experiences with identification of joint programming initiatives. Based on Seiser (2010)

Drivers of transnational research priority setting from point-of-view of science	Drivers of transnational research priority setting from point-of-view of policy-making
Bottom-up	Top-down
More focus on scientific frontier	Feeding existing clientele
Risk taking for new discoveries	Risk averse
Priority setting by peers	Priority setting by diplomacy
Long-term perspective	Time pressure
Simplified yet sustainable funding	Juste retour[a]
Institutional barriers	Institutional power play
Excellence rather than relevance	Relevance rather than excellence

[a]Juste retour means that member states get approximately the same amount back in research grants as they contribute.

conflicting, or at least diverging, interests. A first tension is the trade-off between basic and exploratory research on the one hand, and applied and societal problem-solving oriented research on the other hand. This is particularly relevant for research performed at universities, where academic freedom has traditionally been a basic principle, and which now experiences increasing pressure to contribute to innovation strategies and to engage more with business and the wider society. Within the focus of problem-solving oriented research a second source of tensions relates to different viewpoints between scientists and policy-makers. Based on experiences in the identification of European Joint Programming Initiatives, Seiser (2010) identifies eight tensions in research priority setting from the point-of-view of policy-makers and scientists (see Table 1). A third set of tensions relates to the multi-disciplinary and multi-level complexity of societal challenges. As current governance systems are incapable of tackling current and future, interconnected, global challenges (Könnölä et al. 2012), more alignment is needed on four dimensions: between national research systems, horizontally between disciplines and policy areas, vertically across governance levels (from local to global) and over time (see Section 2.2). If effective research and innovation are seen as part of the solution to these tensions, they also require alignment along these dimensions.

Transnational research co-operation in itself is also very diverse. Gnamus (2009) proposes eight levels in international science and technology (S&T) co-operation (see Fig. 1). This paper will focus on level four 'programme co-operation and co-ordination'. The different levels defined by Gnamus are not mutually exclusive, activities and different levels can co-exist within transnational co-operation between nations. Within the EU initiatives between Member States exist on all eight levels and all are part of the same research and innovation system. Co-ordination of research and innovation activities therefore needs to take into account possible links between different levels of transnational co-operation. For instance, some programmes may require joint infrastructure investments, innovation clusters may benefit from links with co-ordinated programmes. Positioning programme co-operation and co-ordination within this wider perspective shows the importance of aligning collaboration between different levels of S&T co-operation.

All in all, the context of transnational research programming tends to be highly complex and uncertain, and different stakeholders take part with diverse expectations and capacities. Dealing with this complexity requires co-ordination tools that are able to address the above-mentioned potential tensions. In the search for such tools we first take a look at key functions in research programming, the dimensions of co-ordination and related barriers.

2.1 Key functions in research programming and related barriers

The implementation of transnational research programming builds largely on programming practices executed at national level. Transnational programmes require similar type of operational functions in their setting up, running and evaluation. For instance, in connection with joint programming (see Section 4.3) six framework conditions have been defined:

- peer review procedures
- forward-looking activities
- evaluation of joint programmes
- funding of cross-border research
- optimum dissemination and use of research findings
- protection, management and sharing of intellectual property rights (CEC 2010)

In the ERA-NET scheme a four-step approach is applied[4] (Matrix-Rambøll 2009). A survey among ERA-NET participants under the Sixth Framework Programme indicates that the main activities other than joint calls/programmes that ERA-NET participants engaged in, included:

- developing an action plan to deal with common strategic issues and to prepare for joint activities (75%)
- undertaking benchmarking initiatives and putting in place common schemes for monitoring and evaluation (67%)
- co-ordination or clustering of ongoing nationally funded research projects (59%)
- generating multinational evaluation procedures (55%) (Matrix-Rambøll 2009).

For the purpose of this paper we define five key functions in transnational research programming, each facing a number of barriers on policy, programming and project levels (see Table 2).

Table 2. Key functions in transnational research programming and related barriers

Function	Description	Key barriers[5]
Scoping and initial commitments	Scoping is initiated by the systematic analysis and sense-making of the context, and followed by the identification of research/innovation topics and societal challenges. Programme design and initial funding commitments are made, appropriate processes for transnational programming are initiated	Differences in priorities between policy-makers and researchers Different public financing and auditing mechanisms (vertical vs. horizontal grants, loans, tax reductions etc.) National regulations constraining funding to national activities Differences in national funding rules Uncertainty at national level of rewards of collaboration Inequality of investment makes it impractical to design joint programmes Programme is designed to address country-specific issues Insufficient knowledge of similar national programmes in other countries Lack of budgetary flexibility Lack of mutual trust Source of funding does not encourage use of funds for transnational activities Language and culture diversity makes opening programmes impractical[6]
Calls, proposals and peer-review	Calls for proposals are prepared and disseminated in order to receive project proposals, which becomes a subject of peer-review and finally selection of projects to be funded with a transnational programme	Insistence on using national peer review rules Different national practices in form, focus, guidance and ways to respond to call Different expertise levels among participants to work with (online) application forms Limited experience/capacity in pan-European collaboration Lack of common technological basis Differences in scientific excellence Calls are lacking an agreed transnational programme and only reflect national programmes that contain mutual issues
Running and monitoring	Running a transnational programme is a subject of effective administration and execution of projects. Monitoring refers to on-going control and evaluation of project performance	Financial administration systems are not designed to cope with non-national contracts No shared points of contact/project ideas Differences in speed of implementation National differences in training for graduate students and postdoctoral fellows involved in transnational research Different assumptions and expectations about how work and interactions should be conducted Differences in legal and regulatory systems
Intellectual property (IP) and use of results	IP issues are addressed within transnational framework in order to have mutual agreement on use of results	Difficulties to fund projects where a company from abroad receives all the IP rights Differences in open access (OA) policies (such as existing incentives, laws and legal provisions supporting OA; OA policies from national funding bodies, universities and research centers; references to OA in grant agreements) Problems of oversight related to research integrity
Evaluation	Evaluation of transnational programme refers to appropriateness, effectiveness and efficiency in execution of entire programme and its parts	Differences in practices and level (project, call, programme level) of evaluation Timescales of national evaluation processes may vary considerably Differences in experience in monitoring, evaluation and learning-based policy-making Lack of national support to fund longer-term collaboration in evaluation

2.2 Dimensions of co-ordination of transnational research programming

The challenges of transnational research collaboration have been addressed for decades, and many instances of its use exist today. For instance in Europe knowledge-sharing platforms offer tools, good practices and information on the current (through mapping of existing programmes), planned (through policy documents) and possible future[7] state of research priority setting and research systems. In the EU platforms exist at regional[8] (e.g. Smart Specialisation Platform[9]), national (e.g. ERAWATCH[10]) and transnational (e.g. NETWATCH[11]) level, each offering some of the functionalities mentioned above.

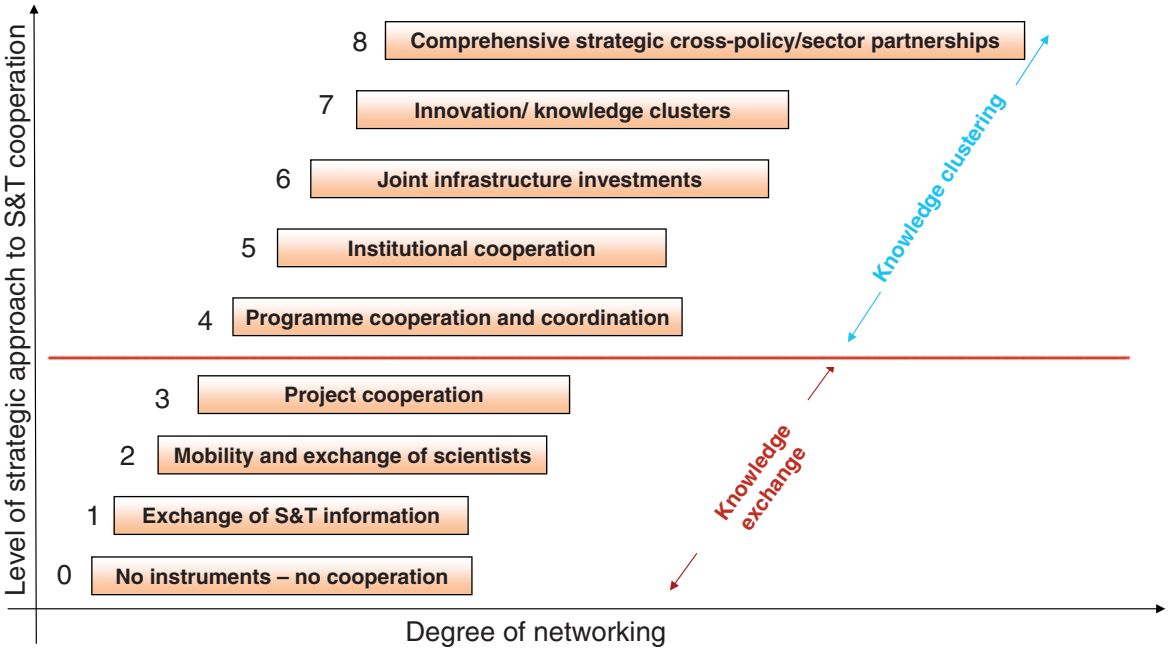

Figure 1. Development phases of international S&T co-operation (Gnamus 2010).

European experiences and ongoing initiatives in transnational research co-ordination[12] also provide many opportunities for mutual learning. The instruments and tools used by one mechanism can be useful in supporting others.[13] But this variety of mechanisms also constitutes an important additional co-ordination challenge, as initiatives undertaken in one mechanism may have important links with initiatives from other mechanisms. An example is the co-operation between ERA-NETs and European technology platforms (Niehoff and Andersdotter 2007).

Also lessons from other levels of S&T co-operation (see Fig. 1) are valuable for transnational programming. For instance, at the level of international research infrastructures, issues like prioritisation criteria, funding, governance, evaluation and impact assessment are being discussed in Europe (European Commission 2010a). At the level of innovation clusters the recently established first knowledge and innovation communities (KICs) of the European Institute for Innovation and Technology (EIT) also face issues of governance, prioritisation and evaluation. A recent evaluation[14] of the EIT proposes to put in place 'robust procedures developed through a mutual learning process with the existing KICs'.

The further development of transnational research and innovation collaboration is likely to benefit from conceptual demarcation of different dimensions of the challenges. Könnölä et al. (2011) identified two challenges:

- vertical co-ordination
- horizontal co-ordination

We elaborate on this work and add two further dimensions:

- alignment of national research systems
- temporal dimension in co-ordination

2.2.1 Alignment of research systems. Nations or regions aiming to collaborate in research programming often face strong differences of varying nature in the way their respective national research systems are built up (Optimat et al. 2005; Anderson 2010). These include: structural differences in national programme orientation[15] and implementation orientation,[16] diversity of programme funding organisations; the distribution of research across research performers,[17] differences in cross-sector collaboration (e.g. university–industry collaboration) and in the degree of control of governments over research agendas;[18] varying levels of interest at national level for collaborating beyond borders and the openness of current programmes to other nations. This diversity of national programmes and their implementation raised major obstacles against establishing optimal transnational programmes. Anderson (2010) also points to the importance of legal and regulatory systems, oversight related to research integrity, and the training of graduate students and postdoctoral fellows, when conducting research collaboration.

2.2.2 Vertical co-ordination of multi-layered research systems. The OECD (2003) has identified vertical coherence as a general long-term policy objective—ensuring that the practices of agencies, authorities and autonomous

bodies, as well as the behaviour of sub-national levels of government, are mutually reinforcing and coherent with overall policy commitments. Historically, research policies have emerged through development paths that reflect the societal contexts of their path-dependent techno-institutional co-evolution. They have also evolved over a long period of time and are thus extraordinarily stable. At present, research and innovation policies are challenged by global market conditions where Member States, regions or even industrial or local clusters compete for critical resources, such as knowledge, human resources, and foreign RTD investments (Kaiser and Prange 2004).

Indeed, today the research system is an integral part of the prevailing multi-layered innovation system. Könnölä et al. (2011) consider experiences from vertical co-ordination between local, regional and (inter-) national levels providing significant insights into the challenges of managing multi-layered research and innovation systems. Such challenges have been related to the systemic nature of innovation (Smits and Kuhlmann 2004), performance of innovation systems (Lundvall 1992; Edquist 1997), and processes of regionalisation (Kaiser and Prange 2004), which have together resulted in complex multi-layered policies especially in Europe.

The articulation of thematic priorities for transnational research and innovation co-operation, e.g. from EU level, raises issues related to their coherence with the priorities and needs of lower levels of governance, particularly in terms of consultation of national, regional and local authorities. Such programmes are implemented in different countries with different priorities. They either complement national and regional policies or become a replacement policy framework in some fields (e.g. in the case of new EU Member States). Given such diversity it may be claimed that achieving an overall multi-level policy consistency will never be possible while policy co-ordination can only assume soft forms (Reid et al. 2007).

2.2.3 Horizontal co-ordination between research and other policy areas. Könnölä et al. (2011) note that successful research and innovation processes can be facilitated by horizontal co-ordination between research and other policy areas (such as competition, regional, financial, employment and education policies). In effect, the adoption of innovation as a cross-cutting policy objective—which is prominent even in sectorally oriented policies—holds promise for the closer integration of innovation and other policies. In more general terms, the OECD (2003) has called for horizontal coherence as a general governance objective—ensuring that individual objectives and policies developed by various entities are mutually reinforcing. Even though it may be unrealistic to assume that complete horizontal policy coherence could be achieved, it is still relevant to aim at strengthening the interconnectivity and alignment of policies and promoting a 'whole-of-government' perspective.

Co-ordination-oriented research and innovation policy differs from other policy areas, because it has to account for an especially cumbersome context—and sector-specific differences. Such differences are caused by the dynamics of evolutionary and systemic processes with different phases of competing technological alternatives and emerging dominant designs (Könnölä et al. 2011). In such settings, efforts at horizontal co-ordination must seek opportunities for collaborative policy formation while recognising the relevance of multiple perspectives in relation to the objectives of different policies. Methodologically, these efforts call for systematic multi-stakeholder processes, lest they be taken over by short-term policy agendas and debates.

2.2.4 Temporal co-ordination of policies and research systems. Temporal co-ordination brings another key dimension to transnational co-ordination. In fact, the alignment of strongly differing national research systems and vertical and horizontal co-ordination are all subject to temporal co-ordination challenges. The aligning of research systems with vertical and horizontal co-ordination efforts face major difficulties in facilitating policy activities that lead to sustainable policy efforts over time. The OECD (2003) defines temporal coherence as a general policy objective that ensures that policies continue to be effective over time and that short-term decisions do not contradict longer-term commitments. Temporal co-ordination focuses on how policies work out as they interact with other policies or other forces in society, including whether future costs are taken into account in today's policy-making. This is crucial for ensuring synergies between the programmes, given the role of time lags in transnational policy-making contexts. Table 3 links the four dimensions of policy co-ordination, as described above, to potential barriers to transnational research programming.

2.3 High level of complexity calls for a systemic, participatory and anticipatory co-ordination approach

The complexity of the co-ordination challenge of transnational research programming calls for approaches that can engage stakeholders horizontally from different policy and research areas as well as vertically and internationally from different countries and regions to support informed decision-making on the scope, structure and subsequent funding commitments. Such stakeholder engagement can enhance the systemic understanding of existing research activities and applied policy instruments that help to define the scope of the transnational programme in line with criteria such as: efficiency, effectiveness and appropriateness.

In last two decades systemic challenges in research and innovation have lead to the development of systemic

Table 3. Dimensions of policy co-ordination and related key barriers for transnational research programming

Dimension of policy co-ordination	Description	Potential barriers[19]
Alignment of research systems	Alignment of structural and systemic differences in national research systems	Structural differences between national research systems hampering co-ordination of programmes Structural differences in national programme orientation and implementation orientation Differences in distribution of research across research performers Differences in degree of control of governments over research agendas Varying interests at national level in collaborating beyond borders Varying openness of current and past programmes to other nations Different funding modes
Vertical co-ordination	Co-ordination between local, regional and (inter-) national levels	National researchers not keen to see more budget used for transnational projects Lack of alignment between policy-makers and implementing organisations Difficulties to agree on the type of contracts at different levels for Research, Development and Deployment co-operation (including currency issues) Lack of networks/no European structures to coordinate co-operation in programme area Geographic distance Policy to achieve national priorities through internal capacity building/sufficient volume of high quality applications from internal capacity Influential decision-makers do not see value Sharing activities/results would dilute international leadership—conflicting interests between competitors Transnational activities are focused on non-EU countries Administration costs of transnational projects outweigh benefits No significant policy changes or explicit criteria to encourage transnational activities No clear priorities at national level
Horizontal co-ordination	Co-ordination between research, innovation and other policy areas (such as competition, regional, financial, employment and education policies)	Another organisation deals with international activities Problems with aligning financial resources and budget disputes over co-funding Diverging degrees of experience with (horizontal) policy co-ordination at national/regional level Differences in degree of cross-sector collaboration (e.g. university–industry collaboration)
Temporal co-ordination	Ensuring that policies continue to be effective over time and that short-term decisions do not contradict longer-term commitments ('dynamic efficiency')	Differences in degree of continuity of policy design and implementation Differences in start and duration of national programmes Different national rules and cycles make collaboration impractical Differences in speed of implementation at national level Differences in degree of long-term planning at national/regional level

instruments for better preparedness, co-ordination and integration of research and innovation systems (Smits and Kuhlmann 2004). Among different systemic instruments foresight has been characterised as a participatory, systemic and anticipatory vision building approach that supports the present-day decision-making (European Commission 2002). In this paper we explore the possible role of foresight in transnational research programming and how it can respond to systemic, horizontal, vertical and temporal co-ordination challenges by mobilising, integrating and facilitating the different functions of programming described in Table 2.

3. Empirical observations on recent foresights in connection with transnational research programming

In this section we describe three European cases of transnational research programming in terms of the role foresight plays in addressing the co-ordination challenges identified in Section 2. First, we take a brief look at the foresight processes, the cases are then linked to the dimensions of co-ordination identified in Section 2. Based on the observations in this section, some possible foresight principles are discussed in Section 4. Further testing of those principles goes beyond the scope of this paper, but opens opportunities for future research and piloting of the proposed approach.

3.1 Foresight processes case by case

The cases were handpicked principally because of the explicit role of foresight activities in their implementation as well as the fact that the present authors had access to the information and were familiar with it. The combination of cases was selected to provide a mix of cases at varying stages of progress and to show the different roles that foresight plays (see Table 4). A more detailed analysis of the

Table 4. Description of selected cases and respective foresight roles

Case	Partners	Timing	Goal	Role of foresight
Wood Wisdom-net[20]	18 partners from 8 European countries	2004–8	Establish and deepen collaboration between European funding organisations in field of wood material science in order to coordinate use of research funds	*Ad hoc* process to support joint programme preparation of Member States and support mobilising and networking of innovation communities across borders
EMIDA ERA-NET[21]	29 partners (and three observers) of 19 EU Member States and Associated Countries	2008–11	Develop a durable focused network[22] of national research funders in Member and Associated States of EU in order to share information, coordinate activities and work towards a common research agenda and mutual research funding activities in field of animal health	Structured long-term foresight process to develop, maintain and update SRA, supported by establishment of a long-term FPU
Urban Europe Joint Programme Initiative (JPI)[23]	14 Member States and associated countries	2010 onwards	'Rethink and manage the increasing urban orientation and concentration in Europe in order to create and exploit synergy in an urbanised Europe, from an economic, social, environmental and transport-related perspective, leading to a strengthened global position in Europe' (Urban Europe, 2011)	Determine specific research needs and roadmaps, short- and long-term policy measures, business opportunities and needs for new co-operation structures Support identification of breakthrough innovations on functions of cities in future (2020–50)

specific processes and roles of foresight in each of these cases is given below and in Fig. 2.

3.1.1 Wood Wisdom-net[24]. The main role of foresight in this case is to support the joint programme preparation of Member States and the mobilisation and networking of innovation communities across borders. The responsibles for the shaping of research agendas realised that a systematic participatory bottom–up foresight process could streamline the engagement of Research and Technology Development communities from eight countries. Stakeholders[25] had specified roles and responsibilities in each consecutive phase of the foresight process. Their inputs were solicited and synthesised through extensive internet-based consultations and carefully planned workshops. 317 future-oriented research issues were proposed by researchers and assessed by researchers and industrial leaders on the basis of different criteria.[26] Those issues that were favourably evaluated on the different criteria were prioritised for discussion in a series of four workshops. Based on the results of the last workshop for funding organisations, three working groups were formed such that each consisted of funding organisations with shared interests in the topic of the working group.

3.1.2 EMIDA ERA-NET[27]. The main role of foresight in this case is to develop, maintain and update the strategic research agenda (SRA), which will support transnational research programming by delivering research issues. To this end, longer-term strategic requirements with a 10–5 year outlook are identified in a systematic way, building on knowledge about future aspects of animal disease development in Europe and the world, and linking this to existing research programmes (see Fig. 2). The partners see the need to repeat such an approach at a certain frequency in order to adapt research programmes to the dynamic environment. To this end a foresight and programming unit (FPU) was established, consisting of a small group with an interest in the animal diseases and their future perspectives. The limited size of the group aimed for an active, flexible and decisive approach. It is also envisaged that the FPU will be sustained in the long term with additional tasks related to implementation of the SRA, ongoing foresight activities aiming to renew the SRA, foresight capacity building and gap analysis. The sustainability of the FPU is intended to be achieved by having the SCAR Collaborative Working Group Animal Health and Welfare (SCAR CWG) take it forward after the EMIDA ERA-NET project has ended.[28]

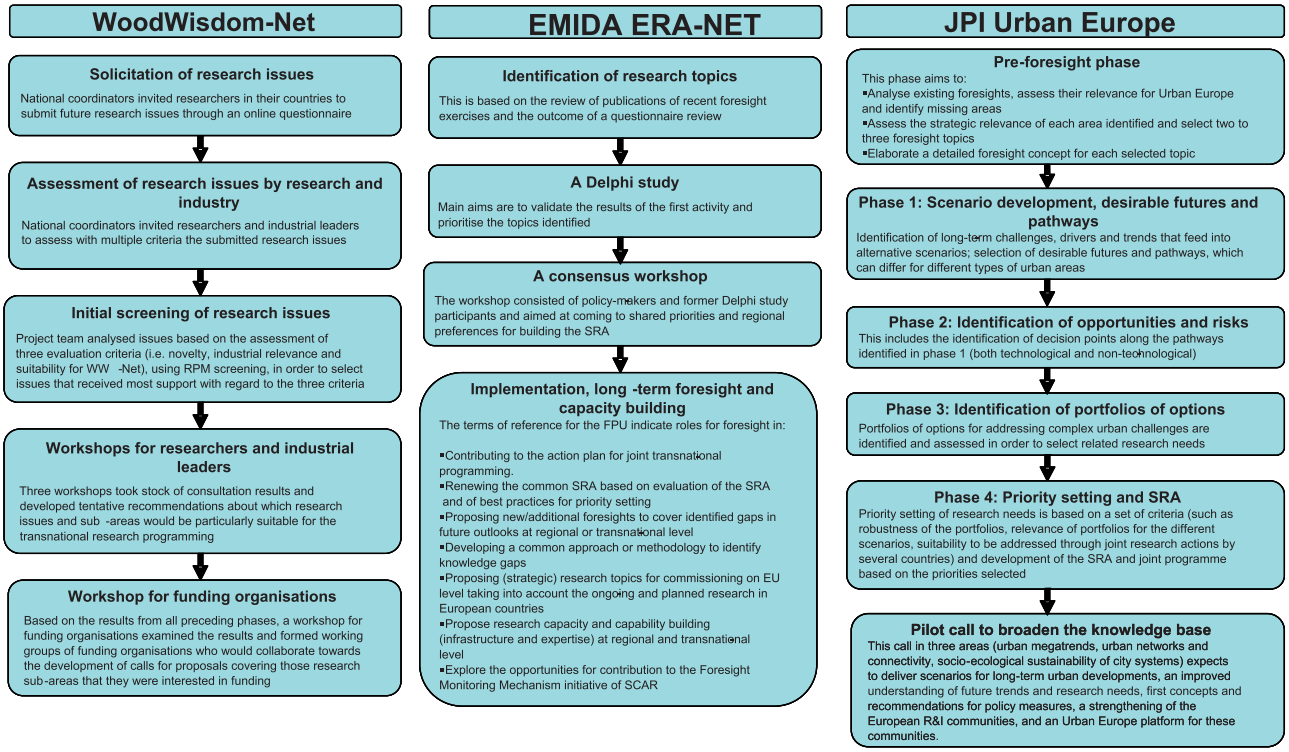

Figure 2. Project phases of foresight in each of three cases selected.

3.1.3 Urban Europe Joint Programming Initiative[29]. In this case foresight supports the identification of specific research needs and roadmaps, short- and long-term policy measures, business opportunities, needs for new co-operation structures and breakthrough innovations with regard to the functions of cities in the future (2020–50). A draft research agenda, known as the Strategic Research Framework (SRF) has been developed building upon and around four interconnected pillars,[30] and making use of foresight techniques (a backcasting experiment, a first vision building workshop and an SRA workshop) The majority of the foresight process is, however, still to be implemented, and there are plans to further refine the SRF. The planned foresight process (see Fig. 2) consists of a pre-foresight phase and four foresight phases. Interestingly, a pilot call is part of the foresight process, and will comprise targeted research within a two-year span in order to broaden the knowledge base in three areas: urban megatrends, urban networks and connectivity, and the socio-ecological sustainability of city systems. Expected outcomes of the pilot call include: scenarios for long-term urban developments, an improved understanding of future trends and research needs, first concepts and recommendations for policy measures, a strengthening of the European research and innovation communities, and an Urban Europe platform for these communities. Stakeholder engagement and networking is a core element of the process, from the design of the Urban Europe process and the further development of the SRF to the participation in research projects and in implementation measures. The participation initiatives embedded in the process include the establishment of an Urban Europe forum (UEF)[31] and an Urban Europe exchange platform.[32] Despite the fact that these forums are not explicitly designed for the anticipation of long-term future developments, they are relevant for ensuring wider stakeholder debate and engagement.

3.2 Conclusions on the cases

Our examination of the three initiatives indicates that foresight activities may alleviate some barriers to transnational programming by way of addressing systemic, horizontal, vertical and temporal co-ordination challenges. As shown in Table 5, foresight activities can find different roles and forms when dealing with co-ordination challenges. Such diversity of foresight activities indicates that it is relevant to tailor the foresight design and management style to the case-specific context and to particular requirements of the participating organisations and related stakeholders.

Based on experiences within the above three cases, some initial conclusions can be drawn on the way in which foresight can support the four co-ordination challenges identified in Section 2.

3.2.1 Alignment of research systems. Foresight supports the alignment of different research systems by

Table 5. Ways in which foresight addresses co-ordination challenges in transnational research programming

Co-ordination challenge	Wood Wisdom-Net	EMIDA	Urban Joint Programming Initiative
Alignment of research systems	Bottom up consultation process networking researchers and industrial leaders across borders. A workshop with funding organisations was organised. Three working groups with funding organisations were composed based on similar interests in future research topics	Mapping of recent foresight exercises with support of FPU Project pays attention to research capacity and capability building (in infrastructure and expertise) on regional and transnational level FPU of project aims to promote transparency and access to research programmes and results across all countries	Mapping and analysis of existing foresight exercises for urban regions and for other non-region specific topics relevant for urban development allows gaps to be identified where additional foresight exercises may be needed Development of an SRF that sets out likely directions of technological and organisational change that need to be converted into research programmes Alignment of existing national programmes and research strategies in a variable geometry
Vertical co-ordination	Bottom up consultation process engaging researchers and industrial leaders providing a wealth of information for national funding agencies on their stakeholders' interest and capabilities to benefit from planned programme	Proposals for new/additional foresights aiming to cover identified gaps in future outlooks on regional or transnational level Proposals for (strategic) research topics for commissioning at EU level taking into account on-going and planned research in European countries Facilitate cost-effectiveness of research-commissioning by trying to establish and publish shared priorities on a transnational programme level Mapping of foresight exercises at all governance levels	Establishment of a UEF, aiming at continuous dialogue between a wide set of stakeholders and JPI Urban Europe Use of a pilot call to engage stakeholders at different levels in broadening knowledge base Engagement with other networks and organisations (e.g. close co-operation with China on foresight)
Horizontal co-ordination	Cross-feeding of research teams was encouraged by assessment of submitted issues and asking researchers for expressions of interest in collaborating in each issue, which allowed advanced network analysis and supported novel research collaboration across research fields	Foresight exercise is multi-disciplinary. It aims to include stakeholders from other disciplines in priority setting and to create a multi-disciplinary co-ordination network of research funders for joint funding of transnational research and research networking	Four pillars for Urban Europe are identified. Foresight efforts focus specifically on interfaces of those four pillars Urban Europe exchange platform aims amongst others at connecting various disciplines and starting new initiatives with European R&I communities
Temporal co-ordination	Consultation on research issues among stakeholders provided future-oriented information on direction and interests of research community. This helped national funding agencies to develop a common agenda for programme and to overcome differences in programming	FPU aims to do continuous foresight, update SRA and extend lifetime of network beyond lifetime of ERA-NET A small and decisive team aims to apply a flexible and adaptive approach, which can change during process according to upcoming needs	Analysis of current time horizon of existing programmes reveals a lack of longer term foresights. Foresights with a time horizon of 2050 and beyond are therefore planned Development of scenarios, desirable futures and pathways towards these futures for specific Urban Europe topics Use of a pilot call to improved understanding of future trends and research needs beyond initial analysis Development of scenarios for long-term urban developments Establishment of an UEF, aiming at continuous dialogue between stakeholders and Urban Europe and ensuring a long-term integration of stakeholders in activities

including different parts of the transnational research landscape in the participatory process, and collecting information on the views of different stakeholder groups within these research systems on future issues such as research priorities and implementation modes. Collecting information on (differences in) the structure of research funding, the ministries and organisations involved, their respective visions for the future, and their plans for

increasing research capacity in a specific thematic area can also contribute to better understanding and aligning research systems. Joint visions and joint research agendas also facilitate the alignment of future joint programmes and of research infrastructure planning with these programmes. The participation of the actors in research systems in a foresight process may also promote transparency and information sharing at different levels and in different phases (information sharing and alignment of existing programmes, sharing of research results), thus also increasing trust. Participation in the context of aligning research systems may also relate to sharing research results.

3.2.2 Vertical co-ordination. Foresight may enhance vertical co-ordination by taking stock of previous anticipatory studies and existing visions for the future at regional, national and transnational level. A gap analysis on missing future outlooks may propose additional studies at regional, national or transnational level. Networking and engagement with related initiatives at different levels, within and beyond the geographical scope of the collaboration, may also support vertical collaboration. Conducting bottom-up consultations or launching a (pilot) call aimed at gathering more anticipatory intelligence are ways to provide different policy levels with rich information about the interests of the stakeholders and project partners.

3.2.3 Horizontal co-ordination. Horizontal co-ordination can be enhanced by foresight by encouraging the sharing of research interests among research teams in different areas and disciplines. Alternatively, multi-disciplinary stakeholder groups can be formed to work together towards common research agendas in different sub-areas, which can be structured to cross-feed one another. Furthermore, comprehensive stocktaking on earlier foresight studies can be conducted to understand future developments and to position the programme in the light of other ongoing activities. While engaging in future-oriented analysis and engaging wide sets of stakeholders, foresight activities prepare the ground for positioning and scoping the programme within the transnational research and innovation system using a multitude of instruments, research activities, infrastructures and institutions. The composition of the research consortium may also help to support horizontal co-ordination, by ensuring representation from different disciplines in the consortium.[33] During the implementation stage, multi-disciplinary supervision of research projects can support horizontal co-ordination.

3.2.4 Temporal co-ordination. Temporal co-ordination can be enhanced by foresight through the joint development of a vision for the future and of a roadmap towards it, and can compare this with current programmes and their time horizons. Alternatively, current and planned programmes can be checked against alternative future scenarios to test their robustness over time. Temporal co-ordination also relates to regularly checking those scenarios, visions and roadmaps against new developments, thus evolving towards a more continuous application of foresight. It can also mean the establishment of a flexible and adaptive approach to foresight, which can change upcoming needs. Here, the establishment of stakeholder platforms for long-term stakeholder engagement in the process and knowledge and collaboration platforms for cumulating knowledge and initiating collaborations between stakeholders have a dimension of temporal co-ordination. Also (pilot) calls can be used to increase the accumulation of knowledge on future trends, scenarios and other relevant data (by dedicating a pilot call to research on such future-oriented issues) and to help building communities over time, thus making use of the collective knowledge of wider stakeholder groups. In particular, the temporal co-ordination dimension calls for safeguarding the existence of a foresight function and capabilities as an integral part of programming.

4. Discussion

Building on our experiences from the case studies, foresight seems to hold the promise of facilitating the implementation of different functions of transnational research programming—way beyond the identification of emerging issues, priority areas and relevant stakeholders. In particular, the role of a supporting tool like foresight for engaging and mobilising the innovation communities can be crucial for understanding (and enhancing) the capacities and capabilities of different countries to participate in joint programmes. We consider that foresight holds promise for a structured and responsive process that efficiently mobilises stakeholders and informs decision-making. Foresight supports a structured organisation of stakeholder involvement, orienting the efforts towards understanding diverse interests and shared visions on future developments, thus contributing to better decision-making in a cost-effective way. We first look at some principles for the use of foresight, drawing on the cases, and then explore more in detail how foresight can play a role as an integrator of different functions of transnational research programming. Section 4 ends with a look at the implications for research programming in and beyond Europe.

4.1 Foresight principles for transnational research programming

To be effective in supporting transnational research programming, foresight activities need to address the

different dimensions of co-ordination challenges. Against this backdrop, the design and management of foresight may benefit from some principles that support the attainment of the objectives of the entire programming initiative and support its legitimacy in the wider research and policy landscape. We crystallise three principles for foresight design and management in transnational research programming.

4.1.1 Scalable design for transnational initiatives. Scalability, the ability to be expanded or upgraded, is needed to process contributions vertically from stakeholders who are accustomed to different levels of abstraction when considering regional, sectoral, national or European priorities. The notion of scalability has at least three sub-dimensions:

- Input scalability, which makes it possible to involve varying amounts of contributions from a changing number of stakeholders.
- Geographical scalability, which makes it possible to involve stakeholders regardless of the geographical distance between them.
- Administrative scalability, which permits the decomposition of the foresight process into manageable sub-processes and enables transitions between different levels of abstraction by way of problem structuring and synthesis (Könnölä et al. 2011).

In WoodWisdom-Net, scalability meant that the consultation process had to deal with varying amounts of contributions from a large number of stakeholders in different countries. Moreover, the overall consultation process had to be decomposed into manageable sub-processes. Decomposition was facilitated by the framework for research sub-areas and by treating research areas and research themes as relevant 'units of analysis' that experts could assess with an internet-based decision support tool. Recomposition of smaller units of analysis was carried out in workshops, in order to first, identify similarities and interdependences between proposed research issues; and secondly to generate more holistic perspectives on the emerging agenda.

4.1.2 Modular and structured process for balanced and diverse stakeholder engagement. Modularity refers to process design where analogous sub-processes—or modules—can be enacted relatively independently from the other sub-processes (Könnölä et al, 2011). This concept is key to attaining scalability: for instance, input scalability can be achieved by carrying out modules of analogous foresight processes in different countries, after which further sub-processes can be conducted to interpret these processes, say, from the viewpoint of internationally agreed priorities. Modularity also makes it easier to compare the results of sub-processes and to achieve economies of scale. In the Urban Europe case, an example of modularity is the preparation of a pilot call to collect anticipatory intelligence, and the organisation in parallel of foresight activities on selected Urban Europe topics. In WoodWisdom-Net, modularity was pursued, for example, by developing a framework for the field of wood material science, consisting of four research areas and 23 sub-areas. Stakeholder participation was also based on the definition of explicit roles and responsibilities for the different phases of the process.

4.1.3 Flexible and responsive management to accommodate with stakeholder expectations. The use of a structured approach and exploitation of the internet can support the monitoring, evaluation and overall legitimacy of the activity by way of allowing traceability of emerging jointly proposed themes or research topics. But accommodating different national interests, capabilities and culture in transnational programming also calls for flexibility in the design and management of the foresight process. On the eve of initiating a foresight exercise and scoping its research programme it is often premature for many national agencies to decide on their level of commitment to that programme and its planning. Foresight can be structured in a way that allows flexibility in design to respond to the changing expectations of stakeholders, for instance including open access and the exit of participating organisations may be taken into account. In the EMIDA ERA-NET flexibility is built into the design through:

- the establishment of a small foresight team prepared to be adaptive and flexible depending on the changing conditions
- search for a balance between planned foresight activities and expected additional non-defined activities of the FPU

In the Urban Europe case, the UEF will use guidelines instead of terms of references, in order to maximise the flexibility in developing the forum. Flexibility is also applied in the pilot phase, which offers participating countries various options and instruments to participate (such as foresights, joint calls, and the alignment of existing programmes) in variable geometry. In WoodWisdom-Net, some 'slack' in scheduling was built into the process schedule as a risk mitigation measure. Moreover, the tasks in the final phases were not fully specified at the outset, because it was expected that results from the earlier phases would be helpful in planning these tasks.

Furthermore, if one regards foresight as a creative process (Salo et al. 2004), then it may be impertinent to fix foresight objectives and design for the duration of the

entire exercise, if only because the foresight exercise produces information about the relevance and attainability of these very objectives. Instead of seeking to 'fix' the objectives and associated process design at the outset, those in charge of the foresight process should anticipate, and even prepare for, later modifications in the implementation plan. The foresight literature contains several accounts of the tensions arising from attempts to map out and execute large-scale foresight exercises according to a clear 'blueprint' (Havas 2003).

Salo et al. (2004) argue that responsiveness to shifting objectives and stakeholder expectations should be regarded as a major concern and even a key design variable in the planning and execution of foresight activities. The need for responsiveness—by which they mean 'purposely designed managerial controls for making warranted mid-course adaptations to foresight objectives and implementation plans'—depends on the envisaged role that is ascribed to a specific foresight activity in an evolving innovation environment.

Hence, while ensuring the scalable, fast and efficient implementation of a transnational foresight process by way of structured and parallel activities coordinated in different modules, it is also important leave room in the design to integrate clear phases that allow for redirecting and redesigning the whole process to better meet the stakeholder expectations and to accommodate new priorities in the plans. Towards this end, the modular design is helpful by way of including process and result flexibility.

Process flexibility refers to the ability to make methodological changes in how certain results are obtained such as: decisions on what methods are used and how they are applied, which stakeholders take part and how long the project phase will last. However, the process flexibility may not alter the format in which the results are expected to be presented, for instance, by way of using commonly agreed units of analysis. Within the modules, which are conducted in parallel, it is possible to apply different tools and methods as long as the results are presented in a similar manner. This approach is illustrated by the Urban Europe case, where a pilot call is planned to collect additional intelligence on future trends and scenarios and support the construction of stakeholder communities and platforms. At the time of writing this paper only the expected outcomes have been defined, as well as criteria to assess potential call topics, such as providing input and insights for developing new concepts and providing input for research roadmaps. In turn, with the notion of 'result flexibility' we refer to leaving flexibility with regards to how the results are expected to be presented. Between the modules executed in sequence, it is possible to have both process and result flexibility, thus to make changes in overall design and objectives of the entire project (see Fig. 3).

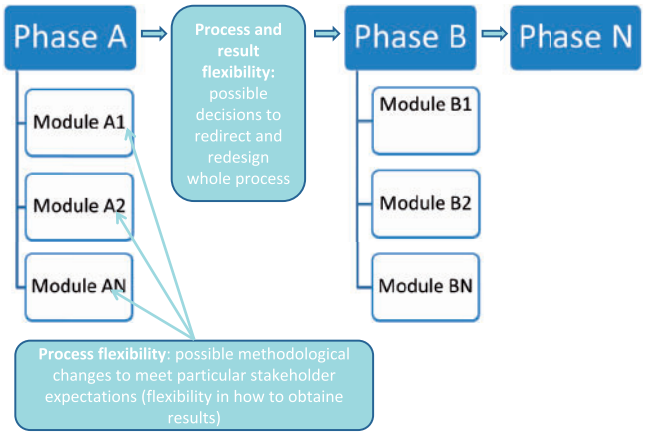

Figure 3. Process and result flexibility in modular foresight design for transnational research programming.

4.2 Foresight as an integrator

Transnational foresight activities may be seen to claim excessive resources and to be time consuming, hence be counter-productive by inhibiting the rapid and efficient implementation of transnational research programming. Hence, foresight can be seen as an integrator of other programming functions, which structures the engagement of stakeholders from different countries, sectors and disciplines and facilitates and speeds up the implementation (see Fig. 4).

Achieving the benefits of foresight activities in support of the implementation of other programming functions is related to the appropriate positioning of foresight design and management in the overall programming process. In this respect we have identified four challenges which are apparent in the implementation of transnational research programming and the consequent roles for foresight.

- *Access to international pool of experts for transnational research programming*. The identification and engagement of experts is crucial for different programming functions, for instance scoping calls for wide stakeholder engagement from different disciplines for the sake of the legitimacy of the entire exercise; answering the calls is expected to mobilise numerous researchers; the reviewers should be selected internationally from among the best existing experts; and the evaluations of the projects, programmes and the instruments for transnational research programming should be conducted by those with the most appropriate expertise. Participatory foresight creates wider awareness on the programme and prepares stakeholders to participate in other functions. Towards this end foresight can facilitate access to and co-ordination of different networks and databases of experts and other stakeholders. The balanced engagement is subject to national differences, which calls for the identification of suitable interfaces at different levels of research and innovation systems

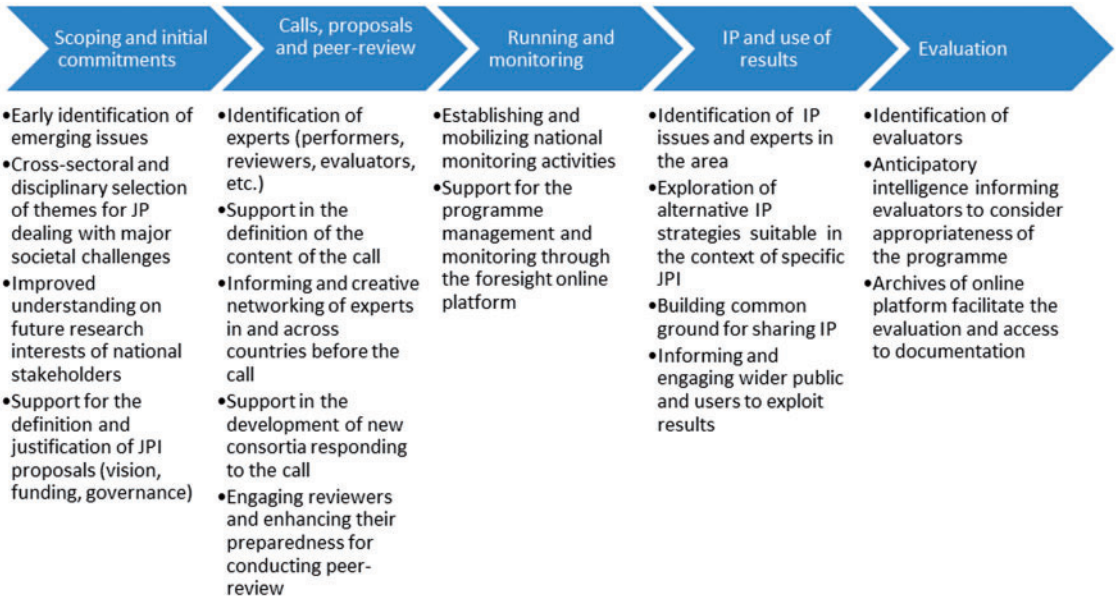

Figure 4. Foresight as an integrator of different functions of transnational research programming.

that can support the access to experts. Foresight extends the sector and discipline focused expert databases and thus provides opportunities to bring in new faces in incumbent collaborative networks, lowering the risk of simply involving the 'usual suspects' if one relies only on internal databases. Also the composition of the initial consortium may impact on the capacity to engage with wider networks. EMIDA ERA-NET faced difficulties engaging stakeholders from other disciplines, because of strong reliance on conventional databases used in the sector from consortium partners. In view of the cross-feeding and understanding of horizontal thematic inter-connections, it may also be useful to explore the development of common expert pools for different instruments for transnational research programming.

- *Access and accumulation of knowledge in support of transnational research programming*. Informed programming decisions necessitate the comprehensive examination of the wider context, building on diverse statistical and policy support databases and the plethora of documentation from different levels of research and innovation systems. In practice, such work faces major obstacles of fragmentation or even suffers from the lack of relevant information, whose use could be considered to be justified for decision-making. In such conditions, foresight processes can support the mapping of information sources and the development of joint knowledge repositories (see for instance the European Foresight Platform).[34] Furthermore, foresight plays particularly a relevant role in learning on future developments in the areas where there is little or no evidence-based record. By way of engaging stakeholders in the creation and codification of tacit knowledge (Nonaka 1994), foresight synthesises key findings for decision-makers from fragmented information and expert recommendations. Hence, foresight can play a significant role of interface and sense-making between diverse sources of information and the decision-makers.
- *Guidance for design and process management*. Transnational research programming faces difficulties in obtaining impartial and neutral process management support without favouring vested interests. This risk of partiality can be limited by introducing a foresight approach into the process. Considering the national differences in foresight capabilities and capacities, particular efforts in organising training[35] for possible national coordinators could enhance the overall quality and participation in transnational research programming, making use of existing initiatives such as the ForLearn Online Foresight Guide (European Commission 2012) or the UNIDO Technology foresight Guide (UNIDO 2012).
- *Availability of IT solutions for process implementation*. The transnational, efficient and effective engagement of numerous stakeholders may lead to time-consuming and resource-intensive processes. Therefore, it is crucial to explore different and complementary forms of engagement and novel process designs that can help overcome such challenges. Towards this end, the case studies in Section 3 and numerous other studies[36] show evidence of the benefits of applying internet-based solutions to obtain fast and cost-efficient stakeholder engagement. An optimal use of internet applications for stakeholder engagement and the exploitation of the information collected in order to implement and evaluate the programme seem to call for sharing best practices

in appropriate applications for the benefit of different types of transnational research programming.

The above-mentioned implementation challenges for transnational research programming and the respective roles of foresight activities can be seen from the viewpoints of an individual programming project, of an instrument, and of transnational research programming in general. All viewpoints are subject to similar types of co-ordination challenges. Against this backdrop, it is probably practical to explore how access to experts and the accumulation of foresight and other types of supporting knowledge through the shared repositories could benefit different types of activities in the realm of transnational research programming.

4.3 Implications for research programming in Europe and beyond

In Europe, one of the recent and most advanced efforts to move forward with transnational research programming has been Joint Programming (JP) in Research (European Commission 2008), a programme set up in connection with the Europe 2020 strategy (European Commission 2010b) and European Innovation Partnerships (European Commission 2010c). Despite the promising initiated pilots on JP, there is scarce managerial support on how foresight processes could be applied in JP so that it facilitates the overall JP process. EU Member States have approved a first version of evolving and voluntary framework conditions for joint programming (ERAC-GPC 2011), which serve as guidelines on how to implement a JP process and which also include a section on forward-looking activities (which is understood to include foresight and other forms of anticipatory intelligence). The above-presented three foresight principles in this section are particularly relevant for JP, as the JP instrument is based on variable geometry, voluntary participation and flexible implementation. The argument for using foresight as an integrator of transnational programming functions pleads for giving a more prominent role to forward-looking activities as an integrator of other framework conditions. Finally, the ways in which foresight can accommodate the four dimensions of the co-ordination challenge may offer a more systematic way for JP to address these dimensions, e.g. to systematically involve regional and local levels in JP.

The analysis and discussion may be of similar relevance to forms of transnational research programming between nations outside Europe, especially when a tradition is lacking in transnational collaboration, in applying participatory approaches and in working with longer-term planning, or when the research and innovation systems and capacities of the countries involved are highly diverse.

5. Conclusions

Recent efforts in transnational research programming indicate that the mobilising effect of embedded foresight activities can lead to novel networking and cross-feeding of research and innovation initiatives between the sectors, disciplines and different countries. However, such international engagements call for a structured and modular design to avoid endeavours that are time- and resource-intensive.

Among strong drivers for transnational research programming, the recent emphasis on pooling resources for finding innovative solutions to major societal challenges has created a strong impetus to overcome these barriers. However, the complexity and the mere scale of the processes required to engage the various stakeholders of research, industry, public administration and civil society in different levels of research innovation systems set a major managerial challenge—how to prepare, run and evaluate such activities in a effective, efficient and appropriate as well as transparent, open and inclusive manner. In order to address this co-ordination challenge we have specified and explored four dimensions and five functions of transnational research programming. Against this background we explored how foresight activities embedded in transnational research programming can support those dimensions and functions. This provided some evidence on a significant role for foresight in facilitating and integrating different functions of programming. However, this requires that foresight and the principles we have outlined are integrated into the overall design and management from the outset of the programming activities. Therefore, we suggest further research and piloting of general foresight principles and guidance for the efficient and flexible implementation of transnational research programming. Towards this end, the further piloting of the principles and roles for foresight in transnational research programming should be enhanced, as well as the general understanding of, and capacity in running, foresight projects through foresight training. Knowledge collected on pilots, methodologies and understanding of transnational research programming needs to be accumulated, calling for institutionalised forms of knowledge repositories.

While choosing the perspective of embedding foresight in transnational programming rather than providing *ad hoc* support, we run a risk of co-optation[37] of foresight and consequent constraints to develop radically new alternatives or particularly bold programmes in terms of scale and ambition. In this respect, particular design structures ensuring minimum autonomy in foresight activities and methodological choices (for instance, horizon scanning and generation of innovation ideas among a wide and diverse set of stakeholders) can alleviate the risk of co-optation, but need to be flexible for tailoring to case-specific contexts. Furthermore, the positioning of foresight

as an integrator of other programming functions can outweigh the risks and offer the opportunities to attain creative results faster with significant societal impacts. Finally, transnational programming in a non-European context may benefit even more from the capacity of foresight to act as an integrator, especially in cases where a culture of participation and of transnational research and innovation policy co-ordination is lacking.

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Notes

1. See Europe 2020 (European Commission 2010b) and the Europe 2020 Flagship Initiative Innovation Union (European Commission 2010c).
2. See, for instance, for the USA: A Strategy for American Innovation: Securing Our Economic Growth and Prosperity. <http://www.whitehouse.gov/innovation/strategy> accessed 15 March 2012.
3. For an analysis of the link between innovation strategies and economic performance, see Dahlman (2008).
4. The four steps used by ERA-Net (European Research Area-NET) are:
   - systematic exchange of information and good practices on existing programmes and activities
   - identification and analysis of common strategic issues
   - planning and development of joint activities between national and regional programmes
   - implementation of joint transnational activities, including joint calls and joint programmes

   Each step also relates to a typology of activities.
5. Based on Optimat et al. (2005), Anderson (2010), Chioncel and Cuntz (2012), European Commission (2011), Seiser (2010) and authors' own expertise.
6. An indicator of the culture of openness may be the past and present openness of research programmes to other nations. For example, ERAWATCH data show that two-thirds of 2009 national research programmes relevant for the Joint Programming Initiative on Agriculture, Food Security and Climate Change have no openness to other EU Member States.
7. Platforms collecting data on foresight exercises can offer deeper insights into possible and desired futures of research priorities, e.g. <www.foresight-platform.eu> accessed 15 March 2012.
8. The use of 'regional' in this paper is to be understood as 'geographically part of a nation', not as a 'grouping different nations'.
9. This platform aims at supporting the process for developing national/regional innovation strategies for smart specialisation that support the development of well-performing national or regional research and innovation systems, often supported by regional foresight. Such strategies also include the analysis of potential partners in other regions in order to avoid unnecessary duplication and fragmentation of efforts. <http://ipts.jrc.ec.europa.eu/activities/research-and-innovation/s3platform.cfm> accessed 15 March 2012.
10. ERAWATCH is a platform collecting data on national research systems in the ERA, including policy documents and research programmes.
11. NETWATCH collects data on transnational research collaboration in the ERA.
12. In Europe the following European and intergovernmental mechanisms are in place: the ERA-NET Scheme (ERA-NET Actions and ERA-NET Plus Actions), Article 185 Initiatives (old Art. 169), European Technology Platforms, Joint Technology Initiatives, Eureka, JP, the Open Method of Coordination, COST, KICs, European Innovation Partnerships. Thematic instruments are the Standing Committee on Agricultural Research (SCAR) in the field of agriculture, and European Industrial Initiatives and the European Energy Research Alliance in the field of energy.
13. For example: JTIs make use of Framework Programme 7 support services such as the IPR Helpdesk (<www.ipr-helpdesk.org> accessed 15 March 2012) and the Finance Helpdesk (<www.finance-helpdesk.org> accessed 15 March 2012).
14. External evaluation of the EIT (External Evaluation 2011).
15. Optimat et al. (2005) defines three types of dominant programme orientation strategies for national research systems in Europe: single framework programme, multiple generic programmes, and multiple thematic programmes.
16. Optmat (2005) defines three types of dominant funding organisations: multi agency/council/ministry, several agencies/councils, and single agency/council.
17. For example, 23.9% of EU gross expenditure on R&D is performed by the higher education sector, but with many national differences. In Luxembourg this is below 10%, while in Lithuania over 50% of gross expenditure on R&D is performed by this sector (calculations based on Eurostat data for 2009).
18. For example, in Belgium thematic choices for research in universities are left to the researchers themselves, the responsible governments focus on the quality of scientific research (Bruno and Van Til 2011).

19. Based on Optimat et al. (2005), Anderson (2010), Chioncel and Cuntz (2012), European Commission (2011), Seiser (2010) and the present authors' own expertise.
20. The case description is based on Brummer et al. (2008).
21. EMIDA ERA-NET stands for 'Coordination of European research on emerging and major infectious diseases of livestock'. The case description is based on EMIDA Description of Work (2009).
22. This initiative builds on the work of the SCAR.
23. Case description based on Urban Europe (2011).
24. The case description is based on Brummer et al. (2008).
25. Over 400 stakeholders from all participating countries participated in the process.
26. The assessment criteria for researcher's were: novelty, tentative researcher's interest and description how the researcher would like to contribute to future projects on the issue. The criteria for industry were: industrial relevance, possible time horizon for industrial use and need for collaboration at EU level.
27. Case description based on EMIDA Description of Work (2009).
28. To this end terms of reference (Ooms 2009) for its establishment have been drafted, which will be part of a wider collaboration agreement.
29. Case description based on Urban Europe (2011). The first experiences with practical implementation following this report may look somewhat different than described in this report. Within the timeframe of this paper it is, however, too early to draw any conclusions on possible discrepancies between planning and implementation of foresight activities in this case.
30. The four pillars are: economy, mobility, environment and ecology.
31. The UEF aims to establish a continuous dialogue between stakeholders and Urban Europe on strategic issues and to ensure a long-term integration of a large number of stakeholders in the implementation activities. It has potential to also identify additional research areas and is directly linked to the Management Board.
32. The exchange platform serves the utilisation of existing infrastructures, data and knowledge for linking various disciplines and for initiating new co-operations within the European research and innovation communities (with scientists from different disciplines and research areas, city representatives, companies and stakeholder organisations).
33. In the EMIDA ERA-NET some difficulties were encountered in engaging stakeholders from other disciplines, mainly because databases from consortium partners were used, and the consortium did not reflect all disciplines involved.
34. See <www.foresight-platform.eu> accessed 15 March 2012.
35. An example is the generic online foresight training, which has been developed as part of the European Foresight Platform, targeting policy-makers at different policy-levels.
36. A set of examples of internet-based tools allowing for integration of data of all sorts in future-oriented technology analysis can be found in Haegeman et al. (in press).
37. In particular, if the foresight function is tightly institutionalised, the established power structures and historical path dependencies related to routines and infrastructures may limit the ability of foresight activities to explore alternatives that differ strongly from current pathways.

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