



European sectoral innovation foresight: Identifying emerging cross-sectoral patterns and policy issues



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ABSTRACT

The research presented in this paper pursues two main goals. Empirically, it aims to explore sectoral futures at European level in a range of different sectors (automotive, construction, textile, KIBS, wholesale & retail), to identify cross-cutting patterns of sectoral change, and to highlight implications that these may raise for European innovation policy. In order to do this in a systematic manner, it also has a conceptual and methodological ambition, namely to devise a sectoral innovation foresight methodology that builds explicitly on concepts derived from sectoral innovation systems approaches. This theory-led methodology allows exploring and interpreting future developments at sectoral level in a coherent and comparable manner. Technologies and knowledge, actors and organisations, user needs and demand, as well as institutional and policy frameworks are taken into account; elements that need to co-evolve for any innovation system scenario to unfold. This conceptual framework is translated into a sector innovation foresight methodology that was used to guide a multi-sector foresight initiative. Based on a meta-analysis of insights from five different sectors, cross-sectoral patterns of future change as well as cross-cutting policy issues are pointed out. Three areas of cross-cutting changes have been identified: a) the shift from products to systems and services, b) blurring boundaries between sectors, and c) sectoral and cross-sectoral integration of sustainability demands, and the governance of interactions between sectors. Foresight projects at sectoral level have been conducted rarely as compared to technology-centered or societal-issue centered foresights or retrospective sectoral innovation system studies. By relying explicitly on a theoretical framework of sectoral innovation systems, this paper explores the potential of better linking innovation theory to policy- and strategy-oriented foresight.

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1. Introduction

A strategic turn has taken place in research and innovation (R&I) policy over the past years. Technology foresight is increasingly oriented towards socio-economic aspects, interdependencies, and towards innovation systems and its transitions. (Weber, 2012). This turn is characterised by a shift away from structure-centered approaches to R&I policy, aiming to foster innovation performance per se as a main driver of competitiveness, and towards prioritisation of R&I societal challenges and generic technologies.

Particular attention was paid to fostering societal demand side aspects in the governance of science, technology and innovation (Edler and Georghiou, 2007). Arising first in programmatic manifestations (Declaration, 2009) and extending to wider processes in innovation policy, the result is a proliferating variety of new approaches, processes, and instruments (Cagnin et al., 2012; Georghiou and Harper, 2011;

Haegeman et al., 2012; Marinelli et al., 2014). Beyond the EU, the need for a broader understanding of innovation for societal demands is also reflected in concepts such as green economy (Gibbs and O'Neill, 2015), social innovation (Shier and Handy, 2015), and in the 2030 United Nations Agenda for Sustainable Development (Sustainable Development Goals).¹

This strategic turn also implies that it is not sufficient any more derive the rationales for R&I policy from a deficit model, i.e. by drawing on the identification of perceived deficits in the conditions and practices of research and innovation in order to legitimize policy action. Instead, a forward-looking approach is needed to address in a pro-active way the challenges and opportunities that are likely to arise in a faster than ever changing future (European Forum on Forward Looking Activities (EFFLA), 2012), often referred to as 'foresight'.

This changing policy context had an influence on the way foresight is conceived and embedded in policy making. From the initial focus on technology foresight, we have moved a long way towards a much

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¹ http://www.un.org/ga/search/view_doc.asp?symbol=A/69/L.85&Lang=E.

stronger emphasis on societal aspects, from a linear understanding of how science and technology exert an influence on society and economy towards a systemic one, and from traditional expert based advice to engagement with stakeholders and embedding in policy making processes.² More differentiated foresight approaches have been introduced, starting with national exercises to regional, sectoral or sectoral ones.

This broadening scope of foresight not only mirrors a strategic shift in policy interest but also a change in the understanding of innovation. Despite cross-disciplinary differences, recent attempts to conceptualize innovation dynamics paint a remarkably congruent picture. Early linear notions of technological development are giving way to more complex, dynamic pictures of systems of research and innovation (Cagnin et al., 2012; Hekkert et al., 2007; Markard and Truffer, 2008; Sharif, 2006; Weber and Rohracher, 2012).

Early attempts of establishing foresight for research policy already stressed the systemic nature of research and innovation (Martin and Johnston, 1999), but they were bound by the – then – dominant focus on national innovation system boundaries. The subsequent evolution of foresight as inspired by a more differentiated understanding of innovation has led to an equally differentiated spectrum of foresight approaches and methods. More recently, the importance of taking the systemic nature of innovation seriously in foresight has been re-emphasized foresight by Andersen and Andersen (Andersen and Andersen, 2014), and in particular in the context of sectoral innovation foresight.

However, two limitations still remain. First, while the initial starting point of foresight from a territorial angle (national, regional) and with a technological focus has been relaxed over the past years, the differences in innovation dynamics across different sectors have not been fully embraced by the foresight community yet. These differences, however, matter for anticipating future developments and thus for policy.

Secondly, there is gap between foresight and innovation theory (Andersen and Andersen), in spite of early references interpretations of foresight as a means to “rewire the innovation system” (Martin and Johnston, 1999). Such a sound theoretical foundation is important if the ambition is to look beyond individual sectors and technologies. As innovation is a practice that involves different actors, and as innovation dynamics differ across sectors, exploring future perspectives on general innovation patterns needs to be rooted in the specific sectoral dynamics but at the same time allow to identify cross-sectoral patterns. One recent example to monitor such related innovation processes is the observatory of Key Enabling Technologies (KETs). KETs are seen as providing the basis for innovation in a wide range of products and processes across all industrial sectors (emerging and traditional), and are essential to solving Europe's major societal challenges (Van de Velde et al., 2015). In spite of these technological and sectoral differences, common policies need to be devised that take into account cross-cutting emerging patterns.

Against this backdrop our main ambition is to move towards a theory-based approach to a sectorally differentiated foresight, and thus allowing to compare sectoral foresights and draw lessons with regard to the anticipation of cross-sectoral future developments.

The common theoretical (and not just methodological) basis should allow for comparative and integrative perspective on (cross-)sectoral dynamics. In this regard, we draw on the concept of sectoral systems of innovation and production (SSIP) (Malerba, 2002, 2004, 2005) which provides a multidimensional, integrated and dynamic view of how and why sectoral innovation systems change. In line with other innovation systems approaches, emphasis is put in the SSIP framework on the role of different types of actors and institutions in shaping innovation, but also on the influence of the demand side of innovation, the

specificities of the sectoral knowledge base and the co-evolutionary dynamics linking these elements to each other.

With this paper, we want to show the benefits of a sound theoretical foundation by looking at cross-sectoral dynamics.

The objectives of the paper are thus

- To develop theoretical underpinnings of sectoral innovation foresight, based on Malerba's initial work and subsequent refinements by other authors;
- To propose an approach and methodology that builds explicitly on the sectoral innovation systems approach to systematically underpin the exploration of future developments in and across sectors;
- To illustrate the value added of the approach and methodology by showing how the interlinked dynamics identified in a multi-sector foresight study³ inspired by this theoretical and methodological underpinnings allows to identify and analyse cross-cutting future developments. Here, we look in particular at a) the shift from products to systems and services, b) sectoral and cross-sectoral integration of sustainability demands, and c) blurring boundaries between sectors and the governance of interactions between sectors.

In order to capture their respective specificities, findings from both industrial and service sectors are used, particular automotive (Leitner, 2010), textiles (Zahradnik et al., 2010), construction (Schartinger, 2010), retail and wholesale (Giesecke and Schaper-Rinkel, 2010), and knowledge-intensive business services (Dachs, 2010). With these sectors, examples of traditional (construction), innovative (automotive) and generic (textiles) industries are chosen, complemented by examples of innovative (KIBS) and seemingly traditional (wholesale and retail) services.

This paper is structured as follows. First, the conceptual underpinnings of the sectoral innovation foresight is outlined. Second, the methodological considerations on the implementation of sectoral innovation foresight is outlined. Third, an overview of the cross-cutting developments that result from the future exploration of individual sectors is given. Fourth, reflections on the results will be placed in the context of new developments in the area of STI policies. Finally, some conclusions are drawn on the policy implications raised by these cross-cutting developments. The hypotheses is that sectoral innovation foresight as key component to support the development of key enabling technologies and to direct innovation towards goals such as sustainability and coping with climate change adaptation.

2. Conceptual framework

Developed initially in the late 1980s in order to understand better why some nations are more competitive than others, the approach of National Innovation Systems proved both highly productive in scientific and highly influential in policy terms (Sharif, 2006). It stresses the interactive, non-linear nature of the innovation and the importance of institutional conditions to enable interaction and learning.

Initially focused on territorial, in particular national, system boundaries, a process of differentiation could be observed during the 1990s. A whole family of innovation systems approaches were developed to give justice to the regional, sectoral or technological specificities of innovation, thus putting the emphasis on the role of institutional settings at regional (Cooke, 2007), sectoral (Malerba, 2005), organisational (Hauschildt, 2004; Tidd and Bessant, 2013), and technological levels (Carlsson and Stankiewicz, 1991; Hekkert et al., 2007).

Sectoral Systems of Innovation and Production were suggested as a specific framework by Malerba in order to reflect not only the sectoral specificity of innovation activities and knowledge bases, but also the

³ The INNOVA Sectoral Innovation Foresight, a foresight on sectoral innovation challenges and opportunities, was conducted as part of the Sectoral Innovation Watch (SIW) project within the Europe INNOVA initiative between 2009 and 2011.

² See different generations of foresight as proposed, for instance by Harper (2013).

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