Automotive industry and blurring systemic borders: the role of regional policy measures

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Abstract: The management of cognitive, organisational and geographical interfaces is a major competitiveness challenge for the automotive industry. Market and network imperfections, like underinvestment in innovation, or finance and labour market suboptimalities, are notorious obstacles in this regard.

It is argued that the capacity of regional policies to help the industry overcome such failures will be critical for automotive localities to ride the wave of ongoing integration of IT components and functions into automotive conjoints.

This paper focuses on the policy actions that can be undertaken at regional level in dealing with blurring sectoral and technological borders to the automotive industry. After developing a conceptual framework for analysis, two empirical cases are reviewed. The primary research results stress the relevance of regional policy action in supporting automotive complexes to overcome market and network failures in order to marry IT and automotive realms more productively.

Keywords: R&D and innovation policies; regional economies; automotive industry; market and network failures.

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1 Introduction

As a consequence of geo-economical evolutions (delocalisation of production, rise and decline of different consumer markets), evolutions in industrial organisation (outsourcing, consolidation and oligopolisation in certain product segments) and of product conceptualisation (penetration of and need to master new materials and technologies, like IT, chemicals, mechatronics, fuel cells, new propulsion systems), the development and production of modern automotive products is increasingly turning into a multifarious affair (European Monitoring Centre on Change, 2004; Mercer/Fraunhofer Institute, 2005; MacNeill and Chanaron, 2005a, 2005b; Prognos, 2007). An increased awareness of the need to care for the environment and sustainable (mobility) development adds to this (Oltra and Saint-Jean, 2005; Rothenberg et al., 2005; European Commission, 2006; Jullien, 2007). A clear exponent of this is the increasing political and societal determination to come to more stringent CO_2-regulations. The reductions demanded by upcoming regulations are such that, without significant innovations, the automotive industry will not be able to meet them while at the same time accommodating future customer demands for comfort, vehicle size and performance (McKinsey&Company, 2009).

Against this background, the development and production of a car has become a more and more complex affair, requiring coordinated design and manufacturing that brings together inputs from a wide range of actors and sectors. In this setting, e.g., the electronics industry has become a crucial input provider. That is, both in terms of upgrading traditional car components (e.g., steering), broadening the functionalities that are integrated into motor vehicles (e.g., infotainment) and a complete rethinking of propulsion systems (e.g., hybrid-electric vehicles and plug-in hybrids).

The increased use of electronics, telematics and electrical drive systems has also brought along the entrance of new players into the automotive industry with importance for the design and manufacture of components and sub-systems, including the chassis (Reuters, 2008). This follows from the establishment that many of the new technologies penetrating the final car product are not mastered directly and solely by the companies that are responsible for delivering the final product to the market. This is both the case for OEMs like Renault, VW and FIAT and for 1st tier suppliers like TRW, Irausa and Faurecia.

Consequently, automotive value chains rely increasingly on the interaction and integration of multiple types of knowledge embedded in activities distributed across different organisations, locations and sectors (Hodges and Van Tulder, 1994; PriceWaterhouseCoopers, 2005; Little, 2005). Similarly, the automotive industry is turning into an industry of 'interfaces'. On the one hand, as regards the tapping into and management of different knowledge bases, which are broadening and acquire a more dynamic and fluid character. On the other hand, as regards putting organisational structures into place to manage the involved information, knowledge and technological flows (Lenfle and Midler, 2003; European Commission, 2007).

The management of these interfaces is a major challenge for automotive companies in their bid to gain competitive advantage and survive and grow in the market place. In fact, it can be argued that the extent with which automotive actors achieve a smooth integration of new technologies influences the success they will ultimately have in the industry's marketplace.

In terms of dealing with this panorama, rather than automotive OEMs attempting to master such technologies in-house (and or absorb relevant players) [1], the way forward is arguably to develop cooperative business models between 'traditional' automotive actors and those from adjacent fields of interest. At the same time, the significant profit margin divergence between suppliers of non-electronic components, which are becoming commoditised, and firms developing and delivering electromechanical systems, exerts an increasing pressure on traditional automotive component suppliers to gain skills in electronics and software (Lewin, 2006).

This outlook means that, more than ever, 'traditional' automotive actors will have to operate as system integrators and interfacing actors to secure an effective symbiosis of knowledge and technologies that are governed on either side of the boundaries of their own firms.

The policy measures that will be presented later on in this article both deal with supporting the development of IT and software technologies for automotive sector. With regard to these cases, there are divergent knowledge spheres, namely mechanical, electronics and software engineering. As the respective product cycles, development processes and paradigms differ between automotive and software products, constantly moving boundaries of interaction in terms of knowledge and relationships have to created and managed. Also, the final products to be developed require simultaneous use of tacit know-how from all three domains. A further issue is the increasing number of interfaces as the software and electronics content of vehicles rise and the value chain becomes more fragmented. These dynamics create a dependence on the knowledge and decisions of others. All this makes the management of knowledge and the development and deployment of cognitive capabilities a crucial assignment. The latter is a huge hurdle for traditional suppliers of mechanical automotive components, which often need to break out of certain path dependences. Without the right (lead) market indications and or

foresight of the supply actors as to what the market will demand, innovators can easily get trapped into market failures. The cases to be presented deal with policy support initiatives to back up such transition processes and also consider the geographical articulation of the networks that stem from such processes.

Although at the level of the focal automotive OEMs and of final product conception (and partly also for components and systems underpinning the final product) there is a preference to direct such integration processes from central places, e.g., from the premises of Renault's Technocentre (Guyancourt, France) or from Daimler Benz' headquarters (in the Stuttgart region, Germany), there may be room for more polycentric orchestration of the development of innovative automotive inputs. Given that, through outsourcing and penetration of new technologies and functionalities in cars, the conceiving and evolution of vehicles has obtained a more bottom-up character (meaning: fed by input providers rather than by the final integrators of cars and the fact that a power shift from mechanical, metal and plastics to electronics suppliers is underway), agglomeration advantages may also emerge in a more decentralised way. Especially, there where (new) automotive-relevant technological hotspots are or arise. This can be in spatially concentrated clusters where players from different, but inter-related, fields of technology relevant for new automotive products are located. And these hotspots need not coincide with (all) the automotive heartlands that traditionally rule the industry map in Europe. In addition, the sets of actors that make up the networks to bring forth new automotive technologies may have their focal point in a specific locality, but it is highly likely that it will not have a 'point mass spatial character'. Instead, it is more presumable to have an 'archipelago articulation' (Veltz, 1996), with an orchestrating core and links to multiple places. As such, the focal hubs act as directors and central interfaces of larger spatially spread networks, where experts interact, cooperate and compete in so-called 'epistemic communities' or 'communities of practice' (Håkanson, 2005; Gertler, 2003). Therefore, there are two geographical dimensions involved here. On the one hand, there are the spatial proximities between actors generated through co-locatedness of actors (Boschma, 2005; Tözün, 2009). On the other, there are the connections to outside/global communities of practice in order to stay abreast of sectoral developments: 'open innovation' (Chesbrough, 2003; Chesborugh et al., 2006). Evidently, to set up and manage such networks is far from easy; e.g., power imbalances, lack of trust and other network imperfections can lead to poor and inefficient interactions and inadequate coordination of actions.

In the remainder of this paper we focus on the question: which policy actions can be undertaken at regional level to establish localised knowledge and network structures to support the automotive industry to deal with blurring sectoral and technological borders? This question stems from the establishment that there are several regions that depend heavily on the automotive texture and, therefore, such regions have an interest in keeping this sector healthy on their turf (Kamp, 2008). In addition, the question follows from the assumption that the possibilities that economic actors have to prosper in industry settings (new standards, new technologies, new actors and new power balances between actors) are influenced by national as well as regional institutional arrangements: e.g., education, training and labour markets, industrial relations, managerial systems, capital markets, legal frameworks and policy involvement (Nelson and Winter, 1982) and cluster potential (Porter, 1990; Krugman, 1991; Saxenian, 1994; Florida, 1995, 2003, 2005; Morgan, 1997; Cooke and Morgan, 1998). Such institutional arrangements can act as 'selection

environments'[2], which influence the success with which the present actors achieve to position themselves in an industrial setting undergoing changes and (re) evolutions.

In line with the former, we argue that the cross-roads at which the automotive industry finds itself today raises the interest into looking whether and how regions attempt to lead the way in becoming a preferred selection environment.

Hereafter, we will first review conceptual literature on the motives for practising support policies vis-à-vis the automotive sector, notably in view of possible market and network failures that can obstruct innovations and further system transitions. Afterwards, we zoom in on two regional policy initiatives that aim to steer such transitions and prepare the local industry for tomorrow's automotive industry. Finally, we discuss implications from these cases and issue conclusions.

2 Rationales for policy intervention in the automotive industry

Policy makers can provide support measures to private market actors and or whole business industries for a series of reasons. Among the most important ones are the existence of: market failures – to overcome (semi)-structural and friction problems with regard to matching supply and demand for products and services to one another, network failures – to overcome a lack of or ineffective liaising activity or to establish missing nodes and links hampering the provisioning of certain goods and services, and conjunctural problems – actions to remediate consequences of declining sales or purchasing power via demand spurring initiatives or subsidies/tax breaks to the supply side – (Arrow, 1962; Carlsson and Jacobsson, 1994; Parsons, 1999; Oxera, 2005; Gustafsson and Autio, 2006).

Such market and network failures, as well as conjunctural problems, are especially harmful and undesirable – both economically and societally speaking – in case an industry requires profound changes. For such failures and problems will obstruct the sight on where to go best and the means on how to get there, in other words: to manage a transition.

We posit that the latter is applicable to the automotive industry in view of accommodating new environmental standards, safety requirements and mobility questions … and to further the 'marriage' of traditional automotive disciplines (propulsion, chassis, …) with new ones like IT, mechatronics, etc.

In the following, we will expand on the way such failures or imperfections can prevent the automotive industry from undergoing a transition[3]. As industry transitions can also be termed as "system innovations: organization exceeding, qualitative innovations, which are realized by a variety of participants within the system and which fundamentally change both the structure of the system and the relation among the participants" (Loorbach and Rotmans, 2006), we draw a parallel with how market and network failures prevent innovations and technological development from taking place effectively.

Furthermore, and following the bottom-up reasoning exposed in the introductory paragraph, we argue that (especially) at decentralised policy levels, relevant initiatives can be undertaken to lay the basis for effective interactions and the management of knowledge interfaces; i.e., through the creation of geographically articulated networks to blend 'separate' sectors and cope with blurring technological borders.

To prepare automotive businesses for blurring technological boundaries and notably by inspiring oneself on eventual market and network failures that may block (regional) automotive systems from seizing opportunities/preparing themselves in this regard, several (regional) policy responses are possible. To determine such possible responses, we will firstly review the failures that may be in play and the policy options that apply to them. Secondly, we will establish – based on a multiple case analysis of relevant policy initiatives from regional level:

- Which policy initiatives are encountered in the field?
- Which market failures do they attempt to tackle?
- How do they attempt to cope with blurring technological borders and with integrated functioning of complementary actors (create network economies)?
- How effective they are?

The cases we source from were selected based on purposive sampling. They were drawn from a good practice inventory on regional policy support initiatives with regard to the automotive industry as established for the INTERREG project 'Network of automotive regions' during 2006–2007. They concern policy initiatives from the Stuttgart region (CARS-IT) and Normandy-Ile de France (Mov'eo).

3 Market failures with regard to technological development

Advances in technological knowledge and applications follow from investments and cooperation in e.g., R&D and product architecture and design. According to the dominant (neoclassical) view in economic theory there may, however, be market imperfections or failures that obstruct optimal and effective advances in technological knowledge and applications.

In the following, we highlight failures on three relevant markets for technological development.

3.1 Failures in the R&D and innovation market

Consensus on the existence of market failures with regard to technological progress and innovation is based on Arrow's argument (1962) that if R&D activities are entirely left to the private market, it will soon lead to under-investments. The latter is arguably the consequence of the fact that private sector firms fail to recoup the full returns from their investments in R&D owing to difficulties in result-appropriations, even in spite of the existence of institutional mechanisms such as patenting that bestow (temporary) monopolies to technology generators and other kind of innovators.

Among others, market failures can lead to under-investments in innovations for the following reasons:

- Competing companies can often benefit from the R&D efforts of an innovator at no or low cost by absorbing new ideas into their own products and processes. In spite of patenting possibilities, 'knowledge spill-overs' can not always be prevented totally.

- Frequently, certain segments of the final beneficiaries of innovations (notably end users and consumers) pay less for new products than they would be willing to dispense if the firm who markets the innovation would apply a price differentiation policy in view of different customer segments and link the pricing policy to the purchasing power and valuation of the innovation on behalf of respective consumer groups. This hampers firms' possibilities to appropriate the complete value increase generated by their innovations as they often are unable to charge resp. consumer groups in function of the rent increase the innovation supposes to them ('rent spill-overs').
- In view of the uncertain prospects on returns on investments in innovation, the tendency to act opportunistically and risk aversive (Williamson, 1975, 1979, 1981) can take the overhand.
- The establishment that – especially small and medium-sized – enterprises are often not able to follow and keep up with all technological developments. They are often too small to set up and finance economically viable R&D on the level of the individual firm. Additional problems for firms can include a lack of technological capabilities and insufficient technology management.
- Imperfect price formation, notably through non-internalisation of external costs.
- Market domination by established actors, leading to mono/oligopolisation of markets and or abuse of dominant position by cartel formation or otherwise raising entry barriers to markets.

Empirical evidence in economic literature seems to confirm that social returns exceed private returns (Jones and Williams, 1998). Economists have attempted to capture this problem by computing the spillover gap. Available empirical estimates of the spillover gap indeed indicate that the desire to under-invest in R&D exists in free market economies, such as the US, Western Europe and Japan (Mani, 2002).

3.2 Failures in the financial market

Obviously, there is a cost to innovations and technological development and innovators do not always have the necessary cash for it, themselves. Consequently, they need to be able to turn to external funds to finance innovation activities. External funding reliance for innovation is especially pronounced among young, start-up and smaller firms. Obviously, also bigger and more established companies turn to third parties for (partly) funding innovation initiatives. As a consequence, well functioning financial markets are an important means to promote innovation activities. However, access to finance is not always assured and can be a major factor hampering innovation (Greene, 1998). As found by Casson (1995), an inappropriate financial system can put a serious mortgage on the generation of innovations even under good macro-economic circumstances. The former is arguably related to market failures based on information asymmetry resulting in 'adverse selection' of organisations in need of funding or picking winners behaviour and risk aversiveness (Casson, 1995; Shane, 1996).

Asymmetric information typically translates into situations where those organisations that are best able to promote and explain their innovation projects and prospects (that

way: overcoming information asymmetry or intelligence differences between the innovating entity looking for funds and the potential financier), are the ones that get funding most easily. In such circumstances 'most likely cases' of large, established companies with high visibility crowd out or reduce the finance potential for smaller and newer companies that suffer from less marketing power and limited verifiability of their projects ('less likely cases')[4].

As a consequence, differences in knowledge about the innovative product (i.e., the product or process innovation to be developed) between innovating firms and suppliers of finance, can result in promising R&D projects not being funded. As this kind of behaviour tends to favour established actors and the status quo, it may stall technology development and innovation in an industry.

3.3 Failures in the labour market

Innovation and technological development, no matter how much our society and businesses have become governed by computers and machines, remains a people's affair for which (teams of) persons remain a necessary ingredient. The functioning of labour markets is, therefore, central to recruiting and preparing the right personnel and composing the right teams.

A flexible labour market typically spurs innovation activity as highly skilled workers can be reallocated to those innovation projects that are expected to purport the highest returns. On the contrary, if there is an inadequate supply of highly skilled workers, this forms a market failure that can have a negative effect on innovation activity. Therefore, labour market rigidities can prevent innovating firms from attracting the right human resources or expand their work forces in function of market needs.

Innovative activity is also in need of workers that upgrade themselves on an ongoing basis. Here, are especially the more specific skills that matter, as well as hybrid education profiles that enable to cross bridges between sectors, business functions and specialisations. This is a different interpretation of specialised skills than the ones that are firm and function-specific. The latter, first of all, benefit the individual worker and his/her employer as it will increase the worker's productivity. Firms thus have an incentive to also invest in increasing the specific skills of their employees, but in an extreme version this leads to lock-ins, idiosyncrasy, obsolete knowledge and skills, and high switching costs for employees, as well as professions and firms as they become subject to a form of high asset specificity and low residual value when wanting to use the education ('asset') for alternative purposes (Williamson, 1975, 1979, 1981).

A region's or nation's labour market institutions often reflect the readiness and willingness towards flexibility and ability to cope with uncertainty and novelty. As such, they influence geographical entities' and industrial complexes' possibilities to prepare for and manage transitions.

4 Network failures with regard to technological development

Advances in technological knowledge and applications follow from investments and cooperation in e.g., R&D and product architecture and design. Next to market imperfections, there may also be network failures that hamper or obstruct technological

progress or a bridging between technological capacity under control of separate actors or networks. This can especially be a risk in sectors, like the automotive currently where new relationships need to be forged and new interfacing patterns in view of technological integration have to be constructed.

This is the thesis sustained by the institutional or systemic approach to economy (Alchian and Demsetz, 1972; Langlois, 1988; Axelsson and Easton, 1992; Nohria and Eccles, 1992; Grabher, 1993; Langlois and Robertson, 1995), which emphasises the interactive dimension to innovations and looks into innovation networks and the interactions among players (organisations) and rules (institutions) that constitute these networks. Within such networks, interactions can be sub-optimal due to structural, institutional and regulatory deficiencies (Gustafsson and Autio, 2006). Network failures, thus, refer to a lack of or ineffective patterns to undertake cross-over and integration activities among different sets of actors and knowledge.

In this regard, in today's industry (especially the automotive) where a lot is outsourced and – consequently – must be achieved in a network-wise way, R&D and innovation is less and less an individual affair. Instead, it is increasingly becoming a multi-party matter requiring inputs from multiple actors and fine-tuning between them. Therefore, the possibilities with which inter-organisational efforts can be coordinated and bundled in a synergetic way matter a lot. Especially since the complexity of many products calls for regular interactions between partners, the ability to articulate such interactions with partners is of growing relevance. The capacity of networks or systems to coordinate mutual and or related activities, therefore, gains in importance.

On the one hand, network failures can be a consequence of lacking nodes in the network (missing actors). If missing links exist, this can prevent competitive networks from coming into being (Oxera, 2005). On the other, and although individual actors may be performing efficiently, networks as such may be performing sub-optimally as a result of poor internal interactions or poor adjustment and streamlining of activities and responsibilities among actors (Carlsson et al., 2002). Notably a lack of actor interactions and functions bridging knowledge production and knowledge use can severely obstruct the creation of multi-faceted technological progress. Also if there is a lack of trust between related actors, network failures can occur (Sako, 1992; Nooteboom, 1996; Nooteboom et al., 1997). When innovations depend on network behaviour and performance, also risk averseness and an 'after you' posture (cfr. prisoners dilemma and tit-for-tat dynamics: Schelling, 1960; Axelrod, 1984) can prevent innovations from coming into being in an efficient way. Another source for network failure is the path dependence and lock-in of firms into prevailing technological and network systems (Grabher, 1993; Uzzi, 1997; Gustafsson and Autio, 2006). In these circumstances, firms find it difficult to break away from these systems and to pursue new knowledge or to establish new collaborations (Smith, 1997). Such lock-ins tend to become strengthened over time due to embeddedness processes (Grabher, 1993; Weick and Roberts, 1993) and can further be fortified by market failures à la imperfect information, high transaction costs and market power (Simon, 1957; Arrow, 1974; Williamson, 1981).[5]

In a similar vein, it appears that system or network failures are more likely to occur when the need for firms to interrelate for the project to succeed is large, when the sunk costs arising from a project are high, when a project bears high risk and when it is difficult for investors to value such risks (Oxera, 2005).

5 Regional policy activity with regard to technological transition management

Comparing the policy rationales on market and network failures, on the one hand, with the technological panorama the automotive industry is facing, on the other, it can be concluded that policy responses are legitimate. This is also the discourse followed by the European economic authorities, who have lately declared themselves in favour of preparing automotive actors for e.g., environmental technology changes, but against the support of 'lame ducks' in the industry.

Furthermore, if interaction is part of the solution, it means proximity (in the broadest sense of the term: social, geographical, technological …) and agglomeration become relevant variables as well. For it makes contact and coordination of competencies and knowledge between partners easier. Consequently, this implies that meso-economic policy levels have a role to play because the relational environment a region can offer is of vital importance for developing, attracting and retaining R&D activities. Therefore, measures and facilities that underpin multi-party innovation efforts and the interaction dimension at large around R&D (e.g., via technology, education, labour market and finance policies to underpin targeted sectors) is an area where regions can provide valuable support (Feldman, 1994; Audretsch, 1998; Audretsch and Feldman, 1996).

As industries are often regionally concentrated and there are regions that depend heavily on the automotive texture, such regions have an interest in keeping this sector healthy (Kamp, 2008). Therefore, cross-over and integration actions between sectoral disciplines on the regional level is appropriate and logical (Florida, 1995, 2003, 2005; Morgan, 1997; Cooke and Morgan, 1998; Antonelli, 2008). Moreover, shorter cultural and physical distances between actors within a regional setting provide a basis for a swift and proactive policy response and may, consequently, be extra indicated and effective (Becattini, 1992; Harrison, 1992).

In view of preparing the automotive industry for new technological watersheds, it can be argued, that while the contours of the industry are crossing traditional sector borders, it is necessary to adopt a holistic approach to 'transition management' that first of all employs a broad view on the automotive business; not as a sector, but as a system. Secondly, to prepare a (regional) automotive system correctly for upcoming changes it is necessary to incorporate – sustainable – future-oriented elements into the strategy formation of the actors. Such transition management aims to set vanguard agendas and create lead markets (Von Hippel, 1986; Beise and Cleff, 2004; Edler and Gheorghiou, 2007; Aschhoff and Sofka, 2009), which attract and gather frontrunners of and trendsetters for system innovations. Such transition management shelters elements of planning, through the participation of public entities, while at the same time it relies strongly on market forces to carry and implement the changes. Parallelly, it aims to provide direction to market dynamics that serve both commercial and societal goals (Kemp and Loorbach, 2005; Kemp et al., 2007).

In this regard, whereas ecological and sustainability issues with regard to the automotive industry have often been portrayed as impediments to economic growth, especially for those that act as prime movers, it can hold in store genuine growth opportunities for localities in terms of employment and industrial development (Jullien, 2007). Consider that technological innovations aiming to improve ecological sustainability can spur the creation of new products and employment. In a similar vein, such innovations can change the competences required in the development and

production of automobiles and cause a restructuring of value chains and automobile production regions. If traditional automobile regions prepare for an orientation towards e.g., ecological sustainability and mobility and corresponding technological capabilities, then they can develop a (temporary) competitive advantage over other localities.

Consequently, existing policy measures deserve a critical investigation as to how they deal with the fusion between sectoral disciplines on the regional level and the interfaces between them. Notably in terms of dealing with market and network failures in the context of transition management; preparing the automotive system for future-oriented and sustainable product directions that serve both business and society.

One way forward here is to analyse and valorise the available knowledge capacity in regions, the potential synergies across thematic borders and the creation of 'cross-sectoral knowledge pipelines'.

The remainder of the paper is devoted to analysing a set of empirical examples of policy actions that deal with automotive system transition management towards the inclusion of IT/electronics to come to more sustainable automotive products, concretely: CARS-IT and Mov'eo. In addition to conducting secondary analysis on written documents with regard to the policy actions concerned, information was collected through a semi-structured expert interview with an executive director of Mov'eo (in March 2009), discussions with members and employees of the Mov'eo initiative during a study-visit programme to the Normandy region (in June 2008)[6] and participatory observation in the CARS-IT initiative.

6 Empirical analysis

The present section gives a presentation of two regional initiatives from Germany and France that aim to overcome some of the aforementioned market and network failures at a regional level and provide guidance to transform and prepare the industrial texture in these regions for the future. To this end, first we introduce the reader to the basics of the policy initiative that is appraised. Secondly, we present some essentials of the regions' automotive texture. Thirdly, a diagnosis is forwarded with regard to problems the regional automotive complex is faced with. Finally, an analysis is presented on the policy initiative that is implemented.

6.1 CARS-IT initiative

CARS-IT is an initiative of the Economic Development Organization of the Stuttgart region ('Wirtschaftsförderung Region Stuttgart': WRS) in Germany. It forms an integral part of WRS' cluster support initiative for the automotive industry: 'Clusterinitiative Automotive Region Stuttgart (CARS)'. At the time of writing, the initiative CARS-IT is financed publicly with regional funds. It aims to extend the activities in the automotive domain and bridge them with IT-related activities in the region that WRS also attempts to leverage.

The region consists of the city of Stuttgart and its five neighbouring districts and has a population of around 2.7 million in an area of 3,700 km². As a mezzanine governance level between the administrative districts and the federal state, the Stuttgart region has its own elected assembly and a unit of coordination (Stuttgart Regional Association – 'Verband Region Stuttgart').

Over 200 firms that have a clear automotive vocation and with further enterprises from different sectors deliver complementary inputs to automotive value chains in the Stuttgart region (Tözün, 2009). It clearly displays a dense concentration of automotive-oriented business activity, to the rate that nearly half of the regional domestic product results from automotive sector (IMU and IAW, 2007). Stuttgart region and its surroundings are historically connected to automotive and various big name automotive firms are embedded here with their headquarters, R&D and manufacturing operations; e.g., Daimler, Porsche, Bosch, Mahle, Behr and Mann+Hummel. The total direct employment of the industry is over 130,000 persons and this number reportedly rises to over 200,000 when firms that are only partly devoted to automotive activity are also included (ibid).[7] Numerous engineering firms with varying degrees on automotive business are also present in the region and cover a broad scope from tool design to complete system development. The R&D investments and patent production figures per capita in the region are among the highest in Germany, and a large portion of both indicators can be traced back to the automotive sector (IMU and IAW, 2007; Altvater-Mackensen et al., 2005).

Following a deep crisis in early 90s, the regional automotive sector set out to turn around its fortunes by transforming its operational and strategic practices. However, many regional enterprises are still overly focused on the development and manufacturing of mechanical engineering components and systems. The ensuing technological transformation of automotive products creates inevitable questions about the future of the traditional supplier base in the region. Several challenges are also at play when it comes to the region's IT and software enterprises. Since they have an obvious potential to add value to the automotive business activities in the region, but they have not yet displayed their full potential in terms of automotive-oriented software development and services.

A first regional challenge is, therefore, the creation of the necessary supplier base so the automotive industry can exploit and ride the technological wave it has ahead of it. In principle, firms in the 'new' automotive-IT domain can come from two reservoirs: from among the existing mechanical-engineering-oriented automotive suppliers and from IT firms that increase their focus on automotive-oriented solutions. For both cases, it goes that risk aversion of actors may form an important barrier to step into a new domain and assume the costs of the accompanying knowledge acquisition. This is especially a serious issue for SMEs, which have limited managerial, R&D and financial resources at their disposal. The former subscribes to the failure that conceptual literature hypothesises on markets for R&D and technology development; i.e., it holds firms back in practice from investing in and acquiring technological and business know-how to move into a new product avenue.

A second challenge is to help regional actors to remain 'in the loop' of knowledge flow that enables them to receive and stay up to date with relevant technological developments and business news in a timely fashion (cfr. tackle the inability of SMEs to keep up with the latest in each field). Such news is neither a traded commodity nor is it available to those outside certain 'communities of practice', and networks of individuals accommodate and stimulate these flows. In such networks, members develop cognitive, social and to a limited extent also organisational proximities, which allow them to communicate and cooperate (Boschma, 2005; Torre and Rallet, 2005). There are smaller networks in the Stuttgart region through commercial transactions and supply relations, which often focus on narrowly defined areas of technological specialisation. An established network that encompasses all actors and issues in automotive-IT field is yet to

materialise. Therefore, towards the considerable community of regional actors that is not yet active at the automotive crossroads (but has potential to get there) there is a clear information shortage to overcome and to facilitate an integration of IT and automotive spheres. In addition, there is a need for community creation and structuring to unlock know-flows between both business worlds and to link the technological capacity under control of separate actors and networks. That way, missing links can be eliminated, and network completion and effective patterns to undertake cross-over and integration activities among different sets of actors and knowledge can take shape.

The third challenge is related to the availability and flow of adequate human resources and imperfections on the labour market preventing and obstructing this. In this regard, there is a need to train cross-skilled individuals; either by training professionals with a background in designing mechanical systems in IT and electronics, or by broadening the automotive skills and propensity of development engineers from the IT and software realm. To this end, the provision of cross-over vocational training tools and services to prepare professionals with the right skills and profile, and an effective system to mobilise and allocate human resources to innovative projects, are of paramount importance.

The above listed challenges correspond to several of the failures discussed in the theoretical section. A central issue is the lack of network nodes that can stretch across the automotive and IT actor landscapes. This leads to restricted networks and eventually impedes the development of new (cross-over) knowledge systems and industrial domains. In this regard, the region counts with few initial deficiencies, like: a lack of lead firms, large gaps in value chains, lack of university programs and alike. However, as the region is highly endowed with firms, infrastructure, actors and heritage, there is in fact a risk of cognitive and organisational lock-ins that may prevent the region from maximising the benefits it can source from a better integration of the existing regional automotive and IT potential. Furthermore, for actors that are yet to enter the automotive-IT domain, there is a perceived gap between the costs of required knowledge acquisition and the potential returns from such investments, which embodies an entry barrier for these actors. This entry barrier becomes higher in case actors engage in activities with patenting and IP difficulties – like design and other service activities, which make rent appropriation a more complex matter. This kind of stalemates should also be overcome in order for the region to valorise its opportunities to stay a leading region for next generation automotive inputs. For this purpose, important elements are the exchanges of knowledge on technological and market developments with peers and customers. They help enterprises to get a better appraisal of potential returns from R&D investments in new areas of activity. And on that basis they are better able to evaluate their market positioning and their investment strategies. Ultimately, it is expected that the support rendered through CARS-IT will allow them to move into more vanguard activities and products.

Therefore, the CARS-IT initiative puts strong emphasis on improving communication interfaces between firms and sectors from the automotive and the IT realm, and by stimulating an improved coordination of activities among regional actors. In practice, the initiative is rich in networking events, knowledge and technology agenda sharing activities, and peer/partner/supplier scanning. Through this, CARS-IT aims to improve the vertical and horizontal communication channels in the region and thereby assist in the formation of technology agendas between and across actors. The improved communication channels shall enable Stuttgart to exploit spatial proximity between

relevant actors in a better way and enable the region in anticipating the structural changes that the automotive cluster is expected to go through in the next decade.

In a similar vein, the initiative aims

a to function as a regional communication platform that catalyses 'the local buzz' and builds 'pipelines' to supra-regional knowledge

b to avoid negative path dependencies (Bathelt et al., 2004; Tözün, 2008).

To this end, CARS-IT provides an open and loosely structured network of actors across disciplines and sectors that thrive on both intra- and supra-regional links.

In order to address labour market failures and human resources issues, the initiative cooperates with regional institutions and with supra-regional sectoral networks. These cooperation activities serve several purposes. On the one hand, they stimulate pre-emptive responses on the side of education and training institutions through frequent contacts with industry; notably the formation of intersectoral study-programs and to develop cross-skilled human resources. On the other hand, they anchor specialised expert communities and the formation of regional know-how transfer processes on critical topics like software process quality. An additional challenge is to overcome problems on the training supply side, in the form of the availability and quality of training providers. Therefore, in the Stuttgart region, much emphasis is placed on 'training-the-training' schemes and on continuously upgrading the palette of training services in automotive-IT field.

In conclusion, the CARS-IT work programme is important for the Stuttgart region, as it seeks to fill eventual gaps in the automotive-IT cluster fabric of the region and the market and network failures that relate to it. In general terms, the region does not have important deficits with regards to business, research, academic and public actors. However, in the current era of technological evolutions in the automotive industry, it is crucial for the region to benefit from vivid regional communication between relevant actors and align their capacities in a future-oriented way.

6.2 Mov'eo

The ways in which Mov'eo is structured and financed, as well as the activities it encompasses, are fairly different from the CARS-IT initiative. To begin with, the Mov'eo activities are organised around research-oriented projects in four main automotive areas: energy and environment, road safety, mobility and mechatronics. In all of these areas, IT is a dominant topic and cross-sectoral thinking and acting with software actors is a prerequisite, therefore in terms of funding and structure, Mov'eo is one of the over 70 clusters (or 'poles de competitivité') in France. These were created in their majority as a response to the French government's strategy in 2004–2005 to provide emerging sectors, mature sectors and clusters (the latter term applies in case sectoral conjoints have a spatially concentrated articulation) with targeted (public) R&D support and promote innovation, partnerships and joint R&D projects (DGE, 2008). For this purpose, a specific inter-ministerial fund was created for eligible clusters. Clusters that would be able to tap into this dedicated fund were selected after a national call for proposals in view of the establishment of so-called 'poles de competitivité', which were assigned on the basis of sector-independent and competitive selection processes.

Governance-wise and budget-wise, Mov'eo operates on a membership-based structure, with a board, an executive board, territorial and operational committees, and over 230 members, which all pay annual fees. Some 30% of the members are large enterprises, about 35% are SMEs, approximately 20% are R&D institutions and public labs, and the remainder is national and regional level public authorities. The fees from members constitute about 50% of the operational financing of Mov'eo and the rest comes from different regional and national public funds (Hurard, 2008). The most crucial ones are the dedicated funds for cluster support (FUI, a joint pool created by different national ministries), support from the National Agency for Advanced Research, and from the SME-oriented innovation agency OSEO (through credits rather than funds).

The Mov'eo activities are implemented in three northern regions in France: Lower-Normandy, Upper-Normandy and Ile-de-France. This area covers 41,919 km² and has a population of almost 15 million persons. Opposite to the Stuttgart case, these three regions form three administratively independent units.

Similar to the Stuttgart region, this geographical area is also historically rich in automotive companies, hosting central operations of the two main French OEMs (Renault and PSA group) and numerous French and international Tier 1 suppliers, like Valeo, Faurecia, Bosch, and Magnetti Marelli. Some 700 firms are reportedly active in the automotive industry in this area, with a total employment of over 200,000 persons.

The regional diagnosis in terms of R&D, labour market and b2b relationships imperfections resembles that of the Stuttgart region and, therefore, the market failures for Mov'eo to tackle are quite similar. A difference in the regional setting in Northern France – compared to the Stuttgart region – is that the local automotive texture suffers from a comparatively higher competitive pressure from low cost locations. This is mainly due to the less high end market positioning of the products that local automotive companies focus on. Therefore, and even more than in the Stuttgart case, climbing up the innovation ladder and embracing and developing future-oriented technologies is a challenge for the regional automotive sector; i.e., in order to move into higher added value product groups, break out of market segments in which cost competitiveness can not be sustained in the long run, and to prevent an overall loss of activities (Hurard, 2008).

Aware of the imposing technological challenges facing the automotive industry; OEMs, large suppliers and regional authorities from Normandy and Ile-de-France developed a cluster support structure. This formed the basis for the Mov'eo initiative, which – besides stimulating R&D efforts – also addresses the under-representation of SMEs in publicly co-financed cooperative R&D projects. As such, Mov'eo tackles several market imperfections that arrest technological change. Like intransparency for SMEs of and access to financial markets to stimulate innovations and technology development, adverse selection processes on behalf of the funders, and domination of the demand side for finance on behalf of big players.

The private sector played an important role in the creation of Mov'eo, and although regional authorities today play key roles in the initiative, the market driven character remains strongly present. Mov'eo is strongly supported by the OEMs, Tier 1 suppliers, and SMEs. The latter group has witnessed a considerable increase in the influence and input into Mov'eo research projects and its overall strategic direction. Whereas in the beginning of the Mov'eo initiative, large firms were more influential on the content of projects; today, certain R&D projects are led by SMEs, whereas large enterprises and research organisations follow. They have also become more active in preparing and

introducing research proposals. This hints at the capacity building leap several of the participating SMEs have undergone through Mov'eo. In a similar vein, Mov'eo has helped actors – that would typically under-invest in innovation and technology – to show a stronger propensity to take the lead in research assignments, to be less afraid of knowledge spill-overs from their initiatives to others, and also to bet on new market domains. Mov'eo has also helped SMEs to deal in a more formal and professional way with intellectual property rights. That way it also secures that fear to innovate diminishes as well as risk aversion towards knowledge creation decreases; i.e., as companies learn how to protect proprietary knowledge and to recoup returns on investments undertaken in R&D, the risk of under-investment in technology also reduces.

Precisely by integrating SMEs as much as possible in cluster and sector-spanning activities and technology development that overarch their individual capacities and scope, SMEs get insights in the direction where their customers and the overall market is heading. Also, they build up capacities in technology and project management beyond their own techn(olog)ical knowledge and skill base. This also prepares them to venture into new (hybrid) product and market directions into which they would prior not have the courage and or vision to step into. The working in multi-party (public-private) settings also serves to build stronger regional networks. And eventual power imbalances in such networks are countered by the Mov'eo initiative through the involvement of public actors, which undertake network moderation, and by capacity building on behalf of SMEs. In addition, it does so by applying distinct compensation rules. For their participation in R&D projects, large firms get a 25% of their project-related costs refunded, whereas SMEs get 45% reimbursed. This substantial allowance, especially for SMEs, incites and ensures commitment of the involved enterprises and overcomes the market failure of under-investment when leaving technology completely to the market.

7 Discussion and implications

In addition to the already highlighted parallels and differences between both policy initiatives while presenting the Mov'eo case (see supra), the following observations are in place.

The CARS-IT initiative and the Mov'eo initiative address similar market and network failures and aim at comparable ends. Also, both locations possess comparably rich capacities in terms of existing enterprises (e.g., hosting of significant OEMs and suppliers), research centres and public institutions. However, they rely on completely different institutional and financial resources and, as a consequence, implement different strategies and programmes. In Stuttgart's case, WRS acts on its own capacity as a regional agency to improve the regional communication between relevant stakeholders and preparing them for a higher IT content in their automotive products. As such, CARS-IT is a grassroots level initiative, which is also keen to cooperate in a bottom-up fashion with supra-regional actors and networks to maximise its effect. In comparison, Mov'eo is an outcome of a top-down initiated national strategy that aims to support innovation performance in France by supporting regional actions that mobilise local SMEs that are susceptible to improve their innovation capacity. In a way, Mov'eo acts as the interface of national and regional strategies. From the national side, this not only refers to the policy makers, but also to large automotive enterprises, like Renault, PSA and Faurecia, who act as national champions. The differences between these initiatives

partly follow from the differences between Germany and France in terms of their governance structures, where Germany has a traditionally decentralised structure, as compared to Paris-led governance practices of France. Mov'eo can be seen as minor part of a larger agenda, where France seeks to shift more involvement and activity to decentralised regional structures. At the same time, CARS-IT is financed and implemented with regional decisions and resources.

In line with the former, there are also differences in the organisational basis of the initiatives. While CARS-IT operates on an open and loosely connected network, Mov'eo has a fairly structured organisational structure. In the case of Mov'eo; both its strategic targets, the highly competitive nature of national cluster financing scheme and the complicated nature of R&D projects (IP management being one of the complex issues), incites a stronger formalisation of operations to achieve success and ensure longevity of the initiative. In a way, Mov'eo goes one step further in solving market failures. Not only does it help the transformation of network interactions into concrete projects, but it also builds a stronger level of trust based on its more elaborate organisational structures. For the contractual basis of cooperation projects and the moderation function of public actors are more effective tools in providing actors with trust that they would appropriate the financial returns of their investments in innovation activity.

On the other hand, the more open nature of CARS-IT offers a potential comparative advantage in accommodating incoming – sometimes self-developed – flows of knowledge from outside the region.

In terms of content, the Mov'eo initiative resembles the CARS-IT initiative. Nonetheless, it puts a stronger emphasis on R&D and on fulfilling an information and intelligence function and boosting network creation. It is clear that in the German case, the lack of a dedicated and substantial public support mechanism for regional funding of R&D projects restricts CARS-IT initiative in its possibilities to provoke a direct technology push.

The above implies that the capacity of region to deal effectively with especially market failures is not only a matter of magnitude of the failure and of the region. In addition, it also depends on the institutional context in which a region is embedded; i.e., the level of federalisation and (de)centralisation of powers in (European) countries with regard to all kinds of policy domains and the budgetary, planning and programming means that follow from that (OECD, 1999).

For the rest, when looking at the cases by means of the rationales and conceptual constructs presented exposed beforehand, it is clear that they fit the former quite well. At face value, the predictive validity of these constructs appears to be considerable, therefore. Similarly, the empirical analyses provide additional support to the theoretical claims presented beforehand in a qualitative manner. Of course, the initiatives screened do not render more than casuistic support to the theoretical claims analysed up front. In the Stuttgart and Normandy-Ile de France cases these constructs and rationales can indeed be recognised as a leitmotif for their policy design. This goes both for there aims to deal with individual market and network failures (Oxera, 2005; Gustafson and Autio, 2006), as well as in trying to come up with a more holistic approach to transition management via the creation of new communities and exploring future technology and industrial avenues (Kemp and Loorbach, 2005; Edler and Gheorgiou, 2007). It remains to be seen, however, whether similar policy initiatives elsewhere also fit with the conceptual constructs presented in this paper. A clear limit to the outcome of this multiple case analysis is, consequently, the lack of generalisability of the obtained findings.

All in all, the reviewed initiatives underpin the relevance and added value of public support in preparing 'automotive-apt' companies for technological evolutions in the sector and to build bridges between separate, yet related, industrial specialisations. Both CARS-IT and Mov'eo subscribe to the need for more pro-active responses to connect the automotive industry and IT/electronics sectors at regional level. An important recommendation is, therefore, to gear regional policy practices more strongly towards valorising technology networks that overarch traditional sectors. At the same time, it also has to be acknowledged that such initiatives should not pretend to be able a fortiori to nurture or create whole niche industries within compact regional territories (like electronic propulsion applications). Rather than being a panacea or a recipe for planned revolutions, they should be seen as policy tools for continuous improvement of the industrial bases of regions.

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Notes

1 Such internalisations would imply coming back on the core business philosophy that most automotive OEMs have followed in the car industry during the past two decades, with subsequent outsourcing of specialised R&D and production of inputs to premium suppliers.

2 Referring to actors present in a locality, the interrelations among them, the way they operate together and the adequacy with which regional institutions prepare and support (market) actors for changes and transitions an industry is submitted to. See e.g., Nelson and Winter (1982), Nelson (1993) and Lundvall (1988, 1992).

3 Also the conjunctural context poses a problem for the development of new links that need to be forged, but rather than the root cause behind obstaculising the absorption of and integration with knowledge bases and actors that traditionally lie outside the boundaries of the automotive sector, this is a force that adds up to the existence of market and network imperfections to justify policy interventions.

Also take note that insufficient or ineffective interaction between private actors ('network failures') is often the result of imperfect information, high transaction costs and market power, in short of market failures; to illustrate also the interdependence between market and network failures, on the one hand, and their mutual impact on (obstaculising) paradigm shifts.

4 The emergence of venture capital markets have brought substantial counterweight to this situation, but the current credit crunch (anno 2008–2009) has taken out a large share of the finance oxygen this market segment offered for more disruptive innovation and newcomer companies. In fact, the financial crisis has also led to a situation in which large shares of risk capital are hold up in previous investments that need more time than originally foreseen to deliver return on investments (if that, because several of such investments may have to be written entirely).

5 Concentration of market power, which leads to economic imperfections as it obstructs the functioning of the market mechanism, has also been termed 'strategic failure' (Bailey et al., 1999). Strategic failure refers in particular to the situation in which the strategic objectives and decisions of those who exert strongest market power conflict with the wider interests in society (Cowling and Sugden, 1994).

6 This visit was organised under the European Commission – supported project BeLCAR.

7 Nowak, *Stuttgarter Zeitung*, 4 April 2009.

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