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Changing from within: the interplay between imaginary, culture and innovation system in regional transformation

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Abstract:

This paper investigates how leading industrial regions may maintain their leadership positions when being confronted with deep and radical transformations of their core industries. Focusing on the evolution of the German automotive sector in Baden-Württemberg over the past two decades, we introduce a theoretical framework for a layered regional architecture that weaves together regional imaginaries, innovation culture, and system change processes. We argue that in response to disruptive threats, active engagement with regional imaginaries becomes essential. The paper critiques conventional approaches in regional innovation policy for overlooking the critical role of the region's intangible facets as vantage points for policy intervention. Hence, it champions a strategy centered on actively shaping regional imaginaries while concurrently fostering the necessary cultural and tangible system transformations.

Keywords: regional transformation, leading industrial regions; regional imaginaries; regional innovation culture; regional innovation system

1 Introduction

Regions today are confronting many complex challenges such as climate change and technological disruptions which motivate radical changes in technologies, products, user behaviours and institutional settings – so called socio-technical transitions. Trends such as digital and green transitions (Bachtrögler-Unger et al., 2023), and servitization of the manufacturing industries (De Propriis & Storain, 2019) are increasingly put under the policy and academic spotlight. Given this context, there is a renewed interest in place-based industrial policies and in the role of the state to coordinate such transformative processes (Foray et al., 2009; Mazzucato, 2013; Schot and Steinmueller 2018). Yet, it is still up to debate whether established conceptual and policy frameworks are sufficient to guide the way through these transformations.

In the present paper, we focus on how leading regions in specific industrial sectors may maintain their leadership positions when being confronted with deep and radical transformations of their core industries. This is quite an unusual situation for much of recent evolutionary economic geography research, which assumes that successful regions are normally at the forefront of technological innovation (Bachtrögler-Unger et al., 2023; Rodríguez-Pose and Bartalucci, 2023). Grand challenges induced radical shifts instead may jeopardize established geographical leadership structures. In a longer-term perspective, the phenomenon is however not new; historically leading regions have descended into stagnation as observed in many of the so-called ‘old industrial areas’ (Hudson, 2005) or had to undergo fundamental transformations, losing their predominant global market position (Glasmeier, 1991). The guiding question is hence, what it will take to navigate the tumultuous waters of global transitions to retain, if not enhance, those regions’ competitive edge?

These types of transformation processes challenge leading regions in fundamental ways and therefore require them to not only transform the tangible resource base such as educational structures, policy strategies, and labour markets, but also intangible resources such as regional identities, visions and cultural vitality to ensure continued economic and social prosperity (Pfothenauer et al., 2023). A historical case in point, was the Quartz revolution in the global watch industry in the 1970s (Glasmeier, 1991). The rise of cheap, accurate quartz watches primarily from Japan challenged the traditional mechanical watch industry in Switzerland. The regional identity of Geneva, for instance, as a global watchmaking center, has evolved significantly over time, reflecting broader changes in technology, market demands, and global economic dynamics (Jeannerat and Crevoisier, 2011). A more recent example, and which will serve as the empirical case for our analysis, is the electrification of the automotive drive-train, which was developed and scaled by outsiders like Tesla or the Chinese car manufacturers and which threatens the leadership position of established leading automobile regions in Europe and the US in terms of their competence base as well as their associated value chains.

For those leading regions, innovation has a dominant role in boosting people’s well-being, and consequently, the influence of innovation on the regional economy is typically more pronounced than in other regions. We specifically argue that leading industrial regions confronted with emerging socio-technical transitions need to engage in reflexive processes of transforming the regional innovation system (RIS) in a rather undisruptive way (Isaksen et al., 2022; Tödtling et al., 2022; Tödtling and Trippl, 2018). Failing to achieve such a coordinated approach may quickly lead to accelerating down-spiraling and disengagement of key companies from the region, which might ultimately lead the region to becoming a problematic region. In order to successfully navigate the transformation process, not only the tangible dimensions of the RIS have to change but equally the deeper, cultural resources that make up the identity and visions of the region and its confidence of successfully managing transformations (Pfothenauer et al., 2023). A core function applies to what we will call “regional imaginaries” that may support the navigation of tedious technological, institutional and symbolic transformations.

We will elaborate this argument for the case of the electrification of the automobile and its impact on the German Federal State of Baden-Württemberg. The region is well suited as a learning case as it is a globally leading hub of internal combustion engine (ICE) automobile manufacturing and also a poster case for the coordinated form of capitalism aiming to align industrial and regional interests. German automakers have for long ignored the challenges that electrification would represent to their leadership position and have now to catch up with new competitors from the US and China. The established regional imaginary being the “cradle-of –the-automobile” proved inadequate to mediate the challenges of this new era. We will reconstruct how regional policy makers, in concert with other actors in the region dealt with the transformation of the tangible and intangible resource base. Work on the regional imaginary proved a core endeavor in this process.

2 Deep structural change in regional innovation systems

A socio-technical transition in the global product sector may require a disruptive transformation of the RIS. In this section, we will review the extant literature on how to manage radical regional transformation and propose a new conceptual approach that extends the conventional focus on tangible structural interventions to reshaping parts of the cultural and symbolic fabric of the RIS to enable the needed change processes.

2.1 Managing regional radical transformation: work on tangible and intangible structures

While prior research has examined the importance of both tangible and intangible structures for successful regional transformations, policy suggestions have often been focusing on addressing deficiencies in the tangible elements of the innovation systems. Evolutionary theory, for instance, suggests that structural change will follow proximities between extant and future knowledge stocks. Regional policy makers should therefore address challenges for companies to move into complex, higher value-added activities that align with the region's existing capabilities (Boschma 2017; Balland et al., 2018).

Another more comprehensive perspective can be found in the RIS/regional industrial path development literature, emphasizing the need for simultaneous transformation of regional industrial structures, regional support structures, and regional institutional conditions (Asheim et al., 2016; Grillitsch et al., 2021; Trippel et al., 2020). Instead of merely focusing on market failures and underinvestment in R&D to justify policy intervention, this literature highlights the necessity of policy inventions to address deficiencies in core elements of the innovation system such as capability failures (e.g., lack of competence labor forces), coordination failures (lack of appropriate networks and interactions among actors), institutional failures (where industry standards and the regulatory setting hinder the development of innovations) and infrastructure failures (Weber and Rohracher, 2012). Institutional change, in particular, is acknowledged as a vital dimension for structural change; however, in empirical exploration, this approach often focuses more on the formal institutional structures such as educational or R&D programs, formal policies and regulations than informal, cultural elements such as norms, values and visions. The implicit assumption is that, culture, as the unwritten code dictating 'how things are done' in a given context, is difficult to change, and therefore, not amenable to intervention. Recent calls for adapting

the RIS to address societal grand challenges, such as the Challenge-oriented Regional Innovation Systems (CoRIS) framework (Isaksen et al., 2022; Tödtling et al., 2022), or transformative innovation policy (Schot and Steinmueller, 2018) have increasingly plead for more attention to the intangible elements, such as normative directionality of structural changes (similarly also by Gong, 2024), yet, it has also not thoroughly examined the influence of factors like symbolic aspects that serve for the coordination of the RIS reconfiguration.

A strong focus on tangible, formal structures risks to overlook potential misalignments between the newly established material realities and the entrenched symbolic and cultural orientations that serve to coordinate the strategies of the diverse actors in the RIS. The intangible assets of a region provide guidance by reducing uncertainties especially during disruptive periods (Saxenian, 1996). They may also create a sense of solidarity during transformations (Bole, 2021). Those latter aspects, however, can also significantly obstruct or even reverse the impact of material interventions and jeopardize the coherence between private industry and local government strategies. As rightly observed by Hughes and Stricker (2009, p. X), “It is not the case that changes in organizational structure, systems, or processes are unimportant, it is that they are rarely sufficient.” To facilitate radical change, a more nuanced understanding of the role of the intangible aspects of the RIS, such as cultures is required.

Culture is often deemed important for understanding socio-economic phenomena across space. However, it was not until the 1980s that culture's significance has been increasingly acknowledged by regional studies (for an overview, see Pfothenauer et al., 2023). The role of culture was first highlighted in the study of the emergence of industrial districts (Piore and Sabel, 1984; Asheim, 1996) and innovative milieus (Crevoisier, 2001), then extended to high-tech clusters and knowledge-intensive industries (Cooke, 2001; Saxenian, 1996; Storper, 1995), and Regional Innovation Systems (Asheim et al., 2016; Tödtling and Trippl, 2018). To a large extent, innovation necessarily carries a unique cultural fingerprint in the way it is rationalized, operationalized, and judged.

Recently, in the context of regional innovation, Pfothenauer et al (2023) provide a much more elaborated framework for assessing a “regional innovation culture” (RIC) along five analytical dimensions: (i) *Imagined social order* refers to the shared, normative understandings and expectations of public goods and innovation within a community. (ii) *Symbolic representations* discuss the significance of local symbols, images or tropes, such as Silicon Valley's 'inventor in the garage' or Bavaria's 'Laptops and Lederhosen' (Pfothenauer et al., 2023). These symbols are instrumental in framing place-based identities, crucial for embedding innovation within the local cultural context. (iii) *Political cultures* encompass the organizational and governance styles of political-economic institutions, and their alignment with broader societal values and discourses. (iv) *Imagined geographies* recognizes the multiscalar nature of innovation in terms of place-making, nation-building, and global influences. It provides a framework to analyze the dynamic interplay between local cultural practices and global innovation discourses (Heiberg et al. 2020). And finally (v), *dealing with controversies and conflicts* acknowledges that innovations have a political dimension, with regional specifics affecting inclusion in decision-making and articulation of innovation

visions. These five dimensions delineate the stability and variance of RIC across regions, and enable the analysis of how innovation is rationalized, executed, evaluated, and who gets to participate in these processes (Pfothenauer et al., 2023, p.4).

Our main premise is that radical socio-technical transitions, or comparable external shocks require strategies for transforming both the tangible and intangible structures of RIS in a balanced way. In the following, we will elaborate a dynamic framework on how this process can be managed by actors in a leading industrial region.

2.2 Initiating change from within: a process framework

The established literature on the role of regional culture, or the RIC framework in particular, maintains that culture has a tendency to stabilize established technological trajectories and rather hindering instead of supporting the ability to respond to external threats (Pfothenauer et al., 2023). Socio-technical transitions however challenge these established structures. We therefore have to better understand by which means the different dimensions of the RIC may be influenced in order to cope with the emerging challenges.

Our vantage point here is on the symbolic representations of the RIC framework which are crucial for embedding innovation within the local cultural context. Symbolic representations leverage local symbols, histories, stories, and imaginations to create resonance within its community. Symbolic representations are used "...not only in everyday practices of regional management, administration, presentation and in regional marketing and branding..., but also for the purpose of surmounting socio-economic and sociocultural problems." (Šifta and Chromý, 2017, p. 101). While the role of symbolic elements in the formation of regional identity and the institutionalization of regions have long been acknowledged (Paasi 1986), their potential role in regional identity 'deinstitutionalization' and place un-making/ re-making in face of fundamental challenges has resulted in far less attention (Zimmerbauer and Paasi, 2013).

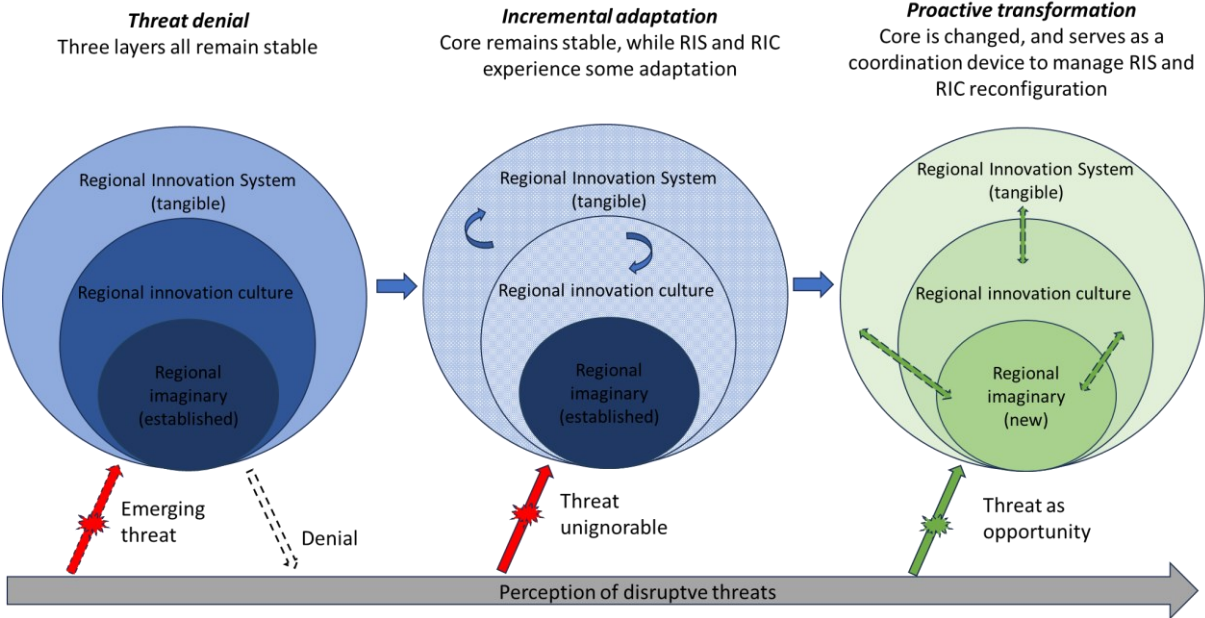
We posit that a major coordination device for managing regional transformations lies in the formulation of shared imaginations of desirable development trajectories for the region, or *regional imaginaries*. Here imaginaries are crucial elements of the symbolic representations that regions can use to unit stakeholders. The concept draws upon insights from two streams of literature, i.e., sociotechnical imaginaries in Science and Technology Studies (Jasanoff and Kim, 2015) and place-making in geography (Murphy 2015; Pierce et al 2011). While the sociotechnical imaginaries literature highlights actors' symbolic embracement of certain technologies and sectors (but overlooks the geographies of such imaginations), the work on place-making highlights local conditions, politics and power relations. Based on the strengths of the abovementioned two strands of literature, regional imaginary in an industrial region is defined here as "*collectively imagined forms of attainable regional futures that privilege, and seek to stabilize some trajectories (of transition) from the totality of sociotechnical relations*". Here a key difference between a leading industrial region and an

average region is that specific industries will play a bigger role in the regional identity and hence play a more important role in its regional imaginaries.

The relationship between symbolic representations (i.e. regional imaginaries), the RIC and the RIS needs to be further teased out. Here, we follow Hughes and Stricker (2009) and conceptualize them as nested layers (Figure 1). Modifications in tangible structures, systems, and processes of the RIS can be seen as operating at the outer layer (Hughes and Stricker, 2009). Conversely, shifts in the symbolic representations—regional imaginaries in particular, constitute the 'inner core' of regional transformation and place-shaping (O'Brien, 2012). It is suggested that only by altering this deep-seated core of the regional structure, in coordination with the changes in the outer layers, can we hope to instigate and successfully change the broader RIS. The RIC, encompassing a wider array of elements beyond regional symbolic representations and functioning as part of the RIS's informal institutions, can then be understood as mediating between the inner core and the outer layer of the RIS.

We may now formulate an abstract process scheme on how change from within occurs in the course of a regional transformation process, and how changes in regional imaginary will work its way out and become an object of strategic action. Figure 1 illustrates the interrelationship between interventions that have to take place at different levels of the RIS structure.

Figure 1. Changing from within: a dynamic structural change model



When disruptive threats initially emerge, it's common that they are dismissed by key stakeholders in a region. This denial occurs because the region's core businesses often continue to grow, and the changes prompted by such threats would be disruptive to the established regional resource base. Consequently, the prevailing regional imaginary—comprising the collective vision and understanding of the region's identity and trajectory—tends to be maintained as long as possible (Šifta and Chromý, 2017). This imaginary serves as a defense base to belittle and deny the potential damage likely to be inflicted by the external

threats. As a result, the RIC and the RIS that underpin this dominant narrative continue to operate unchallenged.

Yet, the perception and framing of threats plays a crucial role of whether and when changes in imaginaries will start to take shape. At a certain point, when threats cannot be ignored anymore, frames and discourses will be developed that specify how regional core resources that were crucial for past success will still enable to hold a leadership position in the future, while other resources will need to undergo transformation. We therefore expect that in periods of increasingly perceived threats, there will be increased discursive and experimental activity to probe on the different dimensions of the RIS and the RIC, while still arguing for the superiority of the established RIS and the mobilizing role of the historically successful regional imaginary. As a result, material interventions into the tangible structures will have to take place, by targeted policy initiatives, and new educational and research programs. Changes guided under this understanding will feature incremental adaptations, and changes in the tangible RIS structure are often observable. Furthermore, adaptations in some elements of the RIC, such as political cultures, imagined geographies, might happen as well. But the overall coherence of the regional structure will be maintained.

As key regional stakeholders progressively recognize the potentially disruptive effects of the threat, the necessity for radical change will become increasingly evident. In such context, a more proactive approach will have to be taken to deal with the uncertainty. The threats can then increasingly be interpreted and labelled as opportunities by regional politicians and/or key industrial figures, and as a result, the discussion about new regional imaginaries is likely to emerge, guiding the continuing reconfiguration in the RIS and the RIC. The transition toward a new regional imaginary will by no means be a smooth process. More likely, it will be accompanied by tensions and conflicts alongside periods of experimentations and exploration. The connection to the old regional imaginary will become a focal point of intense debate and discussion among regional stakeholders. The development of a new regional imaginary will necessitate concurrent exploration and adjustments within the RIC and RIS structures. Misalignments among these layers could pose significant obstacles to the transformation process. The interaction and feedback between the three layers are therefore important for the institutionalization of the new regional imaginary, as well as the success of the change initiated from within.

Of course, changing the inner core of a RIS can be extremely difficult, and in many cases impossible, as the inertia of the established structures is very high due to interdependencies among the different layers (Grabher, 1993). A special role therefore accrues to deliberate strategies of institutional work (Fünfschilling and Truffer 2016) initiated by visionary place leaders and/or transformative leaders (Heifetz et al., 2009). An explicit agency perspective on industrial transformation is therefore appropriate. Transformation efforts can however not entirely be delegated to strong individual leaders but importantly need the inclusion, buy-in and active support by different parties constituting the (current and future) RIS. Successful transformation will therefore depend on the ability of core actors to mediate between the different tangible and intangible elements while keeping a strategic focus on the needed direction of change.

3 Case selection and research methods

To test this framework, we adopt a single case design. Single case research needs to satisfy at least one of the following three conditions: (1) the case is an unusual phenomenon (extreme); (2) the phenomenon has not been accessible to researchers before (revelatory); (3) the case can be observed over extended time periods (longitudinal) (Seawright and Gerring, 2008). The case of Baden-Württemberg's change from a regional imaginary of 'the Cradle of the Automobile' to one of the 'Future Mobility Made in Baden-Württemberg' fits these conditions and therefore is likely to produce new conceptual insights. Specifically, we want to explore how work on the regional imaginary enabled the implementation of a consensual approach to the highly uncertain and potentially disruptive transformation in the regional automotive industry.

Baden-Württemberg stands out as a beacon of competitiveness, largely attributed to the innovative prowess of its enterprises and the robustness of its extensive public research and science infrastructure. The region benefits not just from solid structural conditions but also from the synergistic effects of 'systemic conditions': it boasts intricately interwoven value chains with tight-knit clusters and networks, characterized by upstream and supply structures, and rich interaction between industrial sectors and public research entities (Baier et al., 2012). Housing some of the most prominent names in the global market—Daimler, Audi, Porsche in the automotive realm; Bosch, ZF, and Mahle in electrical engineering and system integration; Trumpf in mechanical engineering. Baden-Württemberg's industrial landscape is further characterized by a plethora of medium-sized component suppliers and numerous 'hidden champions'—highly specialized firms that command significant market share in their respective niches.

We adopted a mixed method approach. Fieldwork was conducted both within and outside of Baden-Württemberg from June to September 2022 and April to May 2023. In total, 37 interviews were conducted with different actor groups (Appendix 1). The central topics included: (1) the history of the automobile sector in Baden-Württemberg and the characteristics of the historically formed RIS and RIC in the region; (2) the pressure felt by different actors for regional transformation; (3) the emergence of a new regional imaginary 'Future Mobility Made in Baden-Württemberg' and (4) the institutionalization process of the new imaginary and its co-evolution with regional RIS and RIC in Baden-Württemberg. References to interviews will be given in the format outlined in Appendix 1, e.g., an interviewee quoted from a research organization will be quoted as ReOrg and numbered.

In the data analysis, similar to the argument by Shi and Shi (2022), we aimed at disentangling the interrelationships between the three layers of regional structure, and retracing how they mutually influenced each other over time. Open coding was first conducted to group together relevant themes into three phases of development. In a second stage, the interview and secondary data were reinterpreted and categorized into primary codes that are related to the elements of the RIS and RIC identified in the analytical framework with a particular focus on references to symbolic representations. Such primary codes were then aggregated into axial codes (i.e. regional imaginaries, RIS and RIC). Finally, interrelationships between

changes in the symbolic representations and other interventions into the RIS and RIC structures were specified.

As a complement to the expert interviews, we furthermore conducted a systematic media analysis of German language newspaper articles addressing the regional transformation process. Actors are reported for their ongoing activities and statements that resonate with larger public concerns such as rationalizing political priorities, challenges and opportunities of regional development or external threats such as environmental change or global industrial competition. To this avail, we selected articles that reported on the future of mobility options in the federal state of Baden-Württemberg.¹ The search term produced 170 articles between 2010² and 2023. This resulted in 36 concept codes which were attributed 517 times and 21 actor codes that were attributed 795 times to different text segments (see Appendix 2 for the resulting coding trees). Articles were coded, aggregated and depicted following the protocol of the recently established method of socio-technical configuration analysis (STCA; Heiberg et al. 2022), a configurational analysis of topics and their interconnections as identified through statements and actions of different actors. STCA enables measuring shifts in positions and priorities as well as divergence or convergence of shared views and strategies in a region.

4 Regional structural change in Baden- Württemberg's automotive sector

Structural change in Baden- Württemberg's automotive sector can be divided into three phases: The first phase (before 2009) is characterized by the dominance of established RIS and RIC based on the regional imaginary of the "cradle of the automobile." The second phase (2009-2014) represents a time of conflict, when the old image was challenged due to various crises and the region began to explore new perspectives for the future with the support of the federal government. Finally, the third phase (2015-2023) is characterized by the emergence of a new regional imaginary based on the "Future Mobility Made in Baden-Württemberg" and its institutionalization process. The STCA analysis then highlights print media coverage in the second and third phase.

4.1 The old consensus around the 'Cradle of the Automobile' (Before 2009)

As numerous studies have shown, Baden-Württemberg's leadership position was based on a stabilized but flexible configuration of three factors including (1) a routinized but highly adaptive RIS that focuses on capital good production and innovation (Fuchs and Wasserman 2005; Heidenreich and Krauss, 2004; Stahlecker and Zenker 2017;); (2) a car-friendly, creative inventor RIC (Wentland, 2017); and (3) a regional imaginary based on the 'cradle of the automobile' (Mögele and Rau, 2020).

The regional imaginary is based on the fact that the pioneers of automobile manufacturing, the two Baden-Württembergers Gottlieb Daimler and Carl Benz, founded their operations at the end of the 19th century, marking the region as a center for automotive innovation. With

¹ After several iterations, the search string was formulated as " Baden-Württemberg AND (Auto OR Automobil) AND (Zukunft OR zukünftig OR von morgen) AND (Mobilität OR EAuto OR Elektroauto) AND Newspapers AND Date between Jan 01, 2010 an Dez 31, 2023)

² 2010 is the earliest year that relevant media discussion could be found

the recovery after World War II and acceleration of economic growth, the German automotive industry gained momentum with increased production and expansion of road infrastructure, while fiscal policies supported this development (Haas 2021). The collective imaginary of the region being the ‘cradle of automobile’ created a strong historical link between people, place and the automobile industry in Baden-Württemberg (Mögele and Rau, 2020).

This imaginary was part and parcel of a strong regional innovation culture, in which the *imagined social order* relied on an identity of Tüftler (tinkerers) (Glückler et al., 2020). The established mode of innovation in the region has been labelled as “Demand Pull” approach (ReOrg. 2). In this model, large OEMs set the stage by identifying clear demands that require innovative solutions. This demand then cascades down through the tiers of suppliers, each focusing on their specialty (ReOrg. 2). This social order was mirrored by a *political culture* in which the conservative *Christlich-Demokratische Union* (CDU) dominated the party landscape for six decades (1953-2011). The cradle imaginary also encompassed a specific *imagined geography* in that the region considered itself as the global leader in automobile manufacturing and as a role model of economic development for other German federal states (Gov. 2; Interm. 4). Since the ICE car became part of Germany’s national pride and central to its export-driven coordinated capitalism after World War III (Wentland, 2017), both the Baden-Württemberg and the federal government aligned on progressive, car-friendly policies and institutional support structures. In line with this particular form of capitalism, *conflicts and controversies* were primarily dealt with in an inclusive, almost harmonious form among the different social partners (Jackson, 2023; Meckling and Nahm, 2018; Stahlecker and Zenker 2017). Relations between employers and employees were regularized through the mediation of strong trade unions and work councils and dense supply networks.

This strongly coordinated RIC formed the base for an internationally leading RIS in Baden-Württemberg, which relies on incremental innovations and institutionally stabilized networks (Baier et al 2012; Stahlecker and Zenker 2017). The *region’s industrial structure* is dominated by capital-goods industries (Heidenreich and Krauss, 2004). Furthermore, the establishment of a dense network of *regional institutions* providing R&D activities, vocational and advanced training, industrial relations and financial services as well as the regional innovation policy with its horizontal and vertical funding instruments (Stahlecker and Zenker 2017). These networks led to a typical “triple helix” model of collaboration. Numerous research centers at universities and research institutes in Baden-Württemberg collaborate with the leading car manufacturers and their suppliers, while the government tends to provide both horizontal and vertical funding schemes that focused on both ICE-related and other technologies. The RIS in Baden-Württemberg exhibits strong features of path-dependent development as well as clear indications for a strong culture of learning and adaptation when faced with historical challenges such as the lean production in the 1990s.

4.2 Shaking up the success model: arrival of the external shock (2009-2014)

Shortly after the global financial crisis of 2008, and the acceleration of energy crises, peak oil, and climate change, the global automotive industry came under increasing public pressure, and this was especially felt in Baden-Württemberg (ReOrg. 9). While the region’s

economy bounced back rather quickly, a stagnating innovation dynamic and a decreasing commitment in certain technology fields (e.g., battery, digital technology) can be observed (Bauer et al., 2018). This resulted in a “defender of its top position” attitude of many leading actors when confronted with the emerging technological revolutions (Bauer et al., 2018).

During this period, controversies surrounding ICE technology and Baden-Württemberg's position as the leading automotive region in Europe became prominent in political and media discussions (Gov. 4). However, the fast-evolving landscape of mobility innovations and the lack of consumer enthusiasm for early electric cars left many stakeholders doubting the imminence of the threat. Among others, electromobility received considerable attention and public support (Wentland, 2017). However, not everyone shared the same enthusiasm for electromobility. Some viewed it as a mere hype and considered it too risky to fully embrace, with the belief that “there should be more continuity in investing in ICE technology” (Interm. 2). Rather than committing wholeheartedly to EVs, the argument centered around maintaining an open stance toward the potential of hydrogen fuel cells and other alternative fuels (Richter and Haas, 2020). The automobile industry in particular emphasized that the ICE technology would remain dominant at least for the next two decades (Firm 5). One of the key defense strategies for the ICE among some politicians and OEMs resided in the promotion of diesel cars as an important bridging technology between the ICE and future emission free forms of transport (Firm 7; Gov. 1).

During this period, the established ICE-centered RIC was frequently debated at the regional and federal level. The *imagined social orders* got challenged as key stakeholders such as OEMs, suppliers, and labor unions displayed reluctance in embracing new mobility forms for various reasons. Uncertainties regarding the future technological directionality (hydrogen, fuel cells, batteries, integrated mobility concepts, etc.) also made OEMs cautious about specific R&D investments (Firm 9; ReOrg. 1). In terms of *political culture*, the state election in 2011, resulted in a coalition government between the Green and the Social Democratic Party (SPD), and for the first time in the history of the state, a Greens politician, Winfried Kretschmann, was elected Prime Minister (ReOrg. 10). The Greens were buoyed by support for ending nuclear power in Germany following the Fukushima disaster in Japan. After election, Kretschmann publicly claimed that “fewer cars are better than more.” (Stuttgarter-Zeitung, 2011). He immediately received sharp criticism from politicians across the political spectrum, accusing him of endangering the established economic resource base of the region (Stuttgarter-Zeitung, 2011). However, after taking office, the different stakeholders were quick to assure the public that they had “entered into discussion” and that they “still” agreed on Baden-Württemberg being a key automotive region that is just preparing for sustainable development. In terms of the *imagined geographies*, recurrent reassurance that the region will remain in its leading international position got challenged by the call for preparing for the next generation of mobility concepts and even concerns regarding the fear of falling behind were increasingly formulated (ReOrg.9). Also relationships with the German federal government, and the EU became progressively complex. Nevertheless, during this period, the federal government could still largely be characterized as being in a ‘regulatory capture’ relationship with the automotive industry (Meckling and Nahm, 2018).

In terms of the tangible RIS structures, regional and industrial policies of the federal government provided substantial financial resources, complemented by funds from local governments, to initiate a series of decentralized experiments after 2008. These experiments aimed to explore an alternative future for the region's car-dependent economy. As a consequence, a whole series of initiatives, pilot projects, as well as research and demonstration programs were initiated to transform the extant RIS structures (Interm. 3). We will further elaborate on these strategies in section 5.

4.3 Emergence of a new imaginary ‘Future Mobility Made in Baden-Württemberg’ (2015-2023)

In the transition to the third phase, the region begun to face significant challenges posed by the green and digital transitions. In terms of market dynamics, global competitors such as Tesla and Chinese automakers were progressively encroaching on the market share traditionally held by German brands (Firm 6; Gov. 2; Interm. 8). As a result of these market pressures, major German OEMs, including those based in Baden-Württemberg, were compelled to accelerate their efforts in the field of electromobility (Firms 2&3). At the same time, the Dieselgate scandal unfolded from September 2015 onwards, which obliterated one of the main defense narratives of automobile companies for the continued dominance of the internal combustion engine (Richter and Haas, 2020; Jackson, 2023). The Dieselgate scandal and more frequent extreme weather events led furthermore to an increasing estrangement among the government and the industry actors (Interm. 5). For instance, Germany’s 2016 Climate Action Law was passed, aiming for climate neutrality by 2050. In 2021, the goal was revised to achieve it by 2045. At the EU level, a series of environmental regulations and climate targets were introduced, culminating in the passage of the EU Climate Law in 2021(Reuters, 2023).

In 2017, based on a series of research as well as various pilot and demonstration projects, Mr. Kretschmann officially announced a new regional imaginary ‘Future Mobility Made in Baden-Württemberg’ in the first “Strategic Dialogue Automotive Industry Baden-Württemberg” (SDA). This new regional imaginary differs from the old one in several important aspects, such as perception of the automotive industry, key actors and networks, afocal technologies, actor collaborations and the role of the state, as summarized in Table 1.

Table 1. Comparison of the old and new regional imaginaries

Change of symbolic representation	‘Cradle of the automobile’	‘Future Mobility made in Baden-Württemberg’
Perception of the automotive industry	ICE cars as core products	Autos as a puzzle piece of the future mobility -e-car as a product (battery and e-motor technologies) -car as a platform for traffic solutions (digitalization) -car as a functional part of the ‘smart grid infrastructure’ (renewable energy)
Key actors and networks	Car-focused value chain, including: OEDs; supply industry; sales and aftersales	Mobility-focused ecosystem: OEMs, battery research and production; IT firms; charging infrastructure providers; renewable energy suppliers; new service providers
Actor collaboration modes	Triple helix with a strong focus on innovation in the conventional, fossil-based automotive technologies	inter-disciplinary, intersectoral collaborations focusing on emerging technologies in different fields (automotive, energy, electrochemistry, mechanical engineering, IT, etc.)
Focal technologies	ICE technologies	Digitalization, electrochemical and battery technologies, energy technologies
Role of governments	Support basic research and address market and system failures	Support joint, cross-sectoral research, high public investments in addressing market, system but most importantly directionality failures

The SDA serves as the fundamental institutional framework to accompany and support this enormous transformation process (Intermediaries 2&3). The SDA conferences were attended by leaders of the automotive industry in the region including key OEMs and system suppliers, but also experts and academics, politicians, labor unions. In terms of *political culture*, the 2016 state election, led to a coalition between the Greens and the CDU, with Kretschmann re-elected as Prime Minister. Kretschmann reconfirmed: "My goal is for Baden-Württemberg to become a beacon for future mobility." (Stuttgarter Zeitung, 2017). The *imagined geographies* in the aftermath of the Dieseltgate scandal, emphasized the urgency to transition to the new technological paradigm and led to an increasing misalignment between the government and the automotive industry on emissions regulations (Jackson, 2023).

Concerning the strategies of OEMs, it's evident that Daimler and Porsche underwent a significant transformation in their commitment to electrification (Firms 2&3). Likewise, labor unions like IG Metall Stuttgart shifted from their previously cautious stance towards actively embracing a rapid transition (Richter and Haas, 2020). They emphasized the importance of retaining manufacturing jobs related to batteries and other emerging technologies within the state and in Germany (Interm. 6). This shift in strategy also led to a new way to deal with *conflicts and controversies*. The imperative to change gained acceptance among broad stakeholders. As one interviewee noted, "*it's not a question of combustion engines being bad and electric mobility being good. Most of them [firms] simply understand that electric mobility is the future*" (Interm. 4). The supply industry started to shift from a 'Demand Pull', reactive collaboration model to a 'Technology Push' model, where SMEs need to proactively anticipate future demands and trends in mobility and to develop solutions that not only meet but lead the market (ReOrg. 2). As one interviewee expressed, "*Now companies have to research on different things simultaneously, which is a significant challenge.*" (Interm. 4) In contrast to a previous phase of tangible RIS reconfiguration, the RIS in this phase is heading towards an agile innovation ecosystem (Adner 2016), where various technologies and sectors converge. Major industry actors are now engaging in investments in manufacturing capacity and charging infrastructures. The new shared agenda is more about making the transition happen instead of debating whether it will happen at all (Interm. 4). Finally, the discourse on "future mobility" is incorporating and integrating several new industries. As one interviewee noted, "*The industry has recognized the need to form entirely new alliances. Today's suppliers may not be the suppliers of tomorrow*" (Interm. 3).

4.4 Retracing the transition through public media coverage (2010-2023)

Before engaging in a more detailed analysis of how this regional transformation process was initiated, debated and shaped by strategies of different actors, we will provide a complementary view on the transformation process through its coverage in public media. We divided the analysis of the newspaper articles (see section 3) into three time periods from 2010 – 2014, 2015-2019 and from 2020 -2023 according to major events in terms of the dieseltgate (2015) and Covid (2020).³ Fundamental shifts in terms of key actions,

³ We did not find any article before 2010 in the Nexis-Uni database, which might be a consequence of our search string focusing on explicit references to the "future". We may assume that challenges to the core technological configuration of the ICE were published under different terms in the times of the unchallenged established RIS/RIC constellation.

controversies and proposed solutions can best be illustrated by comparing the first (2010-2014) with the last period (2020-2023) of the analysis. The middle phase was showing early trends of this shift with a strong emphasis on labor market questions featuring in particular positions of the trade unions.⁴

The first period (see figure 2) shows a clear central topic (the “EM relevant option” node), which stands for statements and activities that acknowledges the challenge of electromobility as a relevant -- although not dominant -- concern. The central position of the node indicates that most actors were acting in this direction. This is complemented by a call for all sorts of policy support to identify options for engagement with required innovations (yellow nodes). Defensive arguments in favor of the ICE drivetrain (red nodes), arguing for their continuing importance are located near the middle of the graph and showing relatively strong salience. References to specific strengths of and challenges to the RIS (blue nodes) are present but are raised by different actors in different contexts and hence are scattered at outer rings of map. The big exception is the reference to the “cradle of the automobile” imaginary, which is mobilized by a diverse set of actors to argue that past success and ability to cope with change will also guarantee to remain in this position in the future. It sits at the center of the network and therefore aligns with the more defensive attitude expressed by the red nodes. References to the “future of mobility”, were in those years rather unspecific and had not converged to a new imaginary, yet.

Overall, the figure clearly shows a general trend of statements and activities that treat the challenges of the technological transition as manageable, not questioning the future dominance of the internal combustion engine and hence assures readers that Baden-Württemberg will not be challenged in its role as a leader of the global automobile industry. This is furthermore corroborated by the marginal position and rather small size of the blue nodes that express fears of Baden-Württemberg falling behind (BW is lagging), that transformations will be rather disruptive (disruptive dynamics) or that global competition will be overly fierce in this sector (international competition). The counter narrative represented by whether disruptive transformation is inevitable (Transition needed), that current mobility is unsustainable (Transp unsust) and that the end of the ICE is foreseeable (End of ICE) are strongly interconnected, but have rather peripheral positions indicating that they are only promoted by some actors. Finally, we see that the beige nodes referring to specific technological and institutional innovations are rather scattered, which hints at a lack of a dominant design or a dominant innovation strategy in the region.

⁴ The network covering the period 2015-2019 can be found in the Annex#2.

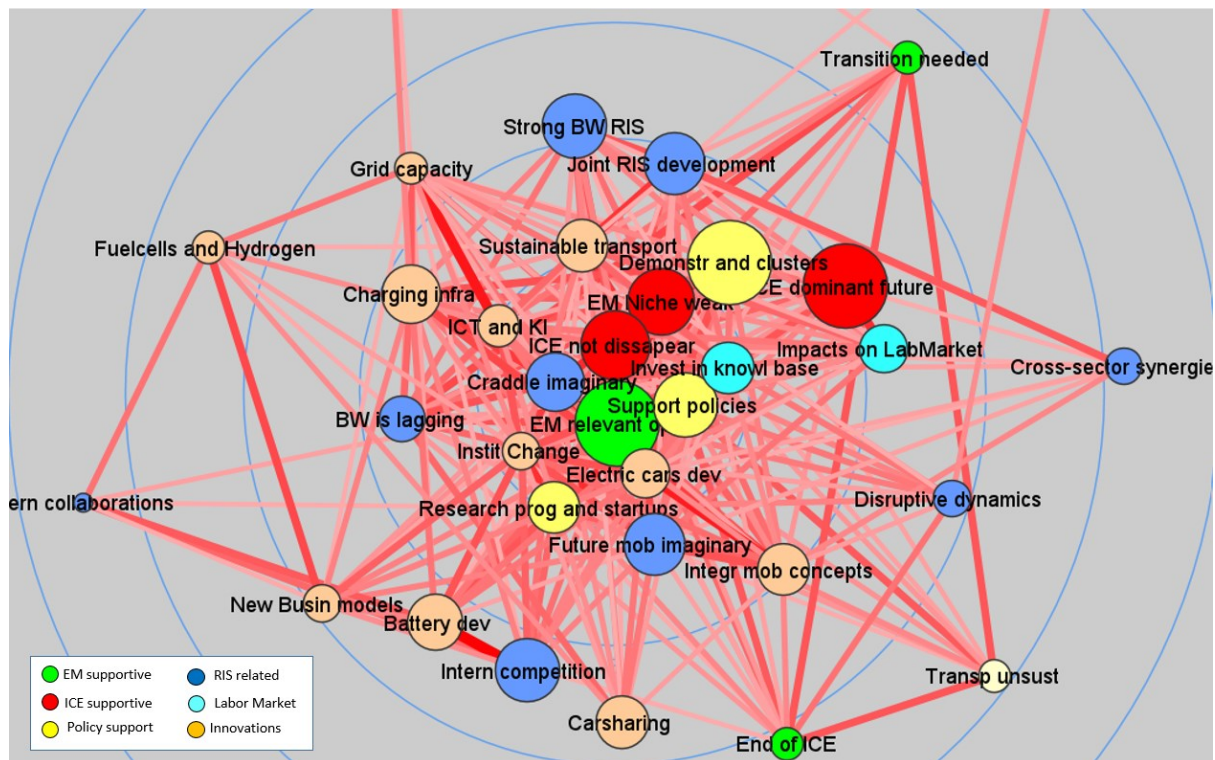


Figure 2: Concept congruence networks 2010-2014: Size of nodes represent the number of codes attributed in the respective time period. Color of nodes are congruent with main themes (see in figure legend). Width of links and red color saturation are proportional to the normalized cosine distance. Links below a value of 0.4 have been eliminated. Position in the radar plot depends on the centrality measure of each node. The center of the plot represents widely shared topics, while more marginal discourses are located at the outer fringes.

After the dieselgate had unfolded between 2015 and 2017 and with the increasing market success of EV companies like Tesla or the Chinese manufacturers, media coverage shifted quite fundamentally between 2020 and 2023 (Figure 3). We see now the center being dominated by concerns about RIS development (Joint RIS development) to accommodate for disruptive industry dynamics (disruptive dynamics), jointly with concerns about labor market challenges (light blue nodes). Support policies are still referred to but have a more peripheral position overall (yellow nodes). Also in the center of the coverage and quite salient are specific innovation and investment activities (beige nodes), in particular actual investments into manufacturing of EVs as well as charging and grid infrastructures.

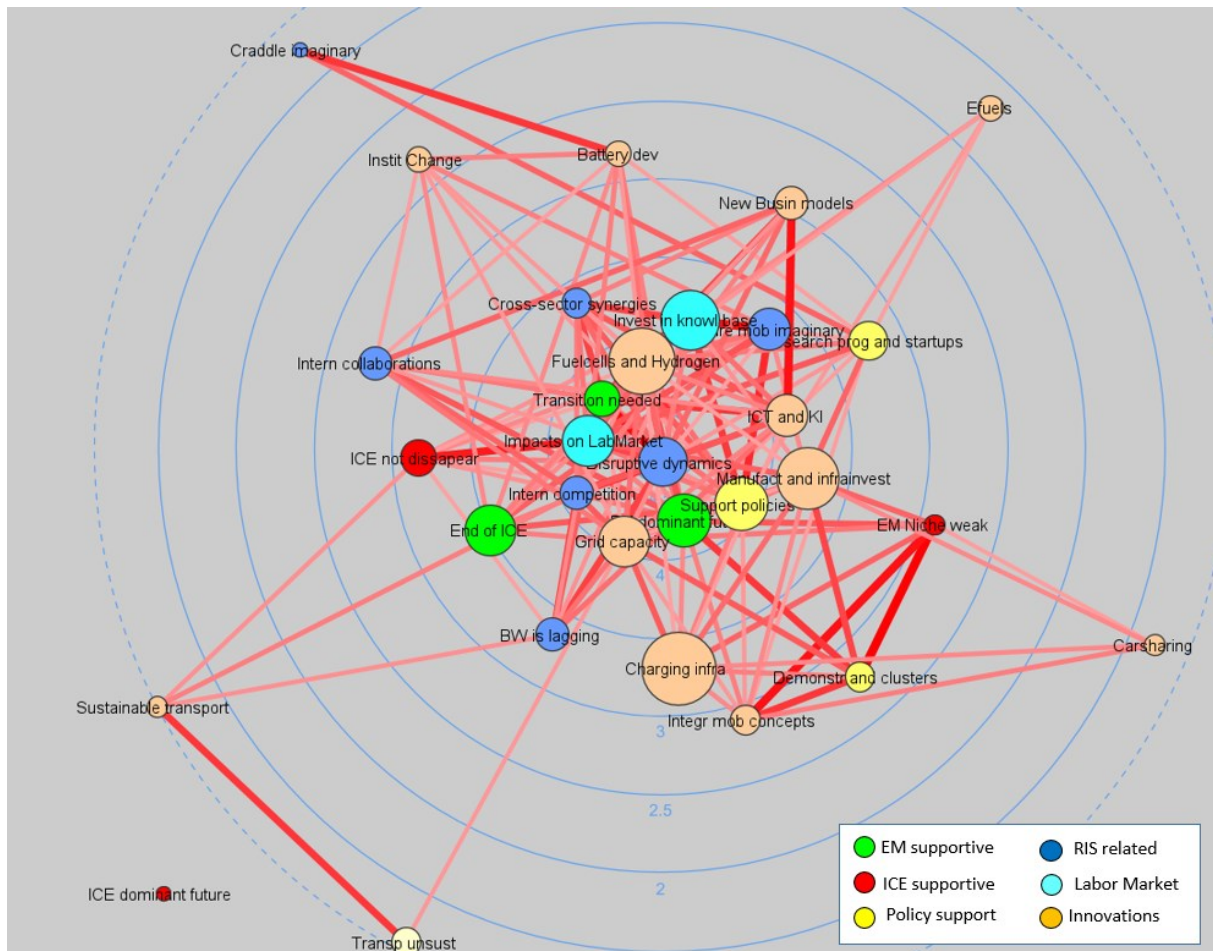


Figure 3: Concept congruence networks 2020-2023: For the explanation of the graphical elements in the plot see legend of figure 2.

Supportive references to the electrification trajectory (green nodes) have grown substantially and moved to the center (“Transition needed” and “End of ICE”). Most remarkably, the rather defensive node of taking EVs seriously (EM relevant option), which represented the center of the first period was replaced by much more assertive statements that electric mobility will become the new dominant design in the automobile industry (EM dominant future). On the other side, the defensive arguments supporting the ICE trajectory (red nodes) shrunk such as assertions that the ICE will not disappear (ICE not disappear) and that the electric mobility niche still suffers from many deficiencies (EM niche weak). Statements claiming that the ICE will remain dominant in the future (ICE dominant future) have virtually disappeared and emerging only in one statement of the far right party AFD, who are known for positioning themselves notoriously outside of mainstream discourses. In a same vein, we see that the position of imaginaries shifted in a rather dramatic way. The ‘cradle of the automobile’ only occupies a very marginal position and was raised in the context of support for battery manufacturing, while the ‘future mobility’ imaginary gained in size and position.

What is remarkable about the whole transformation process is that the corresponding actor congruence structure, which depicts the relative position of actors regarding their stance in

different topics, did not change much over the whole course of these rather dramatic developments (represented by Appendix 3, which depicts the aggregated pattern over the whole period under investigation). Key actors like the government, the automobile industry and research largely share the issues that need to be addressed. In the following, we will elaborate how this congruent, rather harmonious development was made possible.

5 How to translate technological disruption into coordinated regional transformation?

The presented analysis on how the external threat of a radically different technology worked out in Baden-Württemberg exhibited a classical cycle of denial, incremental adaptation and proactive transformation as suggested by our conceptual framework. During all this period, the regional actors managed to largely keep a constructive and cooperative approach to dealing with the fundamental challenge. However, it also became clear that the former confidence of having been able to weather all storms in the past and hence also doing so in the future was broken (ReOrg. 9). This confidence which was perhaps best epitomized by the regional imaginary of the ‘cradle of the automobile’ giving way to new symbolic representations of ‘future mobility made in Baden-Württemberg’, even if it still represents a rather fuzzy and generic formulation of a new imaginary. We will now elaborate in some more detail how this transition was managed. We will proceed with the analysis along four analytical lines: (i) the launching of a strategy dialogue within the region in which the construction of a new imaginary was more or less directly negotiated, (ii) the foundation of a systemic intermediary set up to coordinate a complex set of tangible and intangible interventions, (iii) changes in the strategies of the different regional actors and (iv) early signs of changes in several dimensions of the RIC.

Core of the coordinated transformation process was the launching of a dialogue platform, the Strategiedialog Baden-Württemberg (SDA). As an intersectoral approach of political and economic change management, the main role for SDA has been to develop a positive, collective visions of the future in the sense of a leading narrative (Fischer and Gicklhorn, 2022) through extensive dialogues among the different stakeholders. In other words, the SDA was an important platform where future imaginaries of Baden-Württemberg’s automobile industry were discussed and partly constructed. Drawing inspirations from capabilities in the pre-existing regional automotive value chain, the initial period of the SDA (2017- mid 2021) featured six topics covering various aspects of the automotive value chain (R&D Production Supplier; Sales & Aftersales; Energy; Digitalization; Traffic solutions; R&D environment) as avenues worth pursuing (see Appendix 4). By formulating a rather vague depiction of ‘Future Mobility’, this new imaginary allowed for different interpretations of their future relevance by different stakeholders. *“Since ‘Future Mobility’ is a very broad term, ... it did not create strong resistance, ... stakeholders still wanted to retain as many of their competences as possible under this new label”* (Interm. 5). Such ambiguity got debated over time in the SDA meetings (ReOrg. 13), and as a result, these six topics were reduced to three in 2022: vehicle, data and energy (see Appendix 4), showing that the regional key stakeholders’ imaginary about future mobility has been decentering from the core of the

automobile (the drive train) to a focus that lies in between different knowledge realms (vehicles, ICT, energy technologies).

The SDA was backed and actually managed by a newly created systemic intermediary *emobil BW*. Established as a State Agency for “New Mobility Solutions and Automotive Baden-Württemberg”, *emobil BW* has played a central role in the region’s industrial transformation. Most interviewees acknowledged this: “...there has never been anything like it before, [and]...someone had to take up the mantle and pull the others along, which can always lead to tensions in some form or another” (ReOrg. 3). *Emobil BW* has also commissioned comprehensive Structural Studies at four-year intervals (2011, 2015, 2019, and 2023) where challenges and opportunities for the state were clearly articulated and coping strategies were discussed. Such detailed and regularly updated information served to provide evidence for consistent policy support and thus helped boosting confidence and pointing to the directionalities of the regional transformation (ReOrg. 2).

The regional transformation was however not solely driven by intermediaries but built on remarkable adaptive and dynamic capabilities among key actors. In particular, the government of Baden-Württemberg and politicians demonstrated strong adaptive capabilities. Interviewees emphasize the importance of foresight across political parties. “Politicians across all party lines at federal and state level are showing the greatest interest and considerable foresight.” (Interm. 4).

The role of government extended of course beyond rhetorical support into material policies oriented at various RIS dimensions. The Ministry of Economic Affairs initiated several effective support programs directly targeting the tangible structure of the RIS, especially knowledge provision for SMEs in transformation. For instance, a voucher program called “Mittelstandsoffensive Mobilität MOM” (SME offensive mobility) was established in 2017, providing incentives for SMEs to seek tailored knowledge by working with professional consulting companies. The “Landeslotsenstelle Transformationswissen BW,” (Office for piloting the transformation in BW), which provides basic knowledge repositories for SMEs in transition, was launched in 2020. “These initiatives have been highly successful,” as one individual noted. “The Landeslotsenstelle Transformationswissen BW has already hosted over 250 talks, and the voucher program has garnered significant interest. Companies can work with consultants from our list or bring their own consultants if they meet our requirements.” (Interm. 4). Several complementary initiatives were launched to facilitate retraining workers. Among others, the cross-departmental program [WEITER.mit.BILDUNG@BW](#) (move forward through education) was established in February 2021 with 40 million euros budget.

Proactive engagement with the new technologies could also be observed among OEMs, the research organizations and the supply industry. Initially, OEMs were rather skeptical regarding the transition and chose to prioritize the optimization of ICE technologies (for an overview of OEMs’ product strategies under the pressure of electrification, see Altenburg, 2014). However, in the last two to three years, the inevitability of the transition to electromobility has increasingly been acknowledged by the OEMs. Today, automotive manufacturers in Baden-Württemberg are actively diversifying, creating new subsidiaries and joint ventures, and partnering with startups to delve into new business areas with the

strongest commitments being directed toward the transition to electric cars (ReOrg. 13). Also suppliers increasingly shifted attention by diversifying into related industries, mergers and acquisitions, often involving foreign partners (ReOrg. 2). Research organizations and universities in Baden-Württemberg have been undergoing substantial changes and by collaborating closely with the automotive and supply industries in the form of interdisciplinary, intersectoral research projects, they increasingly focus on exploring emerging technologies in different fields such as next-generation battery design, vehicle-to-grid integration, autonomous driving and so forth (ReOrgs. 8 & 13).

Interventions however not only aimed at changing tangible RIS structures, also key dimensions of the RIC were targeted. While the interrelationship between the state and the automotive industry could be described as 'regulatory capture' (Meckling and Nahm, 2018) up to the early 2010s the relationship became more conflictual after 2015. The Dieselgate scandals (Jackson, 2023) shattered mutual trust between parties and the OEMs found themselves increasingly at odds with progressively stringent environmental regulations imposed by the EU. With increasing number of actors embracing mobility as the future for Baden-Württemberg, the vested interests seem to be realigned again lately. Baden-Württemberg increasingly aims to position itself as an exemplary model for regional sustainability transitions for the rest of the Europe, with the 5th SDA conference relocating from Stuttgart to Brussels in 2022 (SDA progress report, 2022).

We can therefore conclude that the different actors managed a rather orderly response to the disruptive threat of a radical change in the core technology of their dominant industries. They acted on the symbolic representation of the regional imaginary, which provided a widely shared frame to organize a diverse set of individual and coordinated actions. The new regional imaginary acted as an orientating framework, coordinating the region's stakeholders towards new regional structures that align with a rapidly changing landscape.

6 Discussion

Reflecting on the interrelated evolution of the RIS, RIC, and regional imaginaries over the past two decades, it is clear that the transition has been triggered by radical shifts in the socio-technical regime of the global car industry, which was accommodated by the actors in Baden-Württemberg by restructuring their tangible and intangible resource base. Key in this transformation was a proactive reconstruction of the regional imaginary from referring to historical success factors of a specific technology towards a future-focused vision of new mobility forms. In the following, we will try to generalize the insights gained from the case to how radical socio-technical disruptions may be accommodated by current leading industrial regional actors to maintain their strong position.

First of all, instead of viewing an established RIS as a monolithic system, we proposed to recognize its nested structure composed of the regional imaginary, the RIC and the tangible aspects of the RIS. This delineation offers regions clearer guidance on where to focus their efforts for targeted interventions when facing radical challenges. In the incumbent literature, there has been a tendency for policy recommendations to focus on the most visible components of the system, overlooking the role of deeper, more foundational structures that can hamper or increase the effects of these interventions. Even though the

tangible RIS structure in Baden-Württemberg has been qualified as adaptive by several earlier commentators (Heidenreich and Krauss, 2004; Stahlecker and Zenker 2017), we saw that the shift towards electrification presented a deeper challenge, which required work on the regional imaginary alongside other dimensions of the RIS and RIC. Consequently, traditional strategies for adapting the RIS's outer layer to address market, coordination, capability, institutional and infrastructure failures (Weber and Rohrer, 2012)—such as enhancing regional industrial diversity, adapting the organizational and institutional set-up, implementing new education and training programs, supporting entrepreneurs and innovation projects, and bolstering stakeholder collaborations and knowledge flows (Isaksen et al., 2018) were still important in our case. However, they were insufficient to tackle the challenges, necessitating a departure from entrenched norms, values, and cultures (Hughes and Stricker 2009).

Secondly, we have shown that a process perspective is essential to grasp the complexity of a leading region's transformation process. In Baden-Württemberg, regional stakeholders have experienced strong changes in their perception of the external threat of electrification of the drive train. From the STCA and the interview-based analyses, we see very clear patterns of issues, structures and strategies that have changed over the past two decades. Threat denial was common in the beginning. The cradle imaginary played a central role as a reassurance that things would remain within known bounds and that established strengths and modes of operation in the RIS were sufficient to confront the challenge. Over the course of time, however, we see that there has been a much more proactive embracement of the challenge and that electrification became the dominant orientation for the regional industry.

Of course, changes did not occur without tensions and setbacks. What proved essential was the state's significant and proactive engagement in guiding the exploration about the region's future, harmonizing diverse interests, and fostering spaces for dialogue and collective action. Over the past two decades, the role of the state in Baden-Württemberg increasingly shifted from primarily addressing market and system failures, to proactively addressing directionality failures (Schot and Steinmueller, 2018; Weber and Rohrer 2012). A common concern in well-established industrial regions revolves around the extent to which incumbent actors, particularly multinational enterprises, are attuned to the imperatives of regional transformation. Operating on a global scale and often perceived as footloose—a perspective that held truth also for OEMs in Baden-Württemberg, incumbent players are often claimed to have less interest than locally-rooted actors in engaging in territorial-specific issues and thus difficult to be mobilized locally. However, this does not preclude the possibility of regional stakeholders driving necessary changes. In Baden-Württemberg, the state government has been at the forefront of initiating a significant shift in regional imaginaries since 2017 despite limited enthusiasm expressed by OEMs, originally. Furthermore, other regional entities, such as SMEs, research organizations, intermediaries, also demonstrated strong adaptability in their strategies to align with the ongoing regional transformation. We therefore argue that a proactive approach in addressing the fundamental transformation process requires dynamic capabilities and a culture of adaptive learning (Gong et al., 2023), not just at the individual or organizational level but also within the broader networks of interconnected organizations. The state, however, has an essential

role in initiating, facilitating and sustaining regional stakeholders' commitment to the needed transformative journey.

Finally, initiating change from within is by no means an easy task in leading industrial regions, precisely because of system's lock-ins to extant successful model (Glasmeier, 1991). In this context, dialogue-based coordination and discussion is of utmost importance. In Baden-Württemberg, tensions among different stakeholders occurred regularly. Yet, the coordinated market economy system has allowed actors to engage in meaningful conversations and collaboratively find solutions. Intermediary organizations and dialogue platforms, which are the core characteristics of the German variety of capitalism, have played a crucial role in smoothing the thorny regional transformation trajectory. Such a consensus-driven approach is obvious in the region's exploration of a new regional imaginary, initially encapsulated by the broad and somewhat nebulous goal of 'Future Mobility Made in Baden-Württemberg.' It can also be observed in the organized change taking place in the RIC and the RIS structures. Particularly, the emphasis on compensating those disadvantaged by the transition process, notably SMEs and workers, stands out as the most vital lesson that can be drawn from the experience of Baden-Württemberg. This approach underscores the necessity of a coordinated strategy to support those who perceive themselves as sidelined. Without this, neglected regions and/or social groups may retaliate through political populism, social discord, and regional discontent, as well-documented in the literature (Rodríguez-Pose, 2018).

7 Conclusion

The inquiry into the transformation of Baden-Württemberg's automotive industry has illuminated the nuanced interplay between symbolic representations, RIC, and RIS, revealing a complex process of changing from within. The case is instructive for regional policy-making in the context of grand challenges. It suggests that regional innovation policy should transcend the traditional focus on addressing market and system failures (Weber and Rohrer, 2012) and increasingly embrace a comprehensive and integrated approach that targets directionality failures (Weber and Rohrer, 2012) with a special focus on the role of soft factors such as the symbolic representations and the RIC.

However, Baden-Württemberg's ability to maintain its leading position is not guaranteed, given the rise of formidable global competitors. Yet, the ongoing revolution in the mobility sector is a litmus test for the region's dynamic capabilities and adaptability (Gong et al., 2023). Moreover, while the ecological modernization of Baden-Württemberg has made significant strides, it still operates within the confines of existing paradigms of car ownership and usage (Mögele and Rau, 2020). This approach has not radically reimagined mobility beyond the individual ownership model, which could be seen as a missed opportunity to fully embrace the potential for transformative change towards more collective and shared mobility solutions (Haas, 2021).

Looking ahead, there is a pressing need for further research on the long-term sustainability of transitions underpinned by ecological modernization. In addition, comparative analyses with other former or current leading regions that have gone through similar situations could provide important insights into the drivers of regional competitiveness in times of

uncertainty. Interesting cases in point include the Swiss watchmaking industry in the Jura region in the 1970s (a successful case), and the falling of the American ‘Motor City’ Detroit in the 1960s to 80s (a failed case). Moreover, it would also be interesting to compare the insights generated from Baden-Württemberg with the former influential work produced in the US context (e.g., Silicon Valley vs Route 128 by Saxenian (1996), Los Angeles vs San Francisco by Storper et al (2015)), as we believe regional transformations underpinned by coordinative forms of capitalism could differ substantially from those embedded in liberal or state capitalism such as the US or China.

Reference

- Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. *Journal of management*, 43(1), 39-58
- Altenburg, T. (2014). From combustion engines to electric vehicles: a study of technological path creation and disruption in Germany (No. 29/2014). Discussion Paper.
- Asheim, B. R. T. (1996). Industrial districts as ‘learning regions’: a condition for prosperity. *European planning studies*, 4(4), 379-400.
- Asheim, B. T., Grillitsch, M., & Trippel, M. (2016). Regional innovation systems: Past–present–future. *Handbook on the Geographies of Innovation*.
- Bachtrögler-Unger, J., Balland, P. A., Boschma, R., & Schwab, T. (2023). Technological capabilities and the twin transition in Europe: Opportunities for regional collaboration and economic cohesion.
- Baier, E., Kroll, H., Schricke, E., & Stahlecker, T. (2012). The regional innovation system of Baden-Württemberg reconsidered. *Innovation system revisited. Experiences from*, 40, 171-192.
- Balland, P. A., Boschma, R., Crespo, J., & Rigby, D. L. (2018). Smart specialization policy in the European Union: relatedness, knowledge complexity and regional diversification. *Regional studies*.
- Bauer, W., Weissenberger-Eibl, M., Ardilio, A., Beckert, B., Bratan, T., Doll, C., ... & Wietschel, M. (2018). Vorfahrt für Innovation—wie Baden-Württemberg seine Spitzenposition behaupten kann: innovationspolitische Impulse des Beauftragten für Technologie der Landesregierung von Baden-Württemberg. *Ministerium für Wirtschaft, Arbeit und Wohnungsbau*.
- Bole, D. (2021). ‘What is industrial culture anyway?’ Theoretical framing of the concept in economic geography. *Geography Compass*, 15(11), e12595.
- Boschma, R. (2017). Relatedness as driver of regional diversification: A research agenda. *Regional Studies*, 51(3), 351-364.
- Cooke, P. (2001). Regional innovation systems, clusters, and the knowledge economy. *Industrial and corporate change*, 10(4), 945-974.
- Crevoisier, O. (2004). The innovative milieus approach: toward a territorialized understanding of the economy?. *Economic geography*, 80(4), 367-379.
- De Propris, L., & Storai, D. (2019). Servitizing industrial regions. *Regional Studies*, 53(3), 388-397.
- Fischer, W., & Gicklhorn, K. (2022). Re-inventing the wheel: the Strategic Dialogue for the Automotive Sector Baden-Württemberg (SDA BW) as key element of an innovation and

transformation strategy of the automotive region Baden-Württemberg. Conference paper in 35th International Electric Vehicle Symposium and Exhibition.

Foray, D., David, P. A., & Hall, B. (2009). Smart specialisation—the concept. *Knowledge economists policy brief*, 9(85), 100.

Fuchs, G., & Wassermann, S. (2005). Path dependency in Baden-Württemberg: Lock-in or breakthrough?. In *Rethinking Regional Innovation and Change: Path Dependency or Regional Breakthrough?* (pp. 223-248). New York, NY: Springer New York.

Fuenfschilling, L., & Truffer, B. (2014). The structuration of socio-technical regimes—Conceptual foundations from institutional theory. *Research policy*, 43(4), 772-791.

Glasmeier, A. (1991). Technological discontinuities and flexible production networks: The case of Switzerland and the world watch industry. *Research policy*, 20(5), 469-485.

Glückler, J., Punstein, A. M., Wuttke, C., & Kirchner, P. (2020). The 'hourglass' model: An institutional morphology of rural industrialism in Baden-Württemberg. *European Planning Studies*, 28(8), 1554-1574.

Gong, H. (2024). Futures should matter (more): Toward a forward-looking perspective in economic geography. *Progress in Human Geography*, 03091325231224434.

Gong, H., Yu, Z., Binz, C., & Truffer, B. (2023). Beating the Casino: Conceptualizing an Anchoring-based Third Route to Regional Development. *Economic Geography*, 1-31.

Grabher, G. (1993). The weakness of strong ties; the lock-in of regional development in Ruhr area. *The embedded firm; on the socioeconomics of industrial networks*, 255-277.

Grillitsch, M., Rekers, J. V., & Sotarauta, M. (2021). Investigating agency: Methodological and empirical challenges. In *Handbook on city and regional leadership* (pp. 302-323). Edward Elgar Publishing.

Haas, T. (2021). From green energy to the green car state? The political economy of ecological modernisation in Germany. *New political economy*, 26(4), 660-673.

Heiberg, J., C. Binz and B. Truffer (2020). "The Geography of Technology Legitimation: How Multiscalar Institutional Dynamics Matter for Path Creation in Emerging Industries." *Economic Geography* 96(5): 470-498.

Heiberg, J., Truffer, B., & Binz, C. (2022). Assessing transitions through socio-technical configuration analysis—a methodological framework and a case study in the water sector. *Research Policy*, 51(1), 104363.

Heifetz, R. A., Grashow, A., & Linsky, M. (2009). *The practice of adaptive leadership: Tools and tactics for changing your organization and the world*. Harvard business press.

Heidenreich, M., & Krauss, G. (2004). *The Baden-Württemberg production and innovation regime: past successes and new challenges. Regional Innovation Systems, Second Edition*. London and New York: Routledge, 186-213.

Hine, A., Gibson, C., & Carr, C. (2024). Green hydrogen regions: emergent spatial imaginaries and material politics of energy transition. *Regional Studies*, 1-18.

Hudson, R. (2005). Rethinking change in old industrial regions: reflecting on the experiences of North East England. *Environment and planning A*, 37(4), 581-596.

- Hughes, R. L., & Stricker, A. G. (2009). Outside-in and inside-out approaches to transformation. *Crosscutting Issues in International Transformation*, 189.
- Isaksen, A., Tödting, F., & Trippel, M. (2018). Innovation policies for regional structural change: Combining actor-based and system-based strategies (pp. 221-238). Springer International Publishing.
- Isaksen, A., Trippel, M., & Mayer, H. (2022). Regional innovation systems in an era of grand societal challenges: Reorientation versus transformation. *European planning studies*, 30(11), 2125-2138.
- Jackson, J. (2023). (Re) coordinating the German Political Economy: E-mobility and the Verkehrswende. *German Politics*, 1-23.
- Jasanoff, S., & Kim, S. H. (2015). *Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power*. University of Chicago Press.
- Jeannerat, H., & Crevoisier, O. (2011). Non-technological innovation and multi-local territorial knowledge dynamics in the Swiss watch industry. *International Journal of Innovation and Regional Development*, 3(1), 26-44.
- Mazzucato, M. (2011). The entrepreneurial state. *Soundings*, 49(49), 131-142.
- Meckling, J., & Nahm, J. (2018). When do states disrupt industries? Electric cars and the politics of innovation. *Review of International Political Economy*, 25(4), 505-529.
- Mögele, M., & Rau, H. (2020). Cultivating the “car state”: a culturally sensitive analysis of car-centric discourses and mobility cultures in Southern Germany. *Sustainability: Science, Practice and Policy*, 16(1), 15-28.
- Murphy, J. T. (2015). Human geography and socio-technical transition studies: Promising intersections. *Environmental innovation and societal transitions*, 17, 73-91.
- O’Brien, K. (2012). Global environmental change II: From adaptation to deliberate transformation. *Progress in human geography*, 36(5), 667-676.
- Paasi, A. (1986). The institutionalization of regions: a theoretical framework for understanding the emergence of regions and the constitution of regional identity. *Fennia-International Journal of Geography*, 164(1), 105-146.
- Pfotenhauer, S. M., Wentland, A., & Ruge, L. (2023). Understanding regional innovation cultures: Narratives, directionality, and conservative innovation in Bavaria. *Research Policy*, 52(3), 104704.
- Pierce, J., Martin, D. G., & Murphy, J. T. (2011). Relational place-making: the networked politics of place. *Transactions of the Institute of British Geographers*, 36(1), 54-70.
- Piore, M. J., & Sabel, C. F. (1984). The second industrial divide: possibilities for prosperity.
- Richter, I., & Haas, T. (2020). Greening the car? Conflict dynamics within the German platform for electric mobility. *Sustainability*, 12(19), 8043.
- Rodríguez-Pose, A. (2018). The revenge of the places that don't matter (and what to do about it). *Cambridge journal of regions, economy and society*, 11(1), 189-209.
- Rodríguez-Pose, A., & Bartalucci, F. (2023). The green transition and its potential territorial discontents. *Cambridge Journal of Regions, Economy and Society*.
- Saxenian, A. (1996). *Regional advantage: Culture and competition in silicon valley and route 128, with a new preface by the author*. Harvard University Press.

- Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research policy*, 47(9), 1554-1567.
- Šifta, M., & Chromý, P. (2017). The importance of symbols in the region formation process. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography*, 71(2), 98-113.
- Storper, M., Kemeny, T., Makarem, N., & Osman, T. (2015). *The rise and fall of urban economies: Lessons from San Francisco and Los Angeles*. Stanford University Press.
- SDA Progress Report (2021). https://stm.baden-wuerttemberg.de/fileadmin/redaktion/dateien/PDF/SDA_BW/211028_SDA_Fortschrittsbericht_2021.pdf
- SDA Progress Report (2022). https://stm.baden-wuerttemberg.de/fileadmin/redaktion/dateien/PDF/SDA_BW/221116_SDA_Fifth-progress_report_October-2022_EN_Web.pdf
- Seawright, J., & Gerring, J. (2008). Case selection techniques in case study research: A menu of qualitative and quantitative options. *Political research quarterly*, 61(2), 294-308.
- Shi, X., & Shi, Y. (2022). Unpacking the process of resource allocation within an entrepreneurial ecosystem. *Research Policy*, 51(9), 104378.
- Stahlecker, T., & Zenker, A. (2017). The Baden-Württemberg innovation system in transition: Players face new challenges. *Site*. 41:180-185.
- Storper, M. (1995). The resurgence of regional economies, ten years later: the region as a nexus of untraded interdependencies. *European urban and regional studies*, 2(3), 191-221.
- .
- Stuttgarter Zeitung. (2011). Winfried Kretschmann: "Weniger Autos sind besser als mehr". <https://www.stuttgarter-zeitung.de/inhalt.winfried-kretschmann-weniger-autos-sind-besser-als-mehr.21ab2ee5-6c1b-4cc1-ad17-31a3a4f6cb3e.html>
- Tödting, F., & Tripl, M. (2018). Regional innovation policies for new path development—beyond neo-liberal and traditional systemic views. *European Planning Studies*, 26(9), 1779-1795.
- Tödting, F., Tripl, M., & Desch, V. (2022). New directions for RIS studies and policies in the face of grand societal challenges. *European Planning Studies*, 30(11), 2139-2156.
- Tripl, M., Baumgartinger-Seiringer, S., Frangenheim, A., Isaksen, A., & Rypestøl, J. O. (2020). Unravelling green regional industrial path development: Regional preconditions, asset modification and agency. *Geoforum*, 111, 189-197.
- Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework. *Research policy*, 41(6), 1037-1047.
- Wentland, A. (2017). An automobile nation at the crossroads: Reimagining Germany's car society through the electrification of transportation 1. In *Imagined futures in science, technology and society* (pp. 137-165). Routledge.
- Zimmerbauer, K., & Paasi, A. (2013). When old and new regionalism collide: Deinstitutionalization of regions and resistance identity in municipality amalgamations. *Journal of Rural Studies*, 30, 31-40.

Appendix 1. key information of Interviewee

Number	Interview partners	Functions
Government and politicians (Gov)		
1	Bundesanstalt für Geowissenschaften und Rohstoffe (BGR, BMWK)	Economic analyst
2	Ministry of Economics, Labor and Tourism, Baden-Württemberg	Regional economic policy office
3	Ministry of Transport, Baden-Württemberg	Electromobility department
4	Verband Region Stuttgart	Regional Assembly
Firms		
1	Cellforce	Engineer
2	Mercedes-Benz	Senior employee, emobility
3	Daimler	Senior employee, emobility group
4	SAP	Engineer for emobility
5	VDI-VDE	Senior consultant
6	P3-Group	Industry analyst
7	M-Five	Industry analyst
8	Accrec	Battery scientist
9	Agora Verkehrswende	Emobility project manager
10	EnBW	Emobility director
Research organizations and universities (ReOrg.)		
1	IFRI, France	Researcher in European energy and climate policies
2	KIT, wbk, Institute for Production (Fit4E)	Scientist and engineer
3	University of Freiburg	Professor in regional development and sustainability
4	Fraunhofer IOSB	Senior scientists on emobility
5	Fraunhofer ISI	Head of the Competence Center New Technologies
6	Fraunhofer ISI	Scientist and project manager
7	Fraunhofer ISI	Senior scientist
8	University of Stuttgart	Postdoc, Automotive engineering
9	Fraunhofer ISI	Professor in regional studies
10	Fraunhofer ISI	Senior scientist in regional studies
11	Fraunhofer FFB	Head of Division at the Fraunhofer FFB

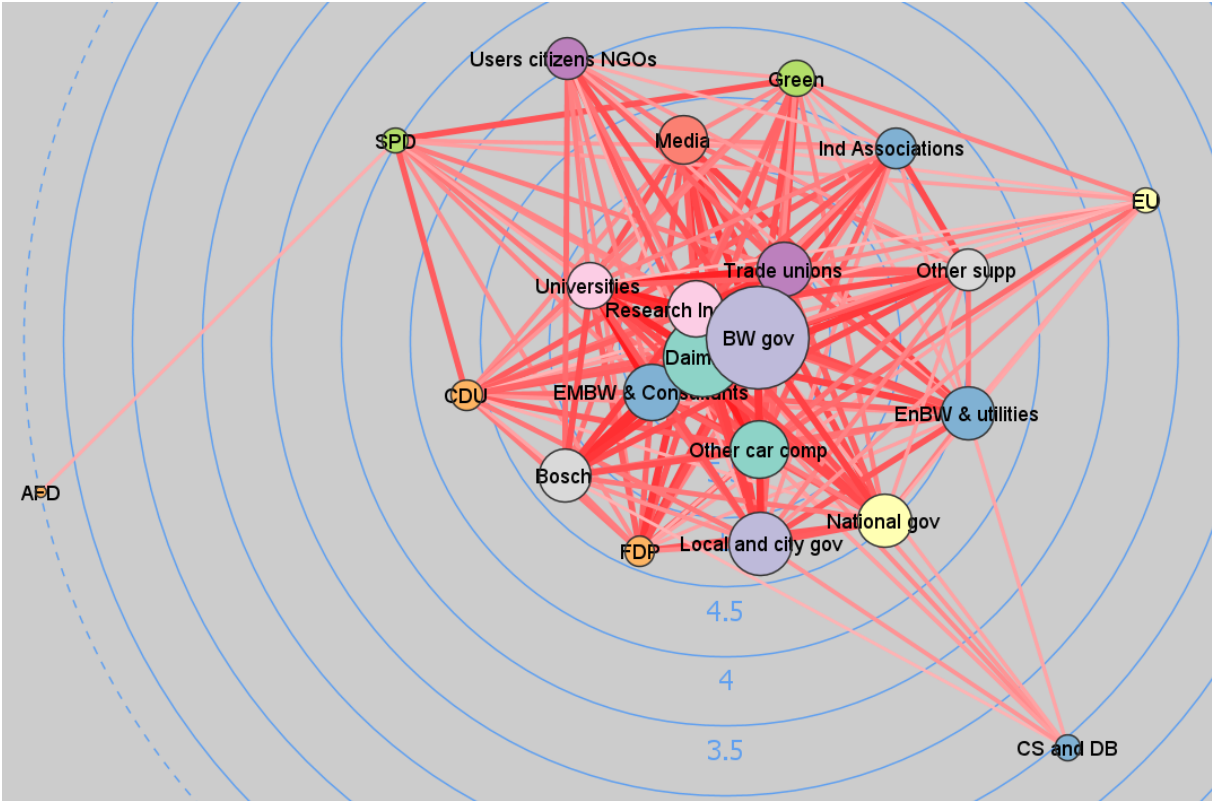
12	KIT	Institute for Technology Assessment and Systems Analysis
13	KIT	Battery technology center
14	University of Uppsala	Scientist in Emobility
15	University of Munich	Social scientists on emobility in Germany
Intermediary and network organizations (Interm.)		
1	Stuttgart Region Economic Development Corporation	Senior analyst
2	E-mobil BW	Head of the project and cluster activities division
3	E-mobil BW	Senior manager
4	Cluster Elektromobilität Süd-West	Group lead
5	Chamber of commerce Stuttgart Region IHK	Emobility promotion
6	IG Metall Baden-Württemberg	PR manager
7	VDMA	Emobility
8	Baden-Wüttermberg International (China)	CEO

Appendix 2: Coding tree of STCA analysis

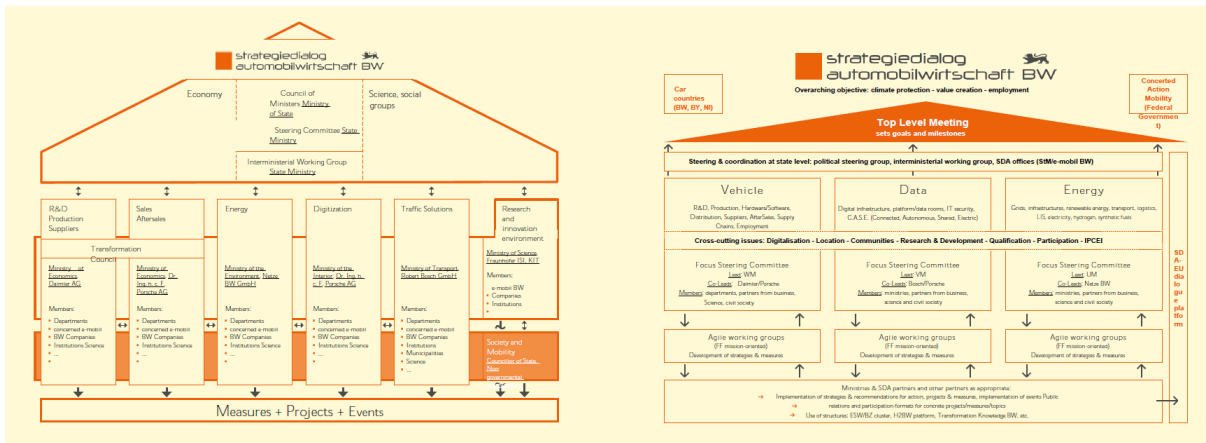
Codes	Explanation	# of times coded
1.1 Transp unsust	General statements about current modes of automobile transport being not sustainable	15
1.2 ICE remains dominant		
1.2.1 ICE dominant future	Statements about ICE remaining dominant at least for the next 20 years	30
1.2.2 EM Niche weak	Problems with EV technology hampering a rapid diffusion of the technology	26
1.2.3 ICE not dissappear	Assertion that the ICE drivetrain will still be strong in the future	24
1.3 EM strong future		
1.3.1 EM relevant option	EM being something to consider in the future mostly in the context of niche applications	29
1.3.2 EM dominant future	EM becoming the new key technology of the automobile sector, replacing the ICE paradigm	23
1.3.3 End of ICE	ICE not having any future and soon being replaced by EVs	19
1.3.4 Transition needed	General references that a deep transformation has to happen to tackle emerging grand challenges	19
1.3.5 Diesel gate	Reports about the diesel scandal unfolding, mostly referring to a de-legitimation of the ICE strategy	5
1.4 Gov support needed		
1.4.1 Support policies	General call for support policies from government	31
1.4.2 Research prog and startups	Specific calls for launching research programs on specific issues	23
1.4.3 Demonstr and clusters	Calls and activities regarding experiments with implementations and promotion of technology clusters	31
1.5 RIS strength		
1.5.1 Strong BW RIS	Assertions that BW has a strong RIS, has survived many challenges in the past and will do so in the future	16
1.5.2 Joint RIS development	Need for a coordinated strategy within the BW RIS	32
1.5.3 Future mob imaginary	General references to a new vision for the core industrial competence and leadership position of the region	35
1.5.4 Cross-sector synergies	Reference to other industrial competencies in the region that will support the transition, in particular ICT	8
1.5.5 Cradle imaginary	Literal reference to the „cradle of the automobile” label as support for the ability to deal with the emerging challenges.	16
1.6 BW falls behind		
1.6.1 BW is lagging	Fear of the region of being outpaced by international competition	21
1.6.2 Disruptive dynamics	Fear of having to pay a very high cost during the transition	24
1.7 International influence		
1.7.1 Intern competition	General references to developments in other car producing regions globally	26
1.7.2 Intern collaborations	Reports about collaborations with international companies	10

1.8 Labor market		
1.8.1 Impacts on LabMarket	Concerns about the disruptions of a future transition on regional jobs	34
1.8.2 Invest in knowl base	Calls for activities of retraining	31
1.9 Mob Services		
1.9.1 Sustainable transport	General claims to move towards more sustainable forms of transport	17
1.9.2 Integr mob concepts	Specific calls for investing in integrated mobility forms	15
1.9.3 ICT and KI	Specific references to new ICT and AI tools that will support future mobility forms	16
1.10 Electric cars dev	References to specific innovation activities in the field of electric car developments	16
1.11 Infra and batteries		
1.11.1 Grid capacity	Statements about fears on impacts on and investments in the electric grid to accommodate to the increasing connection of EVs.	19
1.11.2 Battery dev	Calls for battery development and investments in production capacity	26
1.11.3 Charging infra	Reports about (plans of) investments in recharging infrastructures.	46
1.12 Manufact and infrainvest	Reports about actual investments in manufacturing and infrastructures	33
1.13 Inst Innovation		
1.13.1 New Busin models	Questions of Business model innovation in the context of new mobility forms	11
1.13.2 Instit Change	General reference to needed changes in terms of regulations, preferences and values	15
1.14 Alt Mobforms		
1.14.1 Fuelcells and Hydrogen	Reports about fuel cells and hydrogen activities	25
1.14.2 Carsharing	Reports about carsharing investments	14
1.14.3 Auton cars	Claims that autonomous cars will be an important future option	9
1.14.4 Efuels	References to e-fuels as an alternative to gasoline	4

Appendix 3: Actor congruence networks 2010-2023: Cosine, BB filter 0.3



Appendix 4: Change of the SDA structure and working methods in 2022



Source: SDA progress report 2021

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