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Reconsidering regional structural conditions for industrial renewal

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ABSTRACT

This article develops a more comprehensive understanding of innovation-based renewal of industries from a structural perspective. Arguably, established perspectives offer rather simplistic views, portraying structures as either enabling or constraining for certain forms of regional industrial change. Inspired by work in organizational institutionalism on 'institutional infrastructures', this article focuses on the degree of elaboration and coherence as decisive features of regional structural conditions. Arguably, this conceptual lens allows for a better understanding of the potentials and limitations for industrial change entailed in different structural configurations. Empirically, we investigate renewal processes in traditional automotive regions in Austria and Sweden.

KEYWORDS

path renewal; institutional infrastructure; structures; elaboration; coherence

JEL O33, R11, R58

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INTRODUCTION

In light of 'grand challenges' such as digitalization or sustainability, the question of how established industries can adapt and renew themselves in order to maintain their economic strength has increasingly gained in importance in academic and policy debates alike (Markard et al., 2012; Organisation for Economic Co-operation and Development (OECD), 2015). It is widely acknowledged that the renewal capacity of an industry is inextricably linked to its ability to innovate. A key research focus thus concerns the identification of favourable economic, social, cultural and institutional structural conditions (Martin, 2010) for the generation and diffusion of innovations that will sustain the success of an industry in the long run.

How innovation-based industry renewal unfolds is a core topic in economic geography and innovation studies. Especially work in Evolutionary Economic Geography (EEG) has helped to specify what structural preconditions matter for regional industrial change, placing an emphasis on assets, skills, connections and competencies inherited from previous rounds of development, which are said to shape present and future activities. Regional industrial change is thus conceived as a 'path-dependent' process. Since assets, competencies and skills acquired in the past are often regionally bound, innovation-driven industrial dynamics are seen as highly localized phenomena (Martin, 2010). Further, EEG directs attention to technological and knowledge-related assets within regions (Boschma & Frenken, 2011). This view, however, has attracted criticism for being too narrow, neglecting other important factors for changes of regional industries such as endowments of formal and informal institutions, support organizations like universities, intermediaries and so on (Carvalho & Vale, 2018; Hassink et al., 2019).

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Adopting a broader view and seeking to capture the wider structural conditions that influence the rate and direction of regional industrial change, scholars have begun to invoke insights from the literature on regional innovation systems (RIS) (Isaksen & Trippl, 2016; Trippl et al., 2020) and institutional thickness (Amin & Thrift, 1994; Zukauskaite et al., 2017). This has enriched our understanding of the role played by different actors, network constellations and institutional fabrics at different spatial scales in regional industrial dynamics.

However, this work still suggests a rather simplistic perspective on structures as being either constraining or enabling, leaving little room for discussing the manifold effects regional structural circumstances might have on the development of an industry. Therefore, the aim of this article is to advance a comprehensive perspective on the role of structural conditions for industrial change in regional contexts to better understand why some regional industries succeed in renewing themselves while others fail.

We contend that economic geography may benefit from a deeper exchange with other disciplines in the social sciences, which have explored the relationship between various forms of structures and change processes. In this article, we argue for the value of recent work on 'institutional infrastructure', a concept developed within organizational institutionalism in sociology, for conceptualizing the transformative capacity of regional industries.

Institutional infrastructure as a concept draws attention to different formal and informal structures (made up of collective interest organizations, regulators and regulations, standards, informal norms, etc.) that govern industrial dynamics, contributing to either stability or transformation (Greenwood et al., 2011; Hinings et al., 2017). Besides identifying structures that are particularly relevant for change processes in a particular industry, the concept focuses attention on the degree of elaboration of the infrastructure (i.e., the number and degree of the institutionalization of structural elements) as well as its coherence (i.e., the degree to which structural components are mutually reinforcing one another). While certain industries seem to have an institutional infrastructure that is well aligned, others can be characterized by a conflicting or poorly developed infrastructure. A core assumption in this article is that the elaboration and coherence of this infrastructure will have important implications for the initiation and unfolding of transformation processes of industries in regions.

The remainder of the article is structured as follows. In the second section, we discuss why it is necessary to take on a more comprehensive approach to structures in order to understand industrial renewal. We then provide in the third section a literature review of some of the most important work in institutional theory, focusing on the notion of institutional infrastructure. In the fourth section we develop a framework that explains how elaboration and coherence of structural conditions might affect innovation-based industrial renewal. In the fifth section, we use the framework to analyse two automotive regions in transition. The sixth section concludes.

CONVENTIONAL PERSPECTIVES ON THE ROLE OF STRUCTURES IN REGIONAL INDUSTRIAL CHANGE

EEG explains industrial change through diversification processes stimulated by recombinations of complementary and related capabilities on the firm level (Boschma & Frenken, 2011). Knowledge dynamics, technological competences and skills are thus perceived as essential for the transformation capacity of whole regions or industries.

In essence, this literature puts an emphasis on the diversity and relatedness of regional industrial capabilities, highlighting the positive impact of sectoral related variety for industrial diversification (Boschma, 2017; Neffke et al., 2011). Accordingly, related diversification, that is, the development of new growth paths based on pre-existing capabilities, is considered the main driver of regional economic evolution. In contrast, unrelated diversification is seen as a more exceptional event, coming with higher costs and fundamental uncertainty, but might prove beneficial for regional competitiveness in the longer run (Boschma, 2017). From an EEG perspective, diversity in regional knowledge capabilities is the key factor that determines the scope for innovation. Other structural factors have so far received little attention. One exception is Boschma and Capone's (2015) assessment of the impact of overarching macro-institutional frameworks on diversification patterns. Using the varieties of capitalism approach, they find that liberal market economies are more likely to diversify into more unrelated industries, while coordinated market economies tend to favour related diversification. Such accounts of broadly defined national institutional contexts can however hardly capture the local, place-specific nature of institutional settings (Rodríguez-Pose, 2013).

Most EEG work still focuses on explaining the evolution of regional economies through knowledge dynamics (Hassink et al., 2019). Advocates of the RIS concept propagate a broader perspective on structural preconditions for regional industrial change (Isaksen & Trippl, 2016; Trippl et al., 2020).

An RIS consists not only of the firms and industries located in a region, but also of the wider support organizations (universities, intermediaries, policy actors, etc.) and institutional arrangements, including both formal (regulations, laws) and informal institutions (culture, norms, values) (Asheim & Gertler, 2005). Despite its focus on regional conditions, the concept does not neglect the openness of innovation systems. Regions are influenced by extra-regional linkages and are embedded in institutional setups at higher spatial scales.

Using RIS as conceptual lens, research has sought to unravel the link between (regional) structural conditions and regional industrial change. A common view is that regions, which already host highly successful firms, well-functioning support organizations, networks and

institutional setups, offer a favourable environment for the rise of new economic activities (Tödtling & Trippl, 2013). Isaksen and Trippl (2016) distinguish between three ideal-type regional configurations focusing on the density of firms and support organizations, institutional set-ups and the degree of industrial specialization, and assess the impact of such structural conditions on innovation patterns and new path development within regional economies. They find that organizationally thick and diversified RISs (often found in core regions) are more likely to facilitate new path development and renewal activities than organizationally thick and specialized (old industrial areas) or thin (peripheral regions) RIS. Highly specialized and/or thin structural conditions are believed to favour continuity rather than change.

These contributions imply that once a region provides certain structures, particular types of development are likely to occur. Contrasting this view, we contend that certain structural characteristics should not be seen as enabling or constraining per se. A more promising approach is to unravel the complex implications they hold for a particular industry. While it might be the case that thick and diversified structures offer great potential for industrial change, they may also come with specific barriers hampering innovation. Similarly, thin or highly specialized structures might entail more positive features for regional economic development than commonly thought. Much depends on the context, the configuration of structural elements and the relation between those elements. We believe that recent work in organizational institutionalism offers highly relevant insights in this regard.

ORGANIZATIONAL INSTITUTIONALISM AND THE NOTION OF INSTITUTIONAL INFRASTRUCTURE

In the last decades, institutional theory has been highly influential in organization and management studies to explain organizational behaviour and change (Greenwood et al., 2017). Studies have shown that actors are embedded in an institutional environment that affects their cognition and behaviour and that legitimacy, that is, conforming to that environment, is essential for organizational survival. Many disciplines have since used institutional theory to describe the environment of actors by using Scott's seminal typology of institutions, characterizing them as either regulative (e.g., laws, regulations), normative (e.g., standards, values) or cultural–cognitive constructs (e.g., categories, typifications), each with its own way of shaping organizations and their behaviour (Scott, 1995).

However, institutional theory has more to offer than the mere conceptualization of institutions. There is also a long tradition to study field-level change. The organizational field is a concept that depicts the relevant institutional environment for a given set of actors. Fields have been defined in various ways (for an overview, see Wooten & Hoffman, 2008; Zietsma et al., 2017), but in general they refer to 'a recognized area of institutional life' (DiMaggio & Powell, 1983, p. 148) or 'a common meaning system' (Scott, 2014, p. 106). Fields typically exhibit a specific actor network that is based on an increased frequency of interaction among its actors; particular power relations and status hierarchies among actors; shared meanings and practices as well as a shared identity, that is, a mutual awareness of each other and the dominant rules of the games (DiMaggio & Powell, 1983; Zietsma et al., 2017). Industries, such as forestry, accounting, building, textiles, art, etc. are prime examples of organizational fields where such dominant rules of the game develop. These rules of the game have also been referred to as institutional logics, defined as 'the set of material practices and symbolic systems including assumptions, values, and beliefs by which individuals and organizations provide meaning to their daily activity, organize time and space, and reproduce their lives and experience' (Thornton et al., 2012, p. 2).

Research has furthermore shown that fields differ in their capacity to innovate and change. This has primarily been tied to the presence of a specific institutional infrastructure, and in particular its degree of elaboration and coherence. The notion of institutional infrastructure is suggested as a way to 'define and typologize field conditions' (Hinings et al., 2017, p. 167). In its essence, institutional infrastructure refers to the formal and informal mechanisms in a field that reproduce or change the dominant rules of the game. It can be regarded as 'the cultural, structural and relational elements that generate the normative, cognitive and regulative forces that reinforce field governance, and render field logics material and field governance performable' (Hinings et al., 2017, pp. 163–164).

Hinings et al. (2017) reviewed a large range of studies that implicitly or explicitly deal with some aspects of institutional infrastructure and developed a list of elements to be considered (see Table A1 in the supplemental data online, and elaborated in more detail below). They refer to a specific type of structure that is particularly important for the maintenance and/or change of the dominant rules of the game and as a consequence crucial for field-level change.

Institutional infrastructure specifies those cultural, relational and structural elements that research has shown to be crucial for the reproduction and/or change in a field because they are instrumental in creating, maintaining and disrupting institutions and in materializing and solidifying them into field level practices. Collective interest organizations, for instance, have been vital in all forms of lobbying processes for regulations, standards, resource mobilization or policies. A high density of interest organizations in a field will arguably have an effect on how the field is organized, what can be done and what not and who has power and authority. Regulatory bodies enable and constrain action, and thus have an effect on what gets institutionalized or deinstitutionalized. The presence of an environmental protection agency or a ministry for innovation not only shows the relevance of these issues for the field, but it can also be assumed that institutions around environmental protection or innovation

will develop, for example, funding schemes, tax incentives, patent laws, industrial policies, and societal values and visions. This, in turn, will affect which types of knowledge are generated and which types of technologies will be developed and diffused. The presence of many informal governance bodies usually is an indication that the field is highly organized and many beliefs, values and ideas have solidified into specific standards and norms that affect the future development of the industry. In addition, educational programs, professional associations or normative networks can all be considered infrastructure elements with a high definitional authority. Their function regarding the definition of legitimacy is very crucial and many institutions get build up or torn down through processes within these types of infrastructures.

However, the concept of institutional infrastructure not only specifies the set of structural elements that prevail in a field, but – more importantly – assesses how they work in concert (Hinings et al., 2017). The idea is to understand the condition of a field and its transformative capacity, which is linked to (1) the degree of elaboration and (2) the coherence of the elements that together form the institutional infrastructure (Zietsma et al., 2017).

First, the degree of elaboration of the infrastructure in a field varies and has consequences for field activity. The different elements can be institutionalized to different degrees (or be lacking altogether). There is a difference between highly established, mature fields where a highly elaborated institutional infrastructure has developed over a long period of time that almost automatically reproduces the rules of the game, and the emerging field, where the dominant designs, values, practices and meanings still have to be negotiated and the infrastructure is under construction. Research indicates that the power of structures increases with their degree of institutionalization and that therefore fields with a highly elaborated institutional infrastructure are more stable (Barley & Tolbert, 1997; Zucker, 1977).

Arguably, a high elaboration of institutional infrastructure may not only hamper but could also benefit processes of change. Considering the fact that institutional infrastructure is important not only for the maintenance of the rules of the game, but also its (de)institutionalization, one could assume that having a strong infrastructure in place is necessary for incorporating change. Examples may include the development of new standards, new training programs, new regulations, new awards, new events, etc.

Second, the condition and transformative capacity of a field is influenced by the degree of coherence of its infrastructure. This refers to the question of whether the infrastructure elements are reinforcing each other and are aligned around a unitary institutional logic, that is, a coherent rationality in the dominant rules of the game, or whether they are mirroring different rationalities that can be competing or in conflict with each other. This is reflected in the notion of institutional complexity (Greenwood et al., 2011). Fields that feature a high institutional complexity come with incompatibilities and diverging meaning, practices and prescriptions for action (Hinings et al., 2017; Zietsma et al., 2017). In contrast, fields with low institutional complexity are settled around one logic with high levels of consistency and predictability (Greenwood et al., 2011).

Overall, the concept of institutional infrastructure specifies the set of structural elements that prevail in a field and considers them together. It focuses attention to the degree of elaboration/institutionalization of a field as well as its coherence and provides a new perspective on the relationship between structural conditions and field maintenance and change (Hinings et al., 2017; Zietsma et al., 2017).

IMPLICATIONS FOR STUDYING INNOVATION-BASED REGIONAL INDUSTRIAL RENEWAL

The notion of institutional infrastructure offers valuable insights for studying the role of regional structural conditions in industry renewal. It helps to assess and compare specific structures that enable, hinder and shape processes of innovation-based change and path development in particular industries. Therefore, investigating the role of institutional infrastructure, its degree of elaboration and coherence is a way to improve our understanding of industrial change from an institutional perspective.

Hinings et al. (2017) and Zietsma et al. (2017) review a large variety of empirical case studies (often focusing on industries, i.e., organizational fields) that either implicitly or explicitly deal with institutional infrastructure and its implication for field-level change. In this section, we seek to systematize these implications for studying innovation-based regional path renewal. Hence, we focus on an industry in a specific region. However, it is important to note that some of the relevant structural elements (e.g., regulatory or educational bodies, standard setting agencies, etc.) might be located elsewhere and still have significant influence on the regional industry's development. Thus, the elements are of multi-scalar nature.

At the same time, there might be structural elements in place at the regional level that are virtually irrelevant for the industry under consideration but are rather tailored to the needs of other sectors located in the region. Herein lies an important difference between the approach proposed in this article and the RIS concept. Both offer relatively broad perspectives on structural conditions. However, the former defines the set of relevant structural elements for a particular industry, while the latter incorporates the setup for the entire regional economy. While both approaches have their merits (see also conclusions), it is argued here that the concept of institutional infrastructure is better suited to unravel how relevant structural elements operate in concert (Hinings et al., 2017) and, hence, allows for a more nuanced understanding of enabling and constraining conditions residing in different structural configurations.

This section is structured as follows. First, we discuss different degrees of elaboration and coherence and the

potentials for and constraints to innovation-based renewal they hold. Second, based on these two characteristics, we zoom in on different types of structural conditions and unravel how they may affect the initiation and unfolding of transformation processes of regional industries.

To begin with, the structural elaboration (i.e., the number and development of structural elements for a particular industry in a region) might be either high or low (Hinings et al., 2017; Zietsma et al., 2017).

High elaboration implies that a large number of elements – often substantially developed – are in place. This resembles the notion of thickness of relevant regional structures for a particular industry (Zukauskaite et al., 2017). On the one side, this variety of structural elements can be used as a platform to bring innovation-based change processes forward (Trippl et al., 2020). Thus, change processes may diffuse and consolidate quickly through well-developed elements, such as education programmes, industry associations or field configuring events (Hinings et al., 2017). On the other side, the presence of many elements – such as regulators, collective interest organizations or status differentiators – requires alteration of a large number of structural components. In other words, many locks might have to be unlocked to trigger change and structures can form strong and overlapping entry barriers, making highly elaborated structural configurations rather resistant to change (Hinings et al., 2017). An important reason is that support for established industries is often strongly institutionalized within the elements that reproduce the dominant rules of the game, making it difficult for change processes to break through (Kivimaa & Kern, 2016).

In contrast, *low elaboration* indicates a poor endowment of infrastructural elements and a weakly built-up infrastructure (thinness). Such structural conditions might be beneficial for innovation-based change processes, as they offer leeway, autonomy and flexibility for the creation of novelty (Hollingsworth, 2000). Zietsma et al. (2017) highlight that low elaboration might provide space for innovation and also weaker field boundaries. Accordingly, one can expect little resistance and considerable experimentation due to the lack of structural components as well as easy access of new actors because of low entry barriers (Hinings et al., 2017; Logue, 2014). However, the lack of structural preconditions might also form a strong barrier to change, as there is no platform to set alterations in motion; that is, there are no elements in place through which change can be distributed. This might be particularly problematic after the initiation and experimentation stage, when accelerating and consolidating change becomes vital (Baumgartinger-Seiringer et al., 2021).

Regarding coherence, that is, the degree to which structural components are mutually reinforcing one another, Hinings et al. (2017) and Zietsma et al. (2017) differentiate between high coherence ('unitary') and low coherence ('competing').

When elements are in a state of *high coherence*, strong agreement on general principles, values and directions is likely (Zietsma et al., 2017). This means that the diffusion of change is facilitated and conflicts can be expected to occur rarely. However, strong ties and reinforcement between structural elements might also be a source of rigidity (Hinings et al., 2017), leading to high resistance to change in the first place (Grabher, 1993) and periods of path dependence and continuity (Empson et al., 2015). Swimming against the stream is often difficult. Hollingsworth (2000) points out that in settings where pressures to conform are greatest, individuals have relatively low autonomy to pursue independent strategies, leading to organizational isomorphism. Accordingly, the initiation of change in highly coherent structures is often hampered; yet, once initiated, change is likely to be diffused rapidly.

In contrast, *low coherence*, on the one hand, might stimulate change, as it might entail an increased capacity to adapt to new circumstances, in particular in early phases (Logue, 2014). Where pressures to conform are weak, actors have greater autonomy to respond to new developments and to be innovative (Hollingsworth, 2000). Additionally, dissent may lead to higher levels of competition between different visions and directions of change, which might have a stimulating effect. On the other hand, low levels of coherence will often go along with fragmentation and conflict, thereby paralyzing an industry. Furthermore, low levels of exchange and collaboration within a region might weaken path development activities due to weak positive lock-in effects (Martin & Sunley, 2006). Accordingly, in weakly coherent structures, the initiation of change is facilitated. At the same time, conflicts concerning the direction of change are likely. As a consequence, change might be frequent, yet difficult to consolidate (Hinings et al., 2017).

Based on these considerations, it is possible to categorize regional industries depending on their elaboration (high and low) and coherence (unitary and competing). This typology of structural configurations (Table 1) offers the basis for a more nuanced discussion of the connection between structural conditions and regional industrial change processes.

As indicated by the discussion above, the connection between structural conditions and regional industrial change can only be fully grasped against the background of the relationship between structures and agency

Table 1. Institutional infrastructure and different structural configurations.

	Unitary (high coherence)	**Competing (low coherence)**
High elaboration	Established	Contested
Low elaboration	Aligned/emerging	Fragmented

Source: Based on Hinings et al. (2017).

(Grillitsch & Sotarauta, 2020). As Zietsma et al. (2017, p. 404) point out, the different types of structural configurations 'have significant impact on the agency that is possible for various actors within the field'. Therefore, the influence of structural configurations on the pace and scope of innovation-based alterations is strongly connected to the embedded actors' capacity to generate (or prevent) change. This capacity is not distributed equally among all actors. It rather depends on the individual subject's position occupied in the field, which – in turn – might be reinforced by the prevailing structural conditions (Battilana, 2006). This has two important implications. First, these structural conditions entail a 'systematic bias' and might privilege (or create barriers to) one group over another in terms of their scope of action (Hinings et al., 2017, p. 183). The institutional infrastructure in a region is selectively reinforcing some forms of actions and strategies, while hindering or reducing the effect of others (Miörner, 2020). Second, actors (incumbents or newcomers) work on structural elements, that is, they will purposefully try to challenge or maintain elements, depending on whether they hamper or support their intentions (Hinings et al., 2017). This relates to the literature on 'institutional work' that studies 'the purposive action of individuals and organizations aimed at creating, maintaining and disrupting institutions' (Lawrence & Suddaby, 2006, p. 215).

Jolly et al. (2020) have recently introduced a differentiation between change and maintenance agency[1] in the context of regional path development and highlight that both play a crucial role in path development processes. Hinings et al. (2017) argue that efforts geared towards challenging or maintaining structures can be either focused or distributed, coordinated or uncoordinated, complementary or contradictory, depending on the structural conditions. To summarize, it is crucial not only to pay attention to institutional infrastructures but also to their interaction with agency to understand change (Zietsma et al., 2017). This enables us to cast more light on the types of structural conditions and their potentials and opportunities for as well constraints and barriers to industrial change.

Industrial structural conditions that feature both a high elaboration *and* coherence are referred to as *established* (Table 1). These characteristics apply, for instance, to mature and prospering regional industries, with many elements like collective interest organizations, formal regulators, professional associations, informal governance bodies or educational programs in place. These elements bear potential for innovation-based industrial change, as they can be used as channels to distribute and consolidate change. The strongly reinforcing state in these settings can accelerate this process, as agreement on the direction of change is likely. At the same time, change might be hard to set in motion. The reason is that established settings provide a 'distinct dominance order' and influential actors – often incumbents with vested interested – have a strong motivation to preserve this order (Zietsma et al., 2017, p. 402). What is more, the high structural elaboration might form substantial entry barriers for new actors (Hinings et al., 2017). Maintenance agency might thus be relatively focused and coordinated, leading to periods of reproduction, while change agency is likely to be seen as contradictory and inconsistent with the strongly institutionalized ways of doing things. This does not mean that established industries do not change. However, renewal processes might follow a temporal pattern (Baumgartinger-Seiringer et al., 2021). In early stages change might be slow, yet in later stages, it could unfold rapidly.

Structural configurations characterized by a high elaboration but low coherence are described as *contested*. These characteristics apply, for instance, to mature industries that face crises or profound pressures (Empson et al., 2015). The presence of many elements may provide the necessary structures for innovation-based change. In contrast to established settings, both the likelihood for change and conflict about its direction is high. This is because agency is expected to be rather uncoordinated, distributed and often contradictory due to low levels of coherence. This might favour considerable experimentation and competition between old, formerly strongly institutionalized and new ways of doing things (i.e., competition between change and maintenance agency), in particular in early phases of change. However, the many structural elements might constitute locks that need to be unlocked (Zietsma & Lawrence, 2010), making the consolidation in later stages of change relatively difficult. Once a direction has been agreed on, the high structural elaboration might again support change.

Industrial structural conditions that feature a low structural elaboration but high coherence are referred to as *aligned*. Such conditions can be found, for example, in structurally poorly endowed industries that follow relatively clear rationalities (Logue, 2014). Zietsma et al. (2017, p. 418) characterize aligned configurations as 'underorganized domains' that begin to converge around mutual interests, objectives and values between actors. As such, change is likely to be agreed on. Agency in these settings is often focused and coordinated. Poor endowments of structural elements make maintenance agency difficult and change agency likely. Additionally, the low elaboration might provide leeway and opportunity for novelty and poses relatively low entry barriers. However, as many elements have to be built, consolidation might be a lengthy process. Moreover, aligned configurations bear the risk of falling out of alignment due to the lack of structural elaboration and the weak stability coming with it (Zietsma et al., 2017).

Finally, structural configurations that combine a low elaboration and a low coherence can be referred to as *fragmented*. These characteristics apply, for instance, to unsettled industries with limited institutional infrastructure. Different ideas about the way forward exist. In such settings, actors are disconnected, networks and institutional elements prescribing ways of doing things are not fully established (Zietsma et al., 2017). On the one hand, this leads to room for manoeuvre and favours change agency, with hardly any (entry) barriers and little pressure

Table 2. Degrees of elaboration and coherence: implications for change.

	Unitary (high coherence)	Competing (low coherence)
High elaboration	*Established* + structure for change; agreement on objectives – hard to set change in motion	*Contested* + structure for change; likelihood for change – conflict is likely
Low elaboration	*Aligned* + leeway and opportunity, change is likely to be agreed on – long way to go, missing stability	*Fragmented* + extensive room for change – require both 'construction & persuasive work'

Source: Authors' own elaboration.

to conform. On the other hand, the fragmentation and the uncoordinated actions coming with it, as well as the missing structural elements will require both construction and persuasive work to consolidate change in a lengthy and tedious process.

In sum, the concept of institutional infrastructure offers a promising new – and arguably more comprehensive – perspective on the impact of structural configurations on innovation-based industrial change, highlighting both the potentials and constraints held by different types of structural conditions (Table 2).

REGIONAL AUTOMOTIVE INDUSTRIES IN TRANSITION: THE ROLE OF INSTITUTIONAL INFRASTRUCTURES IN WEST SWEDEN AND THE AUSTRIAN TRIANGLE

Employing a comparative case study analysis, this section applies our conceptual framework to two automotive regions in transition: the 'Austrian Triangle' and 'West Sweden'. In both regions, the automotive industry is currently undergoing substantial changes due to increasing digitalization and the advent of connected and automated vehicles (CAVs).

Case comparisons are particularly useful when cases share a set of commonalities, but also display variation on some aspects of theoretical relevance (Rihoux & Lobe, 2009). As the results in this section will show, both the Austrian Triangle and West Sweden are characterized by highly elaborated regional structures that have evolved over long periods of time. However, when comparing the structural preconditions at the time when transformation processes were initiated in the two regions (around 2010), one can find decisive differences. The structural elements in Sweden were less coherent, that is, they were reinforcing each other to a lesser extent than those in Austria. Thus, these two comparable empirical cases are suitable to shed light on theoretically relevant aspects of structural conditions for innovation-based industrial renewal.

Our empirical investigation serves as a first test of the applicability of our conceptual framework. By investigating how the combination of the degree of elaboration and coherence influences change processes extending across different regional industrial contexts, we seek to demonstrate how our reconsideration of the role of structural configurations could help to better understand industrial renewal processes in concrete empirical settings. Moreover, the comparison of the two regional automotive industries provides additional insights into how change processes unfolded under certain structural preconditions, allowing us to draw further conclusions (discussed in the sixth section section).

The empirical analysis is based on an extensive document analysis and 45 in-depth qualitative interviews (25 of them taken in Austria in the first half of 2019 and another 20 one in Sweden between March 2017 and May 2018) with representatives of firms, research organizations, intermediaries and policy makers. Interviews lasted between 30 minutes and two hours, with the majority of them being around one hour. The interviews were semi-structured and organized around themes derived from the conceptual discussion, such as the influence of existing structural conditions, the details of ongoing change processes, and opportunities and challenges. Furthermore, each interview guide was adapted to the particular actor type and case, and reflected our background knowledge of actor characteristics gained through previous interviews or the analysis of secondary material. We identified relevant interview partners based on an initial analysis of secondary data followed by a snowballing method (Valentine, 2005). For each of the two cases, the interview process continued until a point of 'data saturation' (Glaser & Strauss, 2017) was reached. The interviews were transcribed and coded according to a set of theoretically informed categories derived from the conceptual framework (Saldaña, 2015).

The Austrian triangle

Potential within structures

The automotive industry in Austria is one of the country's economic drivers. As much as 10 percent of the workforce depends on the automotive sector (Kleebinder et al., 2019), even though the country does not host any original equipment manufacturers (OEMs). Most activities in the industry are concentrated in three provinces (Upper Austria, Styria, Vienna), which together make up the Austrian automotive triangle. Over decades, supplier firms have developed strong ties to German manufacturers (Trippl

et al., 2021). Our analysis shows that the Austrian automotive triangle can be characterized by its distinctly 'established' structure.

The institutional infrastructure of Austria's automotive triangle is historically established and highly elaborated. A wide array of institutional infrastructure elements is in place. The industry benefits from a number of (often large) educational and research organizations, financial support organizations, infrastructural agencies, governance bodies on both the provincial and federal level, industry associations and intermediaries, all of which contribute to the high elaboration of the automotive region (for a more detailed list, see Table A2 in the supplemental data online). Furthermore, our empirical investigation reveals a historically developed high degree of coherence. First, several interviewees pointed to a 'strong culture of cooperation' between firms, research institutes, universities and the public domain. One firm representative stated: 'Austria is small and Austria's different automotive players are strongly connected indeed, everyone knows everyone, … this is a huge advantage.'

In addition, the institutional infrastructure has reflected the prevalence of a strong engineering culture in Central Europe's automotive industry. Elaborated elements, from educational organizations and governance bodies to certification and regulation agencies, were reinforcing each other, preserving features such as reliability, precision and determinism, which have long been trademarks of the industry.

The recent emission scandal demonstrates the 'dark side' of strongly coherent structures. As one firm representative put it: 'They were blind. The authorities said "that's alright", the engineers said "we know what we are doing" and the laws supported that. … It's one of those systems that slowed itself down.' These structural conditions are vital to understand the transformation and digitalization of the Austrian automotive industry that started to unfold some years ago. The well aligned set of elaborated elements produced relatively stable conditions in which actors were embedded, leading to relatively coordinated maintenance agency. Accordingly, the more radical change processes which are currently observable were largely inconsistent with the way the industry in the Austrian triangle was organized.

Yet, our interviewees have also pointed out that the enabling dimension of strongly elaborated and coherent institutional infrastructures should not be overlooked. Highly elaborated structures offer reliability, even though they might be hampering in early phases of radical change processes. However, in later stages of the path development process, 'established' structures might function as a platform for upscaling and enable more substantial change. For example, a representative from a technical university commented on new agile automotive players in the United States in the following way:

> At some point maybe, these new players will be overtaken by their own agility. The power of innovation may be lost again when they move towards mass production. These are completely different dimensions. Sales, maintenance, all these things are big challenges. … And then it falls back into the established structures again.

Unfolding of change

The increasing digitalization and the advent of CAVs is a major upheaval for the Austrian automotive triangle and, is reinforced by concerns over the climate crisis, calling for alterations of historically grown structures. However, the initiation of change was slow in the Austrian case that was long in a 'state of self-satisfaction' (firm representative).

Our analysis reveals that after a phase of reluctance, in which change was deterred and seen as contradictory, actors have begun to embrace CAVs as a new field of innovation and value creation. As one interviewed researcher put it: 'Five years ago, it became clear that the classical, mechanical engineering potential for innovation was exhausted; now we have a new hype around CAVs.' The fact that a wide set of coherent elements has to change was and still is connected to various efforts of change agency targeting the reorientation of existing institutional infrastructure elements. The Ministry of Transport and Innovation (BMVIT), research organizations and large automotive and microelectronics firms have started to actively approach the current transformation and digitalization. The office for mobility transitions and decarbonization organized a number of large-scale network meetings with 140 stakeholders that resulted in two strategy plans ('Aktionspläne', 2016–18, 2019–22), outlining the most important measures jointly carried out by actors from industry, policy and academia for this transformation to unfold.[2] The high coherence of the elaborated structures strongly facilitated such a collaborative approach to change, which arguably leads to an even stronger coherence of structures for CAVs in the Austrian triangle.

One of the biggest 'unsettled' issues concerning the current unfolding of change is the integration of information technology (IT) knowledge and norms into rather rigid automotive elements that are still dominated by traditional ways of doing things. Intermediaries are thus eager to facilitate and support the inflow of IT competencies into the car sector, shedding light on change agency in 'established' types of structures. However, an analysis of curricula and interviews taken with representatives of technical universities shows that these reorientation endeavours are still at an early stage in educational organizations, where the distribution between traditional fields and more digital competencies is still strongly tending towards the former.

Drawing on the findings outlined above, one can indeed recognize an acceleration of change after a period of reluctance that is conditioned by certain structural configurations. However, two other decisive factors should be emphasized. First, the recent emission scandal has been an important trigger of change. The aftermath of the scandal clearly shifted incentives away from maintenance to change agency. Second, the BMVIT has been identified

as an important facilitator and coordinator of current transformation activities, demonstrating the role of key actors in orchestrating change processes.

West Sweden

Potential within structures

The region of West Sweden is both the cradle and the heart of the Swedish automotive industry. It hosts the headquarters of OEMs such as Volvo Cars and Volvo Group (parent company for Volvo Trucks, Volvo Buses and others), as well as a range of suppliers, automotive technology firms and consultancies, catering to local as well as global markets (Miörner & Trippl, 2019). Similar to the Austrian automotive triangle, the institutional infrastructure of West Sweden's automotive industry is highly elaborated. A range of well-developed elements reflect the industry's long and successful history. The region hosts various educational and research organizations, science parks, cluster organizations and incubators, testbeds, innovation support initiatives, governance bodies at the local, regional and national levels, and funding organizations (for a detailed list, see Table A2 in the supplemental data online).

In terms of coherence, previous studies point to a high degree of coherence as a significant characteristic of the regional industry from a historical perspective, with strong reinforcing effects between the elements (James et al., 2016). However, both elaboration and coherence declined in the late 1990s and early 2000s. In that period the regional industry was realigning towards more technology-focused 'active' safety features as the primary competitive edge (James et al., 2016). Nevertheless, while the elaboration of the institutional infrastructure quickly increased again after the global financial crisis, it had not regained the strong coherence that had characterized the industry historically. Accordingly, in contrast to the Austrian triangle, regional automotive structures in West Sweden were characterized by a lower degree of coherence around 2010. The different elements were reinforcing each other to a lesser extent.

In other words, our empirical analysis reveals that West Sweden can be characterized as a 'contested' structure, with institutional infrastructure elements pointing towards different, sometimes contradictory, directions of change, rationalities and logics. Associated with the thematic shift towards active safety technology in the regional automotive industry, several interviewees pointed at a divide between the traditionally oriented development of 'hardware' versus the development of 'software'. The latter requires more agile ways of working that were somewhat incompatible with established practices. One interviewee from an innovation support organization stated that: 'We can forget the whole old logic. It is no longer possible to talk about vehicle industry, IT industry, and so on. These boundaries have been completely wiped out in the new landscape.'

Our interviews also revealed that around 2012, when autonomous technology was brought into the spotlight of automotive firms, winds of change were already blowing in the industry, fuelled by low levels of coherence and different change directions. Examples include electric vehicles (including battery technology, hybrid technologies), connected vehicles, and various services (e.g., carsharing). Interview results point at safety technology being the lowest common denominator, while 'everything else goes' (Interview with former executive at Volvo Cars).

The relatively low degree of coherence is also exemplified by the fact that a large number of 'fringe' elements have become part of the institutional infrastructure of the regional automotive industry (see above). Instead of being dominated by clearly defined 'automotive' elements, firms in the automotive industry are engaging with infrastructure elements being shared with other regional industries, within cross-industry thematic focus areas. The same goes for educational and research programmes; instead of being oriented at 'automotive technology' they are focusing on broader themes, such as artificial intelligence (AI) and machine learning.

In order to understand the shift towards CAVs, the combination of a high degree of elaboration and relatively low degree of coherence in the institutional infrastructure of the automotive industry has explanatory power. When it comes to potentials for change, 'contested' structures increase the likelihood for change to occur, which was also confirmed by our empirical results. The competition over direction of change in the region provided plenty of opportunities for change agents to pursue their strategies and intentions, and the elaborated institutional infrastructure provided a platform to set in motion change processes. Our empirical analysis shows that the close technological relationship between 'active safety' and 'autonomous technology' meant that many existing infrastructure elements could be used to embrace CAVs (e.g., test infrastructure and funding programmes). For example, one technology expert at Chalmers University said with respect to autonomous technology: 'we already know how to do this'.

Unfolding of change

Initiation of change took place rather quickly. Due to a low degree of coherence, structures were not particularly rigid and it was easy to trigger change processes. Actors had a lot of freedom to engage in change agency, primarily targeting the reorientation of existing elements, but also involving the introduction of new ones focusing explicitly on CAV development.

However, a high degree of elaboration also meant that the initial stage of the change journey became incremental, even though there was a lot of buzz around CAVs. Activities were largely built on the existing ways of doing things of the regional industry. It is possible to argue that firms in the automotive industry went for the 'low hanging fruit', hardly challenging the institutional infrastructure. Interviewees expressed that 'everyone wants to get on board', if not by completely reorienting towards CAVs then at least by aligning one or a few key activities to the emerging theme, but simultaneously balancing with agency targeting the maintenance of status quo. With the large number of well-developed institutional infrastructure elements in

place, interviewees argued that it would not have been a feasible strategy to try to 'change everything at once' (interview with regional industry expert). Nevertheless, the analysis also highlights the introduction of dedicated CAV elements, such as new education programs for automotive artificial intelligence.

In other words, a 'contested' institutional infrastructure featuring a low degree of coherence in terms of technological focus, direction of change, and long-term goals promoted experimentation and transformative efforts among a wide range of actors. In combination with a high degree of elaboration, this meant that actors were incentivised to engage in change agency and the development of solutions related to CAVs defined broadly, sometimes even defined in contradictory ways. For example, organizations such as Lindholmen Science Park provided support to actors that developed new products that would enhance the driving experience in privately owned cars, and to actors that rejected a future with privately owned cars altogether, developing mobility solutions for a future with shared vehicles. It is possible to observe contradictions between emerging activities and prevailing logics in the institutional infrastructure. This is manifested in a tension between change agency opting for radical change, and maintenance agency with the goal of sustaining the status quo to the largest extent possible.

But yet, the existence of a wide range of change directions also enabled the participation of different types of private and public actors, working together under the umbrella of CAVs. For example, through a newly established AI research centre in the region, actors with different goals and ideas about change directions are brought together in AI research, aggregating underlying logics to a kind of 'mission-oriented' one.

COMPARISON AND CONCLUSIONS

This article advocates a more comprehensive understanding of structural conditions for innovation-based regional industrial renewal. Established EEG perspectives portray structures as either enabling or constraining for particular forms of path development, leaving little room for a more in-depth discussion of the implications certain structural configurations hold. Inspired by recent work in organizational institutionalism on 'institutional infrastructures', we propose to focus on the degree of elaboration and coherence as decisive features of regional structural conditions to gain a better understanding of their positive and negative implications for innovation-based regional industrial change. We argue that this conceptual lens allows for a more elaborated discussion of the varying potentials and limitations entailed in different structural conditions.

The comparison of two empirical cases with different structural preconditions demonstrates the applicability of the framework. The Austrian triangle and West Sweden are both traditional automotive regions undergoing profound transformation processes due to the increasing digitalization of the sector and the advent of CAVs. This current upheaval is global in nature and – because of climate change and new, highly innovative players entering the market – affects an industry currently finding itself in distress. It is thus hardly surprising that we can observe parallels between two cases (most notably concerning the clash between traditional 'engineering' logics and new agile, IT-related approaches). Despite similarities, there are a number of differences between the two regions that highlight the place-specific dimension of radical innovation processes. Both regional industries are characterized by historically grown and well-elaborated automotive structures that can – in particular in early phases – pose barriers to change. We found evidence in both cases that the initiation of change was indeed hampered due to its inconsistency with the way the automotive structures were organized. However, West Sweden's 'contested' structural conditions (featuring a lower degree of coherence as a result of a shift towards active safety technologies in the 2000s) were allowing for more experimentation and change agency early on compared with the Austrian triangle with its more 'established' structural conditions, where change is now, after a period of reluctance and maintenance agency, unfolding quickly. These observations are in line with expected distinct temporal patterns of industrial change associated with different structural conditions. Moreover, our empirical investigation points to different routes of transformation. In West Sweden, structural elements formerly only connected to the automotive industry are losing their strong focus, supporting now a wider variety of different regional industrial paths. In contrast, structures in the Austrian triangle have become even more coherent. The complexity of change leads to the reorientation of structural elements and to the prioritization of activities related to CAVs. In this sense, the different structural elements in Austria are now more strongly reinforcing each other in order to advance this transformation.

Importantly, our framework moves structural influences centre stage. Yet, the concept should not overstate their importance at the expense of agency. As outlined above, the different structural configurations 'have significant impact on the agency that is possible for various actors within the field' (Zietsma et al., 2017, p. 404). At the same time, structures are created, maintained and disrupted by the actors who are influenced by these structures in the first place (i.e., 'the paradox of embedded agency'; Hinings et al., 2017, p. 183). Accordingly, it is crucial to examine the impact of varying degrees of elaboration and coherence on innovation-based change in the context of the 'recursive and dialectical' interaction between structure and agency (Lawrence et al., 2011, p. 55). Our empirical investigation confirmed that the different structural conditions in Austria and West Sweden promoted certain types of agency (i.e., activities either oriented towards change or maintenance) while impeding others depending on the stage of the ongoing process of industrial renewal.

Juxtaposing the results of our conceptual and empirical analyses with studies emphasizing 'related variety' as a core explanatory variable for understanding how structural

conditions shape regional path development (Boschma, 2017; Neffke et al., 2011) reveals highly relevant insights. In the Austrian automotive triangle, fitting the description of an 'established' structure, elements were in place to leverage the combination of related capabilities from different sectors, but the very same structures made it hard for actors to set change in motion. In West Sweden, representing a 'contested' structure, existing inter-industry linkages fostered by shared institutional infrastructure elements facilitated the combination of more unrelated capabilities, but transformation processes have been slowed down by the lack of consensus on the direction of change. In other words, our study explicates that focusing on regional knowledge capabilities alone is not sufficient to explain innovation-based renewal processes. Transformative change in regions characterized by highly elaborated institutional infrastructures need to be triggered by actors' agency and depends to a large degree on the continuous reinterpretation and reorientation of existing institutional infrastructures. Related and unrelated diversification must thus be understood as processes that are subjected to both structural influences beyond knowledge capabilities per se (in the current study exemplified by the influence of the degree of elaboration and coherence of existing institutional infrastructures) and agentic processes.

This implies that future studies should pay more attention to the role of other industries located in the region and to their institutional infrastructure. While still under-theorized in the original literature, inter-industry relations have been framed as field overlaps enabling mechanisms of influence (Zietsma et al., 2017). They might have an either positive or negative impact on the development of the industry under consideration. Potentially, an aligned industry (low elaboration and high coherence) might be able to compensate its lack of structural elaboration by drawing on already existing elements or resources from an adjacent field (Hinings et al., 2017). At the same time, an established industry might lose resources to other industries in such a process.

Future work should further exploit the potential benefits of combining institutional perspectives and conceptual apparatuses from economic geography. Our approach directs attention to relevant regional structural elements and their conditions for a particular path. However, the relationship to the broader regional structures requires more investigation.[3] The broader regional setup an industry is embedded in has important implications, opening up promising avenues for future research. First, the link between different configurations of institutional infrastructure (Table 2) and different RIS types (Isaksen & Trippl, 2016) should be examined. It arguably makes a difference for an industry with – for instance – fragmented structural conditions (low elaboration and coherence) whether it is embedded in a thick and diversified, in a thin or in specialized RIS. One could assume that change processes in such an industry are easier to set in motion in the former region than in the latter, as the broad variety of existing elements could be integrated in the industry's institutional infrastructure. Second, the relation between the region and the industry will also depend on the latter's degree of spatial embeddedness. In essence, the stronger the regional embeddedness of an industry, the stronger regional structural conditions will affect its development. In contrast, industries that are oriented globally in terms of their innovation and valuation practices are more independent of regional conditions (Binz & Truffer, 2017). Third, as outlined above, other regional industries play a crucial role. In sum, exploring the role of the region is complex but a promising next step.

Finally, this article is mainly concerned with the influences of structural preconditions on regional industrial change. In line with other recent work (Miörner & Trippl, 2019; Tödtling & Trippl, 2013) and based on our empirical findings, we acknowledge that the structural conditions themselves are often subject to alterations in regional processes of industrial change. Future work should not only focus on the conditions for innovation-based change, but should also examine how structural configurations and the degree of elaboration and coherence are evolving themselves in transformation processes. It would be intriguing to further advance the typology of different configurations presented in Table 2 and develop different pathways of change under these conditions (Hinings et al., 2017).

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NOTES

1. According to Jolly et al. (2020, p. 179), maintenance agency 'involves actions such as introducing new practices to create deterrence for change, supporting the persistence of existing institutional routines, and using narratives to support the routinization of existing practices and adherence to rules'.
2. Among other things, this implies the initiation of projects for real-world testing, newly established professorships, digitalization of existing infrastructure, the stepwise adjustment of the legislative framework, new strategies for enhanced cooperation between different structural elements, reorientation of funding schemes and measures to increase public awareness.

3. We are grateful to an anonymous reviewer for very helpful remarks in this regard.

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