

## Challenge-oriented regional innovation systems: towards a research agenda

Michaela Trippl\*, Simon Baumgartinger-Seiringer\*\*, Jannik Kastrup\*\*\*

Received: 31 October 2023

Accepted: 26 January 2024

### ABSTRACT:

In this *letter*, we reflect on recent modifications of the regional innovation system (RIS) approach that have been prompted by persistent environmental, social, and economic problems. Scholars have begun to advocate a reorientation of the RIS framework towards addressing territorial sustainability challenges and have introduced the notion of challenge-oriented regional innovation systems (CORIS). While the CORIS approach holds promise given the challenges of our time, several unresolved issues remain. We elaborate on and discuss three themes that demand further research. Firstly, there is a need for in-depth studies of the *geographies of problems*. Systematic analyses of the origins and interrelations of territorial challenges are high in demand. Secondly, the *geographies of challenge-oriented innovation-exnovation dynamics* warrant more attention. We argue that future research should delve into questions around the development, testing and upscaling of innovative solutions, as well as the unlocking and destabilisation of unsustainable practices in various spatial contexts. Lastly, we contend that a better understanding of the *geographies of RIS reconfiguration* is necessary. This entails shedding light on various forms of system-level agency involved in reorienting or transforming historically-grown real-world RIS in different types of regions.

**KEYWORDS:** Challenge-orientation; regional innovation systems; CORIS; challenge-oriented regional innovation systems; research agenda.

**JEL CLASSIFICATION:** P48; R11; R58.

## Sistemas regionales de innovación orientados a los retos: hacia un programa de investigación

### RESUMEN:

En esta carta reflexionamos sobre las recientes modificaciones del enfoque de los sistemas regionales de innovación (SRI) impulsadas por los persistentes problemas medioambientales, sociales y económicos. Los especialistas han empezado a abogar por una reorientación del marco de los SRI para abordar los retos de la sostenibilidad territorial y han introducido la noción de sistemas regionales de innovación orientados a los retos (en inglés: *Challenge-Oriented Regional Innovation Systems*, abreviado: CORIS). Aunque el enfoque CORIS resulta prometedor para afrontar los retos de nuestro tiempo, quedan varias cuestiones por resolver. Desarrollamos y debatimos tres temas que exigen más investigación. En primer lugar, es necesario estudiar en profundidad las *geografías de los problemas*. Hay una gran demanda de análisis sistemáticos de los orígenes y las interrelaciones de los retos territoriales. En segundo lugar, las geografías

---

\* Department of Geography and Regional Research, University of Vienna, Vienna, Austria. [michaela.tripp@univie.ac.at](mailto:michaela.tripp@univie.ac.at)

\*\* Department of Geography and Regional Research, University of Vienna, Vienna, Austria. [simon.baumgartinger-seiringer@univie.ac.at](mailto:simon.baumgartinger-seiringer@univie.ac.at)

\*\*\* Department of Geography and Regional Research, University of Vienna, Vienna, Austria. [jannik.kastrup@univie.ac.at](mailto:jannik.kastrup@univie.ac.at)

Corresponding author: [simon.baumgartinger-seiringer@univie.ac.at](mailto:simon.baumgartinger-seiringer@univie.ac.at)

de las dinámicas de innovación-exnovación orientadas a los retos merecen más atención. Sostenemos que la investigación futura debería profundizar en cuestiones relacionadas con el desarrollo, la puesta a prueba y la ampliación de soluciones innovadoras, así como el desbloqueo y la desestabilización de prácticas insostenibles en diversos contextos espaciales. Por último, sostenemos que es necesario comprender mejor la geografía de la reconfiguración de los SRI. Esto implica arrojar luz sobre diversas formas de agencia a nivel de sistema implicadas en la reorientación o transformación de los SRI existentes, incluyendo su evolución marcadamente histórica, que se desarrollan en diferentes tipos de regiones.

**PALABRAS CLAVE:** Orientación a retos; Sistemas Regionales de Innovación; CORIS; Sistemas Regionales de Innovación orientados a retos; programa de investigación.

**CLASIFICACIÓN JEL:** P48; R11; R58.

## 1. INTRODUCTION

Over the course of more than three decades, the RIS approach has spawned an expansive body of literature that explicates the uneven geography of innovation (Cooke, 1992; Asheim et al., 2019). It has also had a significant impact in policy circles, informing place-based innovation strategies and policies such as smart specialisation (Tödtling & Trippl, 2005; Barca et al., 2012; Foray et al., 2012; European Commission, 2014; Foray, 2014; Belussi & Trippl, 2018).

The core argument of the RIS concept<sup>1</sup> is that the innovation capacity of regions is essentially shaped by systemic interdependencies between three RIS elements: actors, networks, and institutions. Interactive learning between firms, research organisations, and policy actors (the so-called triple helix) is considered vital for the innovation performance of regions. Over the past years, a substantial corpus of research has illuminated that regions differ markedly in terms of their endowments of RIS elements, internal connectivity, and external connectedness (Cooke et al., 1997; Tödtling & Trippl, 2005; Asheim et al., 2019). RIS scholarship has thus helped to better understand the spatially uneven structural conditions for novelty generation. In the last decade, the RIS notion was also linked more explicitly to questions around longer-term innovation-based regional economic restructuring, highlighting the role of industrial specialisations, organisational and institutional support structures, and regional networks for the emergence of new industrial paths and the rejuvenation of mature ones (Isaksen & Trippl, 2016, 2017). Acknowledging that RIS are open systems (Belussi et al., 2010), attention is also devoted to the role of global production and innovation networks, market linkages, as well as national and supranational institutional contexts and policies in influencing innovation-driven industrial path development in regions (Binz & Truffer, 2017; Trippl et al., 2018; Hassink et al., 2019).

In recent years, however, the question has been raised as to whether the RIS framework warrants adaptation, given the multiple crises and challenges of our time (Tödtling et al., 2022). The climate urgency, the re-emergence of social and territorial inequalities and other grand societal challenges contribute to the emergence of new risks and confront regions all over the world with an immense imperative for transformation. In this *letter*, we reflect on recent modifications of the RIS approach that have been undertaken in light of this dramatic shift in the contextual conditions for regional innovation and development. RIS scholars propose the notion of challenge-oriented regional innovation systems (CORIS) and advocate new policies that promote place-based transformative change towards sustainability (Bugge et al., 2022; Isaksen et al., 2022; Tödtling et al., 2022; Trippl, 2023).

---

<sup>1</sup> For an in-depth discussion on the origins of the RIS concept and its positioning within the broader literature on territorial innovation models (Moulaert & Sekia, 2003) such as industrial districts (Becattini, 1990; Boix et al., 2015; Belussi & Sedita, 2019), clusters (Porter, 1998; Belussi & Hervás-Olivier, 2018; Belussi & Trippl, 2018; Harris, 2021), innovative milieus (Jeannerat & Crevoisier, 2022) and innovation system approaches (Weber & Truffer, 2017), see, for example, Asheim et al. (2019).

## **2. CHALLENGE-ORIENTED REGIONAL INNOVATION SYSTEMS**

At the outset of this decade, a critical rethinking and reassessment of the RIS approach is underway. Contending with the predominant focus of RIS scholarship on innovation aimed at economic growth and competitiveness, Tödting et al. (2022) championed a modification of the concept and introduced the notion of challenge-oriented regional innovation systems (CORIS). This represents a deliberate endeavour to redirect the RIS approach towards addressing territorial sustainability problems. This rethinking of the RIS concept is situated within the broader context of an evolving trend in economic geography, regional development and innovation studies.

First, several scholars are questioning the prevailing research priorities and theoretical frameworks in regional studies and related fields (Patchell & Hayter, 2013; Phelps et al., 2018; Martin et al., 2021). They call for research that moves beyond the dominant focus on “innovative growth models [that are] often divorced from the broader social and ecological context” (Donald & Gray, 2019, p. 297) and advocate scholarly engagement with an alternative agenda for regional development, one that places less emphasis on short-term economic growth and instead stresses the importance of environmental and social sustainability (Evenhuis, 2017; Morgan, 2019; Jeannerat & Crevosier, 2022; MacKinnon et al., 2022).

Second, in innovation studies, a more critical and progressive understanding of innovation has emerged (Schot & Steinmueller, 2018; Biggi & Giuliani, 2021). The discourse highlights the inherent concern that innovation can have unintended adverse social and ecological consequences, thereby precluding an unequivocal association of innovation with social progress. Questions about the directionality of innovation are increasingly raised and efforts are being made to incorporate societal challenges into innovation system frameworks. This trend is evidenced in the literature on dedicated innovation systems (Pyka, 2017; Schlaile et al., 2017), temporary mission-oriented (or mission-specific) innovation systems (Hekkert et al., 2020; Elzinga et al., 2023), and problem-oriented innovation systems (Ghazinoory et al., 2020).

Third, and closely related to the previous points, in the realm of innovation policy, a new paradigm is emerging. Scholars advocate a reorientation of innovation policy towards societal challenges and explore new ways to legitimise policy interventions. This is clearly reflected in mission-oriented (Mazzucato, 2018) and transformative innovation policy approaches (Schot & Steinmueller, 2018), which have gained increasing attention recently. There is also a growing discussion about spatially sensitive variants of such policy approaches (Flanagan et al., 2023; Henderson et al., 2023; Pontikakis et al., 2022).

The CORIS approach draws inspiration from and ties in with these recent dialogues. It expands the conventional perspective on the purpose of innovation, moving beyond the typical focus on economic growth and competitiveness. CORIS scholarship emphasises addressing place-based problems and needs (Tödting et al., 2022). Dealing with territorial challenges necessitates acknowledging a wider array of innovation activities and agents. The conventional focus of RIS studies and policies on technological innovation in the firm sector is broadened to encompass diverse forms of innovation. These include social, user-driven, and institutional innovations generated by various actors operating in different domains and at multiple spatial scales. In addition to the established triple-helix actors, new and previously overlooked agents – such as civil society groups, public sector actors, municipalities, users, and citizens – are recognised as playing pivotal roles in developing, applying, and scaling innovative solutions for urgent territorial challenges (Tödting et al., 2022; Tripl, 2023; Tripl et al., 2023).

The CORIS approach directs attention to the capacity of regions to address various, and partly interrelated, territorial sustainability problems by developing challenge-oriented initiatives. Following the CORIS framework, this capacity is not only conditioned by regional dynamics but also by non-local processes and the ways a region is embedded in national and supranational regulatory arrangements and policy structures (multi-level governance settings), global innovation and production networks, and trans-local learning linkages (Tödting et al., 2022).

While some progress has been made in elucidating the potential the CORIS framework holds in an era of persistent sustainability problems, several unresolved issues persist. The following sections introduce and discuss three key themes that require further research: (1) the geographies of problems, (2) the

geographies of challenge-oriented innovation-exnovation dynamics and (3) the geographies of RIS reconfiguration.

### 3. GEOGRAPHIES OF PROBLEMS

As noted above, the CORIS approach calls for a stronger alignment of regional innovation and transformation activities with territorial challenges and place-based needs. This constitutes an important shift in focus. The CORIS approach clearly ties in here with recent work that holds that there is not only a geography of innovation but also a geography of problems (McCann & Soete, 2020). To make sense of such claims, more research on the problem endowments and vulnerability of regions and comparative assessments (also based on new measures) are required. Recent work in this field (see, for instance, Rodriguez-Pose & Bartalucci, 2023; OECD, 2023) should be complemented by broadly-designed empirical investigations of the multifaceted and uneven spatial variations of vulnerabilities. But also studies that zoom in on particular regions and their specific challenges will strengthen the emerging research agenda on the geography of problems<sup>2</sup>.

In addition to the **question of their origin** (sustainability problems can range from territorial manifestations of global challenges to very region-specific crises or problems), it should be considered in such research efforts that regions often face multiple problems, and that they can, as emphasised by CORIS protagonists (Tödtling et al., 2022), be **interrelated**. The examination of these interrelations holds significance not only from an academic perspective but also for political decision-making processes. Addressing environmental problems, for example, can at times lead to profound social challenges (Sovacool, 2021). Consequently, conflicts and trade-offs may arise among economic, social, and ecological goals. How regions navigate these complexities merits more in-depth investigations.

A central issue is **which problems are selected and prioritised** in regional innovation and development agendas and how are they framed. These processes can be heavily contested. More research is required that delves into the question of which actors, both within and outside the region, wield power to shape the process of problem selection (and framing) and thus influence the directionality of change (MacKinnon et al., 2022). Without empirical studies that examine and systematically compare these questions for different (types of) regions, statements on problem endowments of regions and quests that innovation activities and policies should respond to territorial challenges remain of little value.

### 4. GEOGRAPHIES OF CHALLENGE-ORIENTED INNOVATION-EXNOVATION DYNAMICS

According to CORIS protagonists (Trippl et al., 2023) and other scholars (Flanagan et al., 2023; Wesseling & Meijerhof, 2023), the framing of problems will also influence how the search for solutions unfolds (for a detailed discussion, see, Flanagan et al., 2023). Moreover, it is stressed that challenge-oriented solutions may not only include innovation activities but also exnovation, that is, the destabilisation of environmentally and socially damaging technologies and practices (Trippl, 2023; Trippl et al. 2023; Wesseling & Meijerhof, 2023).

**Challenge-oriented innovation** is said to encompass the development, testing and upscaling of innovative solutions in the region (and beyond). This might include the development (or importation) of technologies or non-technological solutions, or a combination of both, since many sustainability challenges require an integration of a range of technological and non-technological innovations (Hekkert et al., 2020).

---

<sup>2</sup> It is vital to recognise that challenges can provide opportunities for regions to embark on more socially and ecologically sustainable trajectories. In this sense, the confrontation with challenges – be it region-specific ones or territorial manifestations of global challenges – can become a source of legitimacy for action, sparking new approaches in finding, developing and/or testing solutions, creating knowledge and markets, etc. in affected regions (Uyarra et al., 2023), hence fuelling challenge-oriented initiatives.

Future research should systematically investigate disparities in regional capacities to facilitate challenge-oriented innovations aimed at addressing territorial challenges. This entails an analysis of asset endowments, and the use or repurposing of various assets, in the development of technological, social, institutional, organisational, and behavioural innovations (Tripl et al., 2023). Additionally, it requires scrutinising how external assets are leveraged through connections such as trans-local networks. Attention should also be directed towards understanding the variations of challenge-oriented innovation across different types of regions. In particular, research should focus on the strategies available to less-developed regions (see, e.g., Vale et al., 2023), especially those facing significant “challenge-asset mismatches”.

**Challenge-oriented exnovation** may, in some cases, be crucial for addressing territorial problems. As noted above, challenge-oriented solutions might encompass not only innovation activities, but also the unlocking, destabilisation and phase-out of unsustainable practices, products, technologies, networks, and institutions (Hölscher et al., 2019; Tripl 2023; Tripl et al. 2023; Wesseling & Meijerhof, 2023). Therefore, it is crucial to pay attention to the geographies of exnovation. This has long been a neglected theme in academic and policy debates. But it is now gaining more momentum (Kivimaa & Kern, 2016; Rinscheid et al. 2021). In future CORIS studies, it is essential to address questions related to “breaking with what” that may have persisted in the region for a long time. Alongside a more detailed examination of exnovation necessities and how they vary across different (types of) regions, it is also vital to investigate which actor groups are affected most by exnovation, and equally important, how resistance to change by powerful incumbents and other actors may hamper exnovation efforts. This places a spotlight on the capabilities of regions in identifying the exigencies for exnovation (at the firm-organisational, industry and regional levels), as well as in legitimising and governing exnovation (including handling resistance to exnovation).

It is essential to map and analyse the **nature of challenge-oriented solutions**, since they can take on diverse forms. These solutions may encompass highly technology-focused approaches primarily developed by companies or research organisations. Examples include carbon storage and capture in heavy industry, artificial meat or plant-based milk in the agro-food sector, and wind and solar technologies in the energy sector (Geels, 2020). Other solutions involve a higher degree of social and grassroots innovation, thereby creating significantly more opportunities for previously underrepresented innovation actors to participate (Coenen & Morgan, 2020; Henderson et al., 2023). Examples of such solutions are alternative food networks and urban farming in the agro-food sector, or decentralised energy production by prosumers in the energy sector (see, e.g., Geels, 2020). Further, solutions may, or may not, involve exnovation activities. Another crucial dimension pertains to the gains, that is, the economic, social, or environmental benefits, the proposed solution offers. Some solutions primarily aim for economic gains, while others prioritise public benefits. Finally, one important aspect is their scalability, which entails distinguishing between regionally bound solutions and spatially transferable ones (Coenen et al., 2015). Future research should concentrate on developing robust typologies of solutions based on the criteria mentioned above, as well as other distinguishing factors, to assist empirical studies and facilitate the categorisation of empirical observations.

An important question concerns the willingness and ability of both established actors and new or hitherto neglected ones, to engage in challenge-oriented initiatives. The question arises as to which **governance** setups are best suited to bring together heterogeneous actors with often very different problem definitions, interests, motivations, and perspectives on what desirable solutions are. It is also vital to investigate why some regions succeed to formulate shared visions, set collective priorities, and minimise trade-offs and conflicts, while others fail. Furthermore, the role of regions in complex multi-level governance settings is worthy of more in-depth investigation. This includes the ways in which policies pursued at higher spatial scales affect regional sustainability transitions as well as the transformation opportunities and challenges these policies bring to regions. Moreover, regional contributions to national and supranational policy goals, and how regions mobilise (or not) support from national and EU policies to meet place-specific problems and address broader societal challenges in the region should be further examined.

Finally, the **outcomes** of challenge-oriented solutions need to be thoroughly examined. This entails addressing questions about the extent to which solutions effectively contribute to addressing specific

territorial challenges, what economic, social and environmental gains and costs these solutions generate, and how these are distributed across different actor groups. In this regard, CORIS research would benefit from a deeper engagement with the literature on just transitions (Upham et al. 2023; Eadson & van Veelen, 2023).

## **5. GEOGRAPHIES OF RIS RECONFIGURATION AND CORIS AGENCIES**

Finally, we seek to critically discuss work that has begun to examine how real-world RIS (i.e., the innovation structures that have been built up in the past) (need to) change in order to generate challenge-oriented innovation (and exnovation) processes. Such reconfiguration is considered essential because the region's organisational and institutional support structures, its research specialisation, skill base, dominant policy approaches and practices tend to be strongly aligned with the economic and industrial configurations developed in the past (Trippl et al. 2020). This implies that historically-grown RIS may prove inadequate for addressing territorial challenges as they seldom provide the necessary assets and resources for challenge-oriented solutions (Markard et al., 2021; Trippl et al., 2023). The place-based structures inherited from the past and the prevailing innovation and entrepreneurial activities may reinforce unsustainable trajectories. Therefore, there could be a pressing need to reconfigure innovation systems (Isaksen et al., 2022).

CORIS scholars have recently brought into focus the reconfiguration processes that RIS need to undergo in order to bolster their capacity for addressing territorial challenges. This reconfiguration may involve the reorientation of established RIS elements and functions, thereby augmenting the challenge-orientation of the existing RIS. It may also manifest as a more profound transformation, entailing the creation of new challenge-oriented RIS elements and functions, while concurrently dismantling outdated and unsustainable components (Isaksen et al., 2022; Trippl et al., 2023). Apart from a few exceptions (see, for instance, a Special Issue of *European Planning Studies*; Isaksen et al., 2022), empirical evidence on how regions rearrange their RIS is still limited. Analysing and comparing RIS reorientation and transformation efforts across different regions should be a focal point for future research endeavours.

Particularly intriguing is emerging scholarly work on the relation between RIS reconfiguration and system-level agency. These contributions examine how multiple actors at various spatial scales are either driving or obstructing a rearrangement of innovation system structures.

**System-level change agency** is defined as “collective and distributed activities enacted by firms, non-firm actors and intermediaries in developing and adapting the relevant supportive innovation system structures” (Gong et al., 2022, p. 527). It can be undertaken by diverse actors seeking to influence (regional) innovation systems through collective vision building, the creation of new system elements (e.g., setting up research centres), networking, resource mobilisation, institutional adaptation, legitimisation of change, or policy design and implementation (Isaksen et al., 2019; Sotarauta et al., 2021).

Equally relevant is the question of how actors undertake strategic interventions to hamper RIS reconfiguration processes. Here, recent work on **system-level maintenance agency** (Henderson, 2020; Jolly et al., 2020; Bækkelund, 2021; Baumgartinger-Seiringer, 2022) provides useful insights. This literature accords attention to agency seeking to secure the persistence of existing structures, thereby countering pressures for change. For instance, a recent study of bioplastics in the province of Lower Austria illustrates how powerful innovation system actors engage in diverse forms of system-level maintenance agency such as obstructing institutional change, delegitimising new solutions in public discourses, and wielding influence over the direction of academic research as well as the shape of cluster activities (Steinböck & Trippl, 2023).

Scholarly work on the link between system-level agency and RIS reconfiguration is relatively new and still evolving. Further efforts are warranted to move beyond limited evidence. Future research should delve into the dynamics of system-level change agency and explore why it manifests differently across various regions. This entails examining in more detail who performs agency to reveal the roles of firms, intermediaries such as cluster organisations, policy makers, universities, or civil society actors in RIS reconfiguration, as well as the coalitions they form in the process. Arguably, such analyses should not be

limited to regional actors but also encompass the influence of external actors. Equally significant is the question of who is deprived of agency (Eadson & van Veelen, 2023). Additionally, more research is needed to uncover the role of system-level maintenance agency in RIS reconfiguration. A deeper understanding of how influential economic and political interests (in the region and beyond) work against the destabilisation of RIS structures and practices, as well as strategies to overcome resistance to change, is necessary. A focus on system-level agency can shed light on the **contested nature of RIS reconfiguration** and contribute to a more profound understanding of how RIS undergo changes or, conversely, remain unchanged.

## 6. CONCLUSIONS

Since its development in the 1990s (Cooke, 1992; Asheim & Isaksen, 1997), the RIS approach has evolved into a potent framework for elucidating the existence of enduring disparities in regional innovation performances. Moreover, it has become a significant wellspring of inspiration for regional policymakers seeking to facilitate place-based strategies and policies. In recent years, however, several scholars have argued for refocusing the RIS concept and policies towards territorial sustainability problems. This has led to a modification of the RIS approach and the development of the notion of challenge-oriented regional innovation systems (CORIS) (Tödting et al., 2022; Tripl, 2023). This letter takes stock of the emerging body of work on CORIS and identifies a number of unresolved issues that demand further research. We centre on three broad themes.

First, we contend that future research needs to pay close attention to the geographies of problems. The requested shift towards orienting innovation and transformation activities around territorial challenges necessitates not only a profound examination of the uneven distribution of problems across regions but also more research on their origins and interrelations. Further, it is essential to investigate how territorial problems are identified, selected and prioritised in regional development agendas.

Secondly, extensive research is needed to map and analyse the geographies of challenge-oriented innovation-exnovation dynamics. These dynamics underpin the development of challenge-oriented solutions to address territorial challenges. A more thorough examination of the factors that shape regional capacities to engage in various forms of CORIS initiatives and the environmental, social and economic outcomes of those initiatives is required.

Thirdly, we propose that future work should delve into the geographies of RIS reconfiguration. We claim that for understanding how historically-grown RIS enhance their challenge-orientation, which forms this takes (reorientation versus transformation), or why this does not take place at all or very slowly, attention should be paid to system-level change and maintenance agencies. Unravelling such CORIS agencies and their relation to RIS reconfiguration should thus rank high on future research agendas.

Arguably, the research directions proposed in this *letter* encompass a non-exhaustive selection of themes. While they could be a first step to enhance our understanding of CORIS dynamics in different regions, they should be supplemented with further topics and questions to fully uncover the transformative potential of CORIS in addressing the territorial dimension of combating the complex societal challenges of our time.

## REFERENCES

- Asheim, B.T., Isaksen, A., & Tripl, M. (2019). *Advanced introduction to regional innovation systems*. Edward Elgar Publishing.
- Asheim, B.T., & Isaksen, A. (1997). Location, agglomeration and innovation: Towards regional innovation systems in Norway? *European Planning Studies*, 5(3), 299-330. <https://doi.org/10.1080/09654319708720402>
- Bækkelund, N.G. (2021). Change agency and reproductive agency in the course of industrial path evolution. *Regional Studies*, 55(4), 757-768. <https://doi.org/10.1080/00343404.2021.1893291>

- Barca, F., McCann, P., & Rodríguez-Pose, A. (2012). The case for regional development intervention: place-based versus place-neutral approaches. *Journal of regional science*, 52(1), 134-152. <https://doi.org/10.1111/j.1467-9787.2011.00756.x>
- Baumgartinger-Seiringer, S. (2022). The role of powerful incumbent firms: shaping regional industrial path development through change and maintenance agency. *Regional Studies, Regional Science*, 9(1), 390-408. <https://doi.org/10.1080/21681376.2022.2081597>
- Becattini, G. (1990). Italy. In W. Sengenberger, G. W. Loveman, & M. J. Piore (Eds.), *The re-emergence of small enterprises: industrial restructuring in industrialised countries*. International Institute for Labour Studies.
- Belussi, F., & Hervás-Oliver, J. L. (2016). *Unfolding cluster evolution*. Routledge.
- Belussi, F., Sammarra, A., & Sedita, S. R. (2010). Learning at the boundaries in an “Open Regional Innovation System”: A focus on firms’ innovation strategies in the Emilia Romagna life science industry. *Research Policy*, 39(6), 710-721. <https://doi.org/10.1016/j.respol.2010.01.014>
- Belussi, F., & Sedita, S. R. (2019). *Innovation districts*. *The Wiley Blackwell encyclopedia of urban and regional studies*, 1-5. Wiley-Blackwell.
- Belussi, F., & Trippl, M. (2018). Industrial districts/clusters and smart specialisation policies. In F. Belussi & M. Trippl (Eds.), *Agglomeration and firm performance*, 283-308. Springer.
- Biggi, G., & Giuliani, E. (2021). The noxious consequences of innovation: what do we know? *Industry and Innovation*, 28(1), 19-41. <https://doi.org/10.1080/13662716.2020.1726729>
- Binz, C., & Truffer, B. (2017). Global Innovation Systems—A conceptual framework for innovation dynamics in transnational contexts. *Research Policy*, 46(7), 1284-1298. <https://doi.org/10.1016/j.respol.2017.05.012>
- Boix, R., Sforzi, F., & Hernández, F. (2015). Introduction: Rethinking industrial districts in the XXI Century. *Investigaciones Regionales - Journal of Regional Research*, 32, 5-8.
- Bugge, M. M., Andersen, A. D., & Steen, M. (2022). The role of regional innovation systems in mission-oriented innovation policy: exploring the problem-solution space in electrification of maritime transport. *European Planning Studies*, 30(11), 2312-2333. <https://doi.org/10.1080/09654313.2021.1988907>
- Coenen, L., Moodysson, J., & Martin, H. (2015). Path renewal in old industrial regions: Possibilities and limitations for regional innovation policy. *Regional Studies*, 49(5), 850-865. <http://dx.doi.org/10.1080/00343404.2014.979321>
- Coenen, L., & Morgan, K. (2020). Evolving geographies of innovation: existing paradigms, critiques and possible alternatives. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography*, 74(1), 13-24. <https://doi.org/10.1080/00291951.2019.1692065>
- Cooke, P. (1992). Regional innovation systems: competitive regulation in the new Europe. *Geoforum*, 23(3), 365-382. [https://doi.org/10.1016/0016-7185\(92\)90048-9](https://doi.org/10.1016/0016-7185(92)90048-9)
- Cooke, P., Gomez Uranga, M., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organisational dimensions. *Research Policy*, 26(4), 475-491. [https://doi.org/10.1016/S0048-7333\(97\)00025-5](https://doi.org/10.1016/S0048-7333(97)00025-5)
- Donald, B., & Gray, M. (2019). The double crisis: in what sense a regional problem? *Regional Studies*, 53(2), 297-308. <https://doi.org/10.1080/00343404.2018.1490014>
- Eadson, W., & van Veelen, B. (2023). Green and just regional path development. *Regional Studies, Regional Science*, 10(1), 218-233. <https://doi.org/10.1080/21681376.2023.2174043>
- Elzinga, R., Janssen, M. J., Wesseling, J., Negro, S. O., & Hekkert, M. P. (2023). Assessing mission-specific innovation systems: Towards an analytical framework. *Environmental Innovation and Societal Transitions*, 48. <https://doi.org/10.1016/j.eist.2023.100745>



- European Commission. (2014). *National/regional innovation strategies for smart specialisation*. DG Regio.
- Evenhuis, E. (2017). New directions in researching regional economic resilience and adaptation. *Geography Compass*, 11(11), 1-15. <https://doi.org/10.1111/gec3.12333>
- Flanagan, K., Uyarra, E., & Wanzenböck, I. (2023). Towards a problem-oriented regional industrial policy: possibilities for public intervention in framing, valuation and market formation. *Regional Studies*, 57(6), 998-1010. <https://doi.org/10.1080/00343404.2021.2016680>
- Foray, D. (2014). *Smart specialisation: Opportunities and challenges for regional innovation policy*. Routledge.
- Foray, D., Goddard, J., Beldarrain, X., Landabaso, M., McCann, P., Morgan, K., Nauwelaers, C., & Ortega-Argilés, R. (2012). *Guide to Research and Innovation Strategies for Smart Specialisation (RIS 3)*. European Union, DG Regio.
- Geels, F. W. (2020). Transformative innovation and socio-technical transitions to address grand challenges. *European Commission R&I Paper Series, Working Paper, 2*. <https://doi.org/10.2777/967325>
- Ghazinoory, S., Nasri, S., Ameri, F., Montazer, G. A., & Shayan, A. (2020). Why do we need 'Problem-oriented Innovation System (PIS)' for solving macro-level societal problems? *Technological Forecasting and Social Change*, 150, 1-18. <https://doi.org/10.1016/j.techfore.2019.119749>
- Gong, H., Binz, C., Hassink, R., & Trippl, M. (2022). Emerging industries: institutions, legitimacy and system-level agency. *Regional Studies*, 56(4), 523-535. <https://doi.org/10.1080/00343404.2022.2033199>
- Harris, J. L. (2021). Rethinking cluster evolution: Actors, institutional configurations, and new path development. *Progress in Human Geography*, 45(3), 436-454. <https://doi.org/10.1177/0309132520926587>
- Hassink, R., Isaksen, A., & Trippl, M. (2019). Towards a comprehensive understanding of new regional industrial path development. *Regional Studies*, 53(11), 1636-1645. <https://doi.org/10.1080/00343404.2019.1566704>
- Hekkert, M. P., Janssen, M. J., Wesseling, J. H., & Negro, S. O. (2020). Mission-oriented innovation systems. *Environmental Innovation and Societal Transitions*, 34, 76-79. <https://doi.org/10.1016/j.eist.2019.11.011>
- Henderson, D. (2020). Institutional work in the maintenance of regional innovation policy instruments: evidence from Wales. *Regional Studies*, 54(3), 429-439. <https://doi.org/10.1080/00343404.2019.1634251>
- Henderson, D., Morgan, K., & Delbridge, R. (2023). Putting missions in their place: micro-missions and the role of universities in delivering challenge-led innovation. *Regional Studies*, in press. <https://doi.org/10.1080/00343404.2023.2176840>
- Hölscher, K., Frantzeskaki, N., & Loorbach, D. (2019). Steering transformations under climate change: capacities for transformative climate governance and the case of Rotterdam, the Netherlands. *Regional Environmental Change*, 19, 791-805. <https://doi.org/10.1007/s10113-018-1329-3>
- Isaksen, A., Jakobsen, S.-E., Njøs, R., & Normann, R. (2019). Regional industrial restructuring resulting from individual and system agency. *Innovation: The European Journal of Social Science Research*, 32(1), 48-65. <https://doi.org/10.1080/13511610.2018.1496322>
- Isaksen, A., & Trippl, M. (2016). Path development in different regional innovation systems: A conceptual analysis. In M. Davide Parrilli, R. Dahl Fitjar, & A. Rodriguez-Pose (Eds.), *Innovation drivers and regional innovation strategies*, 66-84. Routledge.
- Isaksen, A., & Trippl, M. (2017). Exogenously led and policy-supported new path development in peripheral regions: Analytical and synthetic routes. *Economic Geography*, 93(5), 436-457. <https://doi.org/10.1080/00130095.2016.1154443>

- Isaksen, A., Trippl, M., & Mayer, H. (2022). Regional innovation systems in an era of grand societal challenges: reorientation versus transformation. *European Planning Studies*, 30(11), 2125-2138. <https://doi.org/10.1080/09654313.2022.2084226>
- Jeannerat, H., & Crevoisier, O. (2022). From competitiveness to territorial value: Transformative territorial innovation policies and anchoring milieus. *European Planning Studies*, 30(11), 2157-2177. <https://doi.org/10.1080/09654313.2022.2042208>
- Jolly, S., Grillitsch, M., & Hansen, T. (2020). Agency and actors in regional industrial path development. A framework and longitudinal analysis. *Geoforum*, 111, 176-188. <https://doi.org/https://doi.org/10.1016/j.geoforum.2020.02.013>
- Kivimaa, P., & Kern, F. (2016). Creative destruction or mere niche support? Innovation policy mixes for sustainability transitions. *Research Policy*, 45(1), 205-217. <https://doi.org/10.1016/j.respol.2015.09.008>
- MacKinnon, D., Kempton, L., O'Brien, P., Ormerod, E., Pike, A., & Tomaney, J. (2022). Reframing urban and regional 'development' for 'left behind' places. *Cambridge journal of regions, economy and society*, 15(1), 39-56. <https://doi.org/10.1093/cjres/rsab034>
- Markard, J., Van Lente, H., Wells, P., & Yap, X.-S. (2021). Neglected developments undermining sustainability transitions. *Environmental Innovation and Societal Transitions*, 41, 39-41. <https://doi.org/10.1016/j.eist.2021.10.012>
- Martin, R., Gardiner, B., Pike, A., Sunley, P., & Tyler, P. (2021). *Levelling up left behind places: The scale and nature of the economic and policy challenge*. Routledge.
- Mazzucato, M. (2018). Mission-oriented innovation policies: challenges and opportunities. *Industrial and Corporate Change*, 27(5), 803-815. <https://doi.org/10.1093/icc/dty034>
- McCann, P., & Soete, L. (2020). *Place-based innovation for sustainability*. Publications Office of the European Union. <https://doi.org/10.2760/250023>
- Morgan, K. (2019). 7. The future of place-based innovation policy (as if 'lagging regions' really mattered). *Regional studies policy impact books*, 1(2), 79-89. <https://doi.org/10.1080/2578711X.2019.1621103>
- Moulaert, F., & Sekia, F. (2003). Territorial innovation models: a critical survey. *Regional Studies*, 37(3), 289-302. <https://doi.org/10.1080/0034340032000065442>
- OECD. (2023). *Regional Industrial Transitions to Climate Neutrality*. OECD Publishing. <https://doi.org/10.1787/35247cc7-en>
- Patchell, J., & Hayter, R. (2013). Environmental and evolutionary economic geography: time for EEG2? *Geografiska Annaler: Series B, Human Geography*, 95(2), 111-130. <https://doi.org/10.1111/geob.12012>
- Phelps, N. A., Atienza, M., & Arias, M. (2018). An invitation to the dark side of economic geography. *Environment and Planning A: Economy and Space*, 50(1), 236-244. <https://doi.org/10.1177/0308518X17739007>
- Pontikakis, D., González Vázquez, I., Bianchi, G., Ranga, M., Marques Santos, A., Reimeris, R., Mifsud, S., Morgan, K., Madrid, C., & Stierna, J. (2022). *Partnerships for Regional Innovation—Playbook*. Publications Office of the European Union.
- Porter, M. E. (1998). *Clusters and competition: New Agendas for companies, governments, and institutions*. Harvard Business School Press.
- Pyka, A. (2017). Dedicated innovation systems to support the transformation towards sustainability: Creating income opportunities and employment in the knowledge-based digital bioeconomy. *Journal of Open Innovation: Technology, Market, and Complexity*, 3(4), 1-18. <https://doi.org/10.1186/s40852-017-0079-7>

- Rinscheid, A., Rosenbloom, D., Markard, J., & Turnheim, B. (2021). From terminating to transforming: The role of phase-out in sustainability transitions. *Environmental Innovation and Societal Transitions*, 41, 27-31. <https://doi.org/10.1016/j.eist.2021.10.019>
- Rodríguez-Pose, A., & Bartalucci, F. (2023). *Regional vulnerability to the green transition. (WP2023/16)*. Chief Economist Team at the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs. <https://doi.org/10.2873/739058>
- Schlaile, M. P., Urmetzer, S., Blok, V., Andersen, A. D., Timmermans, J., Mueller, M., Fagerberg, J., & Pyka, A. (2017). Innovation systems for transformations towards sustainability? Taking the normative dimension seriously. *Sustainability*, 9(12), 1-20. <https://doi.org/10.3390/su9122253>
- 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. <https://doi.org/https://doi.org/10.1016/j.respol.2018.08.011>
- Sotarauta, M., Suvinen, N., Jolly, S., & Hansen, T. (2021). The many roles of change agency in the game of green path development in the North. *European Urban and Regional Studies*, 28(2), 92-110. <https://doi.org/10.1177/0969776420944995>
- Sovacool, B. K. (2021). Who are the victims of low-carbon transitions? Towards a political ecology of climate change mitigation. *Energy research & social science*, 73, 1-16. <https://doi.org/10.1016/j.erss.2021.101916>
- Steinböck, N., & Tripl, M. (2023). The thorny road towards green path development: the case of bioplastics in Lower Austria. *Regional Studies, Regional Science*, 10(1), 735-749. <https://doi.org/10.1080/21681376.2023.2244572>
- Tödting, F., & Tripl, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy*, 34(8), 1203-1219. <https://doi.org/https://doi.org/10.1016/j.respol.2005.01.018>
- 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. <https://doi.org/10.1080/09654313.2021.1951177>
- Tripl, M., Grillitsch, M., & Isaksen, A. (2018). Exogenous sources of regional industrial change: Attraction and absorption of non-local knowledge for new path development. *Progress in Human Geography*, 42(5), 687-705. <https://doi.org/10.1177/0309132517700982>
- Tripl, M., Baumgartinger-Seiringer, S., Frangenheim, A., Isaksen, A., & Ryppestøl, J. O. (2020). Unravelling green regional industrial path development: Regional preconditions, asset modification and agency. *Geoforum*, 111, 189-197. <https://doi.org/https://doi.org/10.1016/j.geoforum.2020.02.016>
- Tripl, M., Fastenrath, S., & Isaksen, A. (2023). Rethinking regional economic resilience: Preconditions and processes shaping transformative resilience. *European Urban and Regional Studies*, in press. <https://doi.org/10.1177/09697764231172326>
- Tripl, M. (2023). Challenge-oriented regional innovation systems and strategies for sustainability transitions. In Schwaag Serger S, Soete L, Stierna S (Eds.), *The Square: Putting place-based innovation policy for sustainability at the centre of policymaking*. Publications Office of the European Union.
- Upham, P., Simcock, N., Sovacool, B., Contreras, G. A. T., Jenkins, K., & Martiskainen, M. (2023). Public support for decarbonisation policies: Between self-interest and social need for alleviating energy and transport poverty in the United Kingdom. *Energy and Climate Change*, 4, 1-10. <https://doi.org/10.1016/j.egycc.2023.100099>
- Uyarra, E., Flanagan, K., & Wanzenböck, I. (2023). *The spatial and scalar implications of missions: Challenges and opportunities for policy*. Manchester Institute of Innovation Research.

- Vale, M., Peponi, A., Carvalho, L., Veloso, A. P., Queirós, M., & Morgado, P. (2023). Are peripheral regions in troubled waters for sustainability transitions? A systematic analysis of the literature. *European Urban and Regional Studies*, in press. <https://doi.org/10.1177/09697764231194316>
- Weber, K. M., & Truffer, B. (2017). Moving innovation systems research to the next level: towards an integrative agenda. *Oxford Review of Economic Policy*, 33(1), 101-121. <https://doi.org/10.1093/oxrep/grx002>
- Wesseling, J., & Meijerhof, N. (2023). Towards a Mission-oriented Innovation Systems (MIS) approach, application for Dutch sustainable maritime shipping. *PLOS Sustainability and Transformation*, 2(8), 1-28. <https://doi.org/10.1371/journal.pstr.0000075>

## ORCID

Michaela Trippl

<https://orcid.org/0000-0001-9779-4836>

Simon Baumgartinger-Seiringer

<https://orcid.org/0000-0002-3576-7725>

Jannik Kastrup

<https://orcid.org/0009-0008-3574-3388>

