An Actor in the Transformation Triad: The Platform Approach "REVIERa"

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Abstract The Rhenish mining area—Europe's largest lignite mining region—is currently undergoing a complex structural change process due to the coal phase-out that is being enacted in Germany. Researchers from RWTH Aachen University—an institution of education and research that is an integral part of the surrounding region—have founded the transformation platform "REVIERa". Their objective is to create a forum around the lignite phase-out and to link up knowledge and activities, both inside the University and with regional partners and residents. With regard to the Aachen Transformation Model, this article reflects on the platform's contribution to researching, shaping, and enabling the transformation process in the Rhenish mining area. We discuss the value added by the platform as well as the related challenges, limitations, interdependencies, and appropriate methods. In this respect, REVIERa can have an integrative function; however, some open questions regarding further research potential and the nature of transformation processes, institutional roles, and structures remain.

Keywords Transformation research · Transformational research · Research transformation · Collaborative research · Post-mining region

1 Introduction

The lignite coal phase-out, which has been enacted into law in Germany (Deutscher Bundestag 2020), is one example of structural change that has established an ongoing transformation process involving 2500 km^2 and more than 10,000 workplaces (RWI

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2018) in Europe's largest lignite coal field situated in the Rhine region between the cities of Köln, Düsseldorf, Mönchengladbach and Aachen in western Germany (Fig. 1). As one of Europe's leading technological universities with more than 47,000 students (RWTH 2022), RWTH Aachen University—located in the greater Rhenish mining area—plays an important role in this transformation process. Not only is the University one of Germany's 11 "Excellence Universities"; its focus on integrated and interdisciplinary research also creates beneficial conditions for participating in and contributing to the transformation process. The changing role of universities in their specific localities, their enhanced responsibility toward societal and contextual challenges as well as the setup of new learning and research environments in their cities and regions: all these issues are currently intensively debated and developed with an active involvement of RWTH, which is reflected in international projects and initiatives (ENHANCE 2023; ENIHEI 2023; Falling Walls Engage 2023; TU9 2023).

The coal phase-out in the Rhenish mining area poses both unique challenges and opportunities for regional development that will span several decades and concern many different aspects of life and work in the region (ZRR 2021). To name just a few: the preservation of jobs, the usage of the opencast mining area, regional identity, and future energy supply. Moreover, the transformation process can enhance the understanding of transformation regarding its underlying nature and its impulses for innovation. In an effort to further research, shape, and enable the transformation process taking place in the Rhenish mining area, RWTH Aachen University has created the interdisciplinary transformation platform "REVIERa", which is described in more detail below. This article aims to show the ways in which a platform of this kind can serve as a helpful actor in the coal phase-out transformation process.

Structural change entails conflict. It further marks disruption and entails challenges to citizens and firms as well as to the political terrain (Andreoni and Chang 2019; Herberg et al. 2020; Oei et al. 2020). The notion of structural change addresses processes of change on a larger scale, forsaking irreversible path dependencies or transitioning from the preservation phase into the decline phase according to the model of panarchy (Boyer 2020; Gunderson and Holling 2002). Regions with structural change problems were previously dependent on a unilateral form of value creation that is frequently linked to structural monopolies. There are three important dynamics in structural change and the related profound transformation processes that can be systematically distinguished between but which are, at the same time, related to each other. First, goal-oriented ex-novation (David and Gross 2019): How does one purposefully get out of the fixations of previous innovation activity? Second, targeted innovation: How does one develop suitable new settlements for innovation? That is, which companies should and can be located? Which impulses for transformation are made possible and which new determinations are made at the same time? Third, there is the task of tailored infrastructure development. For it is in the infrastructures that the new paths are defined—but which then also influence the future development possibilities of regions under transformation.

This article focuses on the multiple roles of science in supporting ongoing transformation processes. Particular attention is drawn to how "Doing Transformation" can

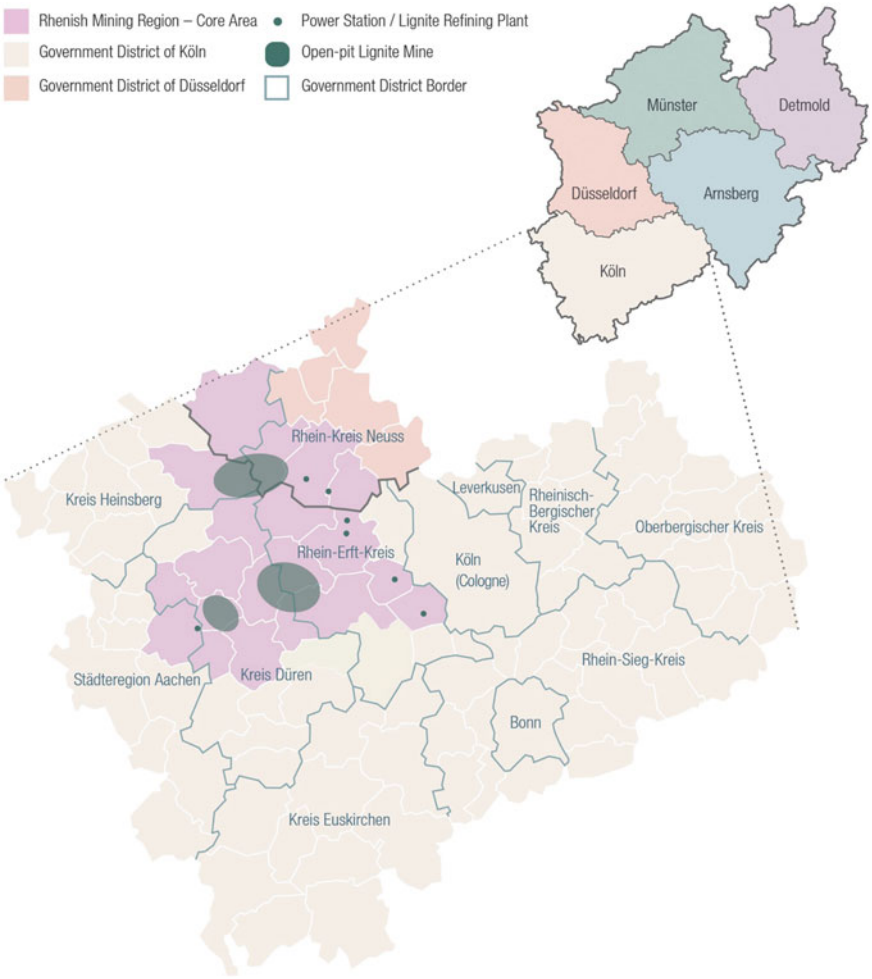

Fig. 1 Rhenish mining area in North Rhine-Westphalia and the neighboring government districts (Schubert 2021)

take place and to what possibilities and limits occur when science takes an active part in these processes. Coal exit regions offer insightful cases in point. They are characterized by specific tensions and ambiguities. First, there is an ambiguity between self-induced structural change—which is related to the notion of "crisis", often followed by a structural aid—and overarching processes of transformation which are happening anyhow. In the case of the German coal phase-out, the affected regions simultaneously face an overall scarcity of energy and material resource, demographic change, and skills shortage as well as a changing geopolitical environment with very different local, regional, national, and European impacts (Churski et al. 2021a, 2021b; Emanuela and Louis 2020; OECD 2019). This can be claimed as a tension between

the intention and the evolution. Second, there is an ambiguity between the global and nationwide transformation toward sustainability (Die Bundesregierung 2021; United Nations 2015) —with the notion of transformation paths and the importance of social and cultural change—and the ambition of shaping a "model region" in a regional context. Although these remain two different phenomena, they are nevertheless interlinked.

Thus, the ambition of transforming a coal mining area into a "model region" is highly presuppositional. The underlying assumption is that "Doing Transformation" is possible and that other technologically or socially driven transformation processes can be purposefully integrated into these processes. Addressing such technologically and socially driven transformation processes is a highly complex matter, as the relevant prerequisites are usually not in place in the regions concerned (Grillitsch and Hansen 2019; Isaksen et al. 2022). This requires an overall understanding of the active and interlinked technological, social and spatial transformation processes in the region as well as an arena of actors that is willing to invest into the capacity to shape transformation—including the management of conflicts and ambiguities between different stakeholders as well as different transformation goals.

Moreover, in the course of the interaction between various actor groups also the complexity of the transformation fields and their respective challenges have to be discussed and dealt with. For example, the above-mentioned topics are often still developing fields for which no established solutions are yet available for the market. At the same time, the question arises as to how a meaningful linkage between various transformation failures can be managed. Two examples illustrate this:

1. Smart energy solutions in energy communities rely on energy from renewable resources. However, since energy is not always available in sufficient quantities, storage solutions, such as battery storage, are needed on the one hand, and clever adaptation of energy consumption to the energy supply on the other. This requires a good data and software basis to enable intelligent energy generation, storage, and use. To this end, there is increasing discussion of how car batteries, for example, can be used as intermediate storage and at what time of the day or night these batteries can best be charged (Szinai et al. 2020). This will lead to a linking of energy and mobility systems, i.e. a coupling of different sectors (Ilieva and Rajasekharan 2018). This example shows that transformation processes not only focus on the implementation of new technologies (e.g., storage systems) but also link up areas that were not previously considered together (energy system, digitization, and mobility). Therefore, such transformation processes almost always require a comprehensive understanding of the entire relevant system, which is essential for the success of the transformation.
2. The creation of new businesses, for example the establishment of circular economy approaches, often requires complex value creation architectures (Calisto Friant et al. 2020). For the example mentioned, processes regarding logistics, sorting, separating, and recycling have to be linked with each other (Dräger et al. 2021). To achieve the necessary economies of scale, various actors

must coordinate their business models and align their actions accordingly (Ghisellini et al. 2016). Particularly the application of new technologies necessitates the establishment of innovation ecosystems in which various actor constellations must be analyzed, linked, and coordinated. This would then often require new or extended infrastructures to be created, political support to be established, and potential partners to be brought together. In addition, the required competence profiles of employees in these areas must also be considered and built up.

In this article, we argue that there is a need for transformation platforms to steer within transformation processes, especially for knowledge actors such as universities. This is why the latter typically overestimate the impact of their own innovation activities while underestimating the need for aligning their innovative ideas with the goals to be reached from a citizen's perspective. Against this background, the argument is developed in five steps. First, we lay out some main points with regard to the conceptual background, thereby the perspective of multi-level thinking is aligned with the idea of openness and the shaping of transformation (Sect. 2). Second, the idea and approach of a transformation platform interlinking the University and regional actors in the context of structural change is placed (Sect. 3). Third, to demonstrate the need for as well as the design of such a platform, three cases that focus on the components of the Aachen Transformation Model are discussed, focusing on different relevant dimensions of structural change (Sect. 4). Fourth, the insights are discussed (Sect. 5) and, finally, the main insights are highlighted (Sect. 6).

2 Conceptual Background

Generally, the term "transformation" describes a profound change process of a complex system from a status quo into a desired target state. In transformation processes, system, goal, and transformation knowledge gradually coevolve, mutually stimulating and influencing one another (Vilsmaier and Lang 2014; Wuppertal-Institut 2013). Hence, transformation processes are inherently open processes that can be kick-started and pushed in very different ways: by exacerbated boundary conditions and related crises or by intention in accordance with transformation goals (Bormann et al. 2018; BUND 2022; Sommer and Welzer 2017). In the case of longer timeframes, different occasions and impulses for transformation may overlap and merge, e.g., goals may be reset or may gain in ambition, or multiple crises may add urgency to the region under transformation. Within the transformation processes, social, economic, ecological, as well as spatial and governance-related factors mutually interplay. Hereby, the status of transformation in a specific phase shows forces, patterns, and dynamics regarding different interdependent system levels (Fig. 2).

In the case of the Rhenish mining area, transformation is self-induced, including an especially long-term perspective. According to German law, coal-based power generation is determined to end fully by the year 2038 (Deutscher Bundestag 2020) at the latest. Recently, this time limit was brought forward to the year 2030 (NWR

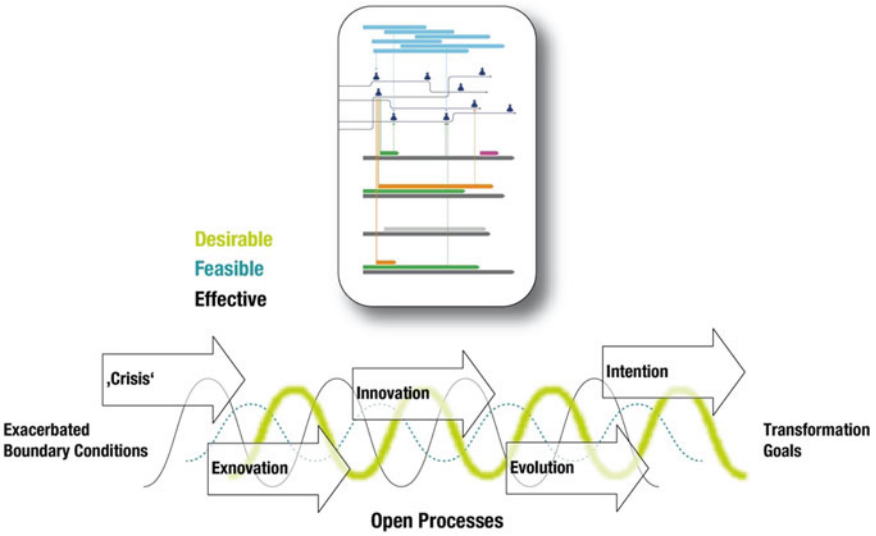

Fig. 2 Basic understanding of transformation processes (authors)

2022). This desired phase-out entails a multitude of structural, technological, spatial, and societal changes. After the closure of the opencast lignite mine in the Hambach District, another change process of lake-filling is planned, lasting several decades and posing the question of interim use of the former mining area and its surroundings. These two target states of mine closure and the presence of a lake should ideally improve the attractiveness and sustainability of the region. Globally, the United Nations has formulated the Social Development Goals, defining targets and indicators for sustainable development (United Nations 2017, 2015). Locally, projects and processes can be oriented toward these goals, with the complex task of conveying these goals to a local perspective, e.g., regarding German municipalities (Assmann et al. 2018). The coal phase-out transformation process in the Rhenish mining area is characterized by a multitude of different players and technologies. This can be illustrated by a look at the literature of transformation studies.

2.1 Understanding Transformation Through Multi-level Thinking

Transformation processes are typically embedded in complex arrangements of regimes and multi-level governance. At the same time, there are difficult questions of how to design transformation processes, if possible. Therefore, one must change the view from the reconstruction of developments toward the question of how to steer in-between developments.

Transformation processes always encounter existing structures, which are reflected in the physical environment, the competencies of existing employees, economic entities, and social and cultural norms. In this context, an important role is played by so-called path dependencies (David 2000), which should be employed as sensibly as possible, but which can also represent significant obstacles to successful transformation processes. For example, employees in the Rhenish mining area often have competencies that are important for lignite mining and the supporting industry. For this reason, it could make sense to focus on the establishment of industries in the Rhenish mining area in which competencies related to raw materials can be applied. In this regard, approaches of a circular economy could be sensible, since these also require raw material-related know-how. If, on the contrary, completely new technological areas were to be established, e.g., the creation of neuromorphic hardware and software in the Rhenish mining area, the appropriate structures must also be developed (see Smolka et al. in this book). However, in each of these cases it is necessary to detect and understand existing path dependencies, possible lock-in effects, and the necessary capacity-building measures and to address them at an early stage (Djelic and Quack 2007; Goldstein et al. 2023).

Looking at these interlinkages of actors, levels, innovation histories, and transformational change, we would like to claim such perspective, multi-level thinking. This label is inspired by, but not limited to, the so-called MLP approach (MLP = Multi-Level Perspective), which has been developed over the past two decades for the targeted study of innovation and transformation processes (Geels 2004; Geels et al. 2016; Geels and Schot 2007). It considers three levels—sociocultural landscape, socio-technical regime, and niches—and their interconnection. By linking these levels, the emergence and diffusion of socio-technical innovations can be studied in the context of transformation processes—or also: processes of structural change. According to this approach, fundamental innovations are prepared primarily in niches. However, to contribute to a regime change, i.e., to change the innovation landscape in a desired direction, specific framework conditions must prevail at the landscape level.

Geels and Schot (2007: 404) classify four possible framework conditions: In addition to "regular change", which stands for a normal, slow, and incremental change at the landscape level and is irrelevant for the dynamic-feedback innovations in focus here, the authors identify the "specific shock" as the second: This is a sudden, strong change which, however, only affects a few dimensions of the landscape. In this respect, this rare event can lead to a serious change for one or a few dimension(s) as well as to a return to the original state. Disruptive changes occur irregularly and slowly. Like the "specific shock", they affect only a few environmental dimensions. One could cite the environmental movement of the 1980s/1990s as an example, which gradually led to a different environmental awareness in society. The "avalanche", or avalanche-like change, is fast-moving, intense, and far-reaching change. Think, for example, of war situations, political revolutions, or stock market crashes.

Transition is therefore not the same as transformation, according to Geels et al. (2016: 898): "The transformation pathway consists of gradual reorientation of the existing regime through adjustments by incumbent actors in the context of landscape

pressure, societal debates and tightening institutions". Transition means the transition from one regime to another, e.g., the transition from a fossil to a post-fossil regime of energy production and consumption. The strength of MLP lies in the analytical discriminatory power between micro-, meso-, and macro-phenomena in connection with innovations. Weaknesses of the approach can be seen above all in the fact that the approach was originally designed only for post-festum analyses; i.e., it provided technology genesis research of innovations that had already been fully implemented. Furthermore, the connection between the levels remains vague.

Still, this approach is insightful to better understand coal phase-out processes. These are induced politically while creating a "specific shock" for regional adaptation processes. Thus, there are then a lot of niches emerging for aligning this structural change. As these evolutions are multifaceted, the problem of synchronizing the different ways of change is becoming important. In the face of these challenges, the enhancement and renewal of organizational and institutional capacities in the region is a crucial prerequisite to any transformative activities, projects, and business models. Against this background, a university may take a central meditating role and position itself as a long-term partner in regional transformation processes.

When it comes to the transformation task in the Rhenish lignite mining area, multi-level thinking may be refined and specified in three dimensions (Fig. 3). First, it relates to a time dimension: multiple levels (co-)evolve over time. This implies thinking in the form of transformation paths and in throughput rather than only in input and output, thus opening up room for change (Audretsch et al. 2021; Preda and Matei 2020; Sydow 2021). Second, multiple levels refer to different levels of spatial scales—from the individual settlement and fractions of the landscape or infrastructure to the region as a whole and its embeddedness and relations to supra-regional levels of scale, with which different transformation drivers, activities, and effects are associated (Bögel et al. 2022; Förster 2020; Lee 2022). Conditions and transformation impulses of the built and lived environment mutually interplay in between these different spatial scales. Third, transformation processes evolve through the interplay of providing a favorable framework and enabling impulses and initiatives. This means that from a regional governance perspective, top-down and bottom-up meet in a countercurrent principle (Benz 2021; Davoudi 2008; Heinen et al. 2022). Governing of transformation processes must draw special attention to the balance between the coherence of activities and investment in the region on the one hand and the diversity—and occasionally healthy competition and frictions—of players, approaches, and projects on the other hand (Böschen et al. 2021).

The operationalization of multi-level thinking in time, space, and governance is the first step to an ex-ante perspective of shaping the transformation within a region. The specific challenge, however, lies in the manifold combinations of the three different perspectives—that once again is an indication of the open nature of transformation processes and the limitations of planning for them.

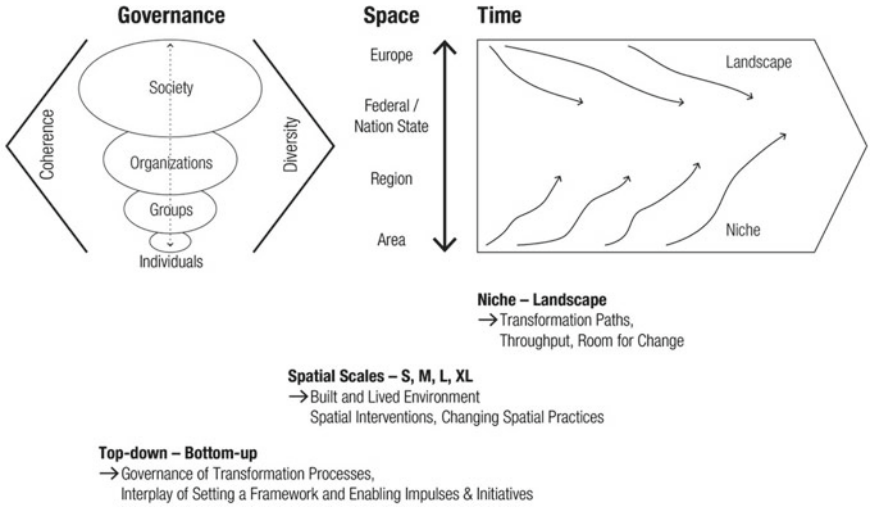

Fig. 3 Specifying multi-level thinking in transformation processes: time, spatial scales, and governance (authors)

2.2 Shaping Transformation as an Open Process

Deliberate shaping and setting of impulses into transformation processes must consider the different layers as well as the inertia and path dependency of the system that is under transformation. There are multiple entry points for effective stimuli and interventions. Beyond the thinking in precise intervention and impact cycles, transformation tends to be shaped in open processes by a multitude of more or less interrelated interventions as well as by effects on different levels. From the perspective of doing and shaping transformation, the following specification of levels and levers seems to be appropriate (Fig. 4) (Förster 2022; Köhler et al. 2019).

(i) Change can be brought about by direct interventions in the built and lived environment of the region. E.g., investments in transport or energy infrastructure are, in many cases, a precondition for attracting new enterprises, a workforce, or tourists. At the same time, the restructuring of the regional landscape—even in an early phase of the regional transformation process—can serve as a tangible impulse to enhance the quality of living in the region as well as to raise awareness among inhabitants for the post-fossil regional future (Bögel et al. 2022; Förster 2020; Förster et al. 2021; von Wirth and Levin-Keitel 2020). (ii) A second, more indirect, level of interventions can be seen in the activation, enabling, and learning of regional actors. Regional transformation processes are closely related to changing roles, ambitions, and competencies of active players—as a precondition for realizing and implementing projects and because of the profound processes of reorientation and change that influence regional stakeholders (Mezirow 2009; Singer-Brodowski et al. 2018). Bringing new players into the region or establishing new intermediaries are important success

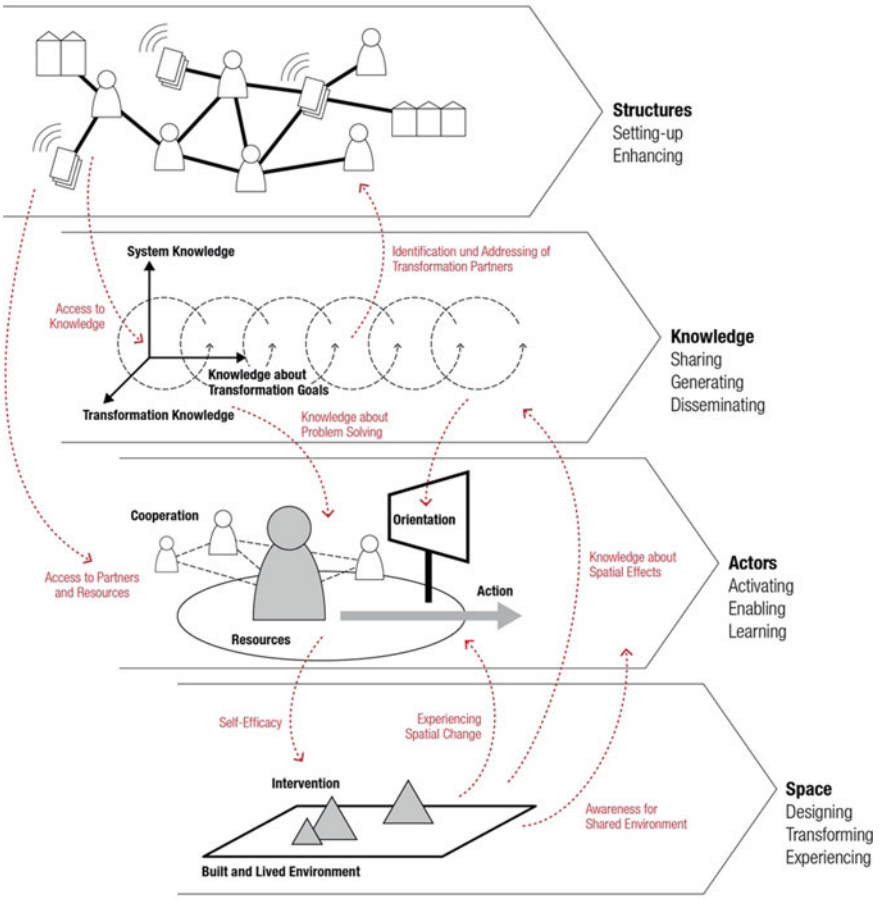

Fig. 4 Interconnected levels and levers of shaping transformation (Förster 2022: 49)

factors in regional transformation processes toward sustainability (Kanda et al. 2020; Kivimaa et al. 2019; Kundurpi et al. 2021). (iii) Thirdly, creating transformative knowledge is an important stimulus for the transformation process. The special feature of transformation processes is the simultaneous change of system, target, and transformation knowledge (Wuppertal-Institut 2013). This is often associated with high uncertainty, a lack of orientation, and even frustration and fear among local and regional communities, employers, administration, and politicians (Abbott 2005; Lamker 2016; Schweizer and Renn 2019). Hence, creating new linkages between the different knowledge domains is a key premise for organizing collective action in view of profound structural change processes. (iv) The most superordinate level of shaping transformation relates to institutions, networks, and governance. Stimulating self-transformation and learning among powerful institutions and governance

arrangements is an important prerequisite for escaping path dependency and enabling ecological, economic, societal, and cultural renewal (Böschen et al. 2021).

The four levels of interventions are highly interlinked and can be initiated in different directions—from the living and economic environment within the region to the superordinate level of regional governance, and vice versa.

In the case of a region under transformation, processes on all four levels run in parallel. Within this multi-level dynamic, positive feedback as well as tensions between the different levels may occur. On-site activities may be kick-started by societies, initiatives, or companies that are capable to act in the region. From the perspective of regional planning associations or politics, such a process may be regarded as unsolicited action and impede ongoing planning and programming processes. Moreover, the generation of transformative knowledge in the face of profound transformation challenges evolves in an open and recursive process. This contradicts the high planning reliability that is demanded by local and regional administration.

These interdependencies and tensions in shaping and transforming the region under transformation go beyond the capacities and responsibilities of individual projects, disciplines, and institutions. Yet, the systemic picture of change cannot be dealt with adequately in the mode of an integrated project or a comprehensive approach. Instead, a platform approach might be an opportunity to bundle the knowledge and experience of shaping transformation at different levels—and to enhance the effective combination of transformation impulses in the region.

3 Platform Approach of RWTH Aachen University

The notion of a platform points to an interface, an arena or a physical or virtual room for communication, negotiation, and exchange. Within different disciplines, the idea of platforms plays a valuable as well as a differentiating role. For example, in computing architecture, a platform is an entity for executing programs on a common and unified ground. Or, in media studies, so-called social media constitute platforms for interaction that cause a structural change of the public (Eisenegger et al. 2021). In business, platforms facilitate economic and social activities such as online matchmakers and technology frameworks. This also includes sharing platforms (Derave et al. 2022) or "mobility as a service" platforms to increase the sustainability of transportation systems (Cruz and Sarmento 2020). In the field of cultural and creative enterprises, platform spaces emerge that are based on multi-stakeholder cooperation and link business activities to local communities and territorial development goals (Tricarico et al. 2022). Or, in education, platforms promise more personalized and adaptive approaches to learning (Kem 2022). In public policy design, platforms help to align top-down as well as bottom-up dynamics (Accordino 2013) or promise more adaptive forms of governance and resilience (Djalante 2012). Or, in city development, cities can be described as "participatory platforms for change" (Anttiroiko 2016). And beyond the smart city concept, a platform urbanism is conceived (Caprotti et al. 2022).

Based on these insights and construction designs, the idea of a transformation platform within a structural change process means enabling communication between the different stakeholders in terms of a superordinate forum, establishing a common basis of knowledge and goals, stimulating transformative learning among and between science and society, as well as networking and cross-linking ongoing transformative activities and projects.

A wide alliance of regional and supra-regional partners follows the ambition of transforming the Rhenish mining area into a model region. Since the process encompasses social, technological, spatial, environmental, and economic factors simultaneously in an outcome-open manner, an inherent and interdisciplinary approach is required. For this reason, contributions from adequately oriented research institutions and their facilities are essential. Hence, there is a need for coordination between and within the diverse research institutions.

RWTH Aachen University maintains strong partnerships and collaborations in research and industry, spanning from international research collaborations to national industry partnerships and regional clusters of innovation. In these contexts, the University fulfills various tasks that, besides training the future workforce and advancing research projects, also include research and application support for, e.g., technologies in industry.

Structural change in the Rhenish mining area reflects a diverse network, consisting of various innovation areas with corresponding projects and a wide variety of actors and stakeholders. While there are many initiatives impacting, researching, and acting within the transformation process, the linking up of these initiatives is a complex task. Hence, regional transformation requires the integration of knowledge from the University and by the University. It is the mission of RWTH Aachen University to contribute to the regional transformation process by.

- providing an integrated interdisciplinary knowledge resource,
- setting up transdisciplinary partnerships with regional stakeholders that go beyond project durations,
- strategically pushing education and career paths in direct contact with transformation issues in the region,
- coordinating and bundling the University's activities, investments, and projects in the region to generate spatial impact, and
- strengthening science communication and science engagement among the wider regional community.

Accordingly, the University takes on a broad range of different roles in the transformation process of the Rhenish mining area: Actively investing in and developing sites; it acts as an intermediary to provide knowledge; it initiates and boosts networks and activities; it educates and enables future generations and potentially raises a critical voice in the political and the societal realm (Förster et al. 2022c: 25).

3.1 Setting Up the REVIERa Transformation Platform

In the context of the challenging transformation process in the Rhenish mining area and the role of RWTH Aachen University as a local co-creator of knowledge, the REVIERa platform was established in 2019. REVIERa derives its name from the German word for district, "Revier", with the additional "a" for "Aachen", where the University is located. At the same time, the name can be associated with the French-Italian Riviera coastline, which is very popular with German tourists, creating a reference to a spatial design that combines work, daily activities, and leisure in a livable and enjoyable way.

The platform was established through an interdisciplinary collaboration between three faculties of the University. Since then, the platform and its associated group of participants have engaged in research to help understand the transformation landscape. They have created networks and open spaces, and they have enhanced their interdisciplinary cooperation. REVIERa aims to enable transformative knowledge through creating linkages between the different actors (Förster et al. 2022c).

Since 2019, the platform activities have been established in an open process in a sequence of different groups and rounds of discussion and cooperation (Fig. 5). The core team of the platform consists of researchers from three faculties that bring together knowledge and competencies from urban and regional planning, technical sociology, and business management and controlling. This team also maintains the platform with its ongoing communication process via a website and various social media. Additionally, a steering team with an enlarged circle of 10 expert researchers from different disciplines advises the core team on strategic issues.

In the first round, REVIERa invited interested researchers from all the University's faculties to share their knowledge about regional transformation and to reflect on the

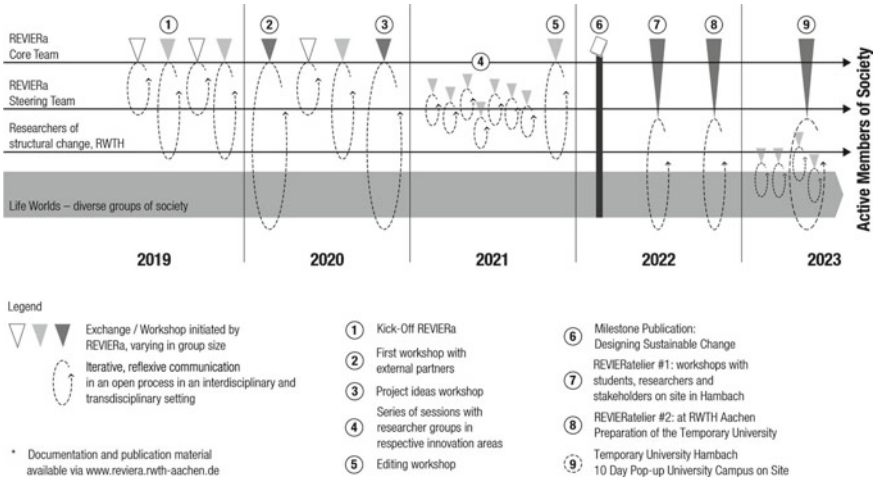

Fig. 5 REVIERa process 2019–2023 (based on Förster et al. 2022c: 32)

University's role in that process. Hence, the platform initiated an inner-University learning process. Soon after the inner-University networking, the platform gave room for encounter and exchange between science and society. From 2020 to 2022, the REVIERa process was very much based on formats such as research and practice workshops—analog as well as digital in times of the COVID-19 pandemic –, interactive forms to promote knowledge transfer and learning, as well as inter- and transdisciplinary teaching (Förster et al. 2022c). In 2022 and 2023, the focus of the platform is shifting toward more specific and on-site co-creation processes with regional players in order to bring the University's knowledge and talents into ongoing transformation activities and to speed up collaborative learning.

3.2 Contribution to the Transformation Triad

This article assesses the contribution of the REVIERa platform with regard to the three pillars of the Aachen Transformation Model (ATM) (see first chapter of this book). The three pillars are "transformation research", "transformational research" and "research transformation". In short, they relate to research concerning the subject of transformation, research which is a stimulus for transformation and the transformation of research itself.

The transformation platform can be primarily assigned to the superordinate pillar of shaping transformation that relates to institutions, networks, and governance (Fig. 4). Beyond that, REVIERa supports the creation of transformative knowledge and activates and encourages regional actors through its participatory and learning formats as well as seniors, junior researchers, and students. Also, REVIERa promotes interdisciplinary collaboration within projects, research, and teaching. Hence, the platform deliberately combines different levels and levers of shaping transformation. But what does that mean from the perspective of research in relation to transformation?

From a research point of view, the platform can be seen as an actor in the ATM transformation triad. The contribution of the University lies precisely in combining three distinct points of contact between research and transformation: to research, to shape, and to enable. Transformation research means to create scientific knowledge that supports ongoing transformation processes as well as the understanding of performed processes. Transformative research directly intervenes into the region under transformation. Research transformation points to the (self-)transformation of the University considering global and regional challenges and is hence associated with inner-University learning processes.

Considering all these aspects, this article addresses the following research question: "How can transformation processes be researched, shaped, and enabled through a platform approach? What is the added value of a platform to the three tiers of research contribution to transformation—and what limitations occur?" To answer this question, we show in the following how REVIERa, as a platform approach, acts regarding the ATM transformation triad.

4 The Dimensions of the Platform

REVIERa, as a platform, acts in and targets the three aspects of transformation research, transformational research, and research transformation. In this sense, the platform approach constitutes a superordinate construct regarding the ATM transformation triad. However, the question arises of how to practice such a platform approach. Here, we showcases for each part of the triad as an exemplary analysis on how transformation processes can be researched, shaped, and enabled.

4.1 Transformation Research ("Research")

Challenges

Transformation research aims to advance scientific knowledge on the complex social, economic, cultural, and spatial interdependencies in transformation processes. It might uncover, among other things, functionalities, operating principles and effect chains, spatial and temporal dynamics, innovation and ex-novation processes, justifications, and possibilities for action. Usually, scientific learning is very much bound to an ex-post perspective on transformation and in many cases gains rigor from comparative research approaches. Furthermore, transformation research is carried out by different scientific disciplines e.g., from social sciences, earth sciences, engineering, spatial development, history, to psychology and medicine. Hence, setting up transformation research in face of a region under transformation, poses three main challenges: First, the temporal perspective is turned from ex-post to ex-ante and real-time scientific support. Second, future-oriented transformation research must find a way to gain empirical evidence in view of the uniqueness and the non-repeatability of the region under transformation and its manifold challenges and processes that occur. Third, scientific theories and explanations of transformation from diverse scientific disciplines and communities must be aligned and interlinked.

Case

REVIERa's platform approach is based on the hypothesis that, in transformation processes, new linkages between system, goals, and transformation knowledge have to be recurringly searched for and established (Wuppertal-Institut 2013). In this process, the questions of who holds this knowledge are crucial. Therefore, actors and arenas and the related methods and processes of communication, negotiation, and cooperation lie at the heart of the platform (Fig. 6). Transformation research can be undertaken in every pillar as well as the respective interdependencies of that layout.

In the initial phase of REVIERa, the focus of transformation research was to organize a landscape of knowledge and competencies of RWTH researchers for the transformation of the Rhenish mining area. The aim was first to gain orientation on the impulses of different disciplines and profile areas and second to better understand

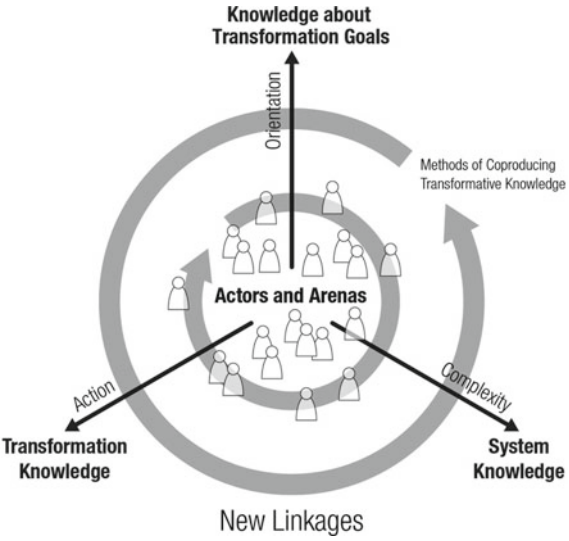

Fig. 6 Basic layout of REVIERa to link up system, goals, and transformation knowledge (Förster et al. 2022c: 31)

their mutual impact. This was a concern from within the University and from the regional partners, who were faced with a confusing multiplicity of projects and partnerships, which had applied for funding during the start phase of the regional transformation process.

REVIERa organized a process of knowledge exchange and structuring among RWTH researchers that led to a series of collaboratively edited materials that were made available open source on the platform. The first step was to gather ongoing projects as well as project ideas from over sixty teams of researchers in a booklet accompanied by a digital map of the region (REVIERa 2020a, b). On this basis and in a series of intense work sessions with researchers, seven core innovation areas for the Rhenish mining area were defined. In each area, a set of innovation stimuli with high relevance for designing sustainable change in the region were specified—and again published as open-source resources (Förster et al. 2022b) (Fig. 7). To complement the research perspective, parallel discussions with active members of society led to the creation of a baseline of perspectives and competencies in society that were also published as a map of "robust" or practical knowledge (Fazey et al. 2020; Förster et al. 2022a; Wuppertal-Institut 2013).

The further processing of the scientific knowledge gathered in the seven core innovation areas included three steps:

First, the over 50 innovation stimuli were assessed by the RWTH research teams on their contribution to the transformation goals, hence, system knowledge was combined with knowledge about transformation goals. More specifically, REVIERa introduced a transformation compass in order to link global sustainability goals to the ambition of the model region. The five dimensions of the compass include: (1) achieve environmental sustainability and climate neutrality, (2) facilitate development, (3) enhance quality of life, (4) establish new forms of value creation, and (5) ensure

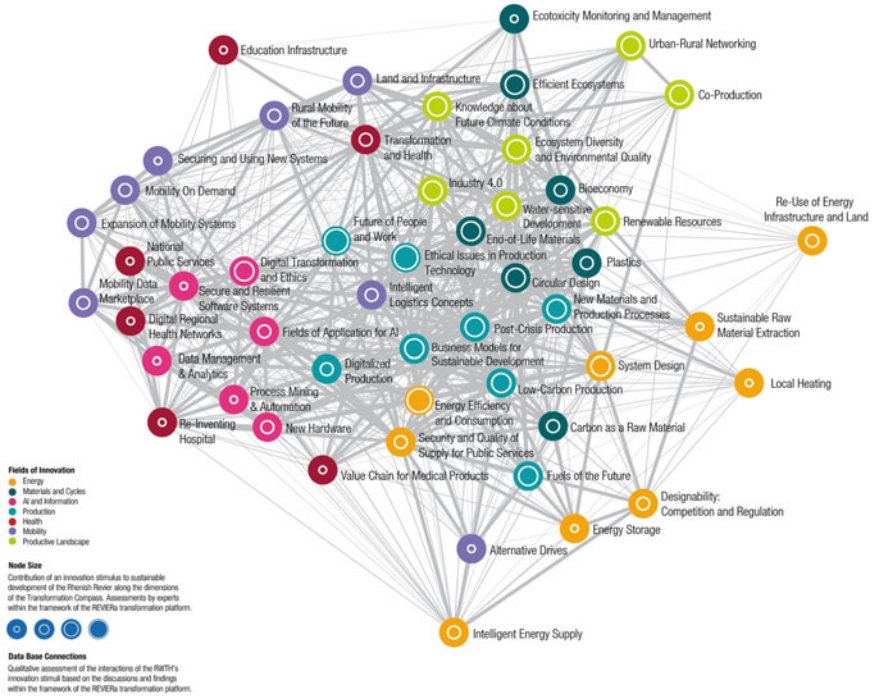

Fig. 7 Landscape of the interconnected fields of knowledge of RWTH Aachen University and its research partners (Förster et al. 2022c: 28)

inclusion and participation (REVIERa 2020b, 2022). The assessment within the framework of that compass raised awareness among RWTH researchers for reflecting and positioning their activities in relation to the regional transformation process and to identify blanks as well as trade-offs in their activities between the different compass dimensions. At the same time, the regional players gained clarity on the specific relevance of the different fields of scientific expertise for shaping a sustainable future for their region.

Second, the mutual interplay of the innovation stimuli was reflected by a network analysis (Fig. 7). In this work step, relations between different fields of system knowledge were established. The resulting network reveals potentials for interdisciplinary activities, e.g., the close interplay of impulses in the areas of materials and cycles, production, and landscape with high relevance both for the economic vitality and for the achievement of environmental sustainability and climate neutrality in the region. Another nexus of interrelationships comprises health, mobility, AI, and information, which all have a strong impact on the regional quality of life. Furthermore, the interdependencies reveal possible tensions between different kinds of value chains, e.g., an inner-regional perspective with high quality of living and leisure versus an energy, resource, and production-oriented perspective of the post-mining landscape that may be shaped.

Third, the innovation stimuli were reflected against the background of a multi-level governance perspective (Fig. 8). This exercise was not performed completely, but it was discussed and developed in selected cases during a scientific colloquium. The basic concept is to further elaborate the understanding of the landscape of knowledge by linking system knowledge with transformation knowledge, i.e., knowledge about how to shape, intervene, and act in transformation processes. As a result, one can evaluate which of the innovation impulses can be supported on a local level with a high diversity of different approaches and which issues must be coordinated regionally with high attention being paid to their consistent integration with other innovation areas and impulses.

Added Value and Limitations of the Platform Approach

REVIERa's effort to elaborate a landscape of knowledge in order to support the transformation process in the region demonstrates the importance of linkages and effects between different fields of knowledge—from an interdisciplinary and a transdisciplinary perspective. The platform provides access to different forms of knowledge as well as opportunities and methods for a diverse range of scientists and regional stakeholders to actively participate in this process of knowledge sharing and networking. Analytical as well as visual approaches to support systems thinking are key to managing this interpersonal and crosscutting process.

At the same time, the ambition of achieving a tailored landscape of knowledge for the region under transformation gives the impression of a theoretically and empirically never-ending process. The possible work character of such a tool has not yet been developed adequately—a smart digital solution is needed to make the landscape interactive and to constantly update it. Such an interactive device for inter- and transdisciplinary knowledge visualization and transfer would correspond to the overall platform approach of REVIERa. Despite the ambition of providing a comprehensive view, the integration of more fine-grained qualitative data that might also reveal

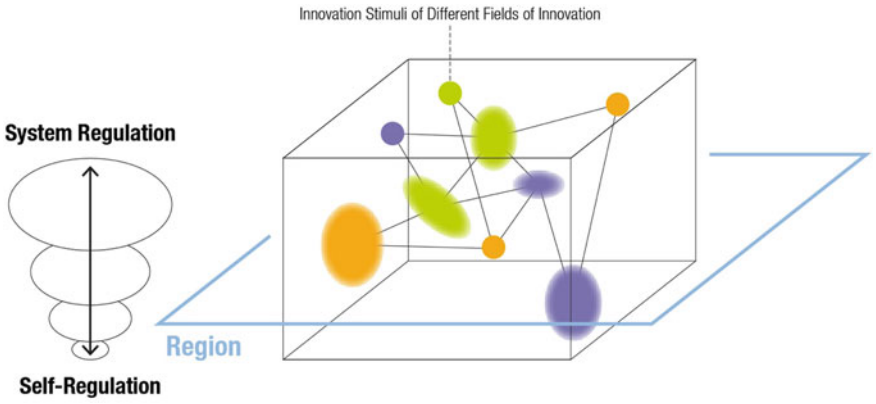

Fig. 8 Conceiving REVIERa's landscape of knowledge in a multi-level perspective (authors)

causal relations is still pending. Beyond the bird's eye perspective of the platform so far, there is a need for zooming in on specific issues, spots, or actor constellations in order to advance transformation research in—and for—the Rhenish mining area.

4.2 Transformational Research ("Shape")

Challenges

The aspect of "transformational research" describes the function of research as an impetus for further transformation. Historic great-scale technological examples would, for instance, be the invention of automobiles or the Internet. However, such transformative moments can also occur on a much smaller scale. Furthermore, the direct involvement of research in the shaping of transformation processes requires strong communicative skills and the ability to meet the motivation and needs of regional partners (Förster 2022). Beyond the motive force of funded projects, trust is an invaluable resource for any long-term cooperation between science and society. Staff fluctuation as well as work overload both within the university and the landscape of regional stakeholders may impede stable contact and confidence building.

Doing transformation can be supported on different levels and by different levers (Fig. 4), more precisely the combination of different interventions enhances the impact of research on the transformation process. For universities and their researchers, the active role in local or regional real-world processes can soon come into conflict with other commitments, such as fundamental research or international networking.

Case

The platform REVIERa aims to create transformative moments by bringing together different stakeholders and disciplines. This follows the concept that latent and tacit knowledge is activated through open-format exchange, stimulating new ideas, activities, and projects, which ultimately shape the transformation landscape. At the level of the platform, transformative research can be conceived as a chain of activities that build on one another (Fig. 9). So far, REVIERa has developed and tested some of these process modules, such as the landscape of knowledge or the transformation compass. However, there is a multiplicity of methods and approaches to stimulate transformative moments in a broad variety of interaction possibilities in the region.

Also, every single step in the chain of activities might unfold transformative power. In the genesis of REVIERa, shaping transformation started with the activation and linking up of diverse groups of science and society. Already in that phase, exchanging knowledge and competencies was a major incentive to participate. The joint debate on transformation goals was another connecting moment between the University and the region. The protected environment of REVIERa beyond political bargaining allowed for an intense and open discussion.

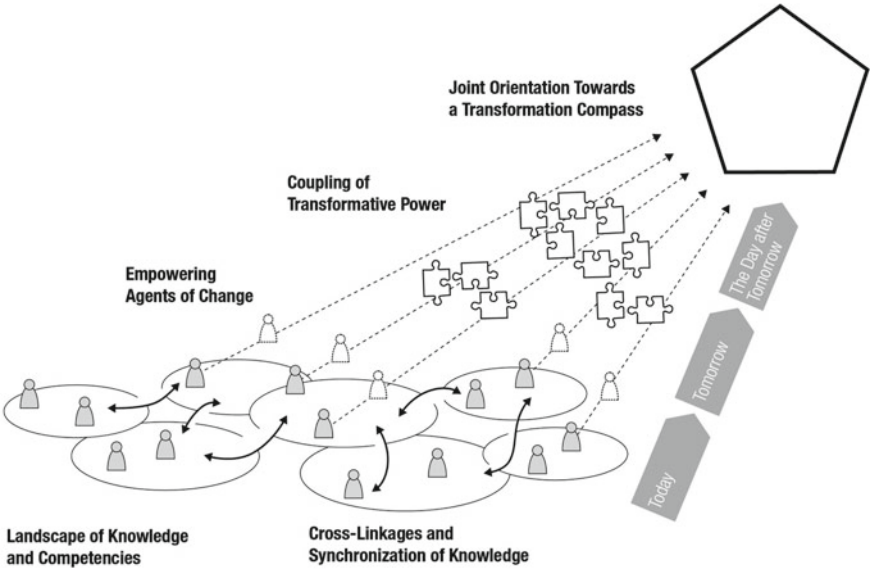

Fig. 9 Set of linkages and interrelated transformative moments in the REVIERa process (Förster et al. 2022c: 34)

Moments of reflection and learning within the REVIERa process are crucial for readjusting expectations and needs from all sides and for further developing participatory approaches. After a series of online formats in times of the COVID-19 pandemic, the request for face-to-face meetings grew. In summer 2022, REVIERa started a collaboration with an intermunicipal initiative around the open mine pit Hambach. Local stakeholders were invited to an interactive workshop format to think about instant projects that might shape the very early phase of regional transformation. The REVIERa team introduced the co-creative method "Future Synthesizer" that allows the linking up of system knowledge ("today"), transformation goals ("the day after tomorrow"), and transformative action and projects ("tomorrow"). Hence, the method enables groups of various stakeholders, researchers, and students to collectively debate and to come into action (Fig. 10). The workshop was run with five parallel groups—each of them came up with their own specific project idea to support the regional transformation process. Hereafter, REVIERa takes up the dynamic of collaboration. Therefore, the Temporary University, as one of the project ideas, is tested in summer 2023, serving as an incubator to further elaborate the transformative projects.

Added Value and Limitations of the Platform

Shaping transformation with a platform approach is an opportunity to complement the operational activities and research projects of the University. REVIERa is situated in distance to traditional funding and institutional or project-based obligations. The platform works at a preparatory level, and it provides room for encounter and

Fig. 10 Impressions from a collaborative work session using the "Future Synthesizer" in the second REVIERatelier in November 2022 at RWTH Aachen University. *Photo* Sebastian Welchlin

exchange unconstrained by tight deadlines and performance pressure. At the same time, the overarching approach is at risk of missing the specific urgency and needs within the region. That is why REVIERa's transformative research approach is—after the initial phase of setting up the platform—linked to concrete issues, sites, and players.

New perspectives of inter- and transdisciplinary teaching, meeting opportunities, and mutual visibility of recent activities turn out to be low-threshold measures to stimulate the platform's connective force between the many disciplines and societal groups. By developing and testing participative and co-creative methods, REVIERa sets the tone for more open and inclusive working formats that have since been taken up and carried forward by various stakeholders in the region. Beyond that, REVIERa's activities fuel the debate about the democratic condition and the levels of openness and inclusiveness of the regional transformation process.

In the long term, the platform will unfold its benefits in close collaboration with transformative activities and projects. Only then will the complementarities develop between focused, but temporarily limited projects and the long-term belief and trust in the platform.

The platform approach raises fundamental issues about the strategy, structure, and culture of the University (see Sect. 4.3). Shaping transformation at this level requires an institutional anchoring, either from an inner-University or from a regional partnership perspective.

4.3 Research Transformation ("Enable")

Challenges

Research transformation describes the transformation of the research culture itself, for example relating to an advancing interdisciplinary cooperation culture. Transformation processes like the structural change evoked by the end of lignite mining are characterized by a widespread involvement of many different stakeholders. This also concerns RWTH Aachen University, which is located in the Rhenish mining area, in relation to the region and its players. Considering the role of the University as a co-creator of knowledge and its aspirations of facing up to global and local challenges, the transformation in the Rhenish mining area is a challenging process which needs to be addressed from different perspectives. For example, challenges concern the ensuring of the energy supply and the maintaining of jobs after the lignite phase-out. Also, the region and the former surface mine need to be attractive for living, leisure, and/or work. The sheer scale of this challenging transformation highlights the need for collaborative efforts. From the University's perspective, activities aim to face the complex transformation process in the Rhenish mining area, which as a bigger picture can only be addressed collaboratively across disciplines. Besides the development of fitting technological and spatial solutions during and after the coal phase-out, connecting the variety of projects and stakeholders within the region is an elaborate challenge.

Case

Again, the aspect of "research transformation" describes a change in the manner of research. The REVIERa platform aims to help the progression of the research and cooperation culture following an open, interdisciplinary approach. These collaborative efforts and approaches are reflected within and supported by the platform in different ways.

First, the REVIERa platform with its three interdisciplinary co-founders has been inherently set up as a cooperation between different disciplines. In everyday operation, this structure has proven to address the challenges within the transformation process from a more well-rounded perspective than a singular discipline could. The co-founders of REVIERa from the faculties/schools of architecture, arts, and humanities, as well as business and economics are able to bring together their spatial planning, sociological, and economic perspectives. Additionally, REVIERa is supported by research assistants and other associated researchers from these and other disciplines, such as engineering. Thus, the establishment of the REVIERa platform is an example for the development of an interdisciplinary, collaborative format within RWTH Aachen University and the surrounding region.

Second, the formats and methods developed and offered by the platform support collaborations between different disciplines and actors. REVIERa's methods aim to support the analysis, visualization, and communication of topics and goals regarding the transformation process in the Rhenish mining area. Inherently, the methods are designed for inter- and transdisciplinary cooperation and knowledge exchange. For

example, the "Future Synthesizer" allows not only researchers from different disciplines but also students as well as stakeholders from the municipalities within the Rhenish mining area to work collaboratively. Moreover, the methods and tools themselves were developed in a collaborative, interdisciplinary effort. This is, for instance, reflected in REVIERa's transformation compass, which was defined in a collaborative workshop in 2019 as a set of five goals for the future development of the region.

Third, these activities and the originating research network support and reflect the transformation of the research process within the University. Here, the platform serves as a meta-learning and research space for members from all faculties/schools, profile areas, and groups. With this, the platform encompasses activities of the University in different areas. In the area of teaching, REVIERa has established the umbrella of "networked teaching and learning", where lecturers and students from different courses addressing the Rhenish mining area and the coal phase-out can connect with each other in interdisciplinary meetings. This has led to the collaboration of student groups from different courses and disciplines on joint topics. Additionally, a combined and enlarged knowledge base was supported through interdisciplinary presentation of results from different courses. In the area of projects, REVIERa has made an effort to compile project ideas and enable connections between project leaders, serving as an incubator for more networked projects and initiatives. For this purpose, the platform can offer room for joint reflection on ongoing projects and transformative activities in the Rhenish mining area. Increasingly, the REVIERa platform has become a brand and a component in research proposals with its role of enabling connections and knowledge regarding stakeholders, activities, and needs in the region.

All in all, the occurring inter- and transdisciplinary knowledge and cooperation initiatives can be described as a culture of integrated interdisciplinarity. This culture is essential for enabling stakeholders to address complex challenges like the structural change due to the coal phase-out. Consequently, research transformation toward integrated interdisciplinarity, as supported by platforms like REVIERa, is necessary within any university aiming to address complex future challenges.

Added Value and Limitations of the Platform

An interdisciplinary, collaborative research and teaching culture enables complex problems to be addressed from diverse and joint perspectives. It also supports a common knowledge base and draws attention to future challenges and possible solutions. Thus, research transformation is the backbone and enabler of a desirable transformation process.

However, the efforts of integrated interdisciplinarity cannot succeed without dedicated individuals and groups, because bureaucratic boundaries as well as disciplinary language barriers have to be overcome. Moreover, funding schemes designed for interdisciplinary projects and activities are necessary. Lastly, the changing research process of enhanced inter- and transdisciplinary cooperation itself must be understood, constituting a task for the future.

5 Discussion and Reflection

The previous chapter has shown cases of how the transformation platform REVIERa acts within the transformation triad of the Aachen Transformation Model. In this section, we conclude and focus on the interplay of the triad with respect to the platform approach with its prerequisites and challenges. This yields an agenda for the REVIERa platform, targeted to enhance future understanding of the coal phase-out transformation process. Regarding the three transformation perspectives (Fig. 11), specific interdependencies, commonalities, and boundaries arise in the context of the platform, which are illustrated and discussed below.

Interdependencies Within the Transformation Triad

In the context of the REVIERa platform, we observe several important interconnections within the transformation triad. Regarding transformation research, enhancing the understanding of transformation processes themselves is a prerequisite for transformational research, meaning the shaping of transformation. Transformation research can serve as a reflective approach to ongoing transformation processes, enabling learning from current experiences and comparable regions or related processes. With this, transformation research can make a valuable contribution toward better-shaping transformation. Hence, transformation research in relation to ongoing and upcoming transformation processes needs adequate formats of knowledge transfer that could also stimulate learning among the regional players as well as the scientists involved.

Regarding transformational research, "shaping" a transformation process demands critical reflection and sound evaluation. In general, transformative research programs must carefully integrate methods and moments of reflection. Scientists whose activities shape a certain process should carefully execute and review their activities. This should also be reflected in the activity's governance structure, e.g.,

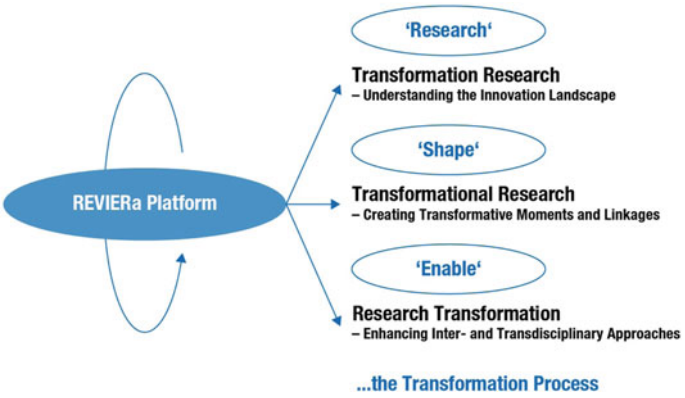

Fig. 11 REVIERa platform acting in relation to the transformation triad of the Aachen transformation model

in the form of setting up scientific teams that consider different roles and tasks and that also manage potential conflicts between them. Consequently, the transformative activities of REVIERa will have to be assessed in the future.

Regarding research transformation, the implementation of inter- and transdisciplinary formats and projects enables complex challenges to be approached, such as the structural change in the Rhenish mining area. While specific issues arising within transformation processes can be addressed from a disciplinary perspective, trans- and interdisciplinary collaboration is needed to address the complex relations within the processes and to approach one issue simultaneously from various perspectives. Given this aspiration, research transformation is a condition for collaborative transformation research.

Finally, applied research might stimulate and promote transformation processes. Thus, in our context, both research transformation and transformation research are prerequisites to be able to shape the transformation process in the form of transformational research. Moreover, ongoing transformation triggered by transformational research has a feedback function: the transformation itself feeds back to transformation research as the object of that research. Also, ongoing transformation serves as a stimulus for the further research transformation that is necessary to address new challenges. In that sense, transformational research serves as a push for research transformation.

Development of Methods

Regarding the work of the transformation platform REVIERa, we find that the development of methods is important for all three perspectives of the transformation triad. Generally, an assessment and methods relating to transformation processes need to be agile and adaptable (Böschen et al. 2022; Häußling et al. 2021). To research transformation and its impacts, it is necessary to understand systemic interdependencies, the formability and elasticity of transition processes and the processes of communication and negotiation. For this, modeling methods and dynamic visualizations can be applied. On a smaller scale, specific activities within a transformation process should be analyzed in a goal-oriented way. Here, life cycle analysis and the consideration of externalities via external costs help to understand concrete aspects of transformation and their impacts on the environment and society. REVIERa's innovation landscape (Fig. 7) is an example of a network analysis which was applied to accomplish a visual overview of innovation impulses of different areas and their interlinkage.

When it comes to research which is transformational, the transformational object, which may be a technology, a shift in mindset (e.g., environmental conscience) or regulatory commands, must be tangible in a literal or superordinate manner. Shaping a transformation process in an inclusive manner can be initiated with the help of participative methods. The goal of such methods is enabling others to handle and discuss complex and uncertain issues. In the context of REVIERa, we aim to enhance future literacy with the help of our collaborative methods and activities in order to eventually enable meaningful transformational moments (Miller 2015; Stuart 2018).

In terms of research transformation, methods and processes that enable interdisciplinary cooperation are necessary on different levels. Overall, to enable an integrated

interdisciplinary research culture, appropriate structural conditions are necessary. For a university, this means enabling collaborative research and teaching by creating the opportunities within regulations and administrative structures. For inter- and transdisciplinary research and teaching itself, this means finding, testing, and combining methods for mutual work. With this, the creation of shared knowledge from different disciplines is the prerequisite for fruitful cooperation.

Learning Processes and Integrative Moments

A platform approach has the particular capacity to stimulate mutual learning within the transformation triad. Each pillar of the triad includes learning processes at different levels: "researching" advances the understanding of transformation, "shaping" entails developing the skills, methods and interventions of researchers to stimulate transformation, and "enabling" changes the conditions in which researchers as well as regional partners may research and shape transformation. In the light of the growing urgency of global as well as regional challenges, a circular and recursive approach that pushes forward learning within the transformation triad helps to speed up a university's capacity building and hence to develop as a reliable and effective player in the region.

Generally, we emphasize the need for integrative moments between the three pillars of the transformation triad, since they relate to and influence each other. In our context, the REVIERa platform can serve an integrating function. For instance, the developed "Future Synthesizer" encompasses all three aspects of the transformation triad. The content of the tool was developed on the basis of transformation research. Its application as a workshop tool creates new linkages and transformative moments between different scientific disciplines and social groups. Finally, the synthesizer itself serves as a new means of teaching and researching under the consideration of interdisciplinary perspectives and hence constitutes an occasion of research transformation. A further opportunity for integrative moments within the transformation triad is the "Temporary University Hambach" in summer 2023, taking place in a small village next to the open mine pit Hambach. Researchers, students, and a broad variety of regional stakeholders and community groups can exchange and negotiate knowledge and ambitions from different perspectives and to coproduce transformative action and projects—hence, "researching", "shaping", and "enabling" are closely related in that innovative university format.

Limitations and Open Questions

Despite the significant potential of REVIERa's platform approach for synergistically integrating three distinct points of contact between research and transformation—to research, to shape, and to enable—there are important limitations and remaining open questions that require further discussion.

First, the advancements and learning in transformation research, transformational research, and research transformation show different speeds and temporal rhythms. While transformation research follows (according to funding programs) a rather rigid scheme of a two- to six-year perspective of empirical research, "shaping" transformation requires an agile and responsive project setup, especially when it also entails

social processes and learning. In many cases, the process architecture must be readjusted every three to six months—according to a changing inter- and transdisciplinary dynamic and based on moments of reflection and learning. Hence, the recommended integration of transformation research in the processes of shaping transformation is a true challenge. Furthermore, the value of shaping truly open transformational research processes and the consequences for the necessary resources and flexibility in the project design should be further discussed. Finally, "enabling" a university for transformation follows a rather long-time horizon that is significantly influenced by the career paths and cycles of the academic staff. Equally, legal framework and national funding conditions of universities strongly influence the advancements in research transformation. Open questions arise in relation to a diversification of career paths within the RWTH Aachen University and between the University and regional player institutions. How and when in their career can researchers contribute to the different pillars of the transformation triad—with what kind of permeability between the different modes of science?

Second, there are conflicting roles of the RWTH Aachen University and important lines of tensions between the three perspectives of the transformation triad. "Researching" transformation requires a critical distance between the research team and the issue and object of investigation. In contrast, when "shaping" processes, the researcher and research institution are collaborating partners—preferably at eye level—that are very much involved in the transformation process. "Enabling" processes are oriented both to the inside of the university and its disciplines, groups, researching, and learning formats and to the outside with the position and relations of a university within the scientific system—and they are hence on a superordinate and more distant level than the societal transformation processes that are researched or shaped. The preoccupation of a university with itself may be viewed critically from stakeholders of a region under transformation. With regard to the different roles of researchers in relation to transformation processes, we may ask, "What kind of knowledge and awareness do we have of these challenges? What consequences does it have for the setup and management of the platform activities? What kinds of shared as well as deliberately separated roles should be established?".

Third, a platform is a novel approach for RWTH Aachen University. It implicates difficulties, both in its actual establishing within the University's matrix structure of faculties/schools and profile areas, and in finding mid- and long-term funding perspectives. Funding is mostly directed toward definable projects with a limited timeframe of funding. Moreover, regional partners still find it difficult to orient and understand the setup, vision, and mission of the platform—since they perceive a polyphony of University approaches, projects, and activities with regard to the regional transformation process. So what kind of governance model is suitable to establish and run a platform like REVIERa in the mid- and long-term? Can the platform be a shared common good and be run following the principle of a cooperative society—which might also include regional partners?

6 Conclusion and Outlook

Overall, this article shows how transformation processes can be researched, shaped, and enabled by means of a platform approach, focusing on the REVIERa platform of RWTH Aachen University and the lignite coal phase-out in the region. Several main findings and further perspectives can be derived from the considerations above.

In the light of the massive ecological, economic, and social challenges, globally as well as on the level of cities and regions, a university of technology like RWTH Aachen University faces various expectations, such as enhanced societal responsibility, providing effective contributions and impulses to solve complex problems, and taking an active role in explaining, discussing, and negotiating its knowledge and innovation stimuli in many different arenas (Brennan et al. 2004; Gilliard 2020). It is becoming increasingly clear that there is a need for contributions of science that go beyond individual projects. To achieve this, however, important limitations of the research and funding systems must be overcome. Moreover, expertise and contributions from technology have to be embedded in fundamental social, economic, and spatial change processes; therefore, new ways of inter- and transdisciplinary integration are needed. A changing role of a university as a partner in transformation processes also brings with it new responsibilities and a raised importance of a university's reliability, transparency, and partnership at eye level.

In response, the transformation platform "REVIERa" was set up in 2019 during the very early phase of orientation in parallel with the political decision-making process on Germany's lignite coal exit. The ambition was to cross-link knowledge and innovation impulses within RWTH Aachen University and to engage as a long-term partner on eye level with a broad range of stakeholders in the Rhenish mining area. The University's scientists agreed that the platform approach would have a model character for other universities of technology and for regions facing other challenges of transformation.

From a science perspective, the added value of the platform is to combine different ways of how science addresses transformation: to research, to shape, and to enable (for) transformation. A platform approach has high potential for fostering learning between the three pillars of the ATM transformation triad, and hence for pushing forward knowledge, action, and implementation as well as institutional capacity for the region under transformation. To make the platform effective, it is important to develop and deploy suitable methods with regard to all three transformation perspectives as well as their interplay. Formats like the REVIERa "Future Synthesizer" have a bridging function within the transformation triad—they represent an accomplished synthesis of "researching", "shaping", and "enabling". In summary, REVIERa's platform approach opens up a broad field of inter- and transdisciplinary learning in relation to fundamental regional challenges and profound and long-term transformation processes.

In the future, it will be crucial to link the platform's activities even better to RWTH Aachen University's landscape of research and transformative projects and to enable recursive learning as well as cross-linking of the related communication

and participation activities. Important open questions arise with regard to conflicting roles and lines of tension both between the different modes of science and the various groups that REVIERa addresses. Therefore, it is even more important to accompany the platform's activities with ongoing monitoring and evaluation—and hence to make use of the capacity of transformation research.

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