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# System-level agency and its many shades: path development in a multidimensional innovation system

Maximilian Benner 

## ABSTRACT

In the path development literature, how agents shape innovation systems has attracted growing interest. However, the concept of such system-level agency suffers from an unclear distinction from other levels of agency, underdeveloped links to other agency concepts, vagueness about the conceptualization of a multidimensional innovation system and the impact of agency on it, and a limited understanding of the variegated outcomes of agentic processes. This article offers a sympathetic critique, suggests ideas for a nuanced multilevel agency conceptualization, and proposes a research agenda to close the gaps in understanding how system-level agency affects the course and outcomes of path development.

## KEYWORDS

system-level agency; innovation systems; institutions; path development; evolutionary economic geography

JEL B52, O31, O38, R11

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## 1. INTRODUCTION

The path development literature increasingly focuses on the role of agency (e.g., Blažek & Květoň, 2022; Gong et al., 2022; Uyarra & Flanagan, 2022). Proposed concepts include change agency (Grillitsch & Sotarauta, 2020), maintenance or reproductive agency (Bækkelund, 2021; Henderson, 2020; Jolly et al., 2020), institutional entrepreneurship (Battilana et al., 2009; DiMaggio, 1988), institutional work (Lawrence & Suddaby, 2006), and the distinction between firm- and system-level agency (Hassink et al., 2019; Isaksen et al., 2019). These overlapping typologies demonstrate that agency is a multifaceted but still not fully understood concept. Grasping the many shades of agency (e.g., in terms of its levels, aspects, functions and dimensions) is crucial for understanding paths. However, attributing the causes and consequences of impactful actions simply to the exogenously given presence of individual 'hypermuscular' (Lawrence et al., 2009, p. 1) heroes is analytically dissatisfying because doing so reduces agency to the serendipity of having the right person in the right place at the right time (Garud et al., 2010; Sotarauta et al., 2021). Hence, we need to better understand the endogenous agentic processes that shape paths in multiple and divergent ways. This paper addresses this gap by contributing to a multilevel conceptualization of agency in its different aspects as it shapes path development along

various functions in a multidimensional innovation system. Such a conceptualization can help explain how agents shape the complex environment in which innovation processes unfold.

A multilevel conceptualization that distinguishes firm- from system-level agency provides a useful analytical device for examining the influence of agency on path development as it corrects the traditional firm-centred focus of evolutionary economic geography (Binz et al., 2016; Dawley, 2014; Hassink et al., 2019; MacKinnon et al., 2019). Early evolutionary economic geography (EEG) put its primary focus on diversification in technologically related industries (e.g., Boschma & Frenken, 2011; Neffke et al., 2011) but has been criticized for generating 'too narrowly conceptualized models of endogenous and *firm-driven* path development processes' (Trippel et al., 2018, p. 688, emphasis added). Understanding the causes and consequences of transformations and reconfigurations of innovation systems through path development requires looking at how agents bring change to the system level (Hassink et al., 2019). Doing so hinges on capturing the complex and multidimensional innovation system that surrounds path development, going beyond the activities of firms (Miörner & Trippel, 2019) and including systemic patterns that enable and condition regional evolution such as institutional relatedness (Carvalho & Vale, 2018).

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This article takes an interest in the link between the macro level of an innovation system with its institutions and organizations (Edquist, 1997) and the agentic micro-level processes that shape this system (Bitektine & Haack, 2015; Kukk et al., 2016; Markard & Truffer, 2008; Musiolik et al., 2020). As these processes spill over from the level of individuals, firms, or other organizations to the system level in highly complex and diverse ways, a nuanced understanding of the many shades of system-level agency is important to comprehend the role of agency in path development. This article aims at contributing to such a nuanced understanding by identifying open questions about agency in an innovation system, contributing to a multilevel agency conceptualization, and suggesting a research agenda.

## 2. AGENCY IN PATH DEVELOPMENT

In line with a view that sees the evolution of paths as a process (Garud & Karnøe, 2001; Martin, 2010; Martin & Sunley, 2006), a typology of positive and negative regional industrial paths has been developed in a rich body of literature (e.g., Blažek et al., 2020; Grillitsch et al., 2018; Isaksen et al., 2019) that also extends to the relationships between paths in regional development (Breul et al., 2021; Frangenheim et al., 2020). In recent years, the literature has deepened its interest for the role of agency (e.g., Bækkelund, 2021; Jolly et al., 2020; Steen, 2016). In early conceptual contributions, Garud and Karnøe (2001) and Martin and Sunley (2006) stressed the role of agents' actions in shaping paths in a process perspective (Martin, 2010). A growing body of empirical studies confirms the importance of agency in path development (e.g., Dawley, 2014; MacKinnon et al., 2019; Sotarauta et al., 2021).

Giddens (1984, p. 9) simply relates agency to 'events of which an individual is the perpetrator' and goes on to explain it in the way that 'whatever happened would not have happened if that individual had not intervened'. Grillitsch and Sotarauta (2020, p. 707) propose a more precise definition by understanding agency as 'intentional, purposive and meaningful actions, and the intended and unintended consequences of such actions' (see also Coe & Jordhus-Lier, 2011). For Rekers and Stihl (2021, p. 90), agency is 'the capacity to act and produce a particular (intended or unintended) effect' in the three temporal aspects proposed by Emirbayer and Mische (1998). In their widely received article on the intertemporality of agency, Emirbayer and Mische view agency essentially as 'temporally constructed engagement by actors of different structural environments ... which ... both reproduces and transforms those structures' (p. 970). Agency fills time-, region- and agent-specific 'opportunity spaces' (Grillitsch & Sotarauta, 2020; Kurikka et al., 2022) and hence explains what at first sight looks like serendipity (Garud et al., 2010) but constitutes 'mindful deviation' by agents (Garud & Karnøe, 2001).

Under Emirbayer and Mische's (1998) past and future-oriented aspects of agency, agents interpret the past and envision the future through imaginaries, visions, narratives

and expectations (Benner, 2020, 2022a; Borup et al., 2006; Sotarauta, 2018; Steen, 2016). Imagined futures by way of imaginaries, visions, and narratives shape processes of path development through system-level agency (Hassink et al., 2019), as a growing number of studies shows (e.g., Baumgartinger-Seiringer et al., 2021; Eder & Döringer, 2022; Fai et al., 2022; Sotarauta et al., 2021). Imaginaries particularly affect the directionality of reconfigurations of the innovation system by shaping its selectivity and, hence, perceived opportunities (Kurikka et al., 2022; Miörner, 2022).

The path development literature has generated different typologies of agency. Grillitsch and Sotarauta's (2020) 'trinity of change agency' includes innovative entrepreneurship (Shane & Venkataraman, 2000), institutional entrepreneurship (Battilana et al., 2009; DiMaggio, 1988), and place-based agency (Sotarauta, 2018). Drawing on Coe and Jordhus-Lier (2011) and similar to the earlier work of Hays (1994), Grillitsch and Sotarauta (2020) distinguish between transformative change agency and reproductive agency. While reproductive agency can consolidate pathways through stabilization and incremental change (Bækkelund, 2021; Baumgartinger-Seiringer et al., 2021; Grillitsch et al., 2022b), when understood as maintenance agency it can aim at resistance to change (Baumgartinger-Seiringer, 2022; Henderson, 2020; Jolly et al., 2020). Both terms tend to be used interchangeably and inconsistently in the literature and can be summarized as stability agency (Benner, 2022c). Bækkelund (2021) further differentiates reproductive agency by complementing the trinity of change agency with three analogous but stabilizing forms of agency (replicative entrepreneurship, institutional work<sup>1</sup> and maintenance leadership). Different agency types can work in combination (Bækkelund, 2021; Baumgartinger-Seiringer, 2022; Grillitsch et al., 2021; Grillitsch & Sotarauta, 2020). Beyond institutional entrepreneurship, the broader notion of institutional work (Lawrence et al., 2009; Lawrence & Suddaby, 2006) has also been applied to path development (e.g., Benner, 2022c; Binz & Gong, 2022; Fuenfschilling & Truffer, 2016). Other categorizations of agency include, for example, Huggins and Thompson's (2019) typology of entrepreneurial, political, and labour agency and the specific groups of agents who exert each, or Sotarauta et al. (2021) who identify distinct roles of agency in path development.

In an attempt at conceptualizing the systemic role of agency in path development (Martin & Sunley, 2006) and based on the distinction between actor- and system-based approaches (Isaksen & Jakobsen, 2017), Isaksen et al. (2019) and Hassink et al. (2019) distinguished between firm- and system-level agency. This dichotomy responds to a critique on the earlier firm-centred approach of EEG (e.g., Hassink et al., 2019; Isaksen et al., 2019; MacKinnon et al., 2019; Steen & Hansen, 2018), according to Martin and Sunley's (2006, p. 426) call that 'it is not just strategic agency among entrepreneurs that is important in path creation' but also, for example, the role of policymakers (Dawley, 2014; Edler & James, 2015). System-level agency speaks to Garud and Karnøe's (2003)

notion of distributed agency which requires a variety of agents to work together and to combine different agency types on both levels (Grillitsch & Sotarauta, 2020; Isaksen et al., 2019; Isaksen & Jakobsen, 2017; Sotarauta et al., 2021; Tripl et al., 2020).

The firm-/system-level dichotomy has become influential in the path development literature (e.g., Rypestøl et al., 2021; Tripl et al., 2020). Blažek and Květoň's (2022) comparison of two Czech regions demonstrates that while firm-level agency is present in either case, it is system-level agency – or its absence – that shapes the success of path development. Hence, for path development to unfold, it is critical for agents 'to look beyond their organizational boundaries and to also devote time and energy to system-level agency' (p. 14). Hence, system-level agency is a central concept for path development that requires a nuanced conceptualization for its application in empirical research.

### 3. FOUR QUESTIONS ABOUT SYSTEM-LEVEL AGENCY

Despite recent refinements of system-level agency (Blažek & Květoň, 2022; Uyarra & Flanagan, 2022), the following four questions still call for a more nuanced multilevel agency conceptualization.

#### 3.1. How to distinguish the system level from other agency levels?

Drawing on Isaksen et al. (2019), Tripl et al. (2020, p. 194) see firm-level agency as occurring when 'actors who found new firms or introduce innovative activities within existing companies' while 'actors who transform innovation systems' exert system-level agency. Firm-level agency is not limited to firms as such but includes individuals engaged in firm-level actions such as startup formation (Grillitsch et al., 2022a; Isaksen et al., 2019) and acting as entrepreneurial role models (Bosma et al., 2012). Hence, the definition of both levels of agency appears to centre on the types of agents that exert them. Such an agent-centric distinction has been criticized (Jolly et al., 2020) as firms can also shape the system level (Baumgartinger-Seiringer, 2022; Rypestøl et al., 2021), and firm-level agency can also include other organizations and might better be called 'organizational-level agency' instead (Blažek & Květoň, 2022).

In a more action-centric definition, Isaksen et al. (2019) originally related firm-level agency to innovation in firms or the setup of new firms while system-level agency refers to 'actions or interventions able to transform regional innovation systems' (p. 52). Similarly, according to Hassink et al. (2019, p. 1638) 'firm-level agency has its main field of influence within one firm or organization, while system-level agency exerts influences outside its institutional and organizational borders', and Gong et al. (2022, p. 527) define it as 'collective and distributed activities enacted by firms, non-firm actors and intermediaries in developing and adapting the relevant supportive innovation system structures' that surround a new path. In

any case, firm- and system-level agency are based on different but related rationalities as firm-level agency is aimed at a firm's competitiveness and thus has a commercial focus but can extend towards the system level, for example, by shaping a region's institutions and eventually its competitiveness at large (Benner, 2022a, 2022b; Isaksen et al., 2019; Jolly et al., 2020; Pacheco et al., 2010).

However, there are forms of agency that elude the firm/system-level dichotomy but are still relevant for path development. While individuals can act both at the firm level (e.g., entrepreneurs) and system level (e.g., policymakers) (e.g., Musiolik et al., 2020; Rypestøl et al., 2021), there is a blind spot that is not captured by either level. For example, from a perspective of labour agency (Coe & Jordhus-Lier, 2011; Huggins & Thompson, 2019), while actions of workers can be located at the firm level and those of trade union leaders at the system level, individual jobseekers or students do not fall into either category although their individual skills acquisition has implications for path development.

#### 3.2. How to link system-level agency to other agency concepts?

To operationalize system-level agency for path development, it is important to clarify how it relates to other agency conceptualizations. For example, Grillitsch et al. (2022a) combine firm and system-level agency with the trinity of change agency, but such a conceptualization does not capture other forms of system-level agency such as maintenance or reproductive agency (Grillitsch et al., 2022b; Jolly et al., 2020). Empirically, system-level agency will often combine change, maintenance and reproductive agency at different stages of path development (Bækkelund, 2021; Baumgartinger-Seiringer et al., 2021). Blažek and Květoň (2022) combine organizational- and system-level agency with three types of either change and reproductive agency, respectively, but the underlying trinities of change agency and reproductive agency raise questions of their own. In particular, the analytical distinction between institutional entrepreneurship and place leadership leaves open how precisely they differ, and the same applies by analogy to Bækkelund's (2021) distinction between institutional work (or, more precisely, institutional maintenance) and place maintenance. While Kurikka and Grillitsch (2021) generally contrast collective interests behind place leadership with individual interests ascribed to institutional entrepreneurs, institutional entrepreneurship can also follow collective interests. Many forms of place leadership will be institutional and which forms do not somehow affect institutions is unclear.

Further, change agency not only contributes to building elements of social structure but can equally destroy them (Benner, 2022c; Fuenfschilling & Truffer, 2016; Kivimaa & Kern, 2016). In particular when it comes to institutions, the concept of institutional work (Lawrence et al., 2009; Lawrence & Suddaby, 2006) that identifies forms of agency that build, maintain or disrupt institutions goes beyond institutional entrepreneurship.

To integrate the diverse aspects covered by different agency concepts into a nuanced conceptualization of system-level agency, these different foci have to be covered by the many shades system-level agency can take.

### 3.3. How to conceptualize the innovation system and how does system-level agency shape it?

To understand how system-level agency affects path development, a clear understanding of what constitutes the ‘system’ level is needed. Does the system refer to an industry or sector, a regional economy, a technological field, or any combination of those? While the original concept focused on regional innovation systems (Isaksen et al., 2019; Isaksen & Jakobsen, 2017; Nilsen & Njøs, 2022), what role do other systemic concepts such as sectoral (Breschi & Malerba, 1997), technological (Bergek et al., 2008), national (Lundvall, 1992; Nelson & Rosenberg, 1993) or global innovation systems (Binz & Truffer, 2017) play, and how do different dimensions of such a system relate to each other and the evolving paths?

Path development can be traced in territorial, sectoral, and technological dimensions (Benner, 2022b; Nilsen & Njøs, 2022; Njøs et al., 2020) which can be conceptualized by drawing on the innovation systems literature. According to Edquist (1997, 2006), the innovation systems approach highlights the interactive, interdependent, and institutionally embedded nature of evolutionary innovation and learning processes. An innovation system consists of organizations, institutions, and their relations that together generate innovation (Edquist, 2006). In their review of innovation system concepts, Warnke et al. (2016) add new elements commonly not in the focus of the innovation systems literature such as the role of consumers, philanthropy, non-technical innovation, or sectors that do not strongly rely on research and development, thus widening the coverage of an innovation system (see also Tödting et al., 2022).

Innovation systems can be defined in a territorial dimension, either on the national (Lundvall, 1992; Nelson & Rosenberg, 1993) or regional level (Asheim & Isaksen, 2002; Cooke et al., 1997). In addition, sectoral innovation systems have been proposed (Breschi & Malerba, 1997; Malerba, 2002), as have technological innovation systems (TISs) (Bergek et al., 2008) that differ from a strictly sectoral perspective because sectors can include several technologies and technologies can span multiple sectors (Bergek et al., 2008; Edquist, 1997; Hekkert et al., 2007; Malerba, 2002). For example, Nilsen and Njøs (2022) link sectoral and territorial aspects and Njøs et al. (2020) propose a framework that combines territorial and technological elements.

Binz and Truffer (2017) combine a territorial logic on various scales with a sectoral or technological logic in their multiscale concept of global innovation systems. Multiscalarity is important because system-level agency on various spatial scales can affect regional industrial path development (Hassink et al., 2019). Combining territorial, sectoral, and technological dimensions of an innovation

system allows for analyzing the impact of phenomena such as extra-regional knowledge flows (Trippel et al., 2018), anchoring of further extra-regional resources (Binz et al., 2016), or policies that support these processes (Giustolisi et al., 2022) on regional paths.

Adding an agency perspective leads to a dynamic conceptualization of innovation systems. Hekkert et al. (2007) criticize static and deterministic tendencies in innovation system concepts and conceptualize agency along ‘system functions’. On a related note, Edquist (2006) identifies functions and activities that shape an innovation system such as setting up organizations, changing institutions, networking, or providing education and research. Drawing on Bergek et al. (2008) and Hekkert et al. (2007), six main system functions driven by agency can be identified. Localized *knowledge development and diffusion* is the core focus of the innovation systems literature (Edquist, 2006) but knowledge can also flow and anchor across space (Binz et al., 2016; MacKinnon et al., 2019; Uyerra & Flanagan, 2022). The knowledge function is extended by *entrepreneurial experimentation* that transforms knowledge into products and services. The *direction of search* includes, for example, visions and perceptions and is more recently conceptualized as challenge orientation in innovation policy (Tödting et al., 2022). *Market formation* refers to the demand side and includes the creation of protected technological niches (Binz et al., 2016; Kivimaa & Kern, 2016; Schot & Geels, 2008) and is related to *legitimation* in terms of acceptance, institutional embeddedness, and overcoming resistance, both on global and regional scales (Binz & Gong, 2022; Bitektine & Haack, 2015; Heiberg et al., 2020). *Resource mobilization* addresses the mobilization of assets and relates to the notion of asset modification that encompasses natural resources, financial capital, human capital, built infrastructure, technologies and capabilities, and institutions (Binz et al., 2016; MacKinnon et al., 2019; Miörner & Trippel, 2019; Rypestøl et al., 2021) which can be created, destroyed, or reused (Musiolik et al., 2020; Trippel et al., 2020; Uyerra & Flanagan, 2022). These system functions are interrelated and can reinforce each other, including through systemic externalities (Bergek et al., 2008; Hekkert et al., 2007).

System functions help elucidate the relationship between system-level agency and the territorial, sectoral, and technological dimensions of an innovation system. Accordingly, Markard and Truffer (2008) discuss the role of agency for system functions and Kukk et al. (2016) specifically highlight how institutional entrepreneurs contribute to system building. System functions have been acknowledged as an important concept in path development (e.g., Binz et al., 2016; Miörner & Trippel, 2019; Njøs et al., 2020). Uyerra and Flanagan (2022) have recently moved towards integrating the system functions of legitimation, market formation, asset modification, and knowledge anchoring into their conceptualization of system-level agency. System functions are shaped by agency in particular when ‘system builders identify systemic problems (e.g. deficits in TIS functions) and initiate activities towards their solution’ (Musiolik

et al., 2020, p. 4) which can be understood as an expression of system-level agency (Isaksen et al., 2019). However, the increasing complexity of the innovation systems concept means that agents can affect functions in multifaceted ways (Warnke et al., 2016).

### 3.4. How to cope with the variegated outcomes of system-level agency?

By interacting with evolving events, agency takes emergent properties that enable both intended and unintended outcomes (Emirbayer & Mische, 1998; Garud et al., 2010; Grillitsch et al., 2022b). Following Martin and Sunley (2007), emergence is a consequence of the complex adaptive nature of an innovation system that includes the ‘tendency for macro-scale structures ... to emerge spontaneously out of the micro-scale behaviours and interactions of system components’ (p. 578). Hence, system-level agency can be expected to unfold a possibly wide range of outcomes that reach from the immediately intended to the vastly unintended, which makes it difficult to assess and virtually impossible to predict outcomes. This issue is related to the temporalities of system-level agency that differ according to agents’ intentions on the one hand and short- and long-term path development outcomes on the other hand, for example, in the sense that actions emanating from short-term intentions can generate unintended long-term consequences or vice versa (Grillitsch et al., 2022a, 2022b).

Gong et al. (2022) discuss the emergence of paths and conceptualize system-level agency at the junction between structural preconditions on the one hand and outcomes of successful or failed path development on the other hand. They list industrial capabilities, support systems, and institutional structures as preconditions of an innovation system that together with system-level agency and serendipity shape diverse path development outcomes in a global context (Gong et al., 2022). Still, how precisely system-level agency affects these diverse outcomes remains little understood.

Further, change agency does not have to be unequivocally ‘good’. Just as stability agency can either consolidate or hamper new paths (Baumgartinger-Seiringer, 2022), so can change agency lead to their success or failure (Eder & Döringer, 2022), thus highlighting the unintended consequences of agency (Grillitsch et al., 2022a, 2022b; Lawrence et al., 2009). On a related note, various difficulties can undermine policy processes and thus lead to unfavourable outcomes of path development efforts (Benner, 2020; Sotarauta, 2018). In terms of directionality, change agency will often be important to increase the challenge orientation of the innovation system and reproductive agency can contribute to upscaling innovations (Tödting et al., 2022). However, change agency can lead to the ‘wrong’ outcomes, for example, when stimulating environmentally questionable paths, and maintenance agency by agents such as environmental advocacy groups can countervail it.

Finally, path development within an innovation system is not free from contradictions due to path multiplicity

(Benner, 2022b). As Hassink et al. (2019) highlight, interdependencies between different existing or emerging paths are possible and likely to occur. Specifically when multiple paths draw on the same assets, interpath relations imply that the evolution of one path will affect the development of others (Breul et al., 2021; Frangenheim et al., 2020; Steen & Hansen, 2018). These interpath relations are relevant in a territorial, sectoral, and technological way because sectors and technologies can support each other’s development, compete with each other, or not interfere with each other in a region (Frangenheim et al., 2020) or across different spatial scales (Frangenheim, 2022). Further, these interpath relations can generate the reformation of pre-existing sectors that are induced by path development in a new sector and the related modification of assets and resources (Breul et al., 2021).

## 4. TOWARDS A NUANCED CONCEPTUALIZATION OF SYSTEM-LEVEL AGENCY

In an attempt to respond to the four questions laid out, this section puts forward ideas for a multilevel conceptualization of agency that embeds system-level agency in a multidimensional innovation system in which path development unfolds.

### 4.1. Towards a multilevel conceptualization of agency

An innovation system provides the arena for contested agentic processes affected by power relations (Baumgartinger-Seiringer, 2022; Hindess, 1986; Miörner, 2022; Seo & Creed, 2002), and how a path within the system develops is an outcome of these possibly tense processes (Eder & Döringer, 2022) that operate and interact on various levels. As a working definition, system-level agency can be understood as those actions that affect path development by shaping the innovation system either territorially, sectorally, or technologically, independently of who acts. These actions share an ability to affect path development beyond what happens in and for organizations such as firms (Hassink et al., 2019; Isaksen et al., 2019). Hence, system-level agency exhibits characteristics of distributed and embedded agency (Battilana et al., 2009; Garud & Karnøe, 2003; Isaksen et al., 2019; Seo & Creed, 2002). In contrast, firm or organizational-level agency takes place within firms or other organizations and refers to the ‘maintenance, improvement, modernization, transformation or up-/rescaling of operations inside the organization’ (Blažek & Květoň, 2022, p. 4). Depending on the nature of the focal organization, firm/organizational-level agency follows the pressures exerted and demands legitimized by its particular institutional environment such as a competitive market, academia, or the public sector which shape their internal ways of working (Meyer & Rowan, 1977). Lastly, a residual category of ‘individual-level agency’ (Blažek & Květoň, 2022, p. 3) captures actions by individuals and shapes neither the firm level nor the system level, such as skills acquisition by students

or jobseekers. Hence, individual-level agency aims at shaping an individual's own opportunities. Table 1 summarizes these three levels. The remainder of this section focuses only on system-level agency as defined above and discusses the different shapes system-level agency can take, drawing on the varying foci of other agency conceptualizations.

#### 4.2. Towards capturing diverse aspects of system-level agency

Concrete instances of system-level agency can be characterized along several aspects (Table 2). Regarding the identity of agents, both individuals and organizations can exert system-level agency (Battilana et al., 2009; Mele, 2013; Musiolik et al., 2020). Organizations include firms, associations, government agencies, universities, research institutes, and other formalized entities (Blažek & Květoň, 2022; Dawley, 2014). Individuals do not need to have a formal position to exert specific forms of agency (Sotarauta & Beer, 2021), although the power, resources, and credibility of formal functions does matter (see also Eder & Döringer, 2022; Sotarauta et al., 2021).

While the agency of individuals is straightforward, the agency of organizations hinges on whether they are seen, in North's (1990, p. 4) words, as 'rules' (hence, institutions) or as 'players' in their own right. If organizations are seen as distinct from institutions, they are capable of exerting agency in complex ways affected by the agency of individuals but also according to their own organizational objectives and strategies (Bathelt & Glückler, 2014; Grillitsch et al., 2022a; Hindess, 1986; North, 1990; Zukauskaitė et al., 2017), as the examples of political parties, trade unions or lobby groups and their campaigns or other forms of collective action highlight (Coe & Jordhus-Lier, 2011; Huggins & Thompson, 2019; Rypestøl et al., 2021; Warnke et al., 2016).

System-level agency can aim at either change or stability (Hays, 1994), represented by change agency (Grillitsch & Sotarauta, 2020) and stability agency (Benner, 2022c), respectively, with the latter including maintenance and reproductive agency (Bækkelund, 2021; Henderson,

2020; Jolly et al., 2020). Change agency is usually proactive in seizing available opportunity spaces (Grillitsch & Sotarauta, 2020; Kurikka et al., 2022) while stability agency is often limited to reactively keeping the status quo (Isaksen et al., 2019). However, change agency and stability agency can coexist (Baumgartinger-Seiringer, 2022; Benner, 2022c; Fuenfschilling & Truffer, 2016).

System-level agency can be constructive or destructive in relation to structures (Benner, 2022c; Fuenfschilling & Truffer, 2016; Kivimaa & Kern, 2016). For instance, agents can engage in institutional work that creates new institutions or destroys existing ones (Lawrence et al., 2009; Lawrence & Suddaby, 2006). Destruction can be beneficial though as path development can be based on a combination of constructive action and the destruction of existing institutions, policies or other structures (Fuenfschilling & Truffer, 2016; Kivimaa & Kern, 2016).

System-level agency can relate to specific outcomes either directly or indirectly (Grillitsch et al., 2022a, 2022b; Warnke et al., 2016). For instance, institutional entrepreneurship can happen indirectly as a by-product of new business models or technological innovations (Battilana et al., 2009; Benner, 2022a; Garud & Karnøe, 2001) and cause the bidirectional coevolution of institutions and industries (Benner, 2022b; Gong & Hassink, 2019).

Given that actions draw on varying rationalities that are not predetermined by an agent's identity (Hindess, 1986), system-level agency can be rooted in a commercial (in the sense of for-profit or capitalist) rationality or a non-commercial (non-profit, non-capitalist) one (Edquist, 1997; Grillitsch & Sotarauta, 2020; Pacheco et al., 2010; Warnke et al., 2016). A commercial rationality aims at 'the discovery and exploitation of profitable opportunities' (Shane & Venkataraman, 2000, p. 217) and goes hand in hand with individual interests while a non-commercial rationality can (but does not have to) involve collective action or combine both individual and collective interests (see also Grillitsch & Sotarauta, 2020; Kurikka & Grillitsch, 2021). Agents can have mixed rationalities that enable actions combining commercial and non-commercial goals (Battilana et al., 2009; Benner, 2022a,

**Table 1.** Levels of agency in path development.

Level of agency	Description
System-level agency	Affects path development by shaping the innovation system either territorially, sectorally or technologically
Firm/organizational-level agency	Affects the internal functioning of firms and other organizations under the pressures and demands of their specific institutional environment
Individual-level agency	Is performed by individuals and remains confined to individual opportunities

Sources: Author's elaboration drawing on Blažek and Květoň (2022) and Isaksen et al. (2019).

**Table 2.** Aspects of system-level agency.

Agents	<ul style="list-style-type: none"> <li>• Individuals</li> <li>• Organizations</li> </ul>
Aim	<ul style="list-style-type: none"> <li>• Change</li> <li>• Stability (reproduction or maintenance)</li> </ul>
Immediacy	<ul style="list-style-type: none"> <li>• Direct</li> <li>• Indirect (as a by-product of other actions)</li> </ul>
Rationality	<ul style="list-style-type: none"> <li>• Commercial</li> <li>• Non-commercial</li> </ul>
Relation to structures	<ul style="list-style-type: none"> <li>• Constructive</li> <li>• Destructive</li> </ul>

Source: Author's elaboration.

2022b; Grillitsch & Sotarauta, 2020; Sotarauta et al., 2021).

### 4.3. Towards understanding micro–macro relationships between system-level agency and the innovation system

System-level agency shapes a multidimensional innovation system through the system functions of knowledge anchoring, development and diffusion, entrepreneurial experimentation, direction of search and challenge orientation, market formation, legitimation, and resource mobilization and asset modification (Bergek et al., 2008; Binz et al., 2016; Hekkert et al., 2007; MacKinnon et al., 2019; Miörner & Trippel, 2019; Rypestøl et al., 2021; Uyarra & Flanagan, 2022). As a micro-level process (Markard & Truffer, 2008), system-level agency can affect all six functions, either directly or indirectly through policies and often in interaction with agency on other levels. For example, while firm-level agency is a major direct driver for the knowledge development and entrepreneurial experimentation functions, system-level agency has an indirect but possibly strong influence through policies (Dawley, 2014; Uyarra & Flanagan, 2022) and other support measures encouraging firm-level agency on these functions. Institutional and organizational change is important for several system functions. Platform policies (Asheim et al., 2011) as well as visions and imaginaries (Jasanoff & Kim, 2009; Sotarauta, 2018) or expectations (Borup et al., 2006) are particularly relevant for the direction of search (Bergek et al., 2008). Demonstration projects, living labs, and test beds (Engels et al., 2019; Schot & Geels, 2008), legitimizing institutional work (Fuenfschilling & Truffer, 2016), and challenge and mission orientation (Robinson & Mazzucato, 2019; Tödtling et al., 2022) can be part of innovation processes or policies. Table 3 summarizes these and further examples and relates them to system functions and system dimensions.

As system dimensions are analytical abstractions that deal with the same underlying phenomena from different perspectives, actions by system-level agents will in most cases touch more than one dimension but might do so to varying degrees. The heuristic value of distinguishing instances of system-level agency along territorial, sectoral, and technological dimensions allows for capturing the different forms and directionalities of agentic processes in an innovation system, even if overlaps will often be empirically observable.

Defining territorial, sectoral, and technological dimensions of an innovation system allows for capturing the multiscale of system-level agency. Sectoral and technological changes are not spatially delimited and cross scales, but they will commonly unfold unevenly across space. Territorially, these changes can induce extra-regional flows of knowledge (Trippel et al., 2018) and an interplay between ‘global pipelines’ and regional knowledge diffusion through ‘local buzz’ (Bathelt et al., 2004), international or interregional mobility of people (Schäfer & Henn, 2018) and resultant institutional change (Saxenian & Sabel, 2008), and the multiscale transmission of further

resources such as legitimacy (Binz et al., 2016). All of these processes can be harnessed by outward-looking territorial policies (Giustolisi et al., 2022). Hence, system functions can be performed not just within the territorial confines of a region but also across regions (Miörner & Trippel, 2019).

To integrate the different dimensions of national, regional, territorial, sectoral, and global (multiscale) innovation system approaches, the following heuristic for distinguishing system dimensions is proposed:

- The territorial dimension of an innovation system refers to processes related to system functions that occur either within a territorial unit (e.g., a nation or region) or between them, thus exhibiting a dominant spatial logic. On a policy level, system-level agency that affects system functions in the territorial dimension follows a place-based logic (Barca, 2019). Promoting the interplay between endogenous and external knowledge flows through outward-looking regional innovation strategies provides an example for system-level agency in the territorial dimension (Giustolisi et al., 2022). Further, interpath relations on various scales will play out in the territorial dimension through processes of resource formation or reformation (Breul et al., 2021; Frangenheim, 2022; Frangenheim et al., 2020).
- The sectoral dimension of an innovation system relates to system functions and system-level agency shaping them as far as they are directed at delimited sectors or industries of economic activity such as the agricultural sector, the tourism industry, or the automotive industry. For example, legal and institutional frameworks are often sector-specific, and so will be system-level agency changing or maintaining them. Further, the sectoral dimension allows for capturing differences in the specific characteristics of industries, for example, their degree and type of newness (Binz & Gong, 2022; Gong et al., 2022).
- In contrast to the relatively clear delimitation of economic sectors or industries, the technological dimension refers to cross-cutting technologies or what often comes under the moniker of enabling technologies. For instance, biotechnology spans various sectors but can be subject to legal or regulatory frameworks specific to the technology itself and regulating aspects such as its ethical use. Fuel cells are another example for a cross-cutting technology that can be applied in different sectors such as electricity production, heating, or the automotive industry (Markard & Truffer, 2008).

Defined along these criteria, system dimensions allow for observing and mapping a wide range of system-level agency, as the examples listed in Table 3 demonstrate. These examples can play out in different ways, according to the many shades of system-level agency. While initiating transformative processes touching any function in any dimension represents change agency, consolidating these changes requires reproductive agency (Baumgartinger-Seiringer et al., 2021), and any of these processes can be



**Table 3.** System functions and system-level agency (examples).

System dimension (criteria)	Knowledge anchoring, development and diffusion	Entrepreneurial experimentation	Direction of search and challenge orientation	Market formation	Legitimation	Resource mobilization and asset modification
Territorial dimension (referring to processes either within a territorial unit or between them with a dominant spatial logic)	<ul style="list-style-type: none"> <li>Support to anchoring of external knowledge and regional diffusion (Giustolisi et al., 2022; Trippel et al., 2018), generating an interplay of 'pipelines' and 'buzz' (Bathelt et al., 2004)</li> <li>Support to knowledge spillovers between sectors and industries in a region</li> </ul>	<ul style="list-style-type: none"> <li>Regional entrepreneurship support (e.g., incubation, acceleration), networking, and innovation support (e.g., calls for tenders or proposals)</li> </ul>	<ul style="list-style-type: none"> <li>Challenge-oriented regional policies (Tödtling et al., 2022) and construction of shared spatial visions and imaginaries (Benner, 2022a; Miörner, 2022; Sotarauta, 2018)</li> </ul>	<ul style="list-style-type: none"> <li>Regional demonstration projects, living labs or test beds (Engels et al., 2019; Schot &amp; Geels, 2008)</li> <li>Territorial certification schemes (e.g., designations of origin)</li> </ul>	<ul style="list-style-type: none"> <li>Participatory policy development processes including users and civil society and addressing local problems (Tödtling et al., 2022)</li> </ul>	<ul style="list-style-type: none"> <li>Regional build-up of skills and education (Eder &amp; Döringer, 2022)</li> <li>External attraction of talent (Schäfer &amp; Henn, 2018; Trippel et al., 2018)</li> <li>Build-up of specific infrastructure</li> <li>Creation, change or intraregional transfer of institutions and organizations (Carvalho &amp; Vale, 2018; Saxenian &amp; Sabel, 2008)</li> <li>Reformation of resources due to interpath relations (Breul et al., 2021; Frangenheim et al., 2020)</li> </ul>

*(Continued)*

Table 3. Continued.

System dimension (criteria)	Knowledge anchoring, development and diffusion	Entrepreneurial experimentation	Direction of search and challenge orientation	Market formation	Legitimation	Resource mobilization and asset modification
Sectoral dimension (referring to processes directed at delimited sectors or industries of economic activity)	<ul style="list-style-type: none"> <li>• Sectorally oriented knowledge development</li> <li>• Support to intersectoral knowledge spillovers</li> </ul>	<ul style="list-style-type: none"> <li>• Sectoral entrepreneurship and innovation support (e.g., calls for tenders or proposals)</li> <li>• Setting of sectoral competitive incentives (Reiner &amp; Benner, 2022)</li> </ul>	<ul style="list-style-type: none"> <li>• Support to intersectoral convergence through platform policies (Asheim et al., 2011)</li> </ul>	<ul style="list-style-type: none"> <li>• Creation of a sectorally delimited legal and institutional framework</li> <li>• Interpath impact of sectoral legal and institutional frameworks (Frangenheim, 2022)</li> </ul>	<ul style="list-style-type: none"> <li>• Legitimizing institutional work, e.g., advocacy, for a new sector (Fuenfschilling &amp; Truffer, 2016)</li> </ul>	<ul style="list-style-type: none"> <li>• Support to financial investment (e.g., venture capital)</li> <li>• Creation, change or international or interregional transfer of institutions and organizations (Saxenian &amp; Sabel, 2008)</li> </ul>
Technological dimension (referring to cross-cutting or enabling technologies)	<ul style="list-style-type: none"> <li>• Support to research and development (R&amp;D) for new cross-cutting technologies (e.g., biotechnology, fuel cell technology, nanotechnology)</li> </ul>	<ul style="list-style-type: none"> <li>• Support to applied research and technology transfer in cross-cutting technologies (e.g., biotechnology, fuel cell technology, nanotechnology)</li> </ul>	<ul style="list-style-type: none"> <li>• Mission-oriented innovation policies (Robinson &amp; Mazzucato, 2019)</li> <li>• Construction of sociotechnical imaginaries (Jasanoff &amp; Kim, 2009) and expectations (Borup et al., 2006)</li> </ul>	<ul style="list-style-type: none"> <li>• Creation of protected niches (Schot &amp; Geels, 2008) and demand-related awareness raising activities</li> <li>• Creation of legal and regulatory frameworks for cross-cutting technologies (e.g., biotechnology)</li> <li>• Institutional system-building for new technologies (Kukk et al., 2016)</li> </ul>	<ul style="list-style-type: none"> <li>• Legitimizing institutional work, e.g., advocacy and educating, for new technologies (Fuenfschilling &amp; Truffer, 2016; Kukkk et al., 2016)</li> </ul>	<ul style="list-style-type: none"> <li>• Support to specific technological skills and capabilities</li> </ul>

Sources: Author's elaboration drawing on Bergek et al. (2008), Binz et al. (2016), Blažek and Květoň (2022), Hekkert et al. (2007), Kivimaa and Kern (2016), MacKinnon et al. (2019), Markard and Truffer (2008), Miörner and Trippel (2019), Musiolik et al. (2020), Rypestøl et al. (2021), Trippel et al. (2020) and Uyarra and Flanagan (2022).

countervailed by maintenance agency. Further, constructive actions can be mirrored by destructive ones (Kivimaa & Kern, 2016). These shades of system-level agency can be illustrated, for instance, in the legitimation function. Actions of institutional work can build, maintain, or disrupt the legitimacy of sectors and technologies (Fuenfschilling & Truffer, 2016; Lawrence & Suddaby, 2006), and territorial participatory development processes can initiate legitimation processes but will often serve to consolidate them, for example, by solidifying trust and reputation among agents (Benner, 2019).

#### 4.4. Towards grasping the variegated outcomes of system-level agency

System functions link system-level agency to path development outcomes in an innovation system. For example, Gong et al. (2022) emphasize the importance of legitimation at the junction between an industry's territorial, sectoral, and technological preconditions on the one hand and eventual path development outcomes on the other hand. The macro–micro dynamics of legitimation (Bitektine & Haack, 2015) shape the contextuality, contingency, and path dependence of path development outcomes in an innovation system (Bathelt & Glückler, 2003).

However, legitimation is just one system function, and system-level agency can affect multiple functions at the same time. Therefore, specific actions can impact path development outcomes differently along different system functions, possibly leading to variegated outcomes that include unintended consequences. In the territorial dimension, agentic processes in each system function can touch multiple paths through interpath relations in unintended ways (Breul et al., 2021; Frangenheim et al., 2020). In addition, the same actions can work in diverse timeframes as they might generate outcomes through some functions sooner than through others, thus offering an analytical lens to capture the multiple temporality of system-level agency (Grillitsch et al., 2022b). Nevertheless, we are still far from fully understanding how precisely system-level agency translates into short and long-term intended and unintended consequences, and further research based on the multifunctional and multidimensional logic proposed will be necessary.

Taken together, the considerations put forward above aim at a nuanced understanding that conceptualizes system-level agency along system functions and in system dimensions, and that sees system-level agency as an element of a multilevel conceptualization of agency, albeit one that is of critical importance for the course of path development in a multidimensional innovation system. Such a multilevel conceptualization of agency is important because it enables researchers to observe how, why, if, and when actions at the individual or organizational level cross levels and turn into system-level agency (or do not). Despite the burgeoning interest in agency that the path development literature has shown recently, our understanding of the causes and consequences of agency scaling up to the system level is still in its infancy and requires

more research along a conceptual and empirical research agenda.

## 5. A RESEARCH AGENDA FOR SYSTEM-LEVEL AGENCY IN PATH DEVELOPMENT

The conceptualization of system-level agency proposed here allows for examining concrete empirical configurations of system-level agency in its many shades. Nevertheless, answering the crucial question which precise forms of system-level agency lead to which forms of path development requires a wider research agenda that should include, for example, the following issues:

- Whether specific agency types on various levels and in various dimensions regularly result in specific forms of positive or negative path development needs further examination, possibly in large datasets to be explored with qualitative comparative analysis (Grillitsch et al., 2022c). Negative forms of path development (Blažek et al., 2020) are of particular importance because they can help understand what leads to the decline of paths in regional innovation systems and how this decline affects other paths (Frangenheim et al., 2020). These issues are intricately related to distinguishing between intended and unintended consequences of system-level agency.
- Analyzing system-level agency along system functions is promising to better understand the mechanisms linking agency and outcomes. For example, system-level agency in the direction of search function offers a basis for empirical research on how agency can advance or hamper the emergence of challenge-oriented regional innovation systems (Tödtling et al., 2022) and thus address a highly topical question. System-level agency in the entrepreneurial experimentation function can help better understand the role of interfirm competition that tends to be neglected in regional development (Reiner & Benner, 2022). Questions such as these could be addressed in qualitative research designs involving in-depth case studies.
- At the fluent borders between the levels of agency (individual, firm/organization, system), how agency scales up from one level to another is little understood. For example, how the agency of individuals *in* organizations (e.g., Edler & James, 2015) affects not just these organizations but also the innovation system is of high interest. This requires better understanding micro-level decision-making within firms and organizations through multidisciplinary research drawing on EEG, innovation studies, and business administration, for example, by resorting to behavioural insights (e.g., Benner, 2020; Huggins & Thompson, 2019).
- Methodologically, the research agenda could benefit from empirical diversification. Given that the path development literature is rife with cases from Nordic countries (e.g., Njøs et al., 2020; Rekers & Stihl, 2021) with their specific characteristics (Grillitsch et al., 2021) as well as from anglophone countries (e.g., Fai et al., 2022; Fuenfschilling & Truffer, 2016), other national and regional economies could

provide additional insights on the role of agency in different macro-institutional contexts (Hall & Soskice, 2001; Hassink et al., 2019). In particular, examining the role of agency in other contexts than high-income countries seems promising. While some recent studies do address path development in middle-income countries such as Namibia (Breul et al., 2021) and Vietnam (Breul & Pruß, 2022), more research at the nexus between EEG and development studies, including comparative studies spanning different contexts, is needed to understand the system-level agency of international donors and their competition with each other or the political rationales behind innovation processes (Haddad & Benner, 2021). Such an empirical diversification requires enriching the toolbox for studying system-level agency, for example, by adding ethnographic research designs known from political science or anthropology such as participant observation (Schatz, 2009).

- In particular when widening the empirical scope of the path development literature, research can raise further important questions about the multiscalarity of system-level agency such as the local impact of the agency of global agents such the World Bank and other international development organizations and thus broaden the path development literature across scales and their diverging institutional environments (Benner, 2022b; Gong & Hassink, 2019; Hassink et al., 2019) and, eventually, contribute to our understanding of the geographical political economy of path development (MacKinnon et al., 2019).

Following the various routes proposed by this research agenda could significantly advance our understanding of the many shades of system-level agency in path development across different contexts.

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1. As Lawrence and Suddaby’s (2006) original concept of institutional work is broader, a more precise term would be institutional maintenance (see also Grillitsch et al., 2022b).

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