

Understanding the Role of Innovation Actors' Social Network in the Digital Age: A Literature Review and Avenues for Future Research

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Abstract—Digital technologies have radically altered the nature of innovation and its development process. Innovations in the digital age are characterized by a reliance on a network of diverse actors who champion innovation. Despite the important role of these innovation actors' social networks in enabling interactions and collaboration for developing innovation, extant research lacks a synthesis of knowledge on innovation actors' social networks in the digital age. We provide a multidisciplinary literature review on the social network of actors championing innovation and its interplay with digital technology based on a theoretical framework derived from social network research. Our analysis gives insights into the flows and structure of innovation actors' social networks. We find that digital technology has predominantly led to gradual changes in innovation actors' activities by functioning as a catalyst. Concerning the characteristics of innovation actors' networks, we find more fundamental changes in the agency of digital innovation as innovation actors form communities and perform activities collectively. Building on the literature on digital technology and digital innovation, we identify promising avenues for future research. Overall, our literature review contributes by proposing a new conceptual model of innovation actors' social networks in the digital age and providing an agenda for future research.

Index Terms—Collaboration, digital innovation, digital technology, innovation actors, innovation champion, innovation management, literature review, social network.

I. INTRODUCTION

THE digital age is characterized by the widespread diffusion and adoption of digital technologies, which increasingly permeate all aspects of value creation in organizations [2, p. 5, 3]. Digital technology is embedded in digital innovation and defined as “a digital object that has been assigned a socially agreed-upon meaning” [4, p. 5].¹ The unique characteristics of

digital technology, such as reprogrammability, homogenization of data, and layered modular architecture [6], have brought about two significant changes for innovation: in its processes and outcomes. First, digital technologies have fundamentally transformed the way companies organize to enable innovation [3], [7]. Companies can now use digital technologies to reconfigure their processes, enabling novel ways of working and collaboration among employees and stakeholders [3], [4]. These technologies, such as digital platforms or digital tools, act as powerful enablers of innovation processes by supporting creativity, efficiency, and collaboration. Second, the unique characteristics of digital technology, such as its layered modular architecture, have given rise to a novel type of innovation outcome [6], [8]. This architecture enables radically new forms of innovation outcome by integrating digital technology into new products, services, or business models—referred to as digital innovation [4], [9]. As a result, digital technologies are not only enabler of innovation processes but also play a central role in shaping innovation outcomes (i.e., digital innovation) [9], [10].

For the development of innovation, networks exhibit a significant role in enabling information exchange and knowledge sharing among actors [11], [12]. The formation of new connections within actors' social networks also facilitates resource acquisition and collaboration among innovation actors [13], [14]. Such actors have been studied in innovation management literature for more than half a century. For the success of innovation projects, the role of innovation actors championing innovation is particularly important, as Schon [15, p. 84] points out: “the emergence of a champion is required. [...] the new idea either finds a champion or dies.” Championing is generally defined as vigorously promoting innovation through the various stages of the development process against potential resistance by taking risks [16], [17], [18]. In that regard, innovation researchers have emphasized the importance of various types of actors who champion innovation [17], [19]. Predominantly such actors have been considered to take up the role of innovation champions who can “bring [the] ideas to life.” However, championing innovation can also be part of the activities of other roles, such as boundary spanners who “acquire, translate, and distribute external information within the organization” [20, p. 89].

In the digital age, the significant importance of digital technology as an enabler or outcome of innovation has challenged our existing understanding of innovation actors and their social networks. Digital technologies have enabled greater involvement of employees and external stakeholders, e.g., through digital collaboration platforms [7], [21] or open innovation initiatives

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¹A digital object encompasses one or more bitstrings and can be described from a purely technical point of view [5].

[22], [23], thus transforming the character of collaboration networks for innovation. Moreover, the combination of diverse knowledge elements stemming from different industries within digital innovation further increases the diversity of innovation actors involved [7]. Consequently, companies increasingly rely on dynamic, heterogeneous groups of innovation actors to develop new product innovation [24]. With the inclusion of diverse actors across unit and firm boundaries, innovation agency has become less predefined and more distributed in the digital age [7]. This has implications for the engineering of new products. As development frequently takes place across departments, engineers need to be able to orchestrate heterogeneous actors and the engineering becomes nonlinear and iterative [22], [23]. Consequently, the distinct characteristics of digital technologies have raised the question about the appropriateness of existing innovation theories [7], including extant literature's considerations on the role of actors and networks in the digital age.

Despite the important role of innovation actors' social networks in enabling interactions and collaboration in innovation, our knowledge of innovation actors in the digital age is scattered. Studies, especially literature reviews, assessing innovation actors' social networks and taking the novel perspectives of the digital age into account are scarce, even though actors' interactions are important for explaining the development of innovation [7], [11]. The perspective in the existing literature reviews is primarily limited to innovation or digital innovation without considering innovation actors [4] or takes an individual perspective on innovation actors without considering their social network [17], [25]. Accordingly, recent literature has called for an analysis of the role of innovation actors' social networks in the digital innovation process [26]. As a step toward improving the knowledge gap in the literature, we examine the following research questions: *What characterizes the social network of actors championing innovation in the digital age?*

We address our research question by conducting a systematic review of the literature on actors championing innovation in innovation management and three related disciplines in the social sciences. To comprehensively investigate actors promoting innovation, we do not concentrate on a particular innovation actor type, such as the innovation champion. Instead, we encompass various innovation actors, individuals, and groups that meet our proposed definition by displaying championing behavior.² Thus, considering our definition of innovation actors, we refer to the literature on, for instance, innovation champions [15], [17], [18], sponsors [20], [27], and knowledge brokers [28], [29] to gain a broad and multifaceted understanding of innovation actors' social network and interplay with digital technology in the digital age. We develop and use a framework based on social network research [12], [30] to analyze innovation actors' social networks and interplay with digital technology.

We identify several distinct changes in the digital age regarding how innovation actors create and use social network ties to champion innovation. Specifically, digital technology increasingly enables innovation actors to use their networks more effectively, including collaboration with external stakeholders alongside traditional actors, such as employees and managers.

²From this point forward, we refer to these actors championing innovation simply as "innovation actors."

Our review also highlights how innovation actors employ novel strategies in digital innovation processes within their networks to align their actions with the unique nature of digital technology. In addition, the existing literature emphasizes the critical role of social network ties between actors championing innovation. We further observe a significant shift in the literature toward collective activities and co-championing within communities of innovation actors, particularly in digital innovation projects.

This article contributes to innovation research in several ways. First, we structure and synthesize the existing literature on innovation actors, offering a comprehensive analysis of the flow and structure of innovation actors' network. Second, we develop a new conceptual model of the dual embeddedness of innovation actors, integrating insights from social network theory and our literature review findings. Third, we propose a research agenda that provides key research questions and future research directions.

II. THEORETICAL BACKGROUND AND FRAMEWORK

In this section, we first outline the characteristics of the digital age and review the literature on the role of digital technology in innovation development (see Section II-A). We outline how the distinctive characteristics of digital technology and digital innovation have changed innovation actors' roles and ways of working. In Section II-B, we discuss extant research on the role of social networks in innovation and introduce terminology. We show how existing literature has pointed to the increasing importance of social networks for innovation in the digital age. Next, we outline different innovation actors, first focusing on innovation champions and then discussing other innovation actors (see Section II-C). Based on previous literature, we then present our research framework in Section II-D.

A. Digital Age: Digital Technology and Digital Innovation

The contemporary era is widely known as the digital age or information age. It is characterized by the availability of vast amounts of information through digital technology [31]. The invention of the World Wide Web, the exponential growth of digital storage capacity, and the increasing number of transistors on microchips—commonly referred to as Moore's law—have significantly contributed to the widespread adoption of digital technology characterizing the digital age [3]. Accordingly, the term "digital age" is widely used in the literature to refer to the pervasive diffusion of digital technology (e.g., [32], [33]). Digital technology and its unique characteristics have impacted innovation processes in two ways. First, digital technology has given rise to a new type of innovation, digital innovation, which is deeply rooted in the layered modular architecture of digital technology. Second, digital technology has changed the innovation development processes of traditional and digital innovation. We argue that these developments have also increased the importance of innovation actors' roles and changed their way of working.

Digital technologies possess unique characteristics, such as reprogrammability, data homogenization, and a layered modular architecture [6]. This layered modular architecture of digital technology consists of four layers that can be modified and

combined in various ways [6]. Newly developed layers or components of layers can easily be recombined without accounting for the specific characteristics of each layer [6]. This opens up unprecedented opportunities to develop novel products or services using digital technologies and has led to the emergence of digital innovation [9], [34]. Digital innovation has been defined as “the creation or adoption, and exploitation of an inherently unbounded, value-adding novelty (e.g., product, service, process, or business model) through the incorporation of digital technology” [4, p. 2]. The novel and exceptional opportunities for innovation through the incorporation of digital technologies result in the high generativity of digital innovation [35], signifying the spontaneous change and malleability of digital technology [6], [35]. This spontaneity of change and malleability of digital technology may increase the need for innovation actors to champion and manage rapidly changing innovation processes. Through their extensive network of contacts, innovation actors may be able to monitor technological advances and steer companies' future direction by identifying and nurturing promising innovative ideas.

The layered modular architecture of digital innovation also enables the combination of more diverse knowledge to create new digital innovations [3], [36]. For instance, the evolution toward connected products, incorporating digital technology in physical products—referred to as smart products [3], [37]—has spurred this progression. Creating smart products often necessitates input from diverse industries and unrelated fields of knowledge [3], [38], leading to digital innovation processes that involve diverse, distributed, and dynamic groups of stakeholders from different industries [39]. This results in a distributed innovation agency, where the decision-making power required for digital innovation is dispersed among different actors but also changes the way innovation actors work, such as their social interactions and knowledge exchange [3], [7]. As a result, innovation actors championing innovation may need to acquire different knowledge, form new social ties in their network, and develop new strategies to manage diverse and dynamic innovation teams in the digital age.

Research has also demonstrated that digital technology is significantly contributing to shaping new approaches to innovation development in both digital and traditional innovation [10]. Previously, companies exclusively relied on their R&D department for innovation. However, the emergence of digital platforms, which comprise software, hardware, organizational processes, and standards that enable interactions between diverse user groups, has simplified collaborative working on innovation projects with diverse stakeholders [40], [41]. Consequently, open innovation [42] and employee-driven innovation [43] form increasingly important approaches. Digital technologies, such as digital platforms or collaboration tools, enable companies to foster idea generation within their organizational boundaries to remain competitive [21]. Consequently, digital technologies may enable companies to systematically support innovation actors.

B. Innovation and Social Networks

According to the Schumpeterian perspective, innovation is the recombination of existing resources in new ways [44]. This

perspective has been echoed in recent research, as digital innovation has been described as novel combinations of physical and digital components [6]. For such combinatorial innovation to occur social networks fulfill a key role [45]. Innovation frequently arises from creating novel connections between people and exchanging ideas, resources, and knowledge within pre-existing or newly-formed relationships [46], [47]. The sharing of concepts and cooperation amongst diverse actors can produce groundbreaking outcomes by generating fresh combinations of knowledge components. This process can entail utilizing present social connections or creating new ones to investigate new domains of knowledge and components that can supplement and enrich actors' current understanding, ultimately resulting in creative ideas. Consequently, researchers have emphasized the essential role of social networks in the creation of innovation [29], [45] since they enable information exchange, interaction, and collaboration of actors [12].

In the digital age, the importance of social networks for innovation has increased, while their nature and topology have changed. Numerous scholars have shown how digital technologies have fostered connectivity by reducing costs and increasing the speed and efficiency of communication and coordination in innovation processes [48]. This development has increased the scope and quality of communication in existing social network ties [11]. Moreover, innovating often requires the creation of new connections between previously unconnected actors, as digital innovation, such as smart products, relies on heterogeneous knowledge from different knowledge communities [36].

Innovation actors rely heavily on their social network, especially informal relationships, to champion innovation projects (e.g., [49], [50]). Thus, innovation actors have been shown to transfer information or knowledge or build networks for resource exchange in their efforts to promote innovation projects against resistance [13], [51]. Despite the critical role of actors' social networks in championing innovation, our knowledge of them in the digital age is scattered. To build a comprehensive understanding of the characteristics of innovation actors' social networks in the digital age, we use social network theory as our theoretical lens.

A social network is composed of multiple nodes, each node representing one actor. Depending on the level of analysis, actors can be individuals, teams, or organizations according to social network theory. This article is especially focused on individuals and groups as nodes within the social network. Ties between actors indicate the social relationships among the actors. Ties can either be dichotomous, characterizing the presence or absence of a social relationship, or denote a valuation, depicting the strength of a relationship. In addition, ties can be directed (e.g., characterized by the direction that resources flow from actor to actor) or undirected (i.e., characterizing the close relationship between two actors). The patterns of ties in a network result in a network structure, wherein each actor occupies a specific position. Moreover, actors can be a part of different networks, whereby the characteristics of the relationships will vary between a collaboration network and a friendship network. Granovetter [12] introduced the concept of embeddedness by describing how economic exchanges are embedded in social networks to move beyond explaining economic exchanges as interactions between purely rational actors. Embedded ties in the social network, characterized by long-term cooperation, have

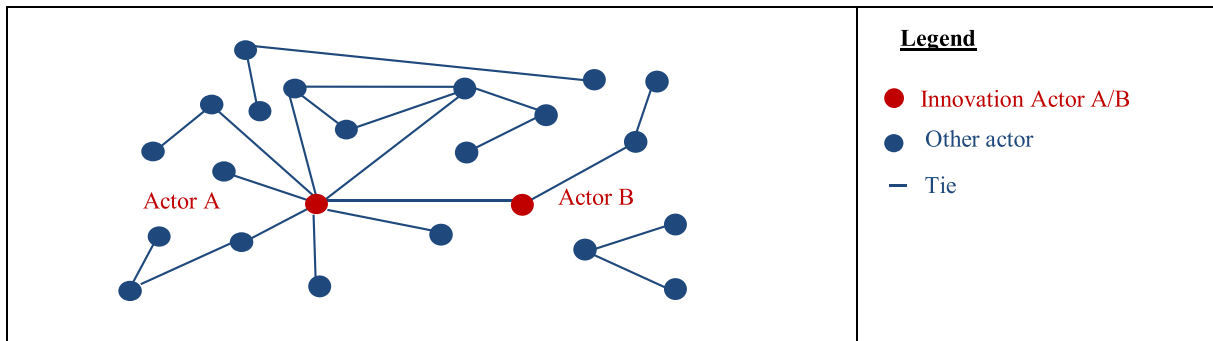


Fig. 1. Innovation actors' social network.

been shown to provide a performance benefit, as actors can benefit from information exchange, learning, and risk-sharing with other actors [52].

Fig. 1 depicts a snapshot of an organization's social network. Network analysis allows us to learn about the network structure and the position of specific actors. Innovation actor A and innovation actor B, represented by two nodes, form a social tie. Actor A takes a rather central position in the social network, as she possesses seven other social ties, while Actor B only forms a tie with one other actor.

C. Innovation Champions and Other Types of Innovation Actors

The innovation management literature identified more than half a century ago that the success of innovation projects is predominantly driven by some individuals who play a key role in the development process by promoting projects inside the organization. First and foremost, the innovation champion was identified as an important innovation actor by Schön [15]. He described the champion as “a man willing to put himself on the line for an idea of doubtful success,” who uses “any and every means of informal sales and pressure in order to succeed” and might “display persistence and courage of heroic quality” [15, p. 84]. Subsequently, a variety of definitions for the phenomena of innovation champions emerged. Jenssen and Jørgensen [17, p. 65] synthesized these by defining the innovation champion as “an individual that is willing to take risks by enthusiastically promoting the development and/or implementation of an innovation inside a corporation through a resource acquisition process without regard to the resources currently controlled.”

There exists a consensus in the literature that an innovation champion promotes an innovation vigorously through the various stages of the development process against potential resistance by taking risks [15], [16], [19]. Nevertheless, other aspects are less clear-cut and vary across literature, such as the question of whether champions can be found in managerial positions [53] or whether champions promote their own idea or the innovative ideas of others [20]. Similarly, innovation champions' actions employed to support innovation projects fluctuate sharply across research articles and extend beyond the resource acquisition process described by Jenssen and Jørgensen [17]. For instance, innovation champions select promising creative ideas and sell them to other actors in the organization [54], motivate their innovation team [13], transfer information and knowledge [55],

connect with others and build networks [16], bring different actors in the organization together [56], and gain management support [16].

As outlined above, extant literature attributes a wide variety of behaviors to innovation champions in their pursuit to promote innovation. Some of these behaviors have traditionally been assigned to other innovation actors, such as knowledge brokers, boundary spanners, and sponsors. For instance, while sponsors perform one particular type of championing, distinctively characterized through their managerial position, the innovation champion combines a wider variety of behaviors that also include but are not limited to sponsoring. Consequently, we see championing as a spectrum of activities, where individuals may enact only parts of the activities that encompass the spectrum. We use the concept of championing, defined as promoting an innovation vigorously through the various stages of the development process against potential resistance by taking risks [16], [17], [18] to account for all innovation actors that overlap with the concept of the innovation champion.

The sponsor supports innovation projects by relying on his formal power as an executive by offering advice, providing resources, and conferring legitimacy [20], [57]. Two other actors, the knowledge broker and boundary spanner, also play an important role in the innovation context.³ A boundary spanner is characterized as an actor who is well-connected inside and outside the organization and responsible for the interaction of the organization with its environment or internally of one group with another group [58]. If boundary spanners interact with contacts that are nonredundant to the organization or group, they occupy a structural hole [29]. In contrast, the knowledge broker's task is to transfer knowledge between actors who are not linked to each other themselves [28], [29]. Especially critical to the success of innovation projects are gatekeepers, knowledge brokers who gather knowledge externally, filter valuable information, and share it within the organization [59], [60]. Alongside these concepts, corporate entrepreneurs play a critical role in driving innovation in organizations. Corporate entrepreneurship, the process of creating a new venture or initiating renewal or innovation within an existing organization [61], exceeds the scope of the phenomena under investigation but also exhibits

³We are aware that the concepts of knowledge broker and boundary spanner expand far beyond championing and the innovation context as they comprise separate strands of the literature. Accordingly, we only include knowledge brokers and boundary spanners that fit within our definition of innovation actors in our literature review.

TABLE I
DEVELOPMENT OF RESEARCH FRAMEWORK BASED ON SOCIAL NETWORK THEORY

	Actor-network: Activities of innovation actors in social network	Network-actor: innovation actors' network characteristics
Topology of innovation actors' social network (structuralist)	Creating new social ties	Structural embeddedness
Flows in innovation actors' social network (connectionist)	Using established social ties	Relational embeddedness

a high overlap. Thus, successful corporate entrepreneurship is based on four competencies: inventing, brokering, championing, and sponsoring [57].

D. Development of the Research Framework

In the following, we rely on the term innovation actor to refer to individuals who perform championing activities to promote an innovation project throughout the development process. The term serves as an umbrella term to integrate other important actors who champion innovation. Innovation actors derive their influence from the social network, which they use to exchange information, knowledge, and resources. Thus, innovation actors often inspire others with their visions [60], transfer information and knowledge [13], [62], and connect with others and build networks [13]. By exploring the distinct elements of the social network in depth, we can reveal the breadth of interacting factors in the innovation process for innovation actors. We build an understanding of how innovation actors use their social networks to promote innovation in the digital age and which network characteristics contribute to innovation success.

One approach to studying actors' social networks is to differentiate between different levels of analysis, such as actors' dyadic relationships, ego-network, and network level. This approach is especially suited to explore an innovation actor's network based on primary or secondary data. However, these different levels cannot always be sharply separated, as different levels may interact and blur within and across studies [30]. Therefore, we take a different approach to studying innovation actors' networks by building a research framework based on Borgatti and Foster's [30] typology and extending it to the context of innovation actors. Table I depicts the research framework that we derive from existing social network theory in the following.

According to Borgatti and Foster [30], research on the consequences of social networks can be distinguished based on the explanatory goals and explanatory mechanisms. For the former dimension, we take a social capital perspective, which aims to explain the relationship between variations in individual or organizational performance and social network ties' characteristics [12], [29]. Thus, we focus on how innovation actors' network characteristics have performance implications, as they may enable actors to succeed when promoting innovation projects.

Concerning explanatory mechanisms, Borgatti and Foster [30] differentiated between two strands in the literature: structuralist and connectionist perspectives, which treat ties in a social network differently. The *structuralist* stream of literature explores the topology of a social network by focusing on the structure and configuration of social ties in a network [29], [63].

Literature in this stream builds on the idea that two actors with similar central positions in a social network or certain structures of their ego network will achieve similar results [64]. Yet, the optimal structure of the actors' network has been debated. Coleman [63] argued that a dense ego network will give actors an advantage since they may be able to better coordinate with other actors. In contrast, Burt [29] outlined the benefits of structural holes that allow an actor to exploit the lack of a social connection between its alters by acting as a broker. In contrast to this perspective, the *connectionist* research stream has focused on analyzing the flow of information and knowledge in the network and considering the quality of ties [65]. This literature relates the success of an actor to his or her access to resources and knowledge and resources available through his or her existing social ties. Granovetter [66] reflected this distinction by differentiating between structural and relational embeddedness when studying networks. Accordingly, we analyze two dimensions of innovation actors' social network: *topology* and *flows* when reviewing the literature.

Moreover, we take two perspectives in our analysis of innovation actors' interaction with the social network by considering the direction of causality [30]. The *actor-network* perspective allows us to study innovation actors' activities in their networks to understand how actors use their networks to drive innovation and how their actions shape their social networks. In addition, the *network-actor* perspective enables us to identify how the characteristics of innovation actors' social networks shape their actions and promote or hinder the success of innovation projects. As a result of these two dimensions (topology versus flows) and two perspectives (actor-network versus network-actor), our research framework forms a two-by-two matrix, as depicted in Table I.

When we take an actor-network perspective to study innovation actors' activities in the social network, we consider both aspects of topology and flows within innovation actors' social network by analyzing the activities that innovation actors take to create social ties (i.e., topology) and use social ties (i.e., flow). Thus, innovation actors perform different activities in the network to *create social ties* and change the structure of their social network. For instance, innovation actors build novel relationships and coalitions to advance innovation [57], [67]. At the same time, innovation actors *use their social ties*, for instance, to obtain resources from the social network [13], [16].

Analyzing the extant literature on innovation actors from a network-actor perspective, we also differentiate between the two dimensions of topology and flow of innovation actors' networks. Innovation actors' embeddedness in the social network can be characterized by the network position and the quantity and quality of their relationships with other actors [68]. Following Granovetter [66], we differentiate between structural embeddedness (i.e., topology) and relational embeddedness (i.e., flow) to consider an innovation actor's network structure and quality of relationships. Structural embeddedness is defined as "the impersonal configuration of linkages between people or units" [69, p. 244] and describes the structure of actors' network ties. Relational embeddedness is defined as the "personal relationships people have developed with each other through a history of interactions" [69, p. 244] and describes the character of actors' ties.

III. METHODOLOGY

We conduct a systematic literature analysis based on Webster and Watson [70] and following the approach of other research articles [23], [71]. We aim to provide a comprehensive review that synthesizes knowledge on innovation actors' social networks and explores the role that digital technologies play in these networks, identifies important knowledge gaps in existing literature, and proposes future research directions. The underlying three-step methodological approach: search process, selection of relevant articles, and coding and review of the literature was adopted from existing research [70], [71] and is described as follows.

A. Search Process

A comprehensive literature review covers all relevant literature on the topic, including related fields of research [70]. As prior literature has found innovation actors to play an important role in the context of digital innovation and digital technology [9], [72], high-quality journals⁴ in the field of IS were included in the search. Furthermore, since this article aims to analyze innovation actors by taking a social network perspective, leading journals in organizational science, human resources, and business administration were searched. Moreover, important contributions from the field of innovation management were incorporated since the scientific concept of innovation actors originates there [15]. Overall, this systematic literature review synthesizes literature from four disciplines: business administration, human resources and organizational science, information systems, as well as innovation management.

To ensure that the literature base consisted of publication outlets that were recognized as leading in the field, the journal selection was determined using the German VHB-JOURQUAL3 [73] in connection with the Journal Quality List [74], a meta-ranking of 12 different journal ratings (cf., see Table C2 in Supplementary Material), such as the Financial Times 50 Ranking 2016. For the German VHB-JOURQUAL3 ranking, the selection of publication outlets was restricted to 136 peer-reviewed journals, ranked in the categories A+, A, or B, and published in English. We used the Journal Quality List to account for international comparability. Thus, we evaluated our earlier selection and added 11 additional journals, which had received a high ranking in the Journal Quality List. The final selection of publication outlets included 146 high-quality, peer-reviewed journals and was searched using a meta-search engine based on different databases, such as EBSCO Business Source Complete.

We utilized an elaborate search string, consisting of three components: innovation, championing, and level of analysis. These three keyword components were derived from our aim of analyzing innovation actors in the digital age by taking a social network perspective. We intentionally excluded search terms addressing the digital age, such as "digital technology" or "digital innovation" to take a comprehensive approach toward innovation actors. This approach allowed us to analyze whether and how characteristics may manifest differently across various aspects of the digital age. While some literature is situated in

⁴We decided to focus on peer-reviewed journal publications only to ensure a high quality and maturity of the reviewed research.

TABLE II
SEARCH STRING

Keyword components	Search terms
Innovation	("innovat*")
Actors	("champion*" OR "promot*" OR "boundary spann*" OR "broke*" OR "sponsor*" OR "corporate entrepreneur*")
Level of analysis	("organi?ation*" OR "network*")

the digital age, it does not explicitly state its focus on digital technology within innovation processes or digital innovation. Consequently, such literature would have been missed with a search strategy that required terms surrounding the digital age.

Table II illustrates the search terms used to signify each keyword component. Regarding the concept of innovation actors, our prior literature research revealed the usage of various terms with comparable meanings to indicate those individuals who champion innovation initiatives and meet our definition of innovation actors (see Sections II-B to II-D for further information). To limit prepossessions on the research topic, we chose keywords for our literature search based on the underlying broad characterization of innovation actors and not based on familiar roles or role labels. Thus, we consolidated a range of activities, such as brokering and championing, which characterize innovation actors (cf., keyword components "actors"). This approach ensured a systematic search of existing research while avoiding any preconceived notions about innovation actors. Furthermore, we included search terms that distinguish the level of analysis, either network or organization, to ensure we approach our analysis of innovation actors from a social network perspective.

Based on these components and to cover our research topic comprehensively, we formed a search string depicting keywords as well as related terms and corresponding adjectives and verbs (cf., Table II). The resulting Boolean expression also specified that these search terms had to be present either in the title, abstract, or subject terms. The literature search was limited to the timeframe from 1995 to 2020. In 1995, the American National Science Foundation lifted the last restrictions on the commercial use of the Internet, thus marking the start of the digital age. As a result, we chose this year as the initial point for our literature review. This selection permits us to examine the literature comprehensively and recognize the distinct function of digital technology in innovation actors' endeavors to champion innovation.

B. Selection of Relevant Papers

The search process resulted in 1428 potentially relevant papers. Two independent researchers manually reviewed the material based on four inclusion criteria:

- 1) provide a research methodology;
- 2) focus on innovation actors championing innovation;
- 3) instantiate innovation actors as individuals or a group;
- 4) take a social network-related perspective on innovation actors.

For our focus on innovation actors, we included all papers that focused on actors that fit our definition. Thus, in addition to innovation champions, we also incorporated other individuals

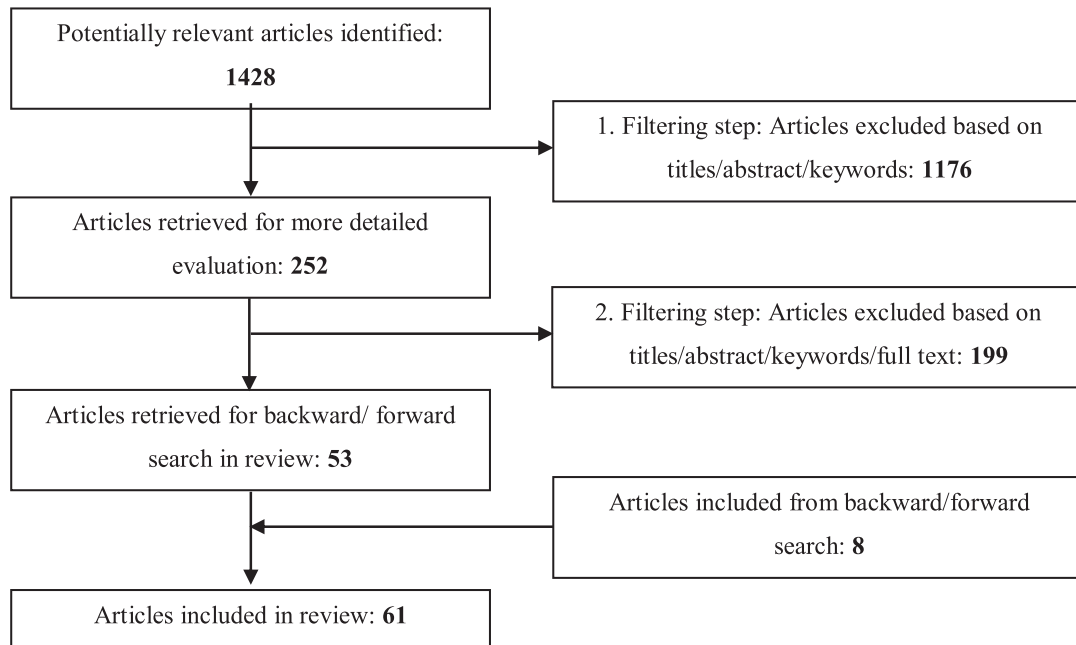


Fig. 2. Filtering process.

who champion innovation and conform to our definition of innovation actors. This resulted in the inclusion of knowledge brokers, boundary spanners, or sponsors who championed innovation projects. At the same time, we excluded actors, who were labeled as champions but did not fit our definition, since they, for instance, focused on champions promoting the implementation of IT [75], [76]. We did not specifically filter literature based on its focus on the digital age. This approach allowed us to derive generalizable findings by first identifying actors' characteristics regardless of their digital or nondigital context. In the subsequent analysis, we then explored shifts and changes triggered by digital technology. Accordingly, we provide valuable and generalizable insights into actors' characteristics in the digital age but also identify future research avenues. The filtering process is depicted in Fig. 2.

In the first filtering step, the title, the abstract, and the keywords of each publication were manually reviewed based on the four inclusion criteria by two independent researchers. Articles, where no decision could be reached, remained in the sample of potentially relevant articles for the next filtering step. In the second filtering step, the remaining research literature was screened again, whereby the same filtering criteria were applied to the full text of the research article. The filtering was conducted by at least two authors, who resolved disagreements through repeated discussions. To exhaust all literature sources on innovation actors, a backward search (i.e., reviewing older literature cited in the articles yielded from the keyword search) and a forward search (i.e., reviewing additional sources that have cited the articles) were conducted [70]. Overall, 61 papers across 30 high-tier journals were identified as relevant to our research topic, as illustrated in Table 4 in Supplementary Material.

C. Coding and Review of Literature

Subsequently, all 61 research articles were categorized based on the research framework derived in Section II-D and by

using the coding scheme given in Table C2 in Supplementary Material. While the coding scheme had been developed by all authors, the coding was conducted by two authors. The two authors carefully extracted findings and insights relevant to the review and its research focus on innovation actors' social networks and included them in the coding table. With respect to innovation actors' social networks, the authors first extracted excerpts that described innovation actors' activities or characteristics in their social networks for each article. The authors then coded these deductively by following the research framework as described in Section II-D. Thus, innovation actors' activities were coded into the two categories "creating new social ties" and "using established social ties." Similarly, the two authors coded characteristics of innovation actors' social networks into the two dimensions "structural embeddedness" and "relational embeddedness." They then examined the research articles on a more granular level within each category and inductively derived themes. Especially, for innovation champions' activities, the authors iteratively derived subcategories, such as "scanning the environment" or "boundary spanning."

For instance, Benbya and Leidner [77, p. 150] described champions, who "act as connectors, suggesting contacts to ensure that ideas reach the people with appropriate and deployable capabilities and assets to develop them." These activities were coded into the category "creating new social ties" as this research article considered innovation champions from an actor-network perspective and innovation champions conduct "boundary spanning" activities to connect different actors to enable the creation of new ties. In contrast, Ebers and Maurer [58, p. 321] took a network-actor perspective by testing hypotheses, such as "Organizational boundary spanners' external relational embeddedness is positively associated with their organization's potential absorptive capacity." Accordingly, we coded the research article's findings for this hypothesis as "relational embeddedness."

To understand the role of digital technology in innovation actors' social networks, the two authors conducting the coding

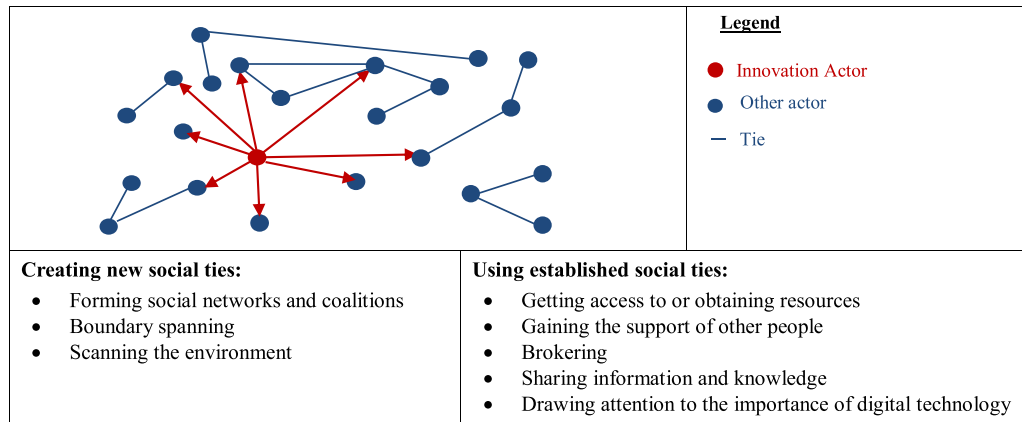


Fig. 3. Innovation actors' activities in the social network.

also extracted excerpts revolving around this theme from the research articles. These excerpts were then categorized based on whether they pertained to the outcome of the innovation projects (e.g., actors championing digital innovation or IT innovation⁵) or whether digital technology enabled actors to promote innovation (e.g., a digital collaboration platform used by innovation actors).

Coding discrepancies were resolved in discussions between the two coding authors. In our analysis, we considered all types of studies but point out if some results have mainly been put forward in conceptual papers. A complete overview of all research articles coded and analyzed in the literature review can be found in Supplementary Material (see Appendix B).

IV. RESULTS OF THE LITERATURE REVIEW

In the following, we analyze innovation actors using the research framework that we developed based on social network theory (see Section II-D). First, we analyze the literature by taking an actor-network perspective and exploring the activities of innovation actors in their social networks. Second, we take a network-actor perspective and identify characteristics of innovation actors' social networks and their implications for innovation actors' performance. Third, we summarize the main findings.

A. Actor-Network Perspective: Activities of Innovation Actors in the Social Network

We approach the actor-network perspective from two sides. First, we analyze activities that innovation actors use to change the topology of their social networks: activities related to *creating new social ties*. Second, we identify innovation actors' activities aimed at altering the flows in their social network: activities related to *using established social ties*. Fig. 3 provides an overview of innovation actors' activities in the social network outlined below.

⁵Note that we considered both digital and IT innovation as many early digital innovation projects were initially identified as IT innovation before the term "digital innovation" gained popularity. To determine whether these projects could be categorized as digital innovation and included in the sample of relevant research articles, we applied the definition provided by Hund et al. [3, p. 2] who define digital innovation as "the creation or adoption, and exploitation of an inherently unbounded, value-adding novelty (e.g., product, service, process, or business model) through the incorporation of digital technology."

1) *Creating New Social Ties*: Existing literature has identified several activities innovation actors use to create social network ties. Innovation actors *form social networks and coalitions* to advance their innovation projects [13], [67]. One strand of the literature describes that innovation actors work on expanding their social network within the organization [49]. Another strand of the literature emphasizes the significance of relationship-building with external actors [16]. In digital innovation literature, especially the importance of forming social ties with customers or users is emphasized [78], [79].

The importance of innovation actors' personal networks, characterized by strong social relationships, has often been highlighted [49]. However, innovation actors also heavily rely on weak ties with acquaintances they build and maintain by staying in contact with former colleagues and volunteering [78]. Innovation actors purposefully join forces with other actors to form coalitions favoring innovation development [80]. In doing so, innovation actors choose to strengthen their connections with people in their network who possess complementary knowledge to form a team of innovation actors together with them [72]. Moreover, innovation actors also encourage others to expand their social network [81], something that can be institutionalized through job rotations.

Innovation actors are also often described as *boundary spanning* [45], [77] by interacting across internal organizational boundaries or between the organization and its external environment [82], [83]. Concerning digitalization efforts, innovation actors' boundary spanning occurs between existing functional units to create a new digital initiative, a strategy named "bridging" [84]. Innovation actors *scan the environment* when performing boundary-spanning activities [16]. Thus, innovation actors draw attention to new ideas or trends that they notice while closely observing their surroundings and gathering information. Moreover, innovation actors actively sense the organizational environment to detect new digital technology and react to newly arising opportunities for digital innovation [84]. Searching and scanning the environment may take place by attending informal meetings with acquaintances [85]. Innovation actors then channel the acquired information to others within the organization [59].

2) *Using Established Social Ties*: With respect to using established social network ties, extant literature points to

innovation actors' activities to *get access to or obtain resources* from their social network—information, knowledge, financial or technical resources [27], [49]. While some studies only provide limited details on the identification and procurement of resources [13], [80], others describe how innovation actors rely on social ties and the influence of their social network to gain access to resources [17], [57]. In their effort to acquire resources, innovation actors do not shy away from conflict [17] or using informal channels [81]. While the focus frequently lies on acquiring financial or human resources, some innovation actors focus on obtaining and using digital technologies as tools in innovation processes [86]. Moreover, innovation actors may use their influence to procure resources that enable them to build the capabilities necessary for digital innovation [79]. Using established social ties to obtain resources is predominantly reported in studies that concentrate on innovation actors in high hierarchical positions, such as sponsors [87], [88].

Extant literature also emphasizes the significant importance of nonmaterial resources by outlining innovation actors' activities of *gaining the support*, motivation, and enthusiasm of *other people* [54], [89]. Innovation champions build support within the organization by involving the right people [89], [90], sharing their vision [91], and building trust by demonstrating honesty, openness, competence, benevolence, and reliability [92]. Innovation actors have been found to use a variety of influence tactics [93] but prefer the use of cooperative influence tactics over confrontational tactics when campaigning for support [94]. Innovation actors use four specific tactics to convince the organization of innovation and gain support: concealing, sequencing, anchoring, and propagating [95]. For instance, the tactic of propagating, where innovation actors “marshal many applications synergistically” [95, p. 379], aligns innovation actors' efforts to gain support with the malleability of digital technology and the open-ended nature of innovation processes [95]. Here again, the literature emphasizes the role of innovation champions in management positions since they have more influential social ties and better access to gaining support among influential stakeholders [88], [96].

Building support for innovation projects occurs on three levels: employees, the management level, and other innovation actors. For instance, in innovation processes that are enabled by online user communities, innovation actors help to achieve the support of users and encourage new users to join the community [97]. Especially, the critical nature of obtaining management support has been shown to increase the likelihood that innovation development processes are successful [16]. Management support may not only result in resource allocation or formal support but also prevent interference in ongoing innovation projects. In building support for an innovation project among senior management, innovation actors need to pay close attention to changes in the opinions of the management board by using formal and informal channels [72]. Innovation actors then match the perceptions of different stakeholders and adjust the strategy to convince management accordingly [72]. Generally, innovation actors acquire support for their projects and inquire about opportunities for collaboration using a combination of informal and formal channels. This tactic helps innovation actors to ensure that, on the one hand, other innovation actors are genuinely interested in teamwork and, on the other hand,

secures the possibility of a formal appointment [72]. Not all innovation actors rely on management support to drive an innovation project. In contrast, some innovation actors purposefully forego formal approval and support by relying on bootlegging behavior [98]. In such cases, innovation actors' personal network still plays an important role in finding collaborators but formal channels are bypassed completely. Innovation actors then use their own resources or rely on their personal ties to mobilize resources [99].

Furthermore, innovation actors *share information and knowledge across* organizational and external boundaries [92], [100]. Thereby innovation actors exchange, share, and merge their organization's knowledge stock with new information and knowledge from the environment across organizational boundaries [101]. If innovation actors enable information sharing and knowledge exchange between actors who are not linked to each other, innovation actors engage in *brokering* [102]. One specific position for sharing information and knowledge is occupied by lead users or leaders of user communities, who sometimes also take the role of innovation actors and promote innovation from outside the organization. They use their knowledge and information exchange with others, such as problems detected and novel ideas for product improvement, to advance products or services [103], [104]. To act as innovation actors, lead users rely on digital platforms to interact with the organization as well as communicate and collaborate with other users [103].

Innovation actors also *draw attention to the importance of digital technology* [88]. They use digital technology to support operational processes and typically raise the profile of digital technology within the organization by “selling” the idea that technology can potentially be leveraged to generate significant business value [88]. Thus, innovation actors encourage the use of digital technology to improve the efficiency of innovation processes [86].

B. Network-Actor Perspective: Innovation Actors' Network Characteristics

We now turn to the network-actor perspective and analyze the literature on innovation actors concerning two dimensions. First, we analyze innovation actors' *structural embeddedness* to understand the structure of innovation actors' social ties. Second, we consider innovation actors' *relational embeddedness* by studying the quality and character of innovation actors' ties in the social network. Fig. 4 summarizes our results.

1) *Structural Embeddedness*: In our analysis of innovation actors' structural embeddedness and its effect on innovation actors' performance, we found several contradictory findings. Researchers disagree on the role of innovation actors' sparseness in social networks, the antonym of network density, depending on the nature of the networks. In an internal network, the absence of structural holes, a characteristic of dense networks, is positively related to innovation actors' effectiveness [45] as actors benefit from collaboration and information exchange with other actors. In contrast, some conceptual and empirical articles suggest the reverse relationship. Thus, De Brentani and Reid [82] theoretically proposed that a higher level of nonredundant ties, which lead boundary spanners to occupy a structural hole, promotes boundary spanners' effectiveness. This relationship is

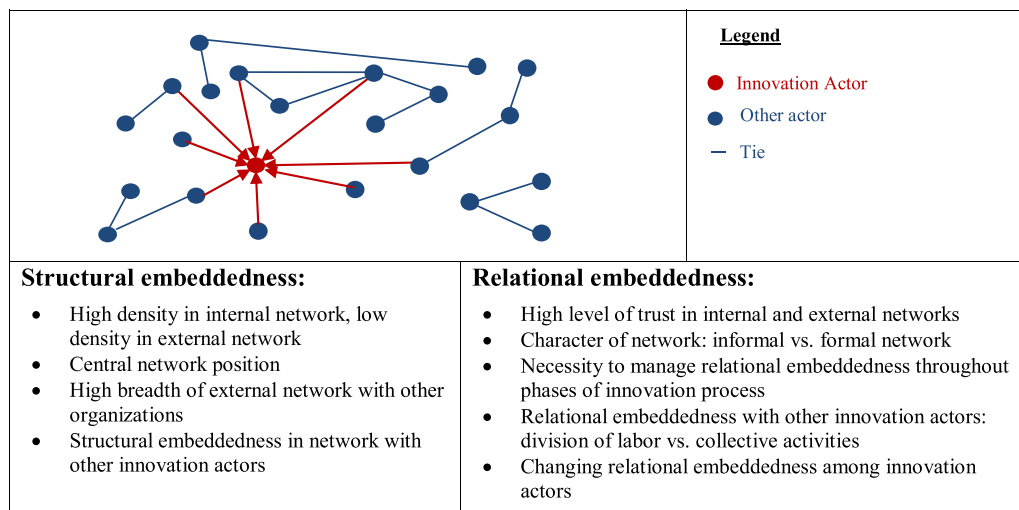


Fig. 4. Innovation actors' network characteristics.

supported by Ramirez and Dickenson [85], who find that innovation actors' activities in sparse, distant external networks are beneficial for innovation actors' effectiveness as these networks might offer nonredundant information.

Regarding innovation actors' position in the social network, extant literature suggests the benefits of innovation actors' central position in their social network. Thus, performing ambassador activities while occupying a central network position is positively associated with innovation champions' effectiveness [105]. This is congruent with the theoretical proposition that more central network positions of boundary spanners promote their effectiveness by enabling a faster and higher quality information flow from outside the organization [74].

Turning to another dimension of structural embeddedness, studies also suggest that a higher breadth of the external network enhances boundary spanners' effectiveness [82]. This theoretical reasoning is echoed and confirmed by other research articles with empirical evidence. Thus, the existence of external relations with other firms' R&D units is positively associated with sponsors' effectiveness [68]. When analyzing innovation actors' network structure, the existence or lack of social ties among innovation actors stands out as another characteristic. Innovation actors might promote innovations as lone wolves or lead a group of other actors in the organization in their pursuit [49], [90]. Alternatively, different innovation actors may form teams or communities to drive innovation success [72], [106]. The network among innovation actors can take different forms. Innovation actors may form small teams [50], [107], or entire "innovation communities" among innovation actors across units or organizations in open innovation settings [91]. The literature is divided on whether complementarity in network structure among innovation actors is beneficial, especially since the hierarchical level of innovation actors may significantly affect the structure of their network. Klerkx and Aarts [108] suggested that innovation actors situated at different hierarchical levels, both within and outside the organization, could complement each other's network by relying on distinct network compositions. In contrast, Glaser et al. [83], focusing on the top and middle management only,

demonstrated that boundary spanning is effective if managers on different hierarchical levels share large parts of their networks.

2) *Relational Embeddedness*: For innovation actors' *relational embeddedness* in the social network, extant literature emphasizes the importance of trust in social relationships as reputation and credibility may be prerequisites for the allocation of resources and the legitimacy of championing activities [49]. Thus, the level of innovation actors' relational embeddedness, measured as the level of trust in their internal and external social networks, is positively related to their effectiveness [58].

Moreover, for the character of networks, both formal and informal channels play a significant role in innovation actors' endeavors to champion innovation [54] and form strategic linkages [109]. However, especially in interactions among multiple champions, the extent to which informal channels are used by champions needs to be carefully managed to avoid problems of coordination and function ambiguity among different innovation actors [108]. Further evidence of the importance of a network's character is provided in extant literature. Thus, a positive association between the communication frequency in the network on the team level and the likelihood of individuals to champion innovation exists [110]. However, when considering to what degree a network is based on friendship, no relationship with individuals' tendency to promote innovation projects can be found [110].

Especially studies focused on the IT industry find evidence that innovation actors may need to actively manage their relational embeddedness as different types of social ties play a significant role throughout the different phases of the innovation process [111]. During the exploration phase, the corporate entrepreneurs uses their large social network to establish a high number of weak ties to generate novel ideas. With the transition to the exploitation phase, the corporate entrepreneurs gradually shifted their focus to a small number of strong ties to commercialize the innovation [111]. The importance of network management is echoed by Parmentier and Mangematin [112] for innovation communities promoting digital innovation projects. Here, the need to balance opening up innovation processes

to the community against the possibility of losing control is emphasized [112].

Concerning innovation actors' social ties to other innovation actors (see Fig. 4), we observe differences in the relational embeddedness of these innovation actors. Innovation actors may form teams of innovation actors to implement a division of labor [50], [107]. For instance, innovation actors form dyads or troikas with inventors [50]. While the sponsor will drive and promote innovation using hierarchical power, the boundary spanner will mediate between different stakeholders in the organization. This division of labor among two, or even three types of innovation actors, is positively associated with higher effectiveness in driving innovation and financial success [50]. The division of labor is also echoed in the literature on digital innovation. Thus, Gupta et al. [107] showed that the division of labor may also take place with respect to the different types of networks, especially in networks of e-commerce organizations. While one champion, called the network champion, builds relationships between organizations and acquires resources and knowledge in the B2B network, another champion focuses on promoting digital innovation inside one organization.

When focusing on actors promoting digital innovation, a group of champions may also drive digital innovation as a team where championing forms a "complex performance of contextually dependent collective social interaction, varying over time" [72, p. 47]. Multiple champions interact and perform championing behaviors, either by performing one championing behavior together or by combining multiple championing behaviors into a meaningful whole. In the studied information systems development project, the champions also switched roles over time as they learned from their collective experience in championing innovation [72].

Groups and communities of innovation actors may not remain fixed in their composition throughout the innovation process [72], [108]. Instead, the arrival and departure of innovation actors over time lead to a constant evaluation of the relationships among innovation actors and renegotiation of the division of labor and roles across different hierarchical levels [108]. The community of innovation actors then evolves into a multilayered entity, where a primary innovation community composed of a core group of innovation actors orchestrates the innovation process and secondary innovation communities that only exist temporarily promote certain aspects of the innovation process [108]. Most studies adopting a network-actor perspective and investigating the role of innovation actors in digital innovation projects primarily focus on the network integration among these actors, whereby they either divide labor or collectively drive innovation initiatives.

C. State of Research on Innovation Actors' Social Network

In this research article, we set out to answer the research question: *What characterizes the social network of actors championing innovation in the digital age?* Regarding innovation actors' activities in the social network (actor-network perspective), we find that innovation actors use three techniques to create novel social ties: 1) forming coalitions [13], [72], 2) boundary spanning [82], [83], and 3) scanning the environment [79], [85]. We also identify some distinct changes in the digital age regarding innovation actors' efforts to create ties. For

instance, innovation actors no longer only focus on employees and managers but also on customers and users when forming coalitions [78], [79]. In addition, innovation actors actively scan the environment to identify new innovation opportunities digital technology offers [84].

Subsequently, innovation actors then rely on these social ties to perform different activities that can be subsumed under five themes: 1) getting access to resources [49], [80]; 2) gaining the support of other people [90], [91]; 3) brokering [102], [104]; 4) sharing information [92], [100]; 5) drawing attention to the importance of digital technology [86], [88].

In the digital age, resources may not only include financial or human resources but also encompass obtaining digital technology to facilitate innovation processes [85]. In addition, existing literature emphasizes innovation actors' use of distinct strategies within their network to gain support for developing new digital solutions and to draw attention to opportunities offered by digital technologies [95]. In summary, innovation actors view digital technology as a critical enabler of innovation, influencing how they create and use social ties in their networks. We discuss these findings and their implications further in Section V-A-1.

We also identified a number of themes in the literature regarding innovation actors' structural and relational embeddedness (network-actor perspective). For innovation actors' structural embeddedness, we pinpoint four themes. First, the density of innovation actors' networks differs depending on the nature of the network (internal versus external network) [45], [98]. Second, innovation actors profit from a central position in their social network [101], [105] as it enables faster information and knowledge exchange. Third, innovation actors benefit from a high breadth of their social ties with other organizations [68], [82]. Fourth, recent research shows that innovation actors increasingly build networks with other innovation actors to champion innovation projects in the digital age [50], [108]. Finally, we also identified differences in the structural embeddedness of innovation actors across different hierarchical levels [83], [108].

With respect to innovation actors' relational embeddedness in their networks, we identified five themes. First, innovation actors' social ties are characterized by a high level of trust [49], [58]. Second, extant literature shows how the relational embeddedness diverges depending on the character and purpose of a network [108], [110]. Third, the literature identifies an increasing necessity for innovation actors to manage their relational embeddedness throughout the innovation process [111], [112]. Fourth, we identified the important role of social ties between innovation actors themselves [50], [107]. In particular, the literature on digital innovation places significant emphasis on the importance of actors managing such relational embeddedness [72]. In addition, we observe a radical shift in the literature that not only explores teams of innovation actors but also points to collective activities and co-championing among innovation actors, especially in digital innovation projects. This shift is related to the fifth identified theme, the changing composition of innovation actors in innovation communities [72], [108]. We discuss our findings in Section V-B-2.

V. DISCUSSION

This literature review examines the characteristics of innovation actors' social networks in facilitating knowledge sharing

TABLE III
RESEARCH AGENDA FOR FUTURE RESEARCH ON INNOVATION ACTORS

Perspective	Formation and characteristics of networks among actors of digital innovation	Suggested research questions for future research
Actor-network (see Section V-A1)	Digital technology and innovation actors	<p>How does digital technology's role in enabling innovation actors' work change with the increasing sophistication of digital technology?</p> <p>How can autonomous tools be used in a meaningful way to support innovation actors?</p> <p>How can digital technology enable the collaboration of innovation actors with a wide spectrum of stakeholders, including other innovation actors?</p> <p>What is the function of digital technology in the formation of innovation teams and communities among innovation actors?</p>
Network-actor (see Section V-A2)	Formation and characteristics of network among actors of digital innovation	<p>How do innovation actors build networks among each other? How do innovation actors recruit coinnovation actors? What roles do trust, expertise, and shared goals play in this process?</p> <p>How do innovation actors sustain collaborations in innovation communities? How do networks of innovation actors deal with conflict?</p> <p>What characterizes the structural and relational embeddedness of innovation actors in networks with other innovation actors?</p> <p>Which dynamics influence the arrival or exit of innovation actors in innovation communities during the innovation process?</p>
	Orchestration and governance of networks among actors of digital innovation	<p>How can organizations support the formation of innovation communities?</p> <p>What are suitable governance mechanisms for innovation communities?</p> <p>How can organizations react to changing actor compositions in the innovation community?</p> <p>How can organizations identify innovation actors in distributed teams or communities?</p> <p>How do organizations with innovation actors operating as lonely wolves shift to teams or communities of innovation actors, when undergoing a digital transformation?</p>

and collaboration in the digital age. In Section V-A, we discuss key observations and derive a future research agenda on innovation actors' social networks in the digital age. We further propose a novel conceptual model illustrating the dual embeddedness of innovation actors within their social networks. In Section V-B, we present our contribution and outline how our study moves beyond the existing literature by proposing a future research agenda and a new conceptual model.

A. Avenues for Future Research

Two key observations regarding innovation actors' social networks distinguish the digital age (see also Section IV-C). First, the existing literature taking the actor-network perspective suggests that innovation actors perceive digital technology as an enabler of innovation processes in the digital age. Consequently, innovation actors increasingly shift their activities to creating and using social network ties to identify, integrate, and utilize digital technology within innovation processes. In Section V-A-1, we discuss this gradual shift in innovation actors' activities in the social network and derive corresponding avenues for future research.

Second, literature taking a network-actor perspective suggests that innovation actors championing digital innovation projects increasingly create innovation communities, where innovation actors collectively champion innovation. This constitutes a radical shift in the literature and shapes the relational and structural embeddedness of innovation actors in digital innovation. In

Section V-A-2, we discuss the implications of this radical shift for future research and derive corresponding research questions.

Table III provides a summary of the future research agenda with a focus on the two key observations: digital technology as an enabler and the formation of communities among innovation actors within digital innovation projects.

1) *Actor-Network: Digital Technology as an Enabler*: Our literature review suggests that digital technology triggers changes in degrees with respect to innovation actors' activities in creating and using social network ties (see Section IV-A). However, despite the growing recognition of digital technologies as enablers of innovation, our understanding of how innovation actors leverage these technologies remains limited. Exploring this topic further becomes increasingly pressing as the pace of digital technology's evolution accelerates, exemplified by recent advancements in machine learning and autonomous tools. Such technologies have the potential to fundamentally reshape innovation processes, for instance, through human-computer collaboration within the creation innovation. While existing literature has examined the interaction between autonomous tools and designers [113], less attention has been given to how these tools can enhance innovation actors' championing efforts and impact innovation actors' activities within their social network. Exploring this topic may also provide valuable insights for practitioners, equipping them with strategies to effectively integrate autonomous tools into innovation processes. By understanding how to harness digital technologies in innovation processes,

organizations can potentially promote faster innovation cycles and design training, workflows, and tools that align with the evolving role of innovation actors in digitally enabled innovation ecosystems.

Our analysis also reveals a growing heterogeneity among innovation actors, who create and use ties to champion innovation, as suggested by literature published over the last decade. Earlier studies adopting an actor-network perspective primarily focused on clearly defined roles within organizations, such as innovation champion, boundary spanner, knowledge broker, or sponsor, operating within structured processes to promote innovation [17]. However, in recent studies, we observe a shift toward a more nuanced spectrum of innovation actors, including highly motivated and assertive lead users. These lead users share information and knowledge they acquired from other users with an organization to promote an innovation project [102]. While they may lack the dynamism typically associated with traditional innovation champions, they can still be considered part of the broader championing spectrum.

Despite these developments, our findings also indicate a significant gap in the innovation literature regarding how heterogeneous innovation actors collaborate with one another and with other actors during the innovation process (see Section V-A-2). Digital technology presents opportunities to orchestrate activities among a group of actors. For instance, digital platforms can foster collaboration among innovation actors by enabling communication, coordination, and cocreation throughout the innovation process [77], [97]. However, our literature review revealed limited knowledge about how digital technologies facilitate the collaboration of heterogeneous innovation actors, offering a possible avenue for future research (see Table III). Exploring this topic can also deepen our understanding of how digital tools shape the formation of ties and the subsequent interactions among actors, enriching theories of actors' social networks in the digital age. For practitioners, addressing these knowledge gaps could provide actionable strategies for designing and implementing digital technologies that enhance collaboration and engage a wider range of actors, such as customers and users, to leverage their unique contributions.

2) *Network-Actor: Innovation Actors and Digital Innovation*: Early literature on innovation actors emphasized the outstanding significance of one innovation actor. For instance, the innovation champion was characterized as a vibrant individual who alone takes the initiative to drive an innovation project forward [18], [60]. Innovation actors were predominantly described to act as lone wolves when promoting their innovations [56], [90]. The occurrence of groups of innovation actors who rely on a division of labor was explored in the literature on innovation champions early on [62] and resurfaced throughout the evolution of this literature stream [50].

Our literature review shows that recent literature focusing on innovation actors championing digital innovation builds on this idea and further extends it. Namely, it indicates a shift toward a distinct form of distributed agency [72], [108], where innovation actors work together as a dynamically changing and heterogeneous assembly of actors. This observation is in line with existing digital innovation literature, which theoretically reasoned that agency has become more distributed and scattered in the digital innovation process [7], [24] (see Section II-A).

This development can be traced to two characteristics of digital innovation: higher heterogeneity of knowledge required [3], [36] and a less bounded digital innovation process [7]. Thus, developing a digital innovation often requires expertise from various domains. Moreover, the boundary between innovation outcome and process has become blurred [7] and actors may join and leave the innovation process at any point in time.

We extend existing knowledge by synthesizing the mechanisms underlying this distributed agency. Thus, innovation champions form a community and act as a collective that co-performs championing behavior [91], [108]. The roles that each member of this championing collective performs may change at any time, as members may enter or depart the community throughout the innovation process [72], [108]. Accordingly, innovation actors' embeddedness in the community of innovation actors may be subject to constant change.

Based on this observation, we derived a novel conceptual model illustrating the dual embeddedness of innovation actors within their social network, which is depicted in Fig. 5. Specifically, innovation actors' social networks in the digital age comprise two distinct layers. First, innovation actors are embedded in a broader social network that includes various actors, such as employees or users [53]. Second, they form a collaborative network exclusively with other innovation actors to jointly promote innovation projects [49], [71]. These two layers are characterized by distinct dynamics: the close, complementary collaboration among innovation actors differs significantly from more distant interactions with other actors. Understanding these two network layers is critical, as each layer requires unique strategies to foster effective communication, collaboration, and engagement in innovation processes.

The dual embeddedness of innovation actors within their social network has also practical implications for organizations seeking to drive digital innovation. For instance, a manufacturing company developing solutions for automating and optimizing assembly lines must integrate expertise across diverse domains, including manufacturing processes, sensors, IT infrastructure, business requirements, and data science, to create effective industrial Internet-of-Things solutions. Achieving such complex digital innovation therefore requires collaboration among heterogeneous stakeholders, each bringing unique skills and perspectives to the table. The broader stakeholder network provides essential inputs, such as specific technical knowledge or information regarding user needs, while the collaborative network of innovation actors focuses on cocreation and problem-solving. To facilitate digital innovation, organizations must consider both layers of innovation actors' social networks and design effective strategies to engage these networks, such as fostering trust, aligning goals, and providing resources.

In addition, the loose coupling between different components of a digital innovation [6], [114] allows different stages of the innovation process—such as conception, development, and deployment—to be distributed among multiple innovation actors [114]. In the digital age, this possibility enables greater flexibility but also requires coordination to manage dependencies across actors and stages. Moreover, digital products' and services' features can be altered after the release of an innovation, with features between updated or reconfigured [115].

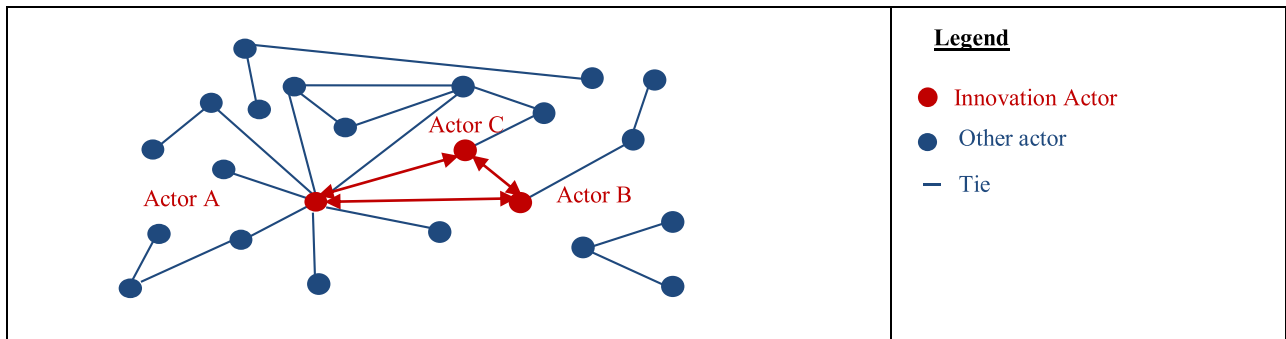


Fig. 5. Novel model of innovation actors' dual embeddedness within the social network.

Consequently, the two layers of social networks may undergo continuous, and potentially divergent, changes over time.

While the social and relational embeddedness of innovation actors with other actors has been extensively explored in the literature (see Section IV-B), there remains a significant gap in our understanding of the networks formed exclusively among innovation actors and the emerging concept of distributed agency (e.g., [71], [106]). Especially, our knowledge in two areas is limited: 1) the processes through which networks among innovation actors are formed and maintained as well as their defining characteristics, and 2) governance and orchestration mechanisms supporting communities of innovation actors in championing innovation. Addressing these gaps is crucial for extending our theoretical and practical knowledge. In line with this, we propose and discuss possible themes and research questions for future research as follows (see also Table III).

With the shift from innovation actors, who act as lone wolves to innovation communities championing innovation collectively, the personal characteristics of individual actors have become less central. Instead, the collective characteristics as well as the quality and dynamics of relationships within these innovation communities play a critical role in determining the failure or success of digital innovation projects. Klerkx and Aarts [108] underscored the complexity of understanding innovation communities, where innovation actors may constantly join or exit. Yet, the mechanisms underlying the formation and persistence of these networks remain poorly understood. While van Laere and Aggestam [72] outlined how innovation champions recruit cochampions, the broader mechanisms, motivations, and dynamics that lead to the formation of an innovation community remain unexplored. For organizations, this knowledge is vital to fostering strong innovation ecosystems that drive creativity and efficiency. Moreover, insights into how innovation actors sustain their collaborations will be instrumental in addressing common challenges, such as conflict resolution, resource misallocation, and loss of momentum in long-term innovation projects. In addition, understanding the dynamics influencing the arrival or exit of innovation actors is critical for managing the continuity and adaptability of innovation communities in environments of constant change.

Organizational theory sheds light on why distributed agency, in the form of communities of innovation actors, is fundamentally different from innovation actors, who act as lone wolves. Benkler [116] emphasized the growing relevance of networks as a flexible organizing framework in the digital economy. Unlike hierarchically organized entities, network organizations allow

individuals to self-organize with like-minded collaborators, free from rigid constraints. Such organizational structures are particularly effective in uncertain and unstructured environments, making them well-suited for the fast-changing technological conditions of the digital age. However, such structures also come with inherent challenges, as network organizations lack clear hierarchies and predefined coordination mechanisms. This raises critical questions about how such network organizations achieve shared objectives amidst their fluid and decentralized nature. Regarding innovation actors, these challenges directly lead to the need to understand the orchestration and governance mechanisms that enable innovation within innovation communities. Companies must balance the flexibility required for creativity with the structure necessary to ensure the successful execution of innovation projects and alignment toward common goals. While the self-organizing nature of network organizations fosters creativity, it also necessitates deliberate strategies to align actors' efforts, manage resource allocation, and maintain focus on shared goals. For incumbent organizations, addressing these challenges is especially urgent, as the question arises of how they can first move to this form of organizing and can then adapt their structure to constantly changing requirements in the digital age.

Consequently, a number of avenues for future research regarding orchestration and governance mechanisms arise that can advance both our theoretical and practical understanding of innovation communities. To effectively navigate the shift toward network organizations, companies must understand how to support the formation of innovation communities that balance inclusivity with collaboration. In addition, identifying suitable governance mechanisms is essential to ensure that these communities can balance creativity with coordination and maintain momentum throughout the innovation process. Given the inherently dynamic nature of innovation communities, research should also explore how organizations can adapt to changing actor compositions, ensuring that innovation actors remain engaged while seamlessly integrating new actors. Identifying innovation actors within distributed teams is another pressing challenge, as organizations must recognize and leverage both core and peripheral actors' contributions to sustain innovation. Finally, understanding how organizations can transition from relying on lone innovation actors to fostering collaborative innovation communities is crucial, particularly for incumbents undergoing digital transformation. Addressing these questions will provide valuable insights into how organizations can design resilient, flexible, and effective organizational structures that align with the demands of the digital age.

B. Theoretical Contribution

The contribution of our study is fourfold. First, we structure and synthesize existing literature on actors championing innovation, providing a comprehensive overview of flows and structure of innovation actors' social network. By integrating empirical and theoretical evidence, we deepen the understanding of innovation actors in innovation processes, addressing a gap in innovation management research that has called for exploring actors' interactions in the digital age [10], [25]. Our multidisciplinary approach adds valuable insights to digital innovation literature, particularly in understanding the distributed nature of innovation agency [7], [24], a topic that has so far predominantly been discussed at an abstract level. In addition, we explore the role of digital technology in supporting innovation activities, responding to the call for a more nuanced understanding of digital technology's role in supporting innovation within companies [2].

Second, we move beyond existing research by developing a research framework of innovation actors' activities and network characteristics based on social network theory [30]. Building on our synthesis of findings in the existing literature and the framework, we then derived a new conceptual model to illustrate the dual embeddedness of innovation actors in both a broad network with other actors and a collaborative network exclusively with other innovation actors. This model of actors' dual embeddedness moves beyond existing literature and enhances our theoretical understanding of how actors engage in innovation projects in the digital age.

Third, we propose a research agenda that builds on the review's insights and the derived model of innovation actors' dual embeddedness to identify gaps in the current literature and outline key research questions. The agenda highlights essential themes surrounding the enabling role of digital technologies in innovation processes as well as the formation, evolution, and governance mechanisms of innovation communities. The identified themes and research questions can guide researchers interested in exploring innovation actors in the digital age in the future.

Fourth, our study contributes to research on champions by distinguishing between the roles of IT champions and innovation champions. While the information systems literature has focused on IT champions driving the adoption of new technologies [74], innovation champions who drive innovation projects have not been sufficiently differentiated. Our review and conceptualization of innovation actors, particularly in the context of digital technology, clarifies this distinction and complements existing literature on innovation actors [16], [24] by taking a social network perspective.

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