Review of Managerial Science (2023) 17:1827–1862
https://doi.org/10.1007/s11846-022-00593-x

REVIEW PAPER

Innovation intermediaries revised: a systematic literature review on innovation intermediaries' role for knowledge sharing

Daniel Feser[1]

Received: 5 February 2021 / Accepted: 13 September 2022 / Published online: 8 October 2022

Abstract

The decision to collaborate for companies in knowledge exchange processes has become more complex due to a greater diversity of innovation intermediaries from companies, universities, government and societal actors. The aim of this study is to uncover and conceptualize the role of innovation intermediaries in knowledge sharing. Specifically in tacit knowledge sharing, intermediaries function as boundary spanners between various stakeholders in the innovation process. Despite this potential, which has been discussed in a large strand of case studies, there is no comprehensive concept to determine factors that influence innovation intermediaries in knowledge sharing. This paper develops an analytical framework of innovation intermediaries for prospective empirical work building on factors influencing innovation intermediaries in knowledge sharing by systematically reviewing related literature. It specifically presents what are the determinants, factors and indicators discussed empirically innovation intermediaries in knowledge sharing. The first results is that the measurement of innovative outcome intermediaries enables a broader perspective in comparison to traditional innovation indicators. The second results that literature discusses indirect innovation that enhances clients' innovative capabilities and their entrepreneurial activities. The third results demonstrates, that while the internal perspective varies with the heterogeneous actors, the development of contextual knowledge of intermediaries in networks and its transfer is central for empirical analysis. The conceptualization of this framework paves the path for further research needed to uncover the role of intermediaries.

Keywords Innovation intermediaries · Knowledge-sharing · Systematic literature review · Innovation systems

Mathematics Subject Classification 91C99

✉ Daniel Feser
daniel.feser@uni-goettingen.de

[1] Chair for Economic Policy and SME Research, Georg-August University of Goettingen, Platz der Göttinger Sieben 3, 37073 Göttingen, Germany

1 Introduction

Knowledge sharing is a key driver for increasing the productivity (Conner and Prahalad 1996). Governing knowledge sharing innovation intermediation can play a central role to widen the access to, integrate external and recombine knowledge to improve companies' competitiveness (Abbate et al. 2013; Lichtenthaler and Ernst 2009). Innovation intermediaries are crucial actors for establishing and sustaining formal and informal ties and innovation-driven interaction in knowledge sharing processes (Coppolino and Abbate 2012; Knockaert and Spithoven 2014; Nonaka and Takeuchi 1995). In particular, the debate on tacit knowledge sharing as origin to knowledge creation and innovativeness has accelerate the discourse of knowledge management (Castellani et al. 2021; Suppiah and Singh Sandhu 2011). Recently, the discussion on co-creation between startups, small and medium-sized enterprises, and corporates for innovativeness and consequently on competitiveness has been intensified emphasizing the role of intermediation (Bouncken and Reuschl 2018; Bouncken and Tiberius 2021; Corvello et al. 2021). However, theoretical perspectives like knowledge spillover theory of entrepreneurship or the knowledge based-view of the firm consistently highlight the relevance of knowledge sharing; analyzing processes like coopetition (Bouncken et al. 2015), entrepreneurial ecosystems (Bichler et al. 2022; Endres et al. 2022), and innovation alliances (Bouncken et al. 2018; Kim and Choi 2014), empirical sound concepts to understand the role of innovation intermediation are still incomprehensive.

Knowledge management research has integrated the view of how businesses benefit from knowledge sharing (Venkitachalam and Busch 2012). Particularly, tacit knowledge have been problematized (Castellani et al. 2021). Measuring concepts have predominantly focused on the perspective of businesses benefitting from sourcing knowledge. Often intermediaries' contribution was surveyed by asking companies specifically about intermediaries' contribution (Albizu et al. 2017; Pinto et al. 2015). For example, the European Community Innovation Survey (CIS) includes questions about cooperation with innovation intermediaries (Bruce S. Tether and Tajar 2008). Nevertheless, the perspective of the role of innovation intermediaries in innovation processes has been neglected. Approaches to systematize innovation intermediaries' influence on companies and actor groups exist only in fragmented approaches. Dalziel and Parjanen (2012) proposed a conceptual framework that focuses on the impact of intermediaries in their case study. Russo et al. (2019: p. 10) calls to "explore a greater range of practices adopted in the areas of indicator design and information collection systems supporting the activities and evaluation of innovation intermediaries". Analyses are only partially available for sub-sectors, whereas a systematic overview is still missing. Therefore, this paper aims to answer the research question: How do innovation intermediaries contribute to knowledge sharing in innovation systems? In order to analyze this, the paper focuses on the determinants, factors and indicators discussed empirically, particularly focusing on innovative outcome and impact, and internal and contextual factors.

Reviewing and synthesizing existing literature for the role of innovation intermediaries in innovation processes is important for three reasons: First, there is a major lack of quantitative data on intermediaries to date. The broad definition of innovation intermediaries includes heterogeneous actors. Quantitative analysis appears rather difficult since a higher level of abstraction is required. A lack of theoretical basis due to fuzzy wording and inadequate theoretical research can explain why a comprehensive framework has not been developed yet (Almodovar and Teixeira 2014; Dalziel 2010; Gao and Hu 2017; Huyghe et al. 2014). Still, the functional and procedural role of intermediaries is important to understanding its role in innovation processes. Second, intermediaries as service providers are central to understanding sectoral and regional development, e.g. fostering startup growth (Bouncken and Reuschl 2018; Corvello et al. 2021; Pinto et al. 2015). Intermediaries play a crucial role providing services and fostering servitization for innovative startups, SMEs and large enterprises (Corvello et al. 2021; Han et al. 2022; Kollmann et al. 2021; Paschou et al. 2020; Villani et al. 2021). The interplay of different actors to recombine innovation is a central capability to innovate benefitting from service innovation. Intermediaries play a crucial role by supporting specialized services in given regions (Villani et al. 2017). Third, innovation intermediaries are often publicly financed. In particular, the lack of private offers in peripheral regions has led to an increasing number of innovation intermediaries directly related to or funded by public institutions. To date it remains difficult to comprehensively analyze the efficient use of resources (Russo et al. 2019).

Building on a systematic literature review, this paper pursues two in-depth objectives. Firstly, this paper examines the current state of measuring innovation intermediaries. It aims to offer an overview of the role of intermediaries in the innovation process and knowledge sharing. To date, a vast number of peer-reviewed articles have discussed various aspects of knowledge processing. In my perspective, these studies lack a systematic and comprehensive synthesis of the role of intermediaries. The article gives a comprehensive framework of intermediaries' activities and connections to other actors connecting to current approaches to improve the conceptual perspective in innovation research (Dziallas and Blind 2019; Grupp and Schubert 2010; Knockaert et al. 2014). Secondly, this article formulates a conceptual framework to develop a system of indicators that can measure the relationship between innovation and intermediaries' internal and contextual conditions. As shown in the past, the improved availability of empirical data can help develop innovation policy for the systematic collection of innovation data in firms (Tödtling and Trippl 2005). Especially for actors like SMEs (Albizu et al. 2017), knowledge-intensive business services (Tether and Tajar 2008) and coworking-spaces (Bouncken and Reuschl 2018) fundamental research has been conducted. This article connects with these insights by helping to researcher and practitioners from innovation and knowledge management to gain systematic insights to analyze collaborations with innovation intermediaries.

2 Literature background and analytical framework

Literature on innovation intermediaries has grown in the recent years. Howells (2006), in a seminal paper, identified the contribution of organizations as "agent or broker in any aspect of the innovation process between two or more parties" (Howells 2006: p. 720).[1] Particularly, scholars in knowledge and innovation management have contributed with analyzing coworking spaces (Bouncken and Reuschl 2018; Bouncken and Tiberius 2021), and organizations like incubators (Han et al. 2022) and accelerators (Kulkov et al. 2021) in entrepreneurial ecosystems. In the following, the functional definition of intermediaries by Howells (2006) is used, which encompasses ten different functions of intermediaries and thus places an emphasis on the role in the innovation process, irrespective of its legal and organizational form: foresighting and diagnosting of innovative and technological trends (1), scan and information processing during the innovation process (2), knowledge procedures such as combining or recombining of knowledge (3), gatekeeper and broker roles in ecosystems (4), test and validating of innovation (5), accrediting for innovation (6), validating and regulating (7), protecting innovative business models, services and products (8), commercializing innovation (9) and evaluating the results of innovation cooperation (10). The definition covers a broad range of actors. Intermediaries often represent autonomous– profit and non-profit organizations, whereas the above definition also includes organizational units of larger entities, like knowledge transfer offices at universities (Alexander and Martin 2013; Sengupta and Ray 2017) but also includes novel types of intermediaries like open innovation intermediaries (Antikainen et al. 2010; Porto Gomez et al. 2016) and digital communities (Randhawa et al. 2017).

Literature on innovation systems suggest that intermediaries play a different role in comparison to 'regular' firms, given that they focus not only on their own innovative capability but also on offering extra value for clients by sharing information and assisting in financial acquisition (Dalziel 2010; Silva et al. 2018). Intermediaries transfer knowledge on different levels as they promote knowledge channels on regional (Parjanen et al. 2011), national (Sinell et al. 2018) and international levels (Kolesnikov et al. 2019). Case studies have shown the many ways in which intermediaries cooperate with companies. The firms' resources play an important role in cooperating with innovation intermediaries (Larty et al. 2017). Furthermore, intermediaries can improve the absorptive capacity and networking abilities in small and medium-sized enterprises (SMEs) (Garengo 2019). The strategic organization of intermediaries with centralized or decentralized strategies also impacts the ways in which intermediaries enable innovation processes (Huyghe et al. 2014). First empirical insights based on surveys conducted by companies confirm that intermediaries contribute to improve innovative capabilities (Gredel et al. 2012; Hayter 2016; Pinto et al. 2015; Sarvan et al. 2012). This paper focuses on the measurement of intermediaries in innovation process as discussed in economics, business and social science.

[1] A variety of definitions have been discussed the ever broader topic of innovation intermediation. This paper focuses exclusively on innovation intermediaries as actors in innovation systems.

Table 1 Analytical framework

Main categories	Factors
Innovative outcome and impact	Direct outcome
	Indirect outcome
	Impact
Internal Factors	General characteristics
	Strategy
	Structure
	Management team
	Functional assets and strategies
Contextual Factors	Industry and technology related factors
	Location factors
	Networks
	Knowledge sharing and transferring activities
	Public policies
	Innovation culture

Measuring innovation and developing indicators presents a key challenge for innovation research in the last decades. This challenge is exacerbated by the identification of indicators on regional, national and international levels (Grupp and Schubert 2010; Janger et al. 2017). A large share of existing literature has investigated firms' innovation processes (Becheikh et al. 2006; Dziallas and Blind 2019; Janger et al. 2017), most prominently, the role of patents as an indicator for technological innovation (Archibugi 1992; Jarchow and Röhm 2019). Upcoming research like studies on service innovation, cluster and innovation systems has accelerated the need to introduce innovation indicators that cover a broader perspective on innovation. Currently, indicators such as the Frascati Manual (OECD 2015) and Oslo Manual (OECD 2018)—that cover R&D and innovation in companies—set a standard for innovation scholars. Additionally, literature reviews have presented a comprehensive overview of company-based indicators (Becheikh et al. 2006; Dziallas and Blind 2019). Since a conceptual framework for indicators of innovation intermediaries does not yet exist, this paper builds upon frameworks of research on innovation in firms (Becheikh et al. 2006; Dziallas and Blind 2019) and adapts them according to the specifics of intermediaries. In particular, the framework was refined towards the function of intermediaries in innovation and their cooperation with various stakeholders as presented in Table 1.

3 Review method

The author conducted a systematic literature review on innovation indicators and determinants for innovation intermediaries (Tranfield et al. 2003). This method allows a high level of reproducibility and transparency by identifying key contributions to respective research fields (Littell et al. 2008). Recently, researchers in the

Table 2 Selection process of analyzed paper

Analyzed paper	823
Analyzed paper without other fields	724
Paper after stage 1	152
Paper after stage 2	65

field of innovation studies (Dziallas and Blind 2019; Miller et al. 2018; Thune and Mina 2016) used similar rule-based approaches for systematic literature reviews to synthesize papers and increase information on the current state of research. Similarly, the aim is to identify underlying theoretical constructs and dimensions that need to be taken into account to assess the role of innovation intermediaries.

In the first step, the keywords "innovation intermediar*" or "innovation intermediation" in combination with "indicator OR element OR determinant" are used to identify relevant articles (Dziallas and Blind 2019). In order to encompass the varying terms used in research on innovation intermediaries, also papers are included that cited Howells' (2006) paper on "Intermediation and the role of intermediaries in innovation". Howells (2006) presented a comprehensive synthesis of innovation intermediaries and was widely cited in intermediary research. The databases Scopus, Web of Science and Science Direct are used to identify relevant peer-reviewed papers (Dziallas and Blind 2019; Thune and Mina 2016). The search was limited to abstract, title and keywords of the papers since a large number of relevant papers were published in recent years. The sample includes only English papers published in 2006 and later. Books, chapters and conference papers were excluded from the review. Following this procedure, 823 papers are identified for further analysis in the first step (14th of November 2019).[2] Furthermore, the sample contains only papers published in social science, business and economics journals (724 papers).

The synthesis of literature follows a two-step approach (Table 2). As a first inclusion criteria, only papers focusing on innovation intermediation using quantitative, mixed and qualitative methods were included. Selection was conducted in the first step only on the basis of the abstracts. Papers with a pure conceptual or theoretical focus were excluded. The inclusion criteria in the first stage aimed to ensure that the innovation intermediaries' perspective is covered. Papers without a clear focus on innovation processes were excluded, e.g. project analyses on collaborative research projects. Papers that used the term intermediation to describe 'to intermediate' for financial intermediation were also ruled out. Papers that solely discussed client firms' perspectives, often conducted as survey studies, were also excluded. After the first stage of synthesis, 152 papers were left. In a second step, empirical articles that analyzed innovation intermediaries' determinants, factors or indicators influencing the innovation process were

[2] The author strictly used results that either included the keywords or cited Howell (2006). There is more literature which discusses concepts similar to innovation intermediaries but without explicitly referring to it. These were excluded.

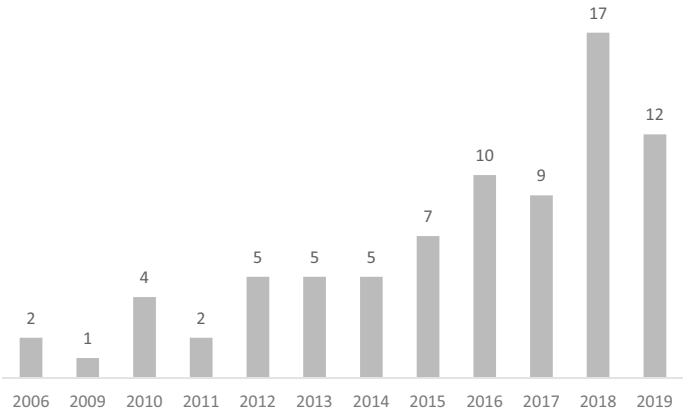

Fig. 1 Year of publication ($n = 65$) (2006–2019)

Table 3 Methods used in articles ($n = 65$)

Methods	Number of articles
Mixed Method	7
Qualitative	43
Quantitative	15

included. Papers that solely included case studies on typologies or processes were not included. In total, the sample of studies contains 65 papers that matched the inclusion and exclusion criteria. In the second stage, the papers were read to identify their relevance for the literature review.

The number of published papers has grown since 2006 as shown in Fig. 1. Particularly, the trend can be confirmed for recent times. More than half the papers in the sample were published between 2017 and 2019. Authors use a broad range of theoretical foundations in their papers, which can be explained by the slow standardization and late attempts to measure intermediaries' contribution to innovation systems (Table 3).

The discussion on measuring the impact of intermediaries on innovation is fragmented (Table 4). 26 journals have published just one article each in the chosen sample. The wide range of intermediaries' services reflects the diversity of journals with varying scopes from sustainability to innovation management to regional studies. Overall, the chosen articles were published in leading interdisciplinary journals with a focus on innovation studies. Knowledge transfer, in particular, is the focus of several journals which have published papers on measuring the impact of innovation intermediaries. The Journal of Cleaner Production and the European Planning Studies published the most papers included in the sampling.

The authors chosen for the sample have published studies on innovation intermediaries conducted world-wide (Table 5). In particular, comparative cross-national

Table 4 Top publishing journals

Journals (with 2 and more publications)	Number of included paper
Journal of Cleaner Production	6
European Planning Studies	5
Journal of Technology Transfer	4
Research Policy	4
Technological Forecasting and Social Change	4
Entrepreneurship and Regional Development	3
European Journal of Innovation Management	3
Industry and Innovation	2
International Journal of Innovation Management	2
International Journal of Technology Management	2
Technology Analysis and Strategic Management	2
Technovation	2

Table 5 Countries analyzed in empirical articles

Countries	Number of articles
More than 1	19
No info	1
Australia	1
Belgium	2
Canada	3
China	2
Finland	3
France	2
Germany	1
Italy	5
Japan	1
Mexico	1
New Zealand	1
Portugal	1
Russia	3
Scotland	1
Spain	3
Sweden	3
Taiwan	3
UK	9

approaches analyzing intermediaries in two or more countries were used as empirical strategies. More than half the studies concentrated on European countries, with seminal papers focusing on a British case study and analyzing British innovation intermediaries. The rest of the sample focuses on Asian and American intermediaries.

The literature is still in an exploratory phase and is not standardized yet (Table 3). Only 15 large scale studies that used quantitative methods could be identified. Knowledge-intensive business services (Silva et al. 2018) are the most analyzed type of innovation intermediaries. 6 out of 15 papers concentrate on the analysis of KIBS (Bocquet et al. 2016; Chichkanov et al. 2019; Hsieh et al. 2015; Lee and Miozzo 2019; Rodríguez et al. 2018; Shearmur and Doloreux 2019). The CIS inclusion of KIBS is partly the reason for it, as large-scale data was easily available for quantitative analyses. Nevertheless, this covered only a small share of innovation intermediaries since institutional intermediaries are not included. Additionally, an upcoming strand of literature analyzed the role of networks and innovation intermediation (Benassi et al. 2012; Kolesnikov et al. 2019; Roxas et al. 2011). Moreover, 43 of 65 papers used qualitative methods to analyze the role of innovation intermediaries. Most papers following this strand conducted semi-structured interviews.

Due to the state of the identified literature strands, the papers focus mostly on the interaction of intermediaries with clients, consisting of analyses of sub-groups of innovation intermediaries (Table 6). Most identified research papers (25) deal with research questions related to the internal perspective of intermediaries. The literature focuses on structural issues concerning the services offered to support cooperation partners and the resultant internal knowledge capability. Furthermore, factors for effective knowledge transfer is the second most analyzed topic (23 papers) in the sample and covers issues concerning the transfer to firms, scientific institutions, societal institutions and other intermediaries. The role of intermediaries in initiating networks and orchestrating them is analyzed in 9 papers. These papers question how intermediaries influence innovation processes. Although, the research conducted on innovation intermediaries follows the structure of innovation processes, further analysis needs to take into account the fragmented status of the research given the heterogeneity of actors.

A synthesis approach including papers combined with qualitative methodology was used to review the paper (Gentles et al. 2016). An in-depth quantitative analysis of the variables is not suitable as the reviewed papers lack the robustness required to generalize the results. Due to the heterogeneity of the literature—which can be explained by varying intermediary definitions and niche actors—a qualitative coding was applied to summarize the existing literature and include heterogeneous data. For the synthesis of the determinants, deductive and inductive codes were used as

Table 6 Domains of research questions

Research question ($n = 65$)	Number
Factors for effective Knowledge transfer	23
Impact / interaction with users for innovation	8
Internal innovation / knowledge capacity	25
Role in networks	9

existing studies apply a broad range of data. An analytical table was used to include information about the research questions (1), main findings (2), factors and dimensions (3), method (4) and dependent variable (5) when applicable.

4 Results

The systematic literature review resulted in three main categories of factors that can impact the role of intermediaries in innovation systems: Innovative outcome, internal factors and contextual factors. The framework of Becheikh et al. (2006) on manufacturing companies was adapted to the framework of intermediaries proposed in this paper. Table 1 presents an overview of the analytical framework which was developed on analyzing the selected papers.

4.1 Measuring innovative outcome and impact

The reviewed papers have a broad scope to address the innovative outcome and impact of intermediaries addressed in the context of their performance. Direct and indirect outcomes as well as intermediaries' influence on a systemic level have been addressed in the analyzed papers as depicted to Table 7.

4.1.1 Direct innovative outcome

Direct innovative outcomes of intermediaries are captured through company-based innovation surveys and rely upon self-declared outcomes (Lee and Miozzo 2019). The OECD innovation manuals are central for intermediary research (OECD 2015, 2018). Namely, the introduction of new and improved products (Hsieh et al. 2015; Li et al. 2019; Chen and Lin 2018) and services (Hsieh et al. 2015; Li et al. 2019; Rodríguez et al. 2018; Shearmur and Doloreux 2019; Silva et al. 2018), processes (Li et al. 2019; Readman et al. 2018; Rodríguez et al. 2018), organizational innovation (Chichkanov et al. 2019; Readman et al. 2018; Shearmur and Doloreux 2019) and marketing innovation (Chichkanov et al. 2019; Hsieh et al. 2015; Shearmur and Doloreux 2019) are used as indicators. In addition, the introduction of new technologies (Chichkanov et al. 2019; Silva et al. 2018), registration of intellectual property rights (Li et al. 2019; Silva et al. 2018), innovation in human resources (Shearmur and Doloreux 2019) and cost innovation (Hsieh et al. 2015) were surveyed as characteristics of innovative outcomes. Studies define the quality of outcomes according to the degree of novelty, differentiating between incremental and radical progress (Bocquet et al. 2016; Lee and Miozzo 2019; Shearmur and Doloreux 2019), degree of standardization (Chichkanov et al. 2019) and new knowledge created (Silva et al. 2018).

Table 7 Factors of innovative outcome and impact

Influence	Factors	Specific factors used in articles
Direct	Degree of innovation	Radical innovation, innovation intensity
	Innovation drivers	Standardization
	Innovation types	Cost innovation, Human Resources, Intellectual Property, marketing innovation, organizational innovation, process innovation, product innovation, service innovation, technological Innovation
	Number of innovations	
	New knowledge	Advanced knowledge, disciplinary knowledge
Indirect	Changes in firms' innovation behaviour	Investments in innovation, demand for (knowledge-intensive) value-added services
	Effectiveness in support	Fulfills goals of funding, objectives of clients
	Impact on clients' innovation process	Business model, marketing innovation, organizational innovation, process innovation, product positioning, service innovation
Impact	Creation of learning and entrepreneurship environment	Perception of satisfaction with cluster
	Development of Capabilities	Growth rate of regional investment, management capabilities, number of structural holes bridged, research capabilities, support to gain commercial knowledge, support to gain market-orientation
	Entrepreneurial experimentation	Examples of entrepreneurial potential
	New actor in innovation system	New firms
	Market formation	New market
	Protected innovation	Degree of protection in cluster

4.1.2 Indirect innovative outcome

In comparison to traditional company-based innovation surveys, studies on intermediaries have investigated innovative outcomes with a broader perspective, thereby capturing indirect innovative outcomes. Indirect innovative outcomes survey the contribution of intermediaries to clients' innovative outcomes. The papers include intermediaries' contributions to firms' new services (Readman et al. 2018) and products (Landry et al. 2013), process innovation (Knockaert and Spithoven 2014; Landry et al. 2013; Matschoss and Heiskanen 2017), organizational changes (Landry et al. 2013; Matschoss and Heiskanen 2017; Readman et al. 2018) and marketing activities (Knockaert and Spithoven 2014; Landry et al. 2013). The influence on business model innovation (Landry et al. 2013), innovation speed (Knockaert and Spithoven 2014) and realization of objectives add to indirect innovative outcome. Furthermore, Russo et al. (2019) introduce the category of changing behavior induced by intermediaries and relate it to business models, the search for market niches and distribution channels, investments in new or improved products and services as well as the demand for knowledge-intensive services (Russo et al. 2019).

4.1.3 Influence on systemic level

The impact of intermediaries also contains the integration of intermediaries into innovation systems. The effectiveness of intermediaries to contribute to specific systemic goals is discussed in some studies, such as the role to foster learning on system levels (Gao and Hu 2017) or clients' satisfaction with intermediaries to understand its contribution to network structures (Mueller and Jungwirth 2016). A central topic is the support of entrepreneurship learning, which entails dimensions like the variety of actors, the number of new actors in the network (Matschoss and Heiskanen 2017), the number of new firms created as a result of intermediation collaboration (Sengupta and Ray 2017; Zeng et al. 2010) and the support received to develop new markets (Kanda et al. 2019). Moreover, the development of knowledge capabilities (Kanda et al. 2019; Silva et al. 2018) reflect an indirect impact on the innovative outcome. For publicly funded intermediaries, the fulfilment of public funding bodies' requirements and goals are also used as a proxy to evaluate intermediaries' impact (Mueller and Jungwirth 2016).

Approaches to connect intermediaries directly to regions' performance is still in its infancy and is often argued on a conceptual level. Zeng et al. (2010) presented a novel exploratory approach to connect intermediaries' performance with regional indicators. They measured the rate of regional investments and the use of intellectual property rights to analyze intermediaries' impact on the regional level (Zeng et al. 2010). A broader set of regional innovation with focus on intermediaries could help understand the embeddedness of intermediaries in regional innovation systems.

4.2 Internal factors

The position of intermediaries in the innovation process influences the dimensions of the internal perspective. The reviewed studies cover a broad range of information about internal processes (Table 8). This section contains five categories of internal factors: general characteristics, strategy, structure, management team, and functional assets and strategies.

4.2.1 General characteristics

In the literature, four dimensions of general characteristics have been discussed: First, the time span of intermediaries' operation (Benassi et al. 2012; Hsieh et al. 2015; Pina and Tether 2016; Soetanto 2006), second, the number of employees (Pina and Tether 2016; Sinell et al. 2018), third, the type of ownership—public or private—(Zaichenko 2018), and fourth, annual budget (Stezano 2018). These dimensions influence the capability of intermediaries to innovate and to enable other actors to increase their innovativeness.

4.2.2 Strategy

The strategy of intermediaries consists of three dimensions: the definition of goals, knowledge creation and innovation strategy, and finally, the commercialization strategy. The formulation of the strategy relies on the clarity of the formulated goals (Kant and Kanda 2019; Mueller and Jungwirth 2016; Chen and Lin 2018) and the specialization of intermediaries (Kanda et al. 2018; Sinell et al. 2018; Villani et al. 2017). Moreover, goal formulation relies on the intermediaries' interaction with clients (Elmquist et al. 2016; Kant and Kanda 2019; Mossberg et al. 2018; Mueller and Jungwirth 2016; Randhawa et al. 2017), making the latter's scope central for successful cooperation projects (Howells 2006; Sengupta and Ray 2017). This refers to the selection strategy of cooperation partners chosen according to their sectors, or chosen with a focus on economy-wide (Fukugawa 2018), international or domestic ranges (Fukugawa 2018) that focus on new or established technologies (Gao and Hu 2017). The goal-orientation also depends on the capability for rule-based selection criteria (Soetanto 2006), cooperative knowledge sources and the ability to negotiate with prospective partners (Howells 2006).

Another relevant dimension for shaping intermediary's strategy is the innovation and knowledge creation strategy, since it determines the function in the innovation system. This includes the decision to pursue open or closed innovation strategies (Li et al. 2019; Sengupta and Ray 2017). As a consequence, the selection of external partners will depend on this choice (Parjanen et al. 2011; Sengupta and Ray 2017; van Geenhuizen 2018). In cases where intermediaries also run internal research units, strategic decisions on the range of research activities conducted—between basic and applied (Readman et al. 2018; Stezano 2018; Vivas 2016; Zaichenko 2018)—and how they are conducted need to be finalized. Specifically, the structure of research processes, level of outsourcing, strategic collaborative learning

Table 8 Internal factors for knowledge sharing

Factors		Specified factors used in articles
Intermediaries' general characteristics	Age	Year of entry, years in business, young intermediaries (less than 10 years old)
	Customer / market	Share of SMEs as clients, regional, national or international focus
	Number of Employees	Small, medium or large-sized enterprises
	Ownership	Entirely public ownership, not entirely public ownership
	Turnover/budget	Average turnover, total budget
Intermediaries' global strategies	Commercialization strategy	Innovation identification and selection (seeking new geographic markets, extending services, developing marked niches), science commercialization
	Goals	Clarity, commitment to shared vision, specialization
	Innovation strategy	Balance between research and commercialization, choice of knowledge transfer channel, evolving learning processes (co-creation), in-house / outsourcing, legitimation, openness
	Selection strategy	Cooperation with regional, domestic or international partners
Intermediaries' structure	Communication and involvement	Client relationship management, involvement of end customers, public communication, conflict management
	Embeddedness in ecosystem	Integration in value chain, knowledge transfer of expertise to ecosystem
	Organizational structure of intermediary	Degree of centralization / formalization / supporting knowledge sharing
	Embeddedness in ecosystem	
Management team	Leadership / staff variables	(Self-)organization and management, commitment, competences of intermediaries' staff, conflict management, satisfaction with payment, time management
	Management of knowledge	Commercialization, exploitation, openness
	Management of the relationship with research institution, clients & stakeholders	Acquisition and implementation, assessment of firm's technological needs, exploitation, funding, identification and selection of innovation goals, identification of firm's innovation needs, information gathering and storing, protection and monitoring

Table 8 (continued)

Factors		Specified factors used in articles
Functional assets and strategies	Funding & Financing	Cycle of investment, mobilization of funding, relation finance and R&D, size of funding
	HR	Cumulative number of graduates, expenses for personnel, growth rate of staff, incentives, recruiting personnel for innovation, share of graduates, share of R&D staff, specialization of employees, training
	Marketing	Advertising / Branding, client statistics, market observation, marketing, support and planning, revenues

and collaboration with clients are dimensions related to the innovation and knowledge creation strategy.

Last but not least, the commercialization strategy states activities for commercialization of products and goods directly (Landry et al. 2013) or indirectly by providing information to third partners who support the commercialization of innovation (Cannavacciuolo et al. 2015; Soetanto 2006). These activities include the search for market niches, exploration of add-value services and the redirection required to attract new customers (Landry et al. 2013). Furthermore, commercialization strategies include the marketing of these activities and the screening of their development (Landry et al. 2013), making commercialization's timing a key for successful cooperation (van Horne and Dutot 2017).

4.2.3 Structure

The articles discuss three dimensions of intermediaries' structure: internal structure, communication and embeddedness in the innovation system. First, the internal structure is analyzed with regard to the degree of formalization of the mediators' organizations. The autonomy of units and employers are determinants to understanding the mode of intermediaries' operations. (Mueller and Jungwirth 2016; Silva et al. 2018; van Horne and Dutot 2017). Moreover, different levels of centralized decision-making influences intermediaries' function (Kant and Kanda 2019; Mueller and Jungwirth 2016; Sengupta and Ray 2017; Stezano 2018). Especially, the number of stakeholders and employers influence the degree of centralization and the establishment of structures (Mossberg et al. 2018).

Second, communicative processes shape the intermediary's structure. Organizations differ according to the communication adopted between various internal units (O'Kane, 2018) and external stakeholders, like clients and researchers (Kant and Kanda, 2019). Intermediaries require different communicative competences depending on the use of technological and non-technological knowledge (Kant and Kanda, 2019). The inclusion of external stakeholders, such as customers and project partners, in communication processes is also highlighted (Kant and Kanda, 2019). Conflict management and its formalization, particularly in larger organizations, can also influence intermediaries' structure (Mueller and Jungwirth, 2016).

Third, the embeddedness of intermediaries in innovation systems depends on its structure. The way in which intermediaries are integrated in the innovation system decides its ability to offer complementary activities (Kant and Kanda, 2019). For example, for intermediaries that operate closely with universities, the capability to absorb knowledge from researchers can directly influence the capability to support the transformation of academic knowledge to market application (O'Kane 2018). Moreover, the embeddedness depends on the structural formation of the innovation system. The presence or absence of central actors or the willingness of incumbent actors to cooperate influences the intermediaries innovative outcome (Mossberg et al. 2018).

4.2.4 Management team

The intermediaries' management team deals with leadership and staff competences, thereby influencing the intermediaries' innovative capability. The ability to self-organize and manage work (Kant and Kanda 2019), and the competences of intermediaries' staff (Owen et al. 2014; Readman et al. 2018; Chen and Lin 2018), concerning time management (Mueller and Jungwirth 2016; Readman et al. 2018) and conflict management (Mueller and Jungwirth 2016) in specific, have been used to account for the quality of managing innovation intermediaries. Furthermore, the commitment of responsible staff (Mueller and Jungwirth 2016; Sinell et al. 2018) and the satisfaction their payment (Mueller and Jungwirth 2016; Chen and Lin 2018) influence the intermediaries' ability to offer their services.

As knowledge brokers interacting with actors in the innovation system, networking and boundary spanning is a relevant activity of intermediaries. Relationships with research institutions, stakeholders and clients are crucial for intermediaries' management (Alexander and Martin 2013; Garengo 2019; O'Kane 2018; Todeva 2013). Management of knowledge creation, its processing and dissemination are at the core of the business model of innovation intermediaries. The intermediaries' openness depends on managerial perceptions of what is valuable for the institution (Kant and Kanda 2019; Moilanen et al. 2015) and how knowledge exploitation is seen as part of the dissemination process (Kant and Kanda 2019). A substantial part of exploitation activities depend on the commercialization of close to market products and services, and their management to support successful innovation (Kant and Kanda 2019; Todeva 2013).

4.2.5 Functional assets and strategies

Funding and financing, human resources and marketing strategically influence innovative outputs and outcomes of intermediaries as functional assets. Funding and financing depends largely on the capability to mobilize these resources (Readman et al. 2018; Todeva 2013) for intermediaries' but also for external cooperative activities. Clients' resources for innovation activities are an important determinant for the output and outcome of the innovation cooperation (Gao and Hu 2017; Kanda et al. 2018; Kant and Kanda 2019; Todeva 2013). This entails the capability of intermediaries to find financial resources (Bush et al. 2017), to allocate them (van Horne and Dutot 2017; Yström and Aspenberg 2017) and to maintain their sustainable flow (Mossberg et al. 2018; Mueller and Jungwirth 2016). Moreover, the size of external funding (Dalziel and Parjanen 2012; Kant and Kanda 2019; Zeng et al. 2010) is decisive for the operation and offer of innovation services. Public sources play a crucial role on regional, national and international levels (Silva et al. 2018; Vivas 2016). The role of intermediaries in the seeking funding is related to the availability of internal resources (Kanda et al. 2018; Chen and Lin 2018; Sinell et al. 2018), funding from host organizations (Sinell et al. 2018), and private (Polzin et al. 2016; Sinell et al. 2018) and public–private funding organizations (Polzin et al. 2016; Sinell et al. 2018). Intermediaries focus their financial support services on different

development stages of clients (Gao and Hu 2017; Howells and Bessant 2012). In cases of intermediaries conducting R&D, the relation between R&D and funding indicates the dependency of R&D activities on public funding (Pina and Tether 2016; Thurner and Zaichenko 2015; Todeva 2013; Zaichenko 2018; Zeng et al. 2010).

In the chosen literature, human resources has been described as a critical part for cooperative innovation processes, particularly in the case of transferring tacit knowledge. The contribution of employed staff is estimated by counting the absolute number of graduates (Fukugawa 2018; Landry et al. 2013; Thurner and Zaichenko 2015; Zaichenko 2018) or by surveying the share of graduates (Chichkanov et al. 2019; Pina and Tether 2016). Moreover, the share of R&D expenses for R&D staff is also measured (Zaichenko 2018). Knockaert and Spithoven (2014) use the share of internal R&D-staff as an indicator for the knowledge-intensity of services (Knockaert and Spithoven 2014). Moreover, with the introduction of a large number of innovation intermediaries, the specialization of intermediaries' influences may impact outputs and outcomes. In order to specialize as proxy, papers use the field of studies (Fukugawa 2018; Readman et al. 2018; Chen and Lin 2018), the time span of experience (Chen and Lin 2018; Silva et al. 2018; Vivas 2016) and the duration required for finding specialized staff (Bocquet et al. 2016; Zaichenko 2018). Moreover, the dynamics of intermediaries is captured by the growth rate of staff (Zeng et al. 2010). The development of the internal capacity is reviewed by analyzing the role of training activities for intermediaries. This includes training of staff (Howells 2006; Silva et al. 2018), exchanging staff with other institutions (Alexander and Martin 2013), setting up post graduate programs (Stezano 2018), and training external staff (Vivas 2016) and students (Alexander and Martin 2013; Readman et al. 2018; van Horne and Dutot 2017). The share of development expenses is used as an explanatory factor (Chichkanov et al. 2019).

Marketing is relevant for intermediaries to be positioned in the innovation system and to act on the relevant markets. This is addressed by surveying the number of (new) clients, size of clients and of knowledge transfer projects (Roxas et al. 2011). Additionally, the revenues in relation to commercialization activities (Landry et al. 2013; Sinell et al. 2018; Zaichenko 2018), e.g. licensing (Stezano 2018), income from research projects (Stezano 2018), service sales (Landry et al. 2013; Stezano 2018) and products (Li et al. 2019) are examined to evaluate the intermediaries' position in the market. Moreover, the screening of markets and competitors comprises activities such as benchmarking and scanning trending topics (Howells 2006; Readman et al. 2018), developing new markets (Lee and Miozzo 2019), technology foresight (Chen and Lin 2018) and stakeholder mapping (Sinell et al. 2018). Furthermore, challenges for intermediaries on the markets are captured by hampering knowledge creation and transfer of the intermediary, for example, by influencing domestic and international competition (Thurner and Zaichenko 2015). Branding and advertising are used by intermediaries as marketing activities to determine their competitive position. The share of expenditure for advertising (Chichkanov et al. 2019), consistent communication strategies (van Horne and Dutot 2017), creation of a brand name and reputation (Kanda et al. 2018), for example, by

receiving recommendations from other clients (Readman et al. 2018) and offering best practices examples (Matschoss and Heiskanen 2017) are surveyed as drivers for innovation.

4.3 Intermediaries' contextual factors for innovation

In order to measure innovation, it is important to consider contextual factors as a main category, thereby receiving information about the function of intermediaries (Table 9). The central functions as boundary spanner and knowledge spanner depend on the embeddedness in the innovation system and proximity to knowledge sources, clients and third parties. Due to intermediaries' specific position in the innovation process, contextual factors are likely to have an impact on how intermediaries effectively operate. Nevertheless, capturing contextual conditions is more difficult since most of the reviewed studies rely solely on the intermediaries' perspective.

4.3.1 Industry and technology related factors

The industry and the technological field where intermediaries primarily operate determines its position in the innovation process. This depends on the technological and scientific background of the intermediary and its parent organization (Kant and Kanda 2019; Zaichenko 2018), sectoral position (Pina and Tether 2016) and sector-specific services of intermediaries (Benassi et al. 2012; Stezano 2018). In literature, the observation of client sectors are utilized to infer intermediaries' success for knowledge transfer and value generation. Specifically, the industrial output and growth rate (Zeng et al. 2010), structural data about the competition, (Vivas 2016), size of clients and prospective clients (Landry et al. 2013; Vivas 2016), and innovative potential of sector served (Chichkanov et al. 2019) demonstrate proxies for conditions that require intermediaries' to be involved in the innovation process. Moreover, the screening of sectorial positioning influences the transfer of knowledge according to existing products, market structure, success rate of projects and capability of human resources (Kant and Kanda 2019; van Horne and Dutot 2017).

4.3.2 Location factors

The role of location in influencing intermediaries has been discussed in connection to economic geography literature. Innovation systems and regional development literature acknowledge regional disparities to explain the influences of location on the context in which intermediaries operate in the innovation process (Hsieh et al. 2015; Kolesnikov et al. 2019; Lee and Miozzo 2019; Pina and Tether 2016; Shearmur and Doloreux 2019; van Geenhuizen 2018). The location of intermediaries defines its capability to operate during the innovation process and to source new knowledge (Hsieh et al. 2015; Huyghe et al. 2014; Kant and Kanda 2019). Furthermore, cooperation partners (Hsieh et al. 2015; Rodríguez et al. 2018) and stakeholders (Huyghe et al. 2014) are affected by the choice of location. Moreover, the location of clients (Mueller and Jungwirth 2016; Parjanen et al. 2011; Readman et al. 2018),

Table 9 Contextual factors for knowledge sharing

Factors		Example factors used in articles
Networking	Network activity for innovation	Initiating, network events
	Network experience	Ability of user, access to innovation network, interaction, network involvement of users, perception of network, role innovation in network, user interaction, motivation of user to use network, use of network by member, use of networks by intermediaries
	Role of intermediary in network	Agenda-setting, boundary spanning, brokerage values, change of firms' network behavior, embeddedness, enabling the network, orchestrating
	Structural properties of network	Average betweenness, centralization, compactness, connectedness, density, heterogeneity of actors, inclusiveness, length of ties, number of actors, quality of ties, reciprocity, number of ties
Knowledge / technology sharing	Knowledge transfer channels	Clients' capability, knowledge sharing activity, ties with industry, ties with research, innovation network and knowledge sharing, factors hampering knowledge transfer channels
	R&D / In-house innovation	Knowledge acquisition, intellectual property rights, access to information, factors hampering R&D / In-house innovation, infrastructure for knowledge creation, innovation mode, intellectual property rights, knowledge processing (internal), screening, technology and innovation activities performed, infrastructure for knowledge
	Services linked to knowledge-based opportunities	Commercialization, entrepreneurial activities, feasibility studies, ICT service, information distribution (newsletter, webinar, best practice), knowledge sharing activity, scouting activity, seminars, service for finance, services for intellectual property rights, technical consultancy, testing, training
Government and public policies	Interaction	Funding bodies, lack of interaction, lobbying, local or national governments, multi-Stakeholder relationship, supranational actors, like EU, trade associations
	Policy goals	Agenda setting, directionality towards authorities, long-term policy support, specific policy goals, like innovation, environmental goals
	Regulation & standards	Implementation, procedure

Table 9 (continued)

Factors		Example factors used in articles
Surrounding culture	Trust development	Confidentiality, knowledge gaps, lack of trust, motivation of partners, quality of service, values of partners
	Communication culture	Accessibility of the communication, creative interventions, functioning, quality, working environment or atmosphere of intermediaries
	Dynamics of innovation culture	Motivation, knowledge transfer culture, motivation, neutrality, open innovation, societal values
	Tools to support cultural dynamics	Creativity practices, tools for idea generation and time management, story telling
Intermediaries' industry related variables	Fields of target knowledge	E.g. engineering, humanities, science, social science, etc
	Sector-specific services of intermediaries	Activities forming each service
	Structure of customer sector	Growth rate of customer sector
	Technological & scientific context	Competencies and knowledge, enlightenment, functioning markets, technology development
Intermediaries' regional variables	Location of clients	Regional, national and international markets
	Location of intermediary	Rural, urban
	Location of knowledge source	Proximity to knowledge sources, to other innovation intermediaries
	Location of stakeholder	Proximity to boundary spanning activities
	Regional innovation capability	Regional innovation activities (R&D, patents, exports, internet user, characteristics of innovative markets), regional innovation culture

geographical distribution of turnover (Hsieh et al. 2015), other local intermediaries (Schaeffer and Matt 2016), and the regional innovation capability processes (Parjanen et al. 2011; Villani et al. 2017; Vivas 2016; Zeng et al. 2010) consisting of various stakeholders involved in the innovation vary between different regions and impact intermediaries' work.

4.3.3 Networks

The structural characteristics of the networks have been described using the number of ties, density, centrality of intermediaries and configuration between the nodes in the networks (Barrie et al. 2019; Belso-Martinez et al. 2018; Chen et al. 2015; Minguillo and Thelwall 2012). Different organizational characteristics, such as the size (large companies), type (SMEs, research organizations, clients, investors, competitors and suppliers (Hsieh et al. 2015; Landry et al. 2013; Lee and Miozzo 2019; Readman et al. 2018; Silva et al. 2018; Todeva 2013)) can sort different nodes in the network. Furthermore, researchers differentiate between links of the network according to social and cognitive proximities (Huyghe et al. 2014; Parjanen et al. 2011; Villani et al. 2017). Criticalities and weak connections that hamper functioning of the networks may affect the intermediaries' networking success (Pino et al. 2016; Thurner and Zaichenko 2015). Changes in the behavior of actors using and participating in networks are screened in the dynamic perspective (Barrie et al. 2019; Belso-Martinez et al. 2018).

Probing deeper, the papers explain the role and function of intermediaries in the network to clarify the positioning of innovation intermediaries. The contributions of intermediaries are perceived as difficult to capture since the direct value is difficult to measure (Kant and Kanda 2019). Scholars have discussed boundary spanning (Comacchio et al. 2012; Schaeffer and Matt 2016; van Geenhuizen 2018) and orchestrating activities in the form of matchmaking that supports network members' knowledge transfer (Huyghe et al. 2014; Mele and Russo-Spena 2015; Silva et al. 2018; Yström and Aspenberg 2017). In order to gather knowledge about this phenomena, the brokerage value between intermediaries and two and more different stakeholders are calculated on the basis of the number of additional links set up by intermediaries (Belso-Martinez et al. 2018; Chen et al. 2015) and the influence that this exerts on their interactions (Mele and Russo-Spena 2015; Parjanen et al. 2011). Links are captured to survey the source of knowledge to diffuse innovation (O'Kane 2018). Additionally, intermediaries are asked to estimate if the connections are new to the network partners (Alexander and Martin 2013).

Networking events managed by intermediaries are used as proxies to analyze the influence of intermediaries on network building. The number of events, number of participants and new contacts resulting from networking activities have been surveyed in specific (Russo et al. 2019; Soetanto 2006). Furthermore, to evaluate intermediaries' events, the selected literature reviews the sharing of direct contacts, the frequency at which information about events are offered and the use of resources by intermediaries to organize events(Alexander and Martin 2013; Bocquet et al. 2016; Knockaert and Spithoven 2014; Porto Gomez et al. 2016; Shearmur and Doloreux 2019). The involvement of intermediaries in knowledge networks (Kant and Kanda

2019; Readman et al. 2018; Silva et al. 2018; Todeva 2013), the capability to get involved in knowledge networks and the networks intermediaries establish with other intermediaries (Cannavacciuolo et al. 2015; Kant and Kanda 2019; Parker and Hine 2014) are also assessed.

4.3.4 Knowledge sharing and transferring activities

The knowledge sharing and transferring activities have been analyzed in three different dimensions: internal knowledge capacities, knowledge cooperation, and knowledge and technology-sharing services. In innovation systems, intermediaries have been perceived as beneficial since positive knowledge externalities are expected by intermediaries' activities (Kanda et al. 2018, 2019). Specific knowledge is key for intermediaries to offer an adequate level of quality (Mueller and Jungwirth 2016). In-house innovation activities and R&D form the basis for subsequent technology and knowledge-sharing activities. Not all innovation intermediaries conduct in-house innovation activities or aim to participate in innovation. Often intermediaries create knowledge bases to conduct supporting processes for clients (Mele and Russo-Spena 2015). Intermediaries' knowledge is differentiated into analytical, symbolic and synthetic knowledge, or is a combination of these (Pina and Tether 2016). Moreover, whether knowledge is tacit or codified is crucial for knowledge transfer and sharing of characteristics (Alexander and Martin 2013; Barrie et al. 2019; Villani et al. 2017). The availability of different knowledge sources determines intermediaries' capability to identify clients' needs and match them with fitting cooperation partners (Cannavacciuolo et al. 2015; Howells 2006; Roxas et al. 2011; Chen and Lin 2018; Soetanto 2006). The availability of choice with regard to internal sources and access to external sources plays a central role in innovation for intermediaries (Bocquet et al. 2016; Garengo 2019; Knockaert and Spithoven 2014; Li et al. 2019; Parker and Hine 2014; Silva et al. 2018).

Some studies have analyzed the innovation mode used by intermediaries to interact and contribute: science and technology-based (STI) or the doing-using and interacting (DUI) mode (Lee and Miozzo 2019; Owen et al. 2014). Most intermediary studies have concentrated on the STI-mode. In these cases, researchers analyze the applicability of knowledge creation on a range of basic to applied research (Readman et al. 2018; Zaichenko 2018). Furthermore, an intermediary's capability to offer knowledge-related services is also defined by its infrastructure, such as laboratories, technical resources, test sites and meeting rooms (Howells 2006; Kanda et al. 2018; Knockaert and Spithoven 2014; Landry et al. 2013; Readman et al. 2018; Thurner and Zaichenko 2015; Vivas 2016; Yström and Aspenberg 2017), and by its application and support of innovation via intellectual property rights (Alexander and Martin 2013; Howells 2006; Li et al. 2019; Sengupta and Ray 2017; Stezano 2018; Thomas et al. 2017; Thurner and Zaichenko 2015; Vivas 2016; Zaichenko 2018).

Knowledge and technology sharing activities are central to the measurement of an intermediary's output. Knowledge services enable the flow and communication of knowledge (Bush et al. 2017; Elmquist et al. 2016). Research has identified that intermediaries play a role of guidance during knowledge sharing activities (Kanda et al. 2019). These activities are separated into cooperative and contracting activities

(Shearmur and Doloreux 2019). Also, the effects of information provision and events have been discussed to describe knowledge-sharing services (Knockaert and Spithoven 2014; Roxas et al. 2011; Silva et al. 2018).

Challenges for knowledge transfers capture the structural aspects of cooperation between intermediaries, clients and knowledge sources (Thurner and Zaichenko 2015; van Horne and Dutot 2017). The interaction for knowledge and innovation collaboration varies between formal and informal interaction (Alexander and Martin 2013). In papers using qualitative methodology, the perception of informal ties has been described as influential but difficult to measure quantitatively. It has been argued that the perception of successful and failing projects influences the dissemination of innovation (Owen et al. 2014; Randhawa et al. 2017; Yström and Aspenberg 2017).

Formal interaction is represented by the variety of collaborative activities. This entails academic and industrial conferences (Alexander and Martin 2013; Porto Gomez et al. 2016; Readman et al. 2018; Silva et al. 2018), collaborative digital platforms (Gao and Hu 2017; Silva et al. 2018), publications in scientific and practice-related journals (Alexander and Martin 2013; Silva et al. 2018; Stezano 2018; Thurner and Zaichenko 2015; Zaichenko 2018), common infrastructure (Alexander and Martin 2013), joint supervision of students with intermediaries and stakeholders (Readman et al. 2018) and collaborative trainings for knowledge-sharing.

Due to the heterogeneous nature of knowledge sharing services, depending on the characteristics of the analyzed sample, studies analyze the general characteristics of contractual services. Studies that cover general services survey the number and volume of services and projects, client's loyalty and new clients of intermediaries (Russo et al. 2019). Furthermore, projects can be differentiated based on cooperation with competitors and their scope for internationalization (Matschoss and Heiskanen 2017; Porto Gomez et al. 2016).

Specific services offered by innovation intermediaries cover a broad range of supporting services to foster knowledge sharing: This includes the support of companies with testing new products and processes (Knockaert and Spithoven 2014; Landry et al. 2013; Thurner and Zaichenko 2015), offering seminars, workshops and trainings for knowledge-sharing (Knockaert and Spithoven 2014; Randhawa et al. 2017; Thurner and Zaichenko 2015; Yström and Aspenberg 2017), office facilities, administrative and legal support (Howells 2006; Soetanto 2006), and technical advice and R&D support for client innovation (Comacchio et al. 2012; Knockaert and Spithoven 2014; Landry et al. 2013; Randhawa et al. 2017; Stezano 2018; Thurner and Zaichenko 2015; Villani et al. 2017). Moreover, scanning IPR and supporting the application of IPR (Knockaert and Spithoven 2014; Landry et al. 2013; Stezano 2018), access to financial support and investors (Landry et al. 2013) and access to ICT support (Randhawa et al. 2017) is provided by innovation intermediaries. Additionally, innovation intermediaries supply technology screening and scouting activities like market research and feasibility studies (Howells 2006; Knockaert and Spithoven 2014; Landry et al. 2013; Readman et al. 2018; Villani et al. 2017), supporting stakeholders through entrepreneurial activities (Landry et al. 2013;

Yström and Aspenberg 2017) and assisting with the introduction and customization of new services and products (Kanda et al. 2018; Landry et al. 2013).

4.3.5 Public policies

Public policy shapes the context that intermediation takes (Barrie et al. 2019). Therefore, policy goals influence intermediaries directly and indirectly (Polzin et al. 2016). The relevance of intermediation in regional policies and its priorities impact the planning of intermediaries (Mossberg et al. 2018; Mueller and Jungwirth 2016). The support of related innovation and technology policies are relevant for intermediaries' performance (Kant and Kanda 2019; Mossberg et al. 2018). Additionally, the satisfaction of intermediaries are used to evaluate the capability of innovation systems (Zeng et al. 2010).

Interactions with governments are perceived as vital for agenda-setting (Yström and Aspenberg 2017). Ties to the government and administration is necessary to receive information about funding (Todeva 2013). Too little interaction serves as a problem that prevents stronger cooperation of intermediaries with the government (Thurner and Zaichenko 2015).

Standards and regulations affect the function and operation of innovation (Polzin et al. 2016; Chen and Lin 2018; Sinell et al. 2018). This can vary between regional, national and international regulators (Thurner and Zaichenko 2015). Implementation of international standards on the national and regional level can influence the diffusion of innovation (Kant and Kanda 2019). Intermediaries also participate in standard-setting programs and shape institutions (Howells 2006).

4.3.6 Innovation culture

Though innovation culture has been discussed for a long time in business contexts, studies on intermediaries have only recently discovered this topic for further analysis. To begin with, studies have analyzed communication culture of intermediaries. The clarity of communication between intermediaries and stakeholders (Mueller and Jungwirth 2016), the ability to bridge different communication cultures (Chen and Lin 2018), creative communication and the number of ideas to accelerate the innovation process (Parjanen et al. 2011) contribute to intermediaries' communication culture. Secondly, trust development influences the interaction between various actors. Studies focused on the role of confidential processes (Randhawa et al. 2017; Readman et al. 2018), committing to users' trust-ensuring mechanism (van Geenhuizen 2018) and the quality of work of cooperating partners (O'Kane 2018; Readman et al. 2018; van Horne and Dutot 2017) to assess the role of trust development. Thirdly, the dynamics of innovation culture changes when innovation evolves and develops. The motivation of stakeholders to be involved in innovation processes depends on the commitment of participants (Mueller and Jungwirth 2016; van Geenhuizen 2018), the intermediary's motivation and motivating processes (Owen et al. 2014; Parjanen et al. 2011; Randhawa et al. 2017). The perception of neutrality has also been seen as a mechanism to effectively position intermediaries inside

innovation systems (Kant and Kanda 2019; Mossberg et al. 2018). Furthermore, the degree of openness during knowledge creation and transferring processes (Li et al. 2019; Parjanen et al. 2011), and the participation and inclusion of different social groups (van Geenhuizen 2018) are also relevant to changes in innovation culture. Finally, the introduction of tools to support cultural dynamics of intermediaries helps foster innovation practices and supports innovation culture (Readman et al. 2018). Instruments like idea generation and storytelling are particularly relevant in this context (Antikainen et al. 2010; Yström and Aspenberg 2017).

5 Discussion and managerial implications

The systematic literature review varying analytical foci have been published based on Howells (2006) and have produced fragmented results. Though a majority of these papers use Howells' generalized definition of innovation intermediaries, their role and function are often discussed by assessing specialized intermediaries, like incubators, KIBS or transfer technology offices. Consequently, the standardization required for the formulation of a better empirical basis to further capture the role of intermediaries in innovation processes is still in an immature state. The conceptual framework as depicted in Table 10 of innovation intermediaries benefits from the broad and inter-sectorial perspective that comes from placing intermediaries in different contexts. This functional perspective helps understand the hybrid role of intermediaries in innovation systems and knowledge-sharing better. Insights from case studies offering in-depth analysis of intermediation and its direct and indirect impact on innovation processes have been presented. As shown in Fig. 2, the conceptual framework presented in the results section ties in with current research discussions:

First, the outcome and impact of innovation intermediaries has been a large width. The role of innovation intermediaries in knowledge sharing is determined by the strategic orientation on direct or indirect focus. This review contributes to the discussion of how intermediaries add value to the innovation process (Lichtenthaler and Ernst 2009; Tran et al. 2011). Innovation management needs to take into account that benefits from intermediaries depend on their aim to innovation which includes intermediaries' outcome and impact on clients' and at the systemic level as well. This article connects particularly to the literature on institutional entrepreneurship (Battilana et al. 2009; Hoogstraaten et al. 2020; Weisenfeld and Hauerwaas 2018). Particularly, the role of the informal and formal rules of innovation processes requires a further understanding of intermediaries in innovation systems has called for more research. The results elaborate on the impact of actors influencing innovation capacity on a systemic level.

Second, the article contributes to the discussion on tacit knowledge and technology-sharing (Castellani et al. 2021; Suppiah and Singh Sandhu 2011). While e.g. insights on individual level have been discussed (Castellani et al. 2021), the reviewed articles point on the relevance of the agency of knowledge-sharing to be understood. Particularly, novel methods to refine network analysis is core to understand the contextual conditions (Almodovar and Teixeira 2014; Pino et al.

Table 10 Summary contextual framework

Outcome and impact	Direct	Degree of innovation
		Innovation drivers
		Innovation types
		Number of innovations
		New knowledge
	Indirect	Changes in firms' innovation behavior
		Effectiveness in support
		Impact on clients' innovation process
	Impact	Creation of learning and entrepreneurship environment
		Development of Capabilities
		Entrepreneurial experimentation
		New actor in innovation system
		Market formation
		Protected innovation
Internal factors	Intermediaries' general characteristics	Age
		Customer / market
		Number of Employees
		Ownership
		Turnover/budget
	Intermediaries' global strategies	Commercialization strategy
		Goals
		Innovation strategy
		Selection strategy
	Intermediaries' structure	Communication and involvement
		Embededness in ecosystem
		Organisational structure of intermediary
		Embededness in ecosystem
	Management team	Leadership / staff variables
		Management of knowledge
		Management of the relationship with research institution, clients & stakeholders
	Functional assets and strategies	Funding & Financing
		HR
		Marketing

Table 10 (continued)

Contextual factors	Networking	Network activity for innovation
		Network experience
		Role of intermediary in network
		Structural properties of network
	Knowledge / technology sharing	Knowledge transfer channels
		R&D / In-house innovation
		Services linked to knowledge-based opportunities
	Government and public policies	Interaction
		Policy goals
		Regulation & standards
	Surrounding culture	Trust development
		Communication culture
		Dynamics of innovation culture
		Tools to support cultural dynamics
	Intermediaries' industry related variables	Fields of target knowledge
		Sector-specific services of intermediaries
		Structure of customer sector
		Technological & scientific context
	Intermediaries' regional variables	Location of clients
		Location of intermediary
		Location of knowledge source
		Location of stakeholder
		Regional innovation capability

2016). Nevertheless, existing approaches are still in their infancy and learning from other research strands offers opportunities to enrich this literature with the use of new methods. The conceptualization of intermediaries' embeddedness in knowledge networks (Axenbeck and Breithaupt 2019; Gök et al. 2015; Sarvan et al. 2012) can benefit from innovative use of methods. This will result in a deeper understanding of boundary spanning and the relevance of intermediation in knowledge networks.

Third, this article offers a framework to build on the role of intermediaries directing innovation. to specific areas, e.g. digitalization or sustainability. It connects with innovation management needs to apply a stronger impact-orientation (Seebode et al. 2012) and challenge operating intermediary frameworks. On the basis of the framework it is possible to define intermediary-specific challenges for

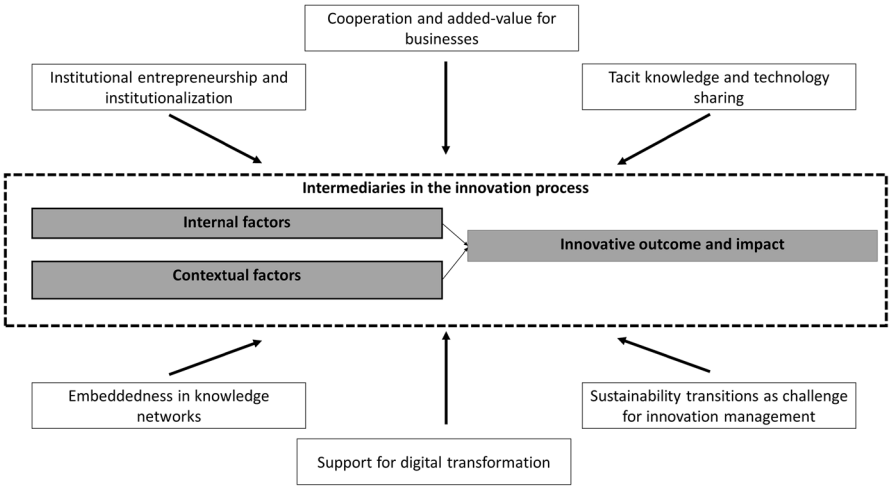

Fig. 2 Intermediaires in innovation process and research topics

developing new product, services and business models. Addressing the growing demand from public policy and the public, analyses of sustainability topics fostered the discussion on directionality of innovation (Røpke 2012), e.g. the literature on intermediaries as accelerating sustainable transitions and providing context specific knowledge has grown in the last years (Kanda et al. 2018, 2019; Mossberg et al. 2018). The conceptual framework proposed supports the building of an empirical base about intermediaries' work understanding the future needs for innovation intermediaries. Insights from literature on sustainable development and sustainable transition (Markard et al. 2012; Smith et al. 2005) can be merged with research on intermediaries in the future.

6 Conclusion

This paper presented an outline of factors that influence the role of intermediaries during the innovation process as well as knowledge-sharing and developed a framework for the same by synthesizing relevant literature. Intermediaries' function in innovation systems has grown to that of knowledge brokers between companies, universities, administrative institutions and societal groups. In order to synthesize heterogeneous literature containing insights on public, public–private and private intermediaries involved in different stages of innovation activities, this paper concentrated on a functional perspective of intermediaries in knowledge-sharing processes. Based on a systemic literature review, a conceptual framework was developed that connects internal and contextual factors with direct and indirect innovative outcomes and impact.

Three main results can be identified. Firstly, the involvement in innovation processes is broader in comparison to traditional innovation studies. Intermediary studies follow traditional innovation studies when it comes to the analysis of patents or self-description of products, processes or organization innovation. Considering the important role played by innovative outputs in the development of intermediaries, it is no surprise that factors such as the influence on clients and on system levels makes the role of intermediaries more complex in comparison to traditional company surveys.

Secondly, till date, there is a lack of analysis with regard to the internal perspective in comparison to contextual conditions. Knowledge management can provide insights to elaborate further on the embeddedness of intermediaries in entrepreneurial ecosystems. Though several papers present the internal structure of intermediaries, a holistic overview of internal factors is still missing. Similarly, though a majority of papers are based on Howells' (2006) functional definition of intermediaries, comparative approaches are still limited to specialized intermediaries. Comparative research can add to existing literature and enable the elaboration of an empirical framework. This perspective is important since a large share of literature analyzes intermediaries to understand the influence required to achieve public policy goals.

Thirdly, the positioning in knowledge networks accelerates the exchange of knowledge between relevant actors. Though a whole research strand sees sub-groups as innovation intermediaries, the tie between these groups have not been reflected on. In particular, modes of interaction, collaboration and competition require further empirical insights. This paper shows pursuable paths regarding networking, knowledge production and sharing and local embeddedness that can be fruitful for comparative work.

However, a number of limitations need to be considered. A broad basis for empirical research is still lacking. A majority of research is based on case studies. Future large-scale studies can elaborate further on innovation intermediaries as important hybrid actors to refine the framework and test potential innovation indicators to capture function in the innovation system. Thirdly, the summation of contextual and internal factors requires further validation. A comprehensive approach to level up the collection of data innovation in ecosystems is important. Cross-sectoral case studies can enrich the understanding of the interplay of factors and the mechanism between internal and contextual conditions. Finally, this paper has only reviewed intermediaries' perspective. Further investigations on the testing and exploring the link of intermediaries on clients and stakeholders can be beneficial for grasping their role in innovation.

Acknowledgements Financial support by the German Federal Ministry of Education and Research with funding code 16IFI110 is gratefully acknowledged.

Funding Open Access funding enabled and organized by Projekt DEAL.

References

Abbate T, Coppolino R, Schiavone F (2013) Linking entities in knowledge transfer: the innovation intermediaries. J Knowl Econ 4(3):233–243. https://doi.org/10.1007/s13132-013-0156-5

Albizu E, Olazaran M, Lavia C, Otero B (2017) Making visible the role of vocational education and training in firm innovation: evidence from Spanish SMEs. Eur Plan Stud 25(11, SI):2057–2075. https://doi.org/10.1080/09654313.2017.1281231

Alexander AT, Martin DP (2013) Intermediaries for open innovation: a competence-based comparison of knowledge transfer offices practices. Technol Forecast Soc Change 80(1):38–49. https://doi.org/10.1016/j.techfore.2012.07.013

Almodovar J, Teixeira AAC (2014) Assessing the importance of local supporting organizations in the automotive industry: A hybrid dynamic framework of innovation networks. Eur Plan Stud 22(4, SI):841–865. https://doi.org/10.1080/09654313.2013.771621

Antikainen M, Mäkipää M, Ahonen M (2010) Motivating and supporting collaboration in open innovation. Eur J Innov Manag 13(1):100–119. https://doi.org/10.1108/14601061011013258

Archibugi D (1992) Patenting as an indicator of technological innovation: a review. Sci Public Policy 19(6):357–368. https://doi.org/10.1093/spp/19.6.357

Axenbeck J, Breithaupt P (2019) Web-based innovation indicators: which firm website characteristics relate to firm-level innovation activity? SSRN Electron J. https://doi.org/10.2139/ssrn.3542199

Barrie J, Zawdie G, João E (2019) Assessing the role of triple helix system intermediaries in nurturing an industrial biotechnology innovation network. J Clean Prod 214:209–223

Battilana J, Leca B, Boxenbaum E (2009) How actors change institutions: towards a theory of institutional entrepreneurship. Acad Manag Ann 3(1):65–107. https://doi.org/10.1080/19416520903053598

Becheikh N, Landry R, Amara N (2006) Lessons from innovation empirical studies in the manufacturing sector: a systematic review of the literature from 1993–2003. Technovation 26(5–6):644–664. https://doi.org/10.1016/j.technovation.2005.06.016

Belso-Martinez JA, Diez-Vial I, Lopez-Sanchez MJ, Mateu-Garcia R (2018) The brokerage role of supporting organizations inside clusters: how does it work? Eur Plan Stud 26(4):706–725

Benassi M, D'Angelo A, Geenen G (2012) IP intermediaries in Europe: a web content analysis. Ind Innov 19(4):307–325. https://doi.org/10.1080/13662716.2012.694677

Bichler BF, Kallmuenzer A, Peters M, Petry T, Clauss T (2022) Regional entrepreneurial ecosystems: how family firm embeddedness triggers ecosystem development. RMS 16(1):15–44. https://doi.org/10.1007/s11846-020-00434-9

Bocquet R, Brion S, Mothe C (2016) The role of cluster intermediaries for KIBS' resources and innovation. J Small Bus Manage 54:256–277. https://doi.org/10.1111/jsbm.12298

Bouncken RB, Reuschl AJ (2018) Coworking-spaces: how a phenomenon of the sharing economy builds a novel trend for the workplace and for entrepreneurship. RMS 12(1):317–334. https://doi.org/10.1007/s11846-016-0215-y

Bouncken RB, Tiberius V (2021) Legitimacy processes and trajectories of co-prosumption services: Insights from coworking spaces. J Serv Res. https://doi.org/10.1177/10946705211050208

Bouncken RB, Gast J, Kraus S, Bogers M (2015) Coopetition: a systematic review, synthesis, and future research directions. RMS 9(3):577–601. https://doi.org/10.1007/s11846-015-0168-6

Bouncken RB, Fredrich V, Ritala P, Kraus S (2018) Coopetition in new product development alliances: advantages and tensions for incremental and radical innovation. Br J Manag 29(3):391–410. https://doi.org/10.1111/1467-8551.12213

Bush RE, Bale C, Powell M, Gouldson A, Taylor PG, Gale WF (2017) The role of intermediaries in low carbon transitions: empowering innovations to unlock district heating in the UK. J Clean Prod 148:137–147. https://doi.org/10.1016/j.jclepro.2017.01.129

Cannavacciuolo L, Capaldo G, Rippa P (2015) Innovation processes in moderately innovative countries: the competencies of knowledge brokers. Int J Innov Sustain Dev 9(1):63–82
Castellani P, Rossato C, Giaretta E, Davide R (2021) Tacit knowledge sharing in knowledge-intensive firms: the perceptions of team members and team leaders. RMS 15(1):125–155. https://doi.org/10.1007/s11846-019-00368-x
Chen S-H, Lin W-T (2018) Analyzing determinants for promoting emerging technology through intermediaries by using a DANP-based MCDA framework. Technol Forecast Soc Chang 131:94–110. https://doi.org/10.1016/j.techfore.2017.09.019
Chen S-H, Egbetokun AA, Chen D-K (2015) Brokering knowledge in networks: institutional intermediaries in the Taiwanese biopharmaceutical innovation system. Int J Technol Manag 69(3–4, SI):189–209. https://doi.org/10.1504/IJTM.2015.072978
Chichkanov N, Miles I, Belousova V (2019) Drivers for innovation in KIBS: evidence from Russia. Serv Ind J. https://doi.org/10.1080/02642069.2019.1570151
Comacchio A, Bonesso S, Pizzi C (2012) Boundary spanning between industry and university: the role of technology transfer centres. J Technol Transfer 37(6):943–966. https://doi.org/10.1007/s10961-011-9227-6
Conner KR, Prahalad CK (1996) A resource-based theory of the firm: knowledge versus opportunism. Organ Sci 7(5):477–501. https://doi.org/10.1287/orsc.7.5.477
Coppolino R, Abbate T (2012) Knowledge sharing and innovation: the contribution of innovation intermediaries. In: de Marco M, Te'eni D, Albano V, Za S (eds) Information systems: crossroads for organization, management, accounting and engineering. Physica-Verlag HD, Heidelberg, pp 251–258
Corvello V, Steiber A, Alänge S (2021) Antecedents, processes and outcomes of collaboration between corporates and start-ups. RMS. https://doi.org/10.1007/s11846-021-00510-8
Dalziel M, Parjanen S (2012) Measuring the impact of innovation intermediaries: a case study of Tekes. In: Melkas H, Harmaakorpi V (eds) Practice-based innovation: insights, applications and policy implications, vol 31. Springer. Berlin Heidelberg, Berlin, Heidelberg, pp 117–132
Dalziel M (2010) Why do innovation intermediaries exist? In: Paper presented that the DRUID Summer Conference, Imperial College London Business School, June16–18, 2010.
de Silva M, Howells J, Meyer M (2018) Innovation intermediaries and collaboration: knowledge–based practices and internal value creation. Res Policy 47(1):70–87. https://doi.org/10.1016/j.respol.2017.09.011
Dziallas M, Blind K (2019) Innovation indicators throughout the innovation process: an extensive literature analysis. Technovation 80–81:3–29. https://doi.org/10.1016/j.technovation.2018.05.005
Elmquist M, Ollila S, Yström A (2016) Beyond intermediation: the open innovation arena as an actor enabling joint knowledge creation. Int J Technol Manage 72(4):273–295. https://doi.org/10.1504/IJTM.2016.081573
Endres H, Huesig S, Pesch R (2022) Digital innovation management for entrepreneurial ecosystems: services and functionalities as drivers of innovation management software adoption. RMS 16(1):135–156. https://doi.org/10.1007/s11846-021-00441-4
Fukugawa N (2018) Is the impact of incubator's ability on incubation performance contingent on technologies and life cycle stages of startups? Evidence from Japan. Int Entrep Manag J 14(2):457–478. https://doi.org/10.1007/s11365-017-0468-1
Gao Y, Hu Y (2017) The upgrade to hybrid incubators in China: a case study of Tuspark incubator. J Sci Technol Policy Manag 8(3):331–351
Garengo P (2019) How bridging organisations manage technology transfer in SMEs: an empirical investigation. Technol Anal Strateg Manag 31(4):477–491. https://doi.org/10.1080/09537325.2018.1520976
Gentles SJ, Charles C, Nicholas DB, Ploeg J, McKibbon KA (2016) Reviewing the research methods literature: principles and strategies illustrated by a systematic overview of sampling in qualitative research. Syst Rev 5(1):172. https://doi.org/10.1186/s13643-016-0343-0
Gök A, Waterworth A, Shapira P (2015) Use of web mining in studying innovation. Scientometrics 102:653–671. https://doi.org/10.1007/s11192-014-1434-0
Gredel D, Kramer M, Bend B (2012) Patent-based investment funds as innovation intermediaries for SMEs: in-depth analysis of reciprocal interactions, motives and fallacies. Technovation 32(9–10):536–549. https://doi.org/10.1016/j.technovation.2011.09.008
Grupp H, Schubert T (2010) Review and new evidence on composite innovation indicators for evaluating national performance. Res Policy 39(1):67–78. https://doi.org/10.1016/j.respol.2009.10.002

Han S, Su J, Lyu Y, Liu Q (2022) How do business incubators govern incubation relationships with different new ventures? Technovation 116:102486. https://doi.org/10.1016/j.technovation.2022.102486

Hayter CS (2016) A trajectory of early-stage spinoff success: the role of knowledge intermediaries within an entrepreneurial university ecosystem. Small Bus Econ 47(3):633–656. https://doi.org/10.1007/s11187-016-9756-3

Hoogstraaten MJ, Frenken K, Boon WP (2020) The study of institutional entrepreneurship and its implications for transition studies. Environ Innov Soc Trans 36:114–136. https://doi.org/10.1016/j.eist.2020.05.004

Howells J (2006) Intermediation and the role of intermediaries in innovation. Res Policy 35(5):715–728. https://doi.org/10.1016/j.respol.2006.03.005

Howells J, Bessant J (2012) Introduction: Innovation and economic geography: a review and analysis. J Econ Geogr 12(5):929–942. https://doi.org/10.1093/jeg/lbs029

Hsieh H-N, Chen C-M, Wang J-Y, Hu T-S (2015) Knowledge-intensive business services as knowledge intermediaries in industrial regions: a comparison of the Hsinchu and Tainan Metropolitan Areas. Eur Plan Stud 23(11):2253–2274. https://doi.org/10.1080/09654313.2014.958133

Huyghe A, Knockaert M, Wright M, Piva E (2014) Technology transfer offices as boundary spanners in the pre-spin-off process: the case of a hybrid model. Small Bus Econ 43(2):289–307. https://doi.org/10.1007/s11187-013-9537-1

Janger J, Schubert T, Andries P, Rammer C, Hoskens M (2017) The EU 2020 innovation indicator: a step forward in measuring innovation outputs and outcomes? Res Policy 46(1):30–42. https://doi.org/10.1016/j.respol.2016.10.001

Jarchow S, Röhm A (2019) Patent-based investment funds: from invention to innovation. J Technol Transf 44(2):404–433. https://doi.org/10.1007/s10961-018-9691-3

Kanda W, Hjelm O, Clausen J, Bienkowska D (2018) Roles of intermediaries in supporting eco-innovation. J Clean Prod 205:1006–1016

Kanda W, Río PD, Hjelm O, Bienkowska D (2019) A technological innovation systems approach to analyse the roles of intermediaries in eco-innovation. J Clean Prod 227:1136–1148. https://doi.org/10.1016/j.jclepro.2019.04.230

Kant M, Kanda W (2019) Innovation intermediaries: What does it take to survive over time? J Clean Prod 229:911–930. https://doi.org/10.1016/j.jclepro.2019.04.213

Kim H-S, Choi S-Y (2014) Technological alliance portfolio configuration and firm performance. RMS 8(4):541–558. https://doi.org/10.1007/s11846-013-0117-1

Knockaert M, Spithoven A (2014) Under which conditions do technology intermediaries enhance firms' innovation speed? The case of Belgium's collective research centres. Reg Stud 48(8):1391–1403. https://doi.org/10.1080/00343404.2012.708405

Knockaert M, Spithoven A, Clarysse B (2014) The impact of technology intermediaries on firm cognitive capacity additionality. Technol Forecast Soc Chang 81:376–387. https://doi.org/10.1016/j.techfore.2013.05.007

Kolesnikov S, Woo S, Li Y, Shapira P, Youtie J (2019) Mapping the emergence of international university research ventures. J Technol Transfer 44(4):1134–1162. https://doi.org/10.1007/s10961-017-9640-6

Kollmann T, Stöckmann C, Niemand T, Hensellek S, de Cruppe K (2021) A configurational approach to entrepreneurial orientation and cooperation explaining product/service innovation in digital vs. non-digital startups. J Bus Res 125:508–519. https://doi.org/10.1016/j.jbusres.2019.09.041

Kulkov I, Hellström M, Wikström K (2021) Identifying the role of business accelerators in the developing business ecosystem: the life science sector. Eur J Innov Manag 24(4):1459–1479. https://doi.org/10.1108/EJIM-04-2020-0139

Landry R, Amara N, Cloutier J-S, Halilem N (2013) Technology transfer organizations: services and business models. Technovation 33(12):431–449. https://doi.org/10.1016/j.technovation.2013.09.008

Larty J, Jack S, Lockett N (2017) Building regions: A resource-based view of a policy-led knowledge exchange network. Reg Stud 51(7):994–1007. https://doi.org/10.1080/00343404.2016.1143093

Lee H-F, Miozzo M (2019) Which types of knowledge-intensive business services firms collaborate with universities for innovation? Res Policy 48(7):1633–1646. https://doi.org/10.1016/j.respol.2019.03.014

Li X, Gagliardi D, Miles I (2019) Innovation in R&D service firms: evidence from the UK. Technol Anal Strateg Manag 31(6):732–748. https://doi.org/10.1080/09537325.2018.1549729

Lichtenthaler U, Ernst H (2009) The role of champions in the external commercialization of knowledge. J Prod Innov Manag 26(4):371–387. https://doi.org/10.1111/j.1540-5885.2009.00666.x
Littell JH, Corcoran J, Pillai V (2008) Systematic reviews and meta-analysis. Oxford University Press
Markard J, Raven R, Truffer B (2012) Sustainability transitions: an emerging field of research and its prospects. Res Policy 41(6):955–967. https://doi.org/10.1016/j.respol.2012.02.013
Matschoss K, Heiskanen E (2017) Making it experimental in several ways: the work of intermediaries in raising the ambition level in local climate initiatives. J Clean Prod 169:85–93. https://doi.org/10.1016/j.jclepro.2017.03.037
Mele C, Russo-Spena T (2015) Innomediary agency and practices in shaping market innovation. Ind Mark Manag 44:42–53. https://doi.org/10.1016/j.indmarman.2014.10.006
Miller K, McAdam R, McAdam M (2018) A systematic literature review of university technology transfer from a quadruple helix perspective: toward a research agenda. R&D Manag 48(1):7–24. https://doi.org/10.1111/radm.12228
Minguillo D, Thelwall M (2012) Mapping the network structure of science parks: an exploratory study of cross-sectoral interactions reflected on the web. ASLIB Proc 64(4):332–357. https://doi.org/10.1108/00012531211244716
Moilanen H, Halla M, Alin P (2015) Openness in university-industry collaboration: probing managerial perceptions. Eur J Innov Manag 18(4):493–507. https://doi.org/10.1108/EJIM-05-2013-0048
Mossberg J, Söderholm P, Hellsmark H, Nordqvist S (2018) Crossing the biorefinery valley of death? Actor roles and networks in overcoming barriers to a sustainability transition. Environ Innov Soc Trans 27:83–101. https://doi.org/10.1016/j.eist.2017.10.008
Mueller EF, Jungwirth C (2016) What drives the effectiveness of industrial clusters? Exploring the impact of contextual, structural and functioning determinants. Entrep Reg Dev 28(5–6):424–447. https://doi.org/10.1080/08985626.2016.1186748
Nonaka I, Takeuchi H (1995) The knowledge-creating company: how Japanese companies create the dynamics of innovation. Oxford University Press, New York
O'Kane C (2018) Technology transfer executives' backwards integration: An examination of interactions between university technology transfer executives and principal investigators. Technovation 76–77:64–77. https://doi.org/10.1016/j.technovation.2016.08.001
OECD (2015) Frascati manual 2015.
OECD (2018) Oslo manual 2018.
Owen A, Mitchell G, Gouldson A (2014) Unseen influence: the role of low carbon retrofit advisers and installers in the adoption and use of domestic energy technology. Energy Policy 73:169–179. https://doi.org/10.1016/j.enpol.2014.06.013
Parjanen S, Melkas H, Uotila T (2011) Distances, knowledge brokerage and absorptive capacity in enhancing regional innovativeness: a qualitative case study of Lahti region Finland. Eur Plan Stud 19(6):921–948. https://doi.org/10.1080/09654313.2011.568804
Parker R, Hine D (2014) The role of knowledge intermediaries in developing firm learning capabilities. Eur Plan Stud 22(5):1048–1061. https://doi.org/10.1080/09654313.2012.758688
Paschou T, Rapaccini M, Adrodegari F, Saccani N (2020) Digital servitization in manufacturing: a systematic literature review and research agenda. Ind Mark Manag 89:278–292. https://doi.org/10.1016/j.indmarman.2020.02.012
Pina K, Tether BS (2016) Towards understanding variety in knowledge intensive business services by distinguishing their knowledge bases. Res Policy 45(2):401–413. https://doi.org/10.1016/j.respol.2015.10.005
Pino G, Capestro M, Guido G, Tomacelli C, Abate M (2016) Knowledge-intensive services and local development: an empirical analysis of networks, channels and customization processes. Local Econ 31(3):359–376. https://doi.org/10.1177/0269094216642750
Pinto H, Fernandez-Esquinas M, Uyarra E (2015) Universities and knowledge-intensive business services (KIBS) as sources of knowledge for innovative firms in peripheral regions. Reg Stud 49(11):1873–1891. https://doi.org/10.1080/00343404.2013.857396
Polzin F, von Flotow P, Klerkx L (2016) Addressing barriers to eco-innovation: exploring the finance mobilisation functions of institutional innovation intermediaries. Technol Forecast Soc Change 103:34–46. https://doi.org/10.1016/j.techfore.2015.10.001
Porto Gomez I, Otegi Olaso JR, Mikel Zabala-Iturriagagoitia J (2016) Trust builders as open Innovation intermediaries. Innov Manag Policy Pract 18(2):145–163. https://doi.org/10.1080/14479338.2016.1187574

Randhawa K, Josserand E, Schweitzer J, Logue D (2017) Knowledge collaboration between organizations and online communities: the role of open innovation intermediaries. J Knowl Manag 21(6):1293–1318. https://doi.org/10.1108/JKM-09-2016-0423

Readman J, Bessant J, Neely A, Twigg D (2018) Positioning UK research and technology organizations as outward-facing technology-bases. R D Manag 48(1):109–120. https://doi.org/10.1111/radm.12192

Rodríguez A, Nieto MJ, Santamaría L (2018) International collaboration and innovation in professional and technological knowledge-intensive services. Ind Innov 25(4):408–431. https://doi.org/10.1080/13662716.2017.1414752

Røpke I (2012) The unsustainable directionality of innovation: the example of the broadband transition. Res Policy 41(9):1631–1642. https://doi.org/10.1016/j.respol.2012.04.002

Roxas SA, Piroli G, Sorrentino M (2011) Efficiency and evaluation analysis of a network of technology transfer brokers. Technol Anal Strateg Manag 23(1, SI):7–24. https://doi.org/10.1080/09537325.2011.537085

Russo M, Caloffi A, Rossi F, Righi R (2019) Innovation intermediaries and performance-based incentives: a case study of regional innovation poles. Sci Public Policy 46(1):1–12. https://doi.org/10.1093/scipol/scy028

Sarvan F, Başer GG, Köksal CD, Durmuş E, Dirlik O, Atalay M, Almaz F (2012) Network-based determinants of innovation performance in yacht building clusters: findings of the SOBAG project. Procedia Soc Behav Sci 58:830–841. https://doi.org/10.1016/j.sbspro.2012.09.1061

Schaeffer V, Matt M (2016) Development of academic entrepreneurship in a non-mature context: the role of the university as a hub-organisation. Entrep Reg Dev 28(9–10):724–745. https://doi.org/10.1080/08985626.2016.1247915

Seebode D, Jeanrenaud S, Bessant J (2012) Managing innovation for sustainability. R&D Manag 42(3):195–206. https://doi.org/10.1111/j.1467-9310.2012.00678.x

Sengupta A, Ray AS (2017) Choice of structure, business model and portfolio: organizational models of knowledge transfer offices in British universities. Br J Manag 28(4, SI):687–710. https://doi.org/10.1111/1467-8551.12224

Shearmur R, Doloreux D (2019) KIBS as both innovators and knowledge intermediaries in the innovation process: intermediation as a contingent role. Pap Reg Sci 98(1):191. https://doi.org/10.1111/pirs.12354

Sinell A, Iffländer V, Muschner A (2018) Uncovering transfer: a cross-national comparative analysis. Eur J Innov Manag 21(1):70–95. https://doi.org/10.1108/EJIM-01-2017-0006

Smith A, Stirling A, Berkhout F (2005) The governance of sustainable socio-technical transitions. Res Policy 34(10):1491–1510. https://doi.org/10.1016/j.respol.2005.07.005

Soetanto DP (2006) Nurturing technology-based firms: the resources-based perspective in the incubation process. Int J Manag Enterpr Dev 3(6):534–547. https://doi.org/10.1504/IJMED.2006.010352

Stezano F (2018) The role of technology centers as intermediary organizations: facilitating links for innovation: four cases of federal technology centers in Mexico. Rev Policy Res 35(4):642–666. https://doi.org/10.1111/ropr.12293

Suppiah V, Singh Sandhu M (2011) Organisational culture's influence on tacit knowledge-sharing behaviour. J Knowl Manag 15(3):462–477. https://doi.org/10.1108/13673271111137439

Tether BS, Tajar A (2008) Beyond industry–university links: Sourcing knowledge for innovation from consultants, private research organisations and the public science-base. Res Policy 37(6):1079–1095

Thomas E, Vieira LM, Balestrin A (2017) Mind the gap: lessons from the UK to Brazil about the roles of TTOs throughout collaborative R&D projects. BAR Braz Adm Rev. https://doi.org/10.1590/1807-7692bar2017170048

Thune T, Mina A (2016) Hospitals as innovators in the health-care system: a literature review and research agenda. Res Policy 45(8):1545–1557. https://doi.org/10.1016/j.respol.2016.03.010

Thurner TW, Zaichenko S (2015) The feeding of the nine billion: a case for technology transfer in agriculture. Int J Innov Manag. https://doi.org/10.1142/S1363919615500267

Todeva E (2013) Governance of innovation and intermediation in triple helix interactions. Ind High Educ 27(4):263–278. https://doi.org/10.5367/ihe.2013.0161

Tödtling F, Trippl M (2005) One size fits all? Res Policy 34(8):1203–1219. https://doi.org/10.1016/j.respol.2005.01.018

Tran Y, Hsuan J, Mahnke V (2011) How do innovation intermediaries add value? Insight from new product development in fashion markets. R&D Manag 41(1):80–91. https://doi.org/10.1111/j.1467-9310.2010.00628.x

Tranfield D, Denyer D, Smart P (2003) Towards a methodology for developing evidence: informed management knowledge by means of systematic review. Br J Manag 14(3):207–222. https://doi.org/10.1111/1467-8551.00375

van Geenhuizen M (2018) A framework for the evaluation of living labs as boundary spanners in innovation. Environ Plan C Politics Space 36(7):1280–1298. https://doi.org/10.1177/2399654417753623

van Horne C, Dutot V (2017) Challenges in technology transfer: an actor perspective in a quadruple helix environment. J Technol Transf 42(2, SI):285–301. https://doi.org/10.1007/s10961-016-9503-6

Venkitachalam K, Busch P (2012) Tacit knowledge: review and possible research directions. J Knowl Manag 16(2):357–372. https://doi.org/10.1108/13673271211218915

Villani E, Rasmussen E, Grimaldi R (2017) How intermediary organizations facilitate university–industry technology transfer: a proximity approach. Technol Forecast Soc Change 114:86–102. https://doi.org/10.1016/j.techfore.2016.06.004

Villani E, Linder C, Lechner C, Muller L (2021) How do non-innovative firms start innovation and build legitimacy? The case of professional service firms. J Bus Res 137:614–625. https://doi.org/10.1016/j.jbusres.2021.08.062

Vivas C (2016) Commercializing technological research and skills: drivers from European technology institutes. Innov Organ Manag 18(3):389–410. https://doi.org/10.1080/14479338.2016.1219232

Weisenfeld U, Hauerwaas A (2018) Adopters build bridges: changing the institutional logic for more sustainable cities: from action to workset to practice. Res Policy 47(5):911–923. https://doi.org/10.1016/j.respol.2018.02.015

Yström A, Aspenberg H (2017) Open for innovation? Practices supporting collaboration in Swedish regional clusters. Int J Innov Manag. https://doi.org/10.1142/S1363919617400084

Zaichenko S (2018) The human resource dimension of science-based technology transfer: lessons from Russian RTOs and innovative enterprises. J Technol Transf 43(2):368–388. https://doi.org/10.1007/s10961-017-9567-y

Zeng S, Xie X, Tam C (2010) Evaluating innovation capabilities for science parks: a system model. Technol Econ Dev Econ 16(3):397–413. https://doi.org/10.3846/tede.2010.25