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THE COMBINATION OF LOCAL AND GLOBAL KNOWLEDGE IN CLUSTERING PROCESSES: THE ROLE OF PUBLIC-PRIVATE INTERACTION

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Abstract

This thesis investigates the “missing link” between knowledge flows dynamics and clustering processes in a public-private interaction perspective. These topics are deeply interrelated, and the relationship between clustering and knowledge has attracted significant scholarly attention. In spite of this, new trends and mechanisms have recently emerged and have brought up open questions that deserve further attention as the conditions, mechanisms, and effects of knowledge sharing are under-explored in the light of the challenges and opportunities of pervasive processes as globalization and digitization.

Therefore, responding to the recent calls for further research on both knowledge dynamics for business clusters and networks and public-private interaction mechanisms, this thesis aims to enhance our understanding of how knowledge flows influence and provoke changes in clustering processes. In particular, of the interaction processes for knowledge recombining within clusters, by taking a public-private interaction perspective. The Industrial Marketing and Purchasing (IMP) approach is adopted as theoretical and analytical framework to integrate different aspects of the key concepts under investigation. Adopting a business network perspective on clustering processes allows investigating interaction along the three dimensions of actors, activities, and resources.

This dissertation takes the form of a collection of papers and it is structured into five chapters. Chapter I introduces the topics and main objectives of the research, it outlines its structure, develops the theoretical framework, and describes methodological considerations. Chapter II presents a conceptual review paper on public-private interaction, aimed at providing a state-of-the-art through a systematic literature review of recent contributions on the topic in IMP research and an outline of possible future lines of investigations. Chapter III and Chapter IV relate to the two empirical investigations conducted. Chapter III introduces a qualitative case study on the diffusion of Industry 4.0-related knowledge in the context of the Italian industrial districts of Pesaro, aimed to examine the dissemination of I4.0 knowledge, exploring the main mechanisms for its spreading and highlighting the main factors shaping such processes. Chapter IV presents and discusses a case study on a Swedish formal cluster initiative in supporting small firms’ internationalization processes. By taking a public-private interaction perspective, it aims at providing an understanding of how international business knowledge is exchanged within an

internationalization project. The final chapter (Chapter V) summarizes the findings of the chapters and discusses them in relation to each other, and in relation to the overarching objectives of the dissertation. Conclusive remarks are outlined, as well as managerial and policy implications. Finally, limitations of the study are pointed out and an agenda for future research is suggested. Indeed, the peculiarities of knowledge flows, clustering processes, and public-private interaction are disentangled in a review chapter and two empirical analyses dealing with different aspects of this phenomenon.

The study of such complex interaction contributes to the literature on interrelated grounds: i) to the literature on districts and clusters, by presenting key drivers of renewals as emerging local learning processes and collective action; ii) to the IMP tradition, by extending the literature on networks and drawing attention to the multiplicity of networks in which clustering processes are embedded and how they affect and are affected by their development; iii) on knowledge flow dynamics, by showing how the complexity of knowledge has led to a re-evaluation and integration of knowledge sharing activities in the contexts of innovation and internationalization and by lifting out emerging collective intentionality.

Keywords: Knowledge, Clustering processes, Public-private interaction, Business networks, Innovation, Internationalization

Abstract (Italian)

Il presente studio indaga il collegamento tra le dinamiche dei flussi di conoscenza e i processi aggregativi in una prospettiva di interazione tra pubblico e privato. Questi temi sono profondamente interconnessi e la relazione tra fenomeni di cluster e flussi di conoscenza ha attirato un'attenzione significativa da parte degli studiosi. Ciononostante, di recente sono emerse nuove tendenze e nuovi meccanismi che hanno sollevato questioni aperte che meritano ulteriore attenzione. Infatti, alla luce delle opportunità e delle sfide di processi pervasivi come la globalizzazione e la digitalizzazione, le condizioni, i meccanismi e gli effetti della condivisione della conoscenza risultano essere ancora poco indagati.

Pertanto, in risposta ai recenti appelli di ulteriori ricerche sulle dinamiche della conoscenza per i cluster e le reti di imprese e sui meccanismi di interazione pubblico-privato, questa tesi mira a migliorare la nostra comprensione di come le dinamiche dei flussi di conoscenza influenzano e provocano cambiamenti nei processi aggregativi. In particolare, dei processi di interazione per la ricombinazione della conoscenza all'interno dei cluster, adottando una prospettiva di interazione pubblico-privato. L'approccio Industrial Marketing and Purchasing (IMP) è adottato come riferimento teorico e analitico per integrare diversi aspetti dei concetti chiave utilizzati. L'adozione di una prospettiva di rete sui processi di agglomerazione di impresa permette di indagare l'interazione lungo le tre dimensioni di attori, attività e risorse.

Questa tesi di dottorato si concretizza in una raccolta di articoli ed è strutturata in cinque capitoli. Il capitolo introduttivo (Capitolo I) presenta gli argomenti e gli obiettivi principali della ricerca, ne delinea la struttura, sviluppa il quadro teorico e approfondisce le considerazioni metodologiche alla base di questa tesi. Il capitolo II contiene un paper di review sull'interazione tra pubblico e privato, volto a fornire uno stato dell'arte attraverso una revisione sistematica della letteratura dei contributi sull'argomento in ambito IMP e delinea possibili linee di indagine future. Il Capitolo III e il Capitolo IV presentano le due indagini empiriche condotte. Il Capitolo III propone un caso studio qualitativo sulla diffusione delle conoscenze legate all'Industria 4.0 nel contesto del distretto industriale di Pesaro, con l’obiettivo di esplorare ed esaminare i principali meccanismi per la loro diffusione ed evidenziando i principali fattori che danno forma a tali processi. Il capitolo IV presenta e discute un caso studio di un’iniziativa di cluster formale

svedese a sostegno dei processi di internazionalizzazione delle piccole imprese. Adottando una prospettiva di interazione pubblico-privata, esso mira a fornire una comprensione di come la conoscenza relativa ai processi di internazionalizzazione viene creata e condivisa nel contesto di un progetto. Il capitolo conclusivo riassume i risultati dei capitoli e li discute in relazione tra loro e in relazione agli obiettivi generali della tesi. Vengono proposte delle riflessioni conclusive sui risultati dello studio e delle implicazioni di carattere manageriale e di policy. Infine, vengono evidenziate le limitazioni dello studio e possibili sviluppi futuri. Riassumendo, le peculiarità dei flussi di conoscenza, dei processi di clustering e dell'interazione pubblico-privato sono sviluppate e analizzate in un capitolo di revisione e in due analisi empiriche che trattano diversi aspetti di questo fenomeno.

Lo studio di tali interazioni contribuisce alla letteratura su basi interconnesse: i) alla letteratura sui distretti e sui cluster industriali, presentando i principali motori alla base del loro rinnovamento, come i processi emergenti di apprendimento e le azioni collettive; ii) alla tradizione IMP, estendendo la letteratura sulle reti e richiamando l'attenzione sulla molteplicità di reti in cui i processi aggregativi sono inseriti e su come influenzano e sono influenzati dal loro sviluppo; iii) sulle dinamiche dei flussi di conoscenza, mostrando come la crescente complessità della conoscenza abbia portato a una rivalutazione e integrazione delle attività di condivisione della conoscenza nei contesti dell'innovazione e dell'internazionalizzazione e sollevando il concetto di intenzionalità collettiva emergente.

Parole chiave: Conoscenza, processi aggregativi, interazione pubblico-privato, innovazione, internazionalizzazione

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Chapter I

Introduction

Clustering and knowledge have been at the core of the policy and institutional discourse for a long time and have been in focus in the academic research in different research streams (Brenner, 2007; Martin and Sunley, 2003; Rebolledo and Nollet, 2011; Speldekamp et al., 2020; Tödtling et al., 2006).

On the one hand, clustering processes have been described as *"one of our times' politically most wanted economic phenomena, expressed in policy guidelines on local, national, regional and transnational levels"* (Waluszewski and Wagrell, 2013: 1), and clustering has become a "benchmark" for academics studying the economic change through analyses at the territorial level (Sforzi, 2015). On the other hand, knowledge has become quantitatively and qualitatively more critical, as the stock of knowledge on which the economic activity is based today plays an important role (Brenner, 2007).

These two topics are deeply interrelated, and research has highlighted the importance of turning our attention to knowledge sharing within clustering processes. Indeed, knowledge sharing is crucial for the understanding of clustering preconditions, functioning, and outcomes. The relationship between clustering processes and knowledge flows has attracted a significant amount of research (Bathelt et al., 2004; Malmberg and Power, 2005; Dahl and Pedersen, 2004). Due clustering advantages, the extent of re- and multiple combinations of knowledge seems to be more pronounced in industrial clusters than in non-localized inter-firm networks (Sammarra and Biggiero, 2008).

One might wonder what remains to be discovered in the relationship between clustering and knowledge. Indeed, these topics seem to have been widely investigated from different perspectives, and the literature on these phenomena appears to be high-saturated (Leick and Gretzinger, 2020).

To answer this question, first, we need to acknowledge the recent emergence of new trends and mechanisms in the dynamics of knowledge flows in firms' agglomerations, which have brought up open questions that deserve further attention as the conditions, mechanisms, and effects of knowledge sharing are under-explored in the light of the challenges and

opportunities of pervasive processes such as globalization and digitization (Halse, 2020; Lazzeretti et al., 2019). Second, we need to introduce the third focus of this study – with the first two being clustering processes and knowledge – that is, public-private interaction. An essential role in the patterns of change and increased complexity is played by the interaction between public and private actors within clustering processes. Public-private interaction is an increasing trend of contemporary society (Waluszewski et al., 2019) and it involves further interaction with an increasing number of actors, thanks to the synergies and to the cross-fertilization processes it implies (Crespin-Mazet et al., 2013).

Starting from these assumptions, the focus of the study is on the interactive aspect of knowledge exchange in clustering processes. In particular, this research accounts for the importance of the geographic space as a catalyst for relationships and not just as physical infrastructure (Schillaci and Gatti, 2011). By taking a public-private interaction perspective, based on the phenomenon-driven Industrial Marketing and Purchasing approach (hereafter IMP), it aims to provide an understanding of how knowledge flows influence and provoke changes in clustering processes. The study's contribution is to address a "missing link" and enhance scholarly and practitioner understanding of the interaction processes for knowledge recombining in clusters in a public-private interaction perspective.

The importance of knowledge flows for clustering processes is an element that is essential but still far from clear in cluster research. The interest in such topics is also shown by recent calls for papers on both knowledge dynamics for business clusters and networks contexts in the *Journal of Innovation Economics & Management* (Leick and Gretzinger, 2020) and public-private interaction mechanisms in the *Journal of Business & Industrial Marketing* (Kronlid and Baraldi, 2020).

The first point identified above, and that we will look into, concerns the new dynamics of knowledge in firms' agglomerations. Although clusters and districts have remained a focus of the economic debate both at the national and supranational level, empirical evidence shows that they are suffering from external factors, such as the pressure of globalization, shaped by the emergence of aggressive international competitors in low-cost countries, by the rising complexity of technology and knowledge, and the increasing organization of production. The rapid rise of globally fragmented production has increased competition and provided alternative sources of inputs and technology, encouraging regions to specialize in narrow slices of the value chain (Murphree et al., 2020). At the same time, evidence shows structural changes, as clusters

and districts are nowadays remarkably different organizational systems, following different trajectories within this rapidly changing context. We are witnessing the fading of the so-called "district effect", a tendency towards increasing heterogeneity within and between clusters, new strategies of internationalization, innovation, and access to external knowledge (Foresti et al., 2009; Iuzzolino, 2008; Milanesi et al., 2016). As firms struggle to cope with an increasingly turbulent economic environment, there is widespread and long-standing recognition that knowledge has become the most strategic component of firms' resources (Grant, 1996). The complexity of modern technologies goes beyond companies' capabilities and makes it essential to manage knowledge beyond a firm's boundaries (Rebolledo and Nollet, 2011).

Changes also concern knowledge flows within clusters and districts. There is a shift from the traditional view of districts as labs for localized learning and tacit knowledge towards globalized systems, highlighting the importance of internationally developed knowledge and competences and of combining and linking distant learning with the concept of absorptive capacity. We can talk about a dual local/global logic of localization and knowledge flows around nodes of firms interconnected by a global framework (Belussi and Sedita, 2012; Mitchell et al., 2014). From a dynamic perspective, the mix of local and non-local knowledge sources has been deemed essential for cluster development. Local since knowledge, relationships, and interaction are exchanged in a specific place and environment; global as there has been an increase in codified knowledge, and even tacit knowledge has become progressively more explicit and transplantable (Nassimbeni, 2003). Indeed, the dichotomy between global and local knowledge represents a challenge to clusters and it is emphasized by higher complexity. Empirical evidence shows patterns of connections and knowledge acquisition, reflecting the dichotomy between external knowledge and locally embedded one (Mitchell et al., 2014).

The local/global dimension is not a new one in itself, nor is the role of institutions for clustering. Indeed, today's complexity of markets and technologies – especially digital ones – gives rise to emerging public-private interaction modes for accessing new knowledge. Therefore, the complexity of knowledge flows raises the question of if and how these processes could overcome social dynamics and the role of localities (Lazzeretti et al., 2019).

This explains the recent calls for a better understanding of how cluster firms engage in knowledge exchanges (Alberti and Pizzurno, 2015; Speldekamp, 2020) and of the interplay of local and external knowledge-related exchanges (Maskell, 2014). Cooperative mechanisms and

collaborative patterns assume in this context new forms through interaction and interdependencies involving the public and the private sphere (Nissen et al., 2014; Xing et al., 2018).

To sum up, there are some main challenges at stake when researching clusters and knowledge. First, we are facing an increasing fragmentation both at the firm and at the institutional level. Fragmentation is apparent when we look at traditional cohesive districts, which now lack close relationships and display a lower degree of cooperation and sense of belonging, as well as when we account for more formal structures, whose temporary initiatives may involve firms interacting episodically but lacking integration and internal cohesion (Palmer et al., 2017; Dana and Winstone, 2008).

Second, knowledge flows, that is, specific technological and market knowledge, and transversal knowledge, driving innovation in clusters and industrial districts, are becoming increasingly complex. In recent years, technologies, which have tremendously improved how to store, transport, and transfer knowledge, have been developed (Brenner, 2007). However, it would be wrong to think that just technological knowledge is getting more complicated. The complexification of modern technologies increases the salience of non-technological knowledge, such as market and managerial knowledge (Sammarra and Biggiero, 2008).

Third, the issue of public-private interaction lacks a systematic investigation of the fine-grained mechanisms of interaction (Xing et al., 2018). As different studies have suggested, more research is needed to understand the development of public-private relationships and cooperation within clustering processes. Despite the variety of public actors, existing on different levels and assuming different roles in business networks, these have been comprehensively being categorized as political or institutional actors (i.e., Bengtson et al., 2009; Welch and Wilkinson, 2004), and they have been typically investigated as customers in public procurement projects (Mattsson and Andersson, 2019). Also, such investigations of public customer-private supplier interaction have often mirrored the classical seller-buyer relationship in business networks (Waluszewski et al., 2019).

In particular, fragmentation and knowledge complexity guide the emergence of a new push for cooperation, which, at the same time, points to a gap concerning the analysis of "collective" interaction. Cooperation and collective interaction cannot disregard the role of public actors, who interact not only with single firms but also with clusters and networks. Such collaborations, involving the public and the private side, have become of increasing concern in

practice and academic literature (Mattsson and Andersson, 2019) as they offer a pathway to tackle different challenges (Xing et al., 2018).

The interesting aspect is the collective dimension of activities, which directly impacts agglomeration vitality. Given the high complexity of firms' agglomerations, the collective dimension is neither automatic nor obvious. Co-location and geographic proximity do not explain in-depth cooperation and active forms of collective intentionality (Schillaci and Gatti, 2011). Therefore, the collective dimension can be qualified as the integration and co-evolution of the multiple and varied individualities (individuals, groups, organizations, institutions) and as an approach that orients individual behavior towards a systemic perspective (Schillaci and Gatti, 2011).

Within this context, the empirically-based IMP tradition could be deemed a useful and appropriate approach due to its phenomenon driven nature aimed to provide a picture of the business world, and, thanks to some critical dimensions investigated and developed, such as those of interaction, network dynamics, relationships, and embeddedness, it has the potential to generate original insights on the business landscape (Håkansson and Snehota, 2017b). In particular, it contributes and integrates knowledge on different aspects, such as clusters and space, public-private interaction, knowledge, and collective level of interaction, populated by several varied species engaged in economic exchange, creating an intricate web of interdependencies across time and space, across the borders of private businesses and public bodies (Håkansson and Waluszewski, 2020).

Thus, IMP could offer insights into the often-overlooked complexities interactions are embedded in, as organizations are part of a broader context of interdependent and interconnected actors, and it provides useful, flexible frameworks suitable to investigate the complexity of phenomena. The IMP approach's basic notions imply that businesses have to operate in a context of private and public entities as well as other societal actors (Elbe et al., 2018). The IMP approach traditionally investigates business and non-business relationships, and recent streams have started dealing with private-public interaction (among others, Kronlid and Baraldi, 2020; Munksgaard et al., 2017; Waluszewski et al., 2019).

In order to address the layers of complexity and the gaps concerning knowledge dynamics within clusters and public-private interaction, this dissertation presents a collection of papers that can be read as self-standing papers but that are also connected through a common thread. This means that, while each chapter accounts for a different configuration of these topics

and different units of analysis, the main idea behind the single outputs is that of disentangling the identified complexity concerning different clustering configurations, typologies of knowledge, and public-private interaction they imply.

The thesis is organized as follows. In the next sections of **Chapter I**, *"Introduction"*, the theoretical framework is developed, and the research design and methodology are described. **Chapter II**, "*Public-private interaction: a systematic literature review and implications for researching business networks"*, presents the first output of the dissertation, a conceptual review paper on public-private interaction, aimed at providing a state-of-the-art through a systematic literature review of recent contributions on the topic in IMP research and an outline of possible future lines of investigation on the issue. **Chapter III**, "*The dissemination mechanisms of Industry 4.0 in traditional industrial districts: evidence from Italy"*, relates to the first empirical paper enclosed in the dissertation and presents a qualitative case study on the diffusion of Industry 4.0-related knowledge in industrial districts. The paper aims to examine the dissemination of I4.0 knowledge, exploring the main mechanisms for its spreading and highlighting the main actors and factors shaping such processes. The application context is the Italian industrial district of Pesaro. **Chapter IV**, "*Formal clusters supporting small firms' internationalization: a case of public-private interaction"*, concerns the second empirical paper and presents and discusses a case study research on the role of a formal cluster initiative from Sweden in supporting small firms' internationalization processes. In particular, by taking a public-private interaction perspective, based on the IMP approach, it provides an understanding of how international business knowledge is exchanged within an internationalization project. To conclude, **Chapter V**, *"Concluding discussion and remarks"*, summarizes the findings and presents each paper's contributions to the thesis's overarching research objective. Following, key reasonings and contributions of the research on a theoretical and empirical level are presented. Finally, both managerial and policy implications are outlined, limitations are pointed out, and an agenda for future research is suggested. Some of the chapters of this dissertation are extended adaptations of early versions presented at international conferences or published in peer-reviewed papers.

The topics of clustering processes, knowledge flows, and public-private interaction are thus disentangled in different ways. Chapter I and Chapter II set the theoretical framework. In particular, Chapter I tries to reconcile the existing view on clustering processes and knowledge

dynamics coming from different literature streams, Chapter II goes more in-depth on the topic of public-private interaction, which has been explored to date empirically, but which lacked a systematic conceptualization. In the empirical part of this dissertation (Chapter III and Chapter IV), in terms of clustering processes, the contexts accounted for are that of a spontaneous Italian industrial district active in a traditional sector (Chapter III) and a Swedish formal cluster initiative (Chapter IV). Different typologies of knowledge are investigated: industry 4.0-related knowledge and internationalization knowledge (including market and product knowledge). Examining the underlying dimensions of different typologies of knowledge helps unravel relationships, the actors involved, knowledge creation, and sharing dynamics and gives a fuller picture of knowledge mechanisms dynamics. Lastly, concerning public-private interaction, the interaction with the public side is accounted for at different levels. The first empirical paper accounts for interaction with regional governments, universities, cluster initiatives, network alliances, and hybrid actors acting as knowledge brokers; the second empirical paper accounts for the interaction between microenterprises and the formal cluster initiatives (together with the business incubator and science park) and provides insights on the interaction among public actors within a single project. Disentangling each focus helps to gain a suitable spectrum of the different settings concerning clustering processes, knowledge-related activities, and public-private interaction mechanisms.

To sum up, Chapter I and Chapter V set up the framework in which the conceptual and empirical chapters are embedded and reconcile the individual outputs in order to address the main objective of the thesis. Within this framework, Chapters II, III, and IV represent the core of the thesis. See Figure 1 for a summary of the thesis' outputs.

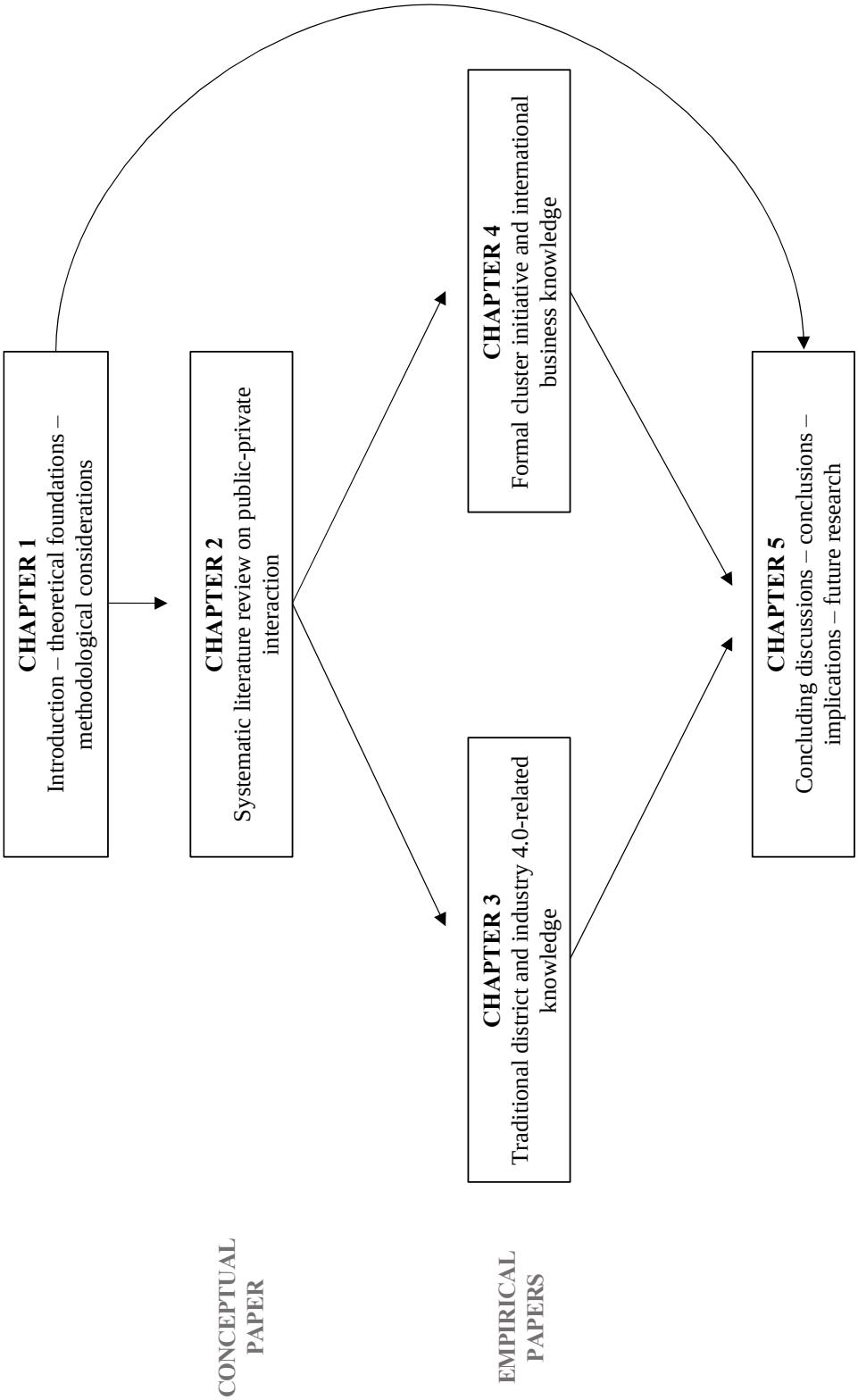

Figure 1 *Summary of the outputs of the thesis*

1. Theoretical orientation and background

This section of the first chapter presents an overview and discussion of the theoretical foundation of the dissertation. Here the fundamental ideas of the theoretical perspectives applied in this research project and the analytical framework of analysis are discussed. First, the idea of cluster is introduced and integrated with the concept of knowledge. Second, since an interactive perspective is critical for understanding such key phenomena, IMP concepts and framework, including interaction – in particular, public-private interaction –, place, and the ARA model are presented.

1.1. Broadening our understanding of clustering processes

Literature deems the phenomena of clusters, industrial districts, clustering, and networking processes as relevant for economic and industrial development in regions and nations, and they have enjoyed enormous success over the years, becoming central in the action programs of policymakers and institutions at different levels (Cumbers and MacKinnon, 2013; De Marchi et al., 2017; Waluszewski, 2004).

The literature on industrial districts and clusters is broad, and there are many definitions[1] and theoretical perspectives provided by numerous scholars in various disciplines and research streams attempting to disentangle the fundamental reasons behind the geographical concentration of economic activities, to develop the concept, its features, and evolution, giving rise to a flourishing debate (Belussi and Sedita, 2012; Camuffo and Grandinetti, 2011; Fornahl et al., 2015; Lazzeretti et al., 2014; Malmberg and Maskell, 2002; Pietrobelli and Rabellotti, 2004).

[1] Various conceptual distinctions have been made primarily between the two terms of "clusters" and "industrial districts". Despite their common roots and having in common a high geographical concentration and specialization of firms, coupled with strong productive complementarities, industrial districts have a homogeneous system of values and are strongly influenced by the social dimension (Zucchella, 2006). Also, industrial districts have been used in the literature as a heuristic tool, with the district as the unit of analysis, while clusters were key in trying to understand individual firms' competitive advantages. Thus, while both use the concept of place as the center of analysis, their aims, developments, and outcomes differ significantly (Ortega-Colomer et al., 2016). Another distinction concerns clusters and cluster initiatives: while the former comprise geographical agglomerations and inter-firm, inter-organizational networks, the latter can be considered as entities enhancing joint activities and collaborations and playing an intermediary role aimed at revitalizing business and regions (Laur, 2015).

The first and most influential seminal works are those by Marshall (1920), Becattini (1990), and Porter (1998), which have motivated a large number of scholars to give attention to agglomerations of interconnected companies and institutions in a particular field and located near to each other. This kind of business organization model has been identified as crucial in explaining competitiveness, regional development, growth, and innovation strategies (Enright, 2003; Karlsson, 2008; Trippl et al., 2015).

The most commonly referred to definition when studying industrial clusters is the one developed by Porter. He defines clusters as "*geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standards agencies, trade associations) in a particular field that compete but also cooperate"* (Porter, 1998: 197), as well as "*forms of networks that occurs within a geographic location, in which proximity of firms ensures a certain form of commonality and increases the frequency and impact of interactions*" (Porter, 1998: 226). His work provided the main and basic conceptual framework of clusters and legitimized its use in the policy arena (Ortega-Colomer et al., 2016). The main advantages deriving from clusters are a common labor market of specialist skills, access to specialized suppliers, and access to knowledge and information (Lis, 2019).

Also, other researchers elaborated further on this definition, describing clusters as groups of firms from the same industry, based in the same place and related by knowledge, skills, inputs, demand, and or other linkages (Delgado et al., 2016; Prevezer and Swann, 1996); as concentrations of firms that, given their geographical proximity and interdependence, produce synergies (Rosenfeld, 1997); as spatial and sectoral concentrations of firms (Bresnahan et al., 2001). The resulting concept of clusters has been interpreted as self-reinforcing networks of different actors and organizations, such as universities and research institutes, governmental agencies, and so on, linked to great competition and collaboration (Raines, 2001).

The literature on districts and clusters has focused on different features of the phenomenon. It has been argued that clusters dynamics and development patterns are determined by the interdependence of different elements, including the local actors traditionally involved in clusters and social and organizational factors leading to formal and informal contacts (Fornahl et al., 2015; Maskell, 2014). While informal ties between individuals are linked to emergent structures of interaction, deliberate structures result from ties between firms

and institutions at the meso-level. Studies have emphasized how local dynamics are less spontaneous and more interwoven with formal mechanisms (Belussi and Sedita, 2012).

Other studies have accounted for the different configurations that clusters may take depending on the business relationships and spatial context they are embedded in (Guerrieri and Pietrobelli, 2001; Markusen, 1996; Porter and Ketels, 2009), that is, Marshallian districts, hub-and-spoke, satellite platform, state-anchored forms. Cluster-based initiatives are also becoming increasingly prevalent in national and regional economic policies (Calignano et al., 2018; Obadić, 2013), and we are witnessing the emergence of formal clusters, which are defined as *"geographic concentrations of actors characterized by formal governance structures and the formal membership of firms and other institutions"* (Colovic and Lamotte, 2014: 451) and as *"an organized business association, geographically and sectorally concentrated"* (Dana and Winstone, 2008: 2178).

It has been argued that cluster dynamics and development patterns are determined by the interdependence of different elements, such as actors, networks, and institutions (Fornahl et al., 2015). Especially, state-level institutions are deemed important in the emergence of clusters, development, and change (Avnimelech and Teubal, 2006; Maskell and Malmberg, 2007; Staber and Sautter, 2011). Indeed, establishing public program support may represent a prerequisite for the emergence of the cluster, and regional institutions may develop together with the cluster to support it (Martin and Coenen, 2015). For example, one possible outcome of *ad hoc* cluster policies, implemented through formal cluster organizations, is the development of a "self-sustaining" network (Calignano et al., 2018).

The importance of understanding the different dynamics connected to the cluster's evolution lies in the development and activation of policies to govern them in the different stages of their life (Belussi and Sedita, 2009; Fornahl et al., 2015; Hervas-Oliver and Albors-Garrigos, 2014). Evolutionary patterns have attracted many scholars' interest, who have contributed to the different phases of the cluster's lifecycle, concerning the emergence, decline, renewal of clusters (Fornahl et al., 2015; Trippl et al., 2015).

Central to the body of literature on clusters are the theoretical developments based on the assumption that clusters' features help firms exchange, acquire and generate new knowledge and promote local learning mechanisms (Belussi and Pilotti, 2002; Malmberg and Power, 2005).

Before getting into the dynamics of knowledge within clustering processes, it could be useful to operationalize and define the boundaries of the concept of knowledge in relation to the cluster approach. Literature defines knowledge as an abstract concept, which relies on the interpretation of a set of information acquired through a direct or indirect experience (Albino et al., 1998). Although knowledge is formed by information, it differs from information as it is associated with meaning by an interpretation process and defines skills and competences. Literature also deals with knowledge as the main resource upon which competitive advantage is founded, and its within and between firm transfer is critical to innovate, respond to changes, achieve competitive success (Albino et al., 1998). In this sense, the transfer of knowledge can be conceptualized as the combination of information and interpretative systems; that is, it can be understood as a communication process involving information, which becomes knowledge through a learning and interpretation process, which largely depends on the combination with existing knowledge (Albino et al., 1998; Belussi and Pilotti, 2002).

Starting from this, the knowledge dimension has been utilized to explain the competitiveness and innovation of firms located in clusters. As knowledge creation, transfer and spillovers become essential for firms' competitiveness, firms embedded in the right environment are considered to learn faster and become more innovative and competitive than their counterparts. Thanks to knowledge spillovers rooted in agglomeration, firms gain key knowledge to nurture their activities and support positive economic outcomes.

Besides, the innovation literature points out the importance of knowledge exchange in fostering innovation processes, shaping the evolution and upgrading of both clusters and cluster firms (Tallman et al., 2004). Given the concept of clusters and their characteristics, they are expected to provide a particularly enabling environment for firms to raise their innovation capacity and, thus, we argue for their nature of cognitive labs, allowing accumulation, elaboration, and circulation of technological, market, and managerial knowledge by different actors through various mechanisms (Alberti and Pizzurno, 2015; Becattini and Rullani, 1996; Camuffo and Grandinetti, 2011; Grandinetti, 2011; Maskell, 2001; Sammarra and Biggiero, 2008).

In particular, the main mechanisms for learning and knowledge diffusion within clustering processes include relationships between customers and suppliers; formal and informal collaborations and other links between firms; inter-firm mobility of workers; the spin-

off of new firms from existing firms, universities, and public sector research laboratories; imitation and emulation mechanisms (Muzzi and Kautz, 2004).

Some studies point out the importance of spatial proximity, thanks to which firms within clusters benefit from explicit and tacit knowledge sharing processes, bringing to growth and innovation. These indicate proximity as the dimension allowing access to a common knowledge base, which is considered the major factor that provides competitive advantages to clustered firms. In general, the major focus is on how clustering and spatial proximity enhance knowledge creation through interactive learning and innovation processes (Malmberg and Maskell, 2002).

The most referred to concepts when talking about knowledge and learning within clusters are "local buzz" and "global pipelines", which rely respectively on the tacit and codified nature of knowledge. The former refers to "*the learning processes taking place among actors embedded in a community by just being there*", whereas the latter concerns "*the knowledge attained by investing in building channels of communications to selected providers located outside the local milieu*" (Bathelt et al., 2004: 31). Externally sourced knowledge through pipelines is typically codified and technical, while intra-cluster knowledge flows are allowed through the local buzz through workplace experiments (Mitchell et al., 2014).

However, it could be argued that such a framework needs to be complemented and integrated with a wider variety of knowledge (Belussi and Sedita, 2012). In this sense, recent studies have shown the increasing diversity and complexity of learning mechanisms and processes, which rely on a mix of emergent (informal) and deliberate (formal) knowledge structures, implemented locally and/or in connection with actors outside the clusters (Belussi and Sedita, 2012).

Another way of addressing knowledge processes is by focusing on technological, market, and managerial knowledge (Sammarra and Biggiero, 2008). Also, studies of Tödtling and Trippl (2005) distinguish between analytical and synthetic knowledge bases, with analytical knowledge relying on scientific inputs and codified knowledge, and synthetic knowledge dominating traditional industries and characterized by the combination of existing knowledge and low levels of R&D (Tödtling et al., 2006).

Learning processes, knowledge, and innovation capabilities are also highly influenced by the existence of a shared identity within clusters (Staber, 2010; Staber and Sautter, 2011). Shared identity – also described as collective, network, or cluster identity – is a process defined as "the shared understanding of the basic industrial, technological, social and institutional

features of a cluster" (Staber and Sautter, 2011: 1350), which is neither automatic nor monolithic, nor trust-based. The concept of shared identity does not simply refer to the sense of belonging of firms, but it is rather based on common anthropology and history (Castellani et al., 2017) and can be identified along different categories: claims, belief, aspirations, institutional arrangements (Tomenendal and Raffer, 2017). Shared identity can also be defined from the "outside" in terms of how firms communicate knowledge to external actors and attract new investment from the outside, how external actors define their commitment to them, and how dialogue-oriented policies refer to the cluster (Staber and Sautter, 2011). The shared identity transforms clusters and districts into a "choral" subject which acts in the forms of synergistic collaborations (Castellani et al., 2017). To preserve identity, clusters need to change without jeopardizing it, that is enduring its core features and establishing sub-identity adaptations to the changing environment. When actors translate shared identity into a collaborative activity they establish "shared identity projects", which allow them to know each other, collaborate, build up trust and perceive each other as potential partners for future work (Tomenendal and Raffer, 2017).

Important factors behind the context-dependence of interactive learning and innovation processes are found in shared identity, norms, and values of members, which promote close cooperation and exchange of knowledge (Halse, 2020). Shared identity is also important in influencing how actors perceive their interest in relationships with others in the community but also with external actors. In this sense, a strong shared identity can be a stabilizing mechanism within clusters and districts and a framework for action (Staber, 2010).

A further issue related to the equation of global and local knowledge concerns the actors belonging to the cluster and acting as "knowledge gatekeepers", meaning that they have the "*ability to access external knowledge and construct a conversion process which deciphers external knowledge and turns it into something locally understandable and useful*" (Hervas-Oliver and Albors-Garrigos, 2014: 431). Their role as brokers is concerned with searching for, absorbing, matching internal and external sources of knowledge, and then disseminating the resulting knowledge within the cluster (Boschma and Ter Wal, 2007; Giuliani and Bell, 2005; Hervas-Oliver and Albors-Garrigos, 2014; Morrison, 2008).

The role of gatekeepers assumes particular importance in the global/local knowledge equation as they facilitate the flow of such complementary types of knowledge (Mitchell et al., 2014). Such a role might be played by leading firms within the cluster and by institutions,

research centers, universities, business associations, and knowledge providers that operate as local/global cognitive interfaces (Belussi and Caloffi, 2018; Grandinetti, 2011; Morrison, 2008).

Finally, concepts such as social capital, value, the attitude of the social community, and the presence of institutions and public actors have traditionally been recognized. Social capital is a useful theory to understand how knowledge resource are accessed through relationships and by virtues of belonging to a network (Portes, 1998). The concept of social capital has been extensively utilized and described in different disciplines (i.e., economic sociology, social network theory) from the 1980s, starting with the work of Granovetter (1985) and Bourdieu (1986), among others. It has been defined by Bourdieu (1986: 248) as *"the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition"*. Later, authors have conceptualized it as *"the sum of the actual and potential resources embedded within, available through, and derived from, the network of relationships possessed by an individual or social unit"* (Nahapiet and Ghoshal, 1998: 243). In more recent times, Halpern (2005: 2) has argued that *"These everyday networks, including many of the social customs and bonds that define them and keep them together, are what we mean when we talk about social capital"*. The concept has been later applied in fields as economic geography to identify the social norms and customs facilitate the transfer of knowledge within spatially defined networks (Eklinder-Frick and Åge, 2017). Thus, social capital can be regarded as a resource facilitating knowledge dispersion between regional actors, which is at the basis of learning processes and, in turn, an important dynamic for innovation since it is facilitated by frequent, repeated informal contacts (Molina-Morales and Martínez-Fernández, 2010). Social capital is believed to play an important role in regional innovation and regional knowledge externalities (Fromhold-Eisebith, 2004). In recent times, there has been an effort from economic geographers (Huggins and Johnston, 2010) to engage with the concept of social capital by analysing social practices in relational networks, therefore including also a micro-level analysis of relational networks and individual actors as an analytical factor. Summing up, social capital largely relies on the regional circumstances enabling knowledge spillovers, with a recent shift and effort towards the relational network. The social dimension of interaction has also been in focus in IMP studies – see the next paragraph – where the social dimension is inherent to the model itself and which have not only drawn on social capital theory to explain social exchange.

Thus, these concepts have played a significant role in agglomeration processes. Some studies have identified networks of knowledge sharing supported by institutions and public actors, which are one of the main mechanisms for learning, knowledge exchange, and innovation diffusion within clusters (Malmberg and Maskell, 2002; Muzzi and Kautz, 2004). Notwithstanding this acknowledgment, the interaction patterns and dynamics between firms and public/institutional actors are changing due to the higher complexity of the object of the exchange process (Tosun et al., 2016).

In the next paragraphs, some criticisms addressed to the cluster approach, and geographical proximity will be addressed, based on the outcomes of IMP research. Preliminary considerations are made on how geographical proximity is not enough to understand innovation in local industrial networks (Alberti and Pizzurno, 2015), as it does not account for the importance of aspects such as networks, institutional, cognitive organizational, and social proximity, as well as absorptive capacity and heterogeneity of place-related features (Camuffo and Grandinetti, 2011; Cohen and Levinthal, 1990; Giuliani, 2005; Milanesi et al., 2016). Instead, local networks function as essential vehicles of knowledge diffusion (Grandinetti, 2011). Being in the right place is necessary, being in the right network is of utmost importance (Boschma and Ter Wal, 2007).

The basics of IMP studies are better discussed in the next paragraphs of this introductory chapter to understand the underlying interaction patterns and dynamics within clustering processes.

1.2. A business network perspective on clustering processes: introducing the IMP approach

The IMP phenomenon-driven tradition has historically challenged the prevailing microeconomic market view of the business world, proposing instead an interactive view of it, made of interconnected relationships between interdependent companies (Håkansson et al., 2009; Håkansson and Snehota, 2017b). The core mission of IMP research consists of fully understanding the features and working of the interactive business landscape (Håkansson et al., 2009), as existing economic and management research only offered limited explanations to it (Håkansson and Snehota, 2017b). The general starting point is that all organizations are

embedded in relationships and are consequently dependent on others in different contexts (Håkansson and Snehota, 1995; Halinen and Törnroos, 1998).

According to this interpretation, IMP thinking developed the idea of interaction (Ford and Håkansson, 2006) as the core process of the business landscape: *"The idea that business interaction between individually significant companies is a primary characteristic of the business landscape is a basic observation in IMP studies. The implication of this observation is that it is not what happens within companies but what happens between them that constitutes the nature of business"* (Håkansson et al., 2009: 27). Empirical IMP observations have led to the argument that actors, activities, and resources are shaped and transformed by interaction (Ford et al., 2010) and that "no business is an island" (Håkansson et al., 2009; Håkansson and Snehota, 2017a).

Capturing and researching business interaction implies looking at how relationships themselves affect each other and accounting for different features and challenges which have been highlighted by the IMP community, such as capturing the complex context in which interaction occurs (Håkansson, 1982; Abrahamsen et al., 2017), and the variety of forms that it may take (Håkansson and Waluszewski, 2013). Indeed, interaction does not take place within the boundaries of an external environment but in a web structure with no center and no defined boundaries (Håkansson and Snehota, 1995).

In this sense, the "rainforest metaphor" has been developed to highlight high complexity and to illustrate relatedness, motion, and variety (Håkansson et al., 2009), as it points at multiple relatednesses between artifacts, at continuous development and movement, and at great patterns' variety (Håkansson and Waluszewski, 2020). IMP covers the context-specific features and content of business exchanges, that is, its technological, social, organizational aspects and consequences for businesses, networks, and society (Håkansson and Waluszewski, 2020).

One of the most relevant frameworks for investigating the process and the interaction outcomes is the ARA model (Håkansson and Snehota, 1995). The model suggests that the content of a business relationship can be described in terms of three interrelated layers: activity links, resource ties, and actor bonds. The first layer relates to the interpersonal and inter-organizational links developed through interaction. It is important to characterize actors by accounting for economic, technological, organizational, and social aspects and to draw attention to the fact that actors engage in common problem-solving processes despite their different interests and aims. The second layer relates to the extent of tangible and intangible resource

adaptation and ties through interaction. Resources are heterogeneous, and interaction patterns influence their development, use, and combination. The last layer relates to activities and looks at the links between the activities of two actors having substantial economic effects on the actors. Activities are linked across company borders and are dependents on each other (Håkansson et al., 2009; Håkansson and Waluszewski, 2020). Interconnectedness among the three dimensions occurs as activities are performed by actors, who use resources, and what occurs in a specific relationship impacts not only the individual organization but also its relationships and the wider network.

Figure 2 summarizes the model for analyzing inter-organizational interaction by looking at three interconnected layers (Activities - Actors - Resources) and analytical levels (Company - Relationship - Network). This framework, which has been adopted throughout the present study, is not employed with the ambition to solve or simplify the complexity of knowledge dynamics within clustering processes and public-private interaction but rather to shed light on this complexity and to understand the implications arising.

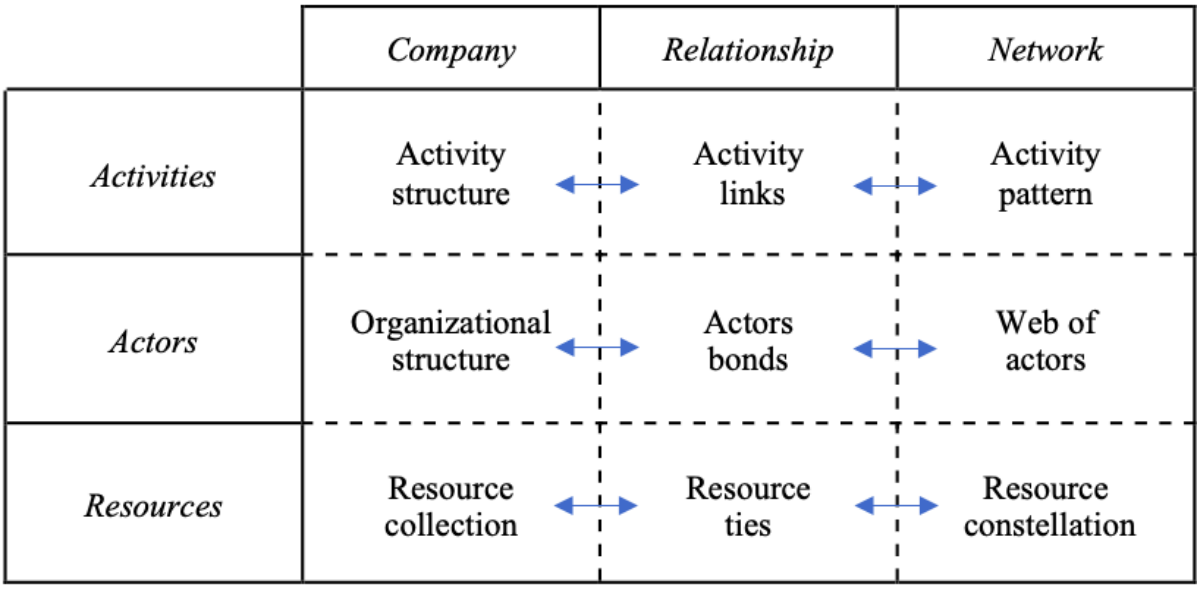

Figure 2 *ARA framework as represented in Håkansson and Snehota (1995)*

In early IMP contributions (Eklinder-Frick and Åge, 2017), space is conceived as hindering firms' operations and social exchange between actors (Håkansson, 1982). Since then, space and the geographical dimension of the interactive world have been in focus in different IMP studies within the regional development and innovation policy streams. Globalization has

accelerated the discourse around place, and, at the same time, it has highlighted the importance of place-related conditions to engage in different forms of industrial activities (Eklinder-Frick and Linné, 2017).

According to these studies, the geographical dimension where interactions take place is a factor that has effects on interaction and on the relationships initiated in a particular geographical context, which are *"unique, inimitable and affect the potential and attractiveness of the region where they are located"* (Correia and Brito, 2014: 697). Thus, there is a connection between the place and the actors embedded in it (Elbe et al., 2018). As a consequence, place can be considered both as the locus where resources, which are accessed through interaction, are located (Cantù, 2017) and as a resource itself as it is significant in the form of how resources are combined (Håkansson et al., 2006; Waluszewski, 2004). Using an IMP lens allows us to understand space as a resource and as a result of ongoing local companies' dynamics (Baraldi and Strömsten, 2006; Håkansson et al., 2006; Eklinder-Frick and Åge, 2017).

Also, research emphasizes places' relatedness across their boundaries, as firms-specific linkages have no boundaries (Eklinder-Frick and Linné, 2017). IMP adopts a different focus in considering industry agglomerations, compared to the cluster approach, as it takes into account a micro-perspective concerning how each organization uses place to develop and affect the attractiveness of the place (Håkansson et al., 2006; Eklinder-Frick and Åge, 2017). Here clusters and districts are understood as deriving from the interaction between specific companies' socio-material resources and not as the precondition for interaction.

Thus, the value-generating mechanism of agglomerations does not only rely on the circumstances under which the exchange occurs but rather on interaction. Districts and clusters are conceived as a tool to identify a set of interconnected actors, address specific industrial policies and financial support, and partially overcome issues related to network dynamics (Guercini and Tunisini, 2017). In this sense, they are defined as *"socio-economic constructs that help policymakers support the qualitative and quantitative development of well-defined business settings, thereby avoiding the problem of the blurred boundaries in the business network context"* (Guercini and Tunisini, 2017: 145).

However, while the cluster and district approaches rely on the so-called atmosphere of a certain place, the interactive approach is based on the idea that renewal depends on the specific interactions that take place even beyond the firm's network boundaries. For this reason, it is necessary to investigate interaction processes occurring between and within firms across time

and space. Thus, within the IMP approach, it is possible *"to investigate how the features of place are created by specific companies and their long-term resource interaction"* (Eklinder-Frick and Åge, 2017: 83).

Criticisms towards the traditional cluster approach moved by IMP studies build on the idea that connections and networks are unavoidable for organizations and, thus, a geographical network arises not only because of what is to be found in the geographical dimension (Waluszewski, 2004). The cluster approach assumes interaction as an exception (Håkansson and Waluszewski, 2020), as something triggered by spatial proximity, where actors are independent in networks and the indirect nature of their connections derives from the coopeting environment.

The context of exchange in a network-like structure that binds places together is disregarded in favor of a view that conceptualizes interaction as social exchange occurring outside the business one and between spatially closed businesses (Håkansson and Waluszewski, 2020; Waluszewski, 2004). The construct of geographical clusters does not account for some relevant dimensions, useful for understanding spatial economic activities, such as institutional thickness, which concerns formal and informal rules, norms, and practices (Eklinder-Frick and Linné, 2017).

A further difference brought about by the conceptual perspective upon which IMP relies concerns the concept of social capital already introduced above. It is indeed argued that the cluster geographic approach has *"neglected the actors-oriented and network-based conceptualizations of social capital"* (Eklinder-Frick et al., 2014). There have been few efforts within the IMP tradition to contribute to social capital[2] despite the different ontological grounds they rely on (see Mandják and Szántó, 2010; Eklinder-Frick and Åge, 2017; Bondeli et al., 2018). These studies focus on how interaction creates mutual values for actors, that is, the content of exchange taking place in ties and focusing on the mutual adaptation of resources, rather than the structural properties of ties. IMP studies understand social capital as a relational resource, which according to Eklinder-Frick et al. (2012: 805), *"can be called a two-sided coin"*, as it does not only imply advantages but also drawbacks, as over-embeddedness and lock-ins. In relation to the ARA framework, the social aspect of the three layers has been

[2] The existing literature on social capital is vast and still growing. Providing a comprehensive overview on the application of the concept of social capital within IMP is beyond the scope of this thesis, thus the aim is to operationalize the concept and define its boundaries for the purpose of this study. For an extensive review on how the concept deriving from economic sociology has been applied in business network studies see Raskovic (2015) and Bondeli et al. (2018).

emphasized by Bondeli et al. (2018), who, however, in line with previous studies, highlight how capital should be placed within the dimension of resource ties to make its resource and dynamic nature visible. Social capital in business relationships is continuously generated through a dynamic cyclical interplay with social connections and social practices integrated into the actor, activity, and resource dimensions (Bondeli et al., 2018). Moving from an analysis of the structural properties of ties towards the exchange that happens within the ties might contribute to the usefulness of the concept in innovation management, as the impact of social processes and resources can bring the analysis to a further level beyond technical and commercial resources (Eklinder-Frick et al., 2014).

On the concept of shared identity, studies in IMP have – to the best of my knowledge – neither addressed the idea of the existence of a "shared identity" nor have conceptualized it within the cluster concept. However, theoretical developments on the idea of identity represent a useful starting point to understand how to adapt identity in the context of clusters. IMP identifies identity attribution as a process (La Rocca and Snehota, 2016). Studies have proposed a combination of the "outside-in view" and "inside (or self)-out view" of the identity construction (Huemer, 2013). Indeed, in the business context, identity is defined by the partners' perception of it. Therefore it is mutually attributed and highly dependent on interaction behaviors, and can consequently be defined as relationship specific (La Rocca and Snehota, 2016). Identities seem to depend both on resources and competences related to the expected potential performance and on trustworthiness, understanding, mutuality, linked to the personality sphere. In line with the IMP spirit, interaction is critical in the formation of identities as it provides the input to the process of sensemaking and construction of meanings leading to the emergence of mutually attributed identity. Identity emerges in interaction and affect, in turn, relationships' development. Identities are also defined as unique since actors are embedded in a set of different relationships thus acquiring multiple identities that reflect the diversity of partners and the context. Thus, *"every business in a business network will have multiple identities because it always interacts with a multitude of actors"* (La Rocca and Snehota, 2016: 179). Huemer (2013) that, other than the network view, actors must also hold a certain degree of control over their own identity development. Therefore, in contrast with studies on clusters and shared identity, within IMP, the relation-specific local identities matter more than some overarching identity, whose use could lead to erroneous explanations and identification of factors underlying outcomes (La Rocca and Snehota, 2016). Deriving from IMP studies, we

can talk about multiple or "organizational identities in networks" (Huemer et al., 2009; Huemer, 2013), adding an explicit awareness of interactive identity constructions and connecting it both to the activity layer and to the actor dimension. In the context of clusters, the adoption of territory and community perspective on networks – emphasizing aspects as local companies and institutions, horizontal and reciprocal ties, with a network organization spanning from informal to engineered by policy – can be useful in understanding the development process of individual and collective identity (Eklinder-Frick et al., 2011).

IMP posits that relationships are crucial for knowledge creation, access and enactment, as this is contextually limited, tacit, and inherent to specific socio-technical resource combinations (Eklinder-Frick and Linné, 2017; La Rocca and Snehota, 2014). Starting from the idea presented in the seminal work of Penrose (1959[3]), it is possible to reflect on how the concept is perceived within the IMP context. Knowledge is here understood not as something merely cognitive and abstract but rather as a practical application, tied to its context, tacit, and as *"a system of connections that extend across different types of user-producer contexts"* (Eklinder-Frick and Åge, 2017: 86). The main boundaries of the concept are given by the idea of the context, which is perceived as the condition forming the enactment of knowledge, rather than a condition enabling knowledge dispersions (Eklinder-Frick, 2016). Knowledge should be understood as a process inseparable from the setting in which it is embedded and used – including actors, resources, and activities (Ståhl and Waluszewski, 2007). IMP proposes to enact knowledge and put it into practice to create value for the actors through joint projects, for example, to turn it into context-specific (Eklinder-Frick and Åge, 2017). Thus, knowledge dispersion is not enough to be enacted and create value, as knowledge cannot solely be disseminated through the act of being there and through the local buzz. Rather, it travels through the socio-material resource interactions within specific relationships to create value (Eklinder-Frick and Åge, 2017). The main contribution of IMP is, starting from existing theory, to expand the focus and consider resources, relationships with others and context (Ståhl and Waluszewski, 2007).

Based on the same argument, IMP studies advance that knowledge spillovers do not occur passively through competition and indirect connection in spatial proximity (Håkansson and Waluszewski, 2020). Instead, direct interaction triggers physical and intellectual resources

[3] Penrose's work (1959) is at the core of the resource-based view, which emphasizes the role of resources for the firm in gaining competitive advantages. The value of resources emerge when heterogeneous resources are combined.

encounter and recombination and thus creating new knowledge and value (Waluszewski, 2004). Also, more than being a way to learn and gain knowledge, interaction represents a way to actively learn, combine knowledge and create it (Håkansson and Ingemansson, 2011). In particular, *"Different typologies of interaction lead to different degrees and types of knowledge exchange"* (Håkansson and Ingemansson, 2011: 76), in order to have more extensive knowledge sharing and joint knowledge creation, networking and cooperation among multiple actors are needed. Relationships are the locus where knowledge is enacted, produced, and accessed (La Rocca and Snehota, 2014). Innovative solutions emerge from actors drawing on each other's experience-based tacit knowledge (Eklinder-Frick, 2016). Also learning processes are described as dynamic and impacting knowledge activation through the combination with existing knowledge in a specific context (Håkansson and Ingemansson, 2011).

IMP studies do not disregard the geographical dimension but rather account for its role in allowing the encounter between resources and the combination of properties belonging to different geographical networks (Waluszewski, 2004). Thus, IMP advances criticism to the cluster approach, but at the same time, it recognizes that such approach acknowledges space-related knowledge variations, that is, within spatial borders, heterogeneity in terms of knowledge on how to develop new resources is supported and gives competitive advantages to actors spatially proximate (Håkansson and Waluszewski, 2020).

Concerning knowledge creation processes within clusters, IMP argues for the context-specific dimension of knowledge and for how value is enacted when heterogeneous resources are combined in interaction (Eklinder-Frick, 2016). However, this idea differs from the disentangled view of knowledge on which policymakers have based their action; in fact, policy efforts have been mainly directed towards creating an arena for actors to interact and, consequently, to disseminate knowledge, without managing the new context and removing the process from the place-specific and time-specific context (Eklinder-Frick, 2016).

Thus, place has also penetrated contemporary policy, as policymakers act to manage the place dimension at different economic activity levels. However, their actions are based on a region-centric perspective. IMP pushes instead for adopting a firm-centric approach, where it is the interacting actors' resources that display, use, and combine place-related features (Eklinder-Frick and Linné, 2017). The idea that through interaction firms can access and take advantage of resources located elsewhere to achieve value benefits implies that both resources

and the place dimension itself are heterogeneous and relative (Håkansson et al., 2006). Resources are place-related as organizations are spatially dispersed but connected through interaction, through which actors develop knowledge about how to use each other's resources efficiently while producing value (Cantù, 2010). Place is thus conceived as *"an integrated and unquestionable aspect of the life of all companies […] every company will be based on a unique combination of place-related features"* (Håkansson et al., 2006: 242).

IMP observations give us insights into the features of place, which impact the geographical, technological, and social dimensions, and that can be described as heterogeneous in terms of local features and elusive in terms of borders. Furthermore, place cannot be isolated within a specific region, and it is not static but in flux and reconstructed over time depending on the dynamics and substance of interaction (Håkansson et al., 2009; Håkansson et al., 2006). The implications are that attention should be redirected towards micro-interaction processes, that is, focusing on the specific company and their relationships rather than on traits of a region or industry, to have positive outcomes for innovation and industrial development (Eklinder-Frick, 2016; Eklinder-Frick and Åge, 2017). The network context characterized by interdependencies and embeddedness goes beyond clear geographical boundaries and, in sum, IMP questions the purely geographical and regional setting approach (Guercini and Tunisini, 2017).

A lack of understanding of the heavy development processes and interactions taking place in business networks inevitably brings to the failure of the different efforts to promote cluster initiatives, such as policy-initiated projects (Rubach et al., 2017). According to the criticism moved by IMP studies, *"creating economically vigorous networks is neither about out-competing surrounding units nor about directing a structure in a particular dimension, but rather about keeping a rainforest-like process alive, in which actors with differing interests attempt complementary methods of creating value out of resources on which they are mutually dependent"* (Waluszewski, 2004: 12). In this sense, it is of utmost relevance to accounting for the historical patterns of organizations' unique combination of resources related to specific places (Waluszewski, 2004).

Table 1 summarizes how the fundamental concepts introduced in this chapter have been characterized in traditional studies on clusters and in studies adopting the IMP approach.

Concept in focus	Summary of the characteristics identified	
	Traditional cluster studies	*IMP approach*
Clustering and place	Clusters are seen as geographic concentrations of companies that cooperate and compete in the same sector and whose geographical proximity ensures collaboration and knowledge spillovers Interaction is triggered by spatial proximity The features of the cluster are at the basis of knowledge dynamics and learning mechanisms Place is understood as the sum of the characteristics (institutional, social, organizational) enabling collaboration among actors and leading to knowledge spillovers	Micro-perspective on industry agglomerations, which derive from the interaction between companies' socio-material resources, and it is not the precondition for interaction Place is the locus where resources are accessed by actor through interaction and a resource itself in the form of how resources are combined. Place is not static but it is the result of ongoing local companies' dynamics
Knowledge	Knowledge is an abstract concept whose creation derives from spillovers to which actors are subject since they are located in a particular geographical area Knowledge and learning are generally associated with the concepts of buzz and pipelines, which have been recently integrated with the conceptualization of formal and informal learning mechanisms	Knowledge is understood as a process tightly related to the context in which it is embedded – entangled view Knowledge travels through the socio-material resource interactions within relationships Knowledge is created by the encounter and combination of resources Relationships are the locus where knowledge is enacted, produced, and accessed
Social Capital	Social capital relies on the regional circumstances enabling knowledge spillovers and it can be regarded as the sum of resources facilitating knowledge sharing and learning processes	Actor-oriented and network-based conceptualization of social capital Social capital has a resource nature and it is consciously created through interaction IMP analyses what happens within the social ties rather than the structural properties of the ties in which social interaction occurs
Shared Identity	It is identified as a process leading to the shared understanding of the cluster's features Shared identity can be translated by actors into collaborative activities and it is important in influencing how actors perceive their interest in relationship with others in the community	Identity is the result of an interactive process of attribution Relationship-specific identities are more important than a shared overarching identity Each actor will develop multiple identity, reflecting the diversity of partners and context Aspects of the network related to the territory and the community can be useful in understanding the development processes of individual and collective identity

Table 1 *Fundamental concept's characterization*

A recent stream of the IMP literature has focused on a particular type of interaction, that is, public-private interaction. The issue will be in focus in Chapter II, which presents a state-of-the-art on the issue through a systematic literature review. Within IMP, the nodes of business networks are the different actors, which are typically business actors and also include stakeholders (Esse et al., 2012), policymakers (Shih, 2010), government-related actors, government agencies, expert groups, academic institutions (Hoholm and Araujo, 2017; Linné and Shih, 2013; Mandják et al., 2018; Shih and Linné, 2016), as well as social actors (Mandják et al., 2012) and NGOs (Mattsson, 2016).

Such actors have been increasingly acknowledged within IMP research as key actors in the evolution and development of business networks: *"All interactions among companies and organizations are part of larger contexts, with specific social, political and technological characteristics that influence and are influenced by business interaction. The social aspect of the context is central for the emergence and content of the supplier-customer interaction [...] this is closely related to the political aspect of the context which, through legislation, policy and standards have a great impact on the emergence and content of business interaction"* (Håkansson and Waluszewski, 2013: 449).

This kind of interaction is sometimes referred to in IMP studies as public-private partnerships, which is an umbrella term referring to diverse types of contract arrangements on costs and responsibility (Waluszewski et al., 2019), formed to fund, build, administer and sustain infrastructure, and it is sometimes applied also to understand collaborative relationships and institutional arrangements (Keränen, 2017). It has been argued that such actors should enter the network context (Guercini and Tunisini, 2017), thus representing another aspect of embeddedness since firms interact with other firms and governments to pursue their business and non-business goals (Hadjikhani and Thilenius, 2005). As stressed by Welch and Wilkinson (2004), in this increasingly globally interconnected world, relationships with these actors may also be critical and should be considered. The numerous relationships between firms and entities from the surrounding environment should also be taken into consideration by policy, as policymaking and its activation should be treated as a set of interactions, whose outcomes are the effects of multiple and heterogeneous relationships (Hoholm and Araujo, 2017; Waluszewski and Wagrell, 2013). Relationships' interconnectedness affects a company's outcome and potential development (Håkansson and Snehota, 1995). It also implies changes in

the resource and organizational interfaces of companies involved in the network, which affect innovation and other types of opportunities (Håkansson and Ford, 2002).

While it is true that such collaborations have a long history (Waluszewski et al., 2019), in recent times, digitalization and the innovative implementation of digital technology have stimulated a new wave of public-private interaction. In this sense, past and current studies on innovation have highlighted the important role played by public-private interaction (Mattsson and Andersson, 2019). Indeed, public actors have received much attention in recent years (Bondeli et al., 2020); however, they have typically been investigated as customers in public procurement projects (i.e., Mattsson and Andersson, 2019), and the public sector has undergone various changes, as the privatization and outsourcing of whole units in many countries. On top of that, the variety of public actors existing on different levels and assuming different roles in business networks have been comprehensively categorized as political or institutional actors (i.e., Bengtson et al., 2009; Welch and Wilkinson, 2004).

Thus, starting from the idea that new forms of public-private interaction deserve to be explored in-depth, a literature review has been conducted, as increased complexity calls for intensified cooperation between private and public actors, and the ability to operate in networks has been noticed to be essential both for companies and for public actors (Keast et al., 2004), to achieve the potential advantages deriving from network and complexity. However, the analysis and understanding of these interaction features are highly challenging given its non-linear trends, the little regularity characterizing relationships, and because both private and public actors are continuously challenged to develop and combine existing elements with new ones. This kind of interaction also implies complex consequences deriving from interaction interfaces, which are difficult to outline and expect in advance (Ingemansson Havenvid et al., 2016; Olsen and Håkansson, 2017; Perna et al., 2015).

Latest studies (Mattsson and Andersson, 2019; Wagrell and Baraldi, 2019) attempt at "classifying" the roles that public actors may assume in the interaction with start-ups. Notably, the authors identify key roles, like that of development partners, since the public actor is a source of scientific knowledge and could contribute to the development of general knowledge or be directly involved in testing and developing its products and solutions. They turn to public actors as financiers, since especially innovative and high-tech solutions are publicly supported, and as customers. Also, a study by Guercini and Tunisini (2017) on the role of regional

development policies identifies relevant tools and corresponding roles that the public actors can use and assume, i.e., rules setter, influencer, investor, moral persuader, non-governance role.

Studies also consider the dark side of such interactions, which have sometimes been criticized as they lack transparency and do not meet expectations (Keränen, 2017). According to these studies, there are tensions and challenges brought up by the high degree of complexity of such relationships that cannot be overlooked (Mattsson and Andersson, 2019; Munksgaard et al., 2017). These emerge because of structural and behavioral barriers and tend to shift over time (Keränen, 2017; Mattsson and Andersson, 2019). Tensions also arise because of the expectations that the public side has that the private one is autonomous and able to deliver innovation, quality, and cost control because they are exposed to competitive forces (Waluszewski et al., 2019).

In recent times, a new stream on industry-university interaction has emerged (Kronlid and Baraldi, 2020; Laage-Hellman et al., 2020), showing the differences hindering collaboration between university and industry due to contrasting logics and cultural distance, as well as divergent motives and time orientation, which have an impact on interaction (Kronlid and Baraldi, 2020). This typology of interaction mainly occurs in science-based sectors through licensing of technologies, joint R&D projects, research consortia and varies depending on the degree of connection between the two parties (from superficial meetings to interdependence of goals and resources (Kronlid and Baraldi, 2020). Recent studies show that university spin-offs are part of the business context, and academia plays an important role in the development new research-based businesses (Laage-Hellman et al., 2020).

What is missing in the contemporary political action is the idea of interaction between active parties on both sides of the interaction interface, their embeddedness into activity and resource structures with often contrasting interests, and that they directly engage and adapt physical and nonphysical resources across their organizational boundaries. It is often assumed that actors are independent of each other, endowed with a set of homogenous resources, and acting along the price mechanisms process (Waluszewski et al., 2019). It is not enough to transfer commodities along some automatic principles to achieve an efficient economic exchange, valuable for both sides. Instead, it is required to be actively engaged in processes characterized by substantial and ongoing changes of material and social resources, involving benefits and costs which are difficult to foresee as they rely on different economic logics and using/producing systems settings (Håkansson et al., 2009; Waluszewski et al., 2017). Intense

interaction is of utmost importance to deal with the wanted and unwanted consequences of exchanging and using resources. Both counterparts are embedded in a wide set of resources directly and indirectly activated in relation to actors. Research should shed light on the intricate patterns of social and material resources in place and the interdependency of resources, activities, and actors they create. All of this implies challenging consequences at the interface level of public-private interaction, as this needs to display the heterogeneous resources involved in the exchange.

The interface between the public and private settings is intriguing because of the interdependencies arising from different logics. For an extensive discussion on the issue, see Chapter II of this dissertation, where state of the art on public-private interaction is provided through a systematic literature review. This discussion opens an avenue for relevant managerially and policy implications as it indicates the importance for the public side to interfere and to be actively involved in structuring the public-private interface so as to organize the exchange of knowledge and information, handle the different dynamics and take advantage of the gains and overcome the obstacles using its experience of resource combinations.

2. Methodological considerations

This section outlines the research methodology applied to address the study's overarching objectives, the motivations behind the choices made, and the research project's main phases.

With an interactive focus as a guide, this research aims at providing an investigation of the combination of local and global knowledge in clustering processes, particularly by accounting for the role of public-private interaction. Thus, the focus is on interaction processes, namely public-private interaction, and knowledge flows in a specific context, that is clustering processes. The overarching research objective is declined and disentangled into the empirical settings to be addressed and according to the focus of each paper enclosed in this dissertation.

As already mentioned, the theoretical and methodological point of departure of this study is the IMP network approach (Håkansson et al., 2009), utilizing, above all, the ARA framework as analytical tool (Håkansson and Snehota, 1995; Håkansson and Johanson, 1992). This choice derives from the research design and tools developed within IMP, which can help in dealing with and handling complexity when analyzing relationships at dyadic and network

levels, focusing on one or more layers namely resources, activities, and actors (Baraldi et al., 2020). According to this perspective, researching the business world requires to observe and describe the phenomena empirically and involves the interplay of empirical research and conceptual development (Håkansson and Snehota, 2017b), and one of its key preferences is the methodological use of in-depth case studies (Baraldi et al., 2020).

In this line, and given the research's explorative nature, this study adopts a qualitative approach based on single longitudinal case studies analysis. Qualitative methods are employed to investigate the different forms of embeddedness in networks, as they provide the opportunity to dig into complex areas, especially when the outside natural setting is difficult to study (Doz, 2011). The qualitative research approach has been chosen to gain a deeper understanding of the chosen phenomenon and to observe its particular context (Yin, 2014). In addition to the fact that it is the most suitable approach for business networks studies (Halinen and Törnroos, 2005), qualitative research also provides the benefit of presenting a broader perspective on the identified problem, and it is beneficial for interpreting empirical data collected both at the organizational and individual level (Koporcic and Törnroos, 2019).

While it is true that qualitative methods encompass some limitations, such as not being susceptible to wider generalization and they are generally non-systematic and non-comparable (Speldekamp et al., 2020), they provide useful tools to account for the specifics of the historically evolved contextual cluster environment, the variety and fluidity of its actors, their strategies and relationships (Waluszewski, 2004b). This is of particular importance when accounting for inter-organizational relationships and related interaction processes, as well as for the consequences for the dynamics of relationships (La Rocca et al., 2017), such as the impact of the network context (Baraldi et al., 2020) on knowledge creation and exchange. which is embedded in local norms, customs, and patterns of behaviors. The qualitative case study and analysis for investigating industry clusters has emerged in the 2000s, with an increasing demand of micro analysis based on qualitative studies (Chain et al., 2019). Overall, it is argued that qualitative aspects outweigh input quantities in cluster studies (Fromhold-Eisebith and Eisebith, 2005) and as qualitative studies dismiss a top-down "one-size-fits-all" solution.

Quantitative methods are disregarded for the purposes of this dissertation as they do not give insights into the nature of highly contextual inter-firm relationships and knowledge exchange, and because quantitative methods (as regression analysis or social network analysis) do not capture the complementarities between different factors (Speldekamp et al., 2020).

Using a case study methodology allows us to investigate an object with many different dimensions and draw the various elements together in a cohesive interpretation (Ghauri et al., 2005; Easton, 2010). As argued by Yin (2009), case studies are generally used for investigating a contemporary social phenomenon within its real-life context. Moreover, case methodology is suitable for the study of business networks, where data is collected from cross-border and cross-cultural settings (Ghauri et al., 2005), since it allows the study of a contemporary phenomenon, which is difficult to separate from its context, but necessary to study within it to understand the dynamics involved in the setting (Halinen and Törnroos, 2005), notably addressing "how" and "why" questions. Case studies capture the dynamics of the phenomenon studied and provide an understanding of the dynamics present within individual contexts (Eisenhardt, 1989), and to capture specific and idiosyncratic details (Ortega-Colomer et al., 2016).

Summing up, the suitability of applying a case study research is strongly supported by the interactive perspective adopted in this thesis, and it is believed to clarify the underlying social and institutional dynamics that underpin patterns of interaction and to map their change over time (Wolfe and Gertler, 2004; Aaboen et al., 2012). Dubois and Araujo (2004) and argue that a case study approach is valuable specifically in the investigation of inter-organizational interactions and relationships, and to understand network dynamics (Guercini and Runfola, 2012). This choice is also in line with other recent and traditional studies on clusters and districts, which mainly adopt qualitative methods or mixed methods by supporting quantitative data with case studies (Buciuni and Pisano, 2018; Götz, 2020; Murphree et al., 2020; Ortega-Colomer et al., 2016). In particular, as the analytical focus is on the interactive aspect of clustering processes, in order to fully grasp the intricate interaction patterns and their consequences, the study had to be based on detailed empirical material which can only be provided by one single in-depth case study (Easton, 1995) and data which might not otherwise be available in public datasets (Murphree et al., 2020). Thus, qualitative case studies are deemed an appropriate method to follow longitudinal change processes and dynamics (Eisenhardt, 1989; Van de Ven and Poole, 1990).

Among the sources of evidence supporting case studies (Yin, 2014), interviews, documentation, archival records, and direct observations have been employed in this study. The interview inquiry has been widely used in the IMP tradition to understand the complexity of relationships. Thus, in relation to the theoretical perspective adopted in this thesis, the primary data collection source is the qualitative research interview method (Kvale and Brinkmann,

2009). The more formal aspects of the interview's investigation are thematizing, designing, interviewing, and transcribing (Kvale and Brinkmann, 2009). Using the semi-structured interviewing type comprising both structured and non-structured components (Cavana et al., 2001; Kvale and Brinkmann, 2009), the interview questions were designed based on theoretical considerations. The interviews are semi-structured and oriented toward encouraging the informants' storytelling. This affects the research's trustworthiness since informants were not influenced and led by researchers' personal opinions. If needed, some interviews (or follow-up interviews) have been conducted with ICT tools. Also, in some cases, the use of graphical representation of the network of actors and relationships around a specific theme, that is by means of network pictures[4], has proved to be useful when different people within an organization are interviewed (Öberg, 2012).

The last stages of the interview investigation are analyzing, verifying, and reporting. These stages are interdependent and non-linear. For this study, they are better conveyed by how the empirical material and theoretical concepts are intertwined. Interview material has been supported by document analysis of collected secondary data (media monitoring, official websites, annual reports, recording by direct observations). In this way, it has been possible to minimize respondent bias by triangulating data from different sources and assure validity and integrity, as each source gives a focus on particular perspectives; so the joint use of multiple sources helps to reduce the vulnerability of a specific source by compensating it with the strengths of the other sources used (Jick, 1979). Concerning the methodology for the analysis, first, all interviews have been transcribed *verbatim*, and transcripts have been read to gain a sense of the context and of the overall approach, second, meaningful and content-based sections to reflect on have been identified and data has been compared.

Regarding the research design and process, this dissertation is mainly based on the understanding that there is a close relationship between theory, objectives, and methodology (Waluszewski et al., 2017). Consequently, an abductive reasoning and process are adopted (Dubois and Gadde, 2002), as they realize a continuous combination of empirical evidence with the theoretical framework, that is between theory and practice. Through this process, it is possible to answer the question of what already exists in the considered literature and what is novel and can be appropriate to integrate and contribute to it.

[4] That is graphical representations of the network of actors and relationships around a specific theme (Ramos and Ford, 2011).

In order to compare empirical observation with the existing theory, the research questions have been adjusted and modified, the empirical approach has been widened, and the theoretical framework based on the cluster studies, knowledge, and the IMP approach has been confronted with concepts from other theories. So, the conceptual framework has been elaborated simultaneously with the empirical results and corresponds both to the empirical results of case studies and to the ways to analyze them.

The strategy applied is defined as systematic combining, characterized by *"a continuous movement between an empirical world and a model world. During this process, the research issues and the analytical framework are successively reoriented when they are confronted with the empirical world"* (Dubois and Gadde, 2002: 554). This stems from the fact that theory cannot be understood without empirical observation and vice versa.

This study uses a longitudinal research process (Pettigrew, 1997; Van de ven, 1992), and follows critical events and episodes that occur in their specific context over time (Halinen et al., 2012). As defined by Van de Ven (1992: 170), *"the meaning of process is a sequence of events or activities that describes how things change over time, or that represent an underlying pattern of cognitive transitions by an entity in dealing with an issue"*. Process in this study denotes networking, during which key informants capture and comprehend critical events in a business network context. A critical event is understood here as an occurrence that transpires in a business network and has a specific impact on the firms investigated and their network development. In this way, this line of reasoning and the dynamics of the research process generate new insights that provide further inputs for analyses and discussions.

The IMP approach is the chosen theoretical and analytical framework of this dissertation as it offers a wide set of useful concepts for the analysis of interorganizational dynamics and knowledge flows. In particular, the ARA framework (Håkansson et al., 2009; Håkansson and Snehota, 1995) allows an in-depth analysis of clustering dynamics along its three dimensions, that is, of the different actors interacting in clusters, the formal and informal processes, and the issue of knowledge as a strategic resource in different clustering processes. The ARA framework has been then adapted according to the objectives and setting of the empirical papers presented. We could argue that adopting an IMP approach allows us to analyze clustering processes and knowledge dynamics in the light of the interaction occurring within and beyond the boundaries of clusters, at the activity resource and actor layer.

Chapter	II	III	IV
Type of study	Systematic literature review	Single case study methodology	Single case study methodology
Case selected	-	Italian Industrial District	Swedish formal cluster initiative
Unit of analysis	IMP literature	Industrial District	Internationalization Project
Data material	32 selected articles	18 semi-structured interviews Mapping of 83 knowledge dissemination activities Network pictures	11 semi-structured interviews Official documentation of the project

Table 2 *Overview of the methodology and data material*

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Chapter II

Public-private interaction: a systematic literature review and implications for researching business networks

Abstract

This paper aims at providing a state-of-the-art on how public-private interaction has been researched within the IMP group. In particular, by adopting a systematic literature review methodology, it aims to understand with whom and how business actors interact in business networks. Through the analysis of 32 selected papers, this study identifies the general observed trends in the growing research on public-private interaction in IMP, it maps the theme and identifies research gaps, opportunities, and challenges using a framework for studying interaction based on the questions "who?", "what?", "how?" and "why?". After providing a state-of-the-art on existing research, avenues for future theoretical and empirical research are outlined, and managerial and policy implications are drawn.

Keywords: Review, Public-private, Non-business actors, Interaction, IMP

1. Introduction

During the past decade, great attention has been devoted to the interdependence and interface between private and public actors (Håkansson and Axelsson, 2020) and to the important organizational strategy, management, and policy implications of their interaction. This interest from scholars might come from the increasing number of public-private interactions, which have become one of the most striking contemporary trends (Waluszewski et al., 2019). The interplay between the public and the private sector of the economy is extensive, and it is often encouraged by policy tools and politicians, as well as by academics. Academic interest is shown by the growing number of articles published in recent years on this topic and by the ongoing debate on international journals as the *Journal of Business & Industrial Marketing* (Kronlid and Baraldi, 2020), and by recent calls for a deeper understanding of the dynamics and interfaces developed in public-private interaction (Leite and

Bengtson, 2018). Policy interest has been acknowledged by policymakers at different levels, encouraging those types of collaborations (Waluszewski et al., 2019). These relationships differ on some central dimensions compared to relationships between businesses, as they include aspects such as public procurement, various decision-making layers, and different sets of values. They imply challenges for businesses, such as identifying adequate partners and building partnerships with actors with different organizational objectives, cultures, decisional processes, and approaches (Hahn and Gold, 2014; Munksgaard et al., 2017). The public sector also differs from the private one as it is structured upon rules, its actions are mostly rule-based, and rules are set by political forces and policymakers. Among these rules, transparency can be mentioned efficiency can be mentioned, measured by the relation between how well the task is done and the total cost (Håkansson and Axelsson, 2020).

While it is true that public actors have received much attention in recent years, these have typically been investigated as customers in public procurement projects (i.e., Mattson and Andersson, 2019), and, despite the variety of public actors existing on different levels and assuming different roles in business networks, these have been comprehensively categorized as political or institutional actors (i.e., Welch and Wilkinson, 2004; Bengtson et al., 2009b; Bondeli et al., 2020). Also, public customer-private supplier interaction has mirrored the classical seller-buyer relationship in business networks. The basic characteristics of the public-private exchange have been traditionally influenced by conventional market and neoliberal economic thinking, which assume away interaction and rather see business exchange as relying only on homogenous resources and price mechanisms, deemed a guarantee for efficiency.

On the contrary, studies within the Industrial Marketing and Purchasing (hereafter IMP) approach have shown how the political expectations on the business landscape do not correspond to the interaction patterns that actually exist (Waluszewski et al., 2019). The public sector has undergone various changes, as the privatization and outsourcing of whole units in many countries. Indeed, public actors have undergone radical transformations in terms of shape, role, and scope. Especially since the 1990s, changes in the European modern public institutions have affected them. For example, with the establishment of the European Single Market, how a public actor is allowed to act is highly regulated through different instruments, as public procurement, which has been governed to a large extent by institutional arrangements such as rules, procedures, and requests for transparency (Mattson and Andersson, 2019) and by international regulations, such as European directives (Torvatn and de Boer, 2017). Such

regulatory strategies have changed the role that public actors play; such changes require more attention to the interaction interface developed between the private and public spheres.

With an interactivity focus in mind, that is, by adopting an IMP lens on the public-private interplay, this paper aims at providing an overview, together with an agenda for research, on how public-private interaction has been researched within the IMP group.

The core mission of IMP research and tradition consists of fully understanding the interactive business landscape (Håkansson et al., 2009). Within the IMP approach, the web composed by the different actors – together with resource ties and activity links – is a key feature of the interaction pattern. Authors in IMP recognize that many conceptual and empirical areas related to the actor dimension still have not been thoroughly investigated (Munksgaard and Ford, 2017). In fact, despite the acknowledgement of the relevance of different typologies of actors in the evolution and development of business networks (Håkansson and Waluszewski, 2013), a more in-depth exploration of how public and private actors interact in business networks is also needed because of the increasing complexity of the overall context where businesses operate, shaped by changing trajectories in terms of social, technological and institutional change (Cantwell et al., 2010; Alcácer et al., 2016).

Empirical studies have kept track of their changing shapes over time, arguing how the neoliberal climate and policy trends have transformed public actors significantly, with new agendas advocating comprehensive privatization of state companies and increased outsourcing of public activities. All these changes and the impact of national public policies (school policies, digitalization policies, and public procurement policies) affect the interaction between public and private organizations, both in the numbers and bases of activities (Mattson and Andersson, 2016).

Accordingly, it is argued that public-private interaction is worthy of being further explored within IMP research to provide a comprehensive understanding of with whom and how business actors interact in business networks. This typology of interaction has been recognized as key in different contexts, and it has been widely studied in the form of public-private partnerships (PPP) or public procurement. However, a coherent and comprehensive analysis and conceptual development of the public-private interaction interface, the role played by the public side in public-private interaction, as well as its features in interaction seem lacking, also due to the nature of actors non-pertaining to the business sphere, which is highly subject to transformations over time.

This research is positioned in this space, and it advances the need to conduct a review of existing contributions on public-private interaction based on different grounds. First, given the increasing interest in the topic, it is necessary to critically summarize the trends and main directions in this rapidly growing field. Second, the further development of this research stream would benefit from identifying research gaps and potential research propositions for future directions based on emerging themes. The reason for conducting a review in the IMP context is given by the fragmentation of this body of literature and by the empirical nature of this stream, which is often based on unique case studies, of hard generalization. In particular, by adopting an interactive focus, this chapter, drawing from existing insights on businesses as nexus of business relationships and as part of a network of relationships (La Rocca et al., 2017), enhance the comprehension and generate novel knowledge on the dynamics of such interaction by adding a further layer of complexity to business networks.

Accordingly, the aim of the literature review is twofold: (1) to identify the general observed trends and leading themes in the growing research on public-private interaction in IMP, and (2) to recognize research gaps and provide propositions for future research within the discourse, building on the IMP perspective.

The objectives set are achieved through the identification and filtering of relevant papers. Then, in order to facilitate further research on this topic in terms of both conceptual and empirical analysis, 32 selected papers are reviewed according to different categories identified to address the following researching questions:

RQ1. Which typologies of public actors have been identified and how have the roles of these actors been researched?

RQ2. How has public-private interaction been approached within IMP research?

To this end, the paper is structured as follows. Section two presents a preliminary discussion on how the non-business dimension has been investigated in IMP studies. In particular, it aims at introducing the context in which the literature review is set by addressing how the concept has been captured in recent studies. Section three addresses the literature review methodology developed, outlining the selection protocol and the main steps adopted to examine the articles' contents. The fourth section presents and discusses the findings of the

literature analysis, while the last section outlines conclusive remarks, pointing out the main contributions and limitations of the study, relating them to possible avenues for further research.

2. Introducing the context of analysis

This paragraph deals with the idea of non-business actors, broadly defined as actors not strictly encompassed in the definition of business actors. This focus derives from the fact that this category includes a wider variety of actors than the public actors one, also encompassing those hybrid actors that lie on the border of public and private spheres or which cannot be encompassed in either of the categories. For example, some non-business actors (such as NGOs) do not have a public nature but cannot either be classified as business actors. Non-business actors are here understood as actors not only contributing to generating value by engaging in physically producing products, but mostly providing non-tangible assets, such as information and know-how, local access and networks, and social capital (Hahn and Gold, 2014).

Therefore, a preliminary analysis[5] has been conducted in order to get an understanding of the counterparts of businesses in interaction in a broader sense and to grasp how the concept has been discussed with regards to IMP concepts and how it has developed in the last decade. In the core of this literature review, the idea of public-private interaction is then accounted for as it has been widely used within the literature to indicate the interaction involving the business and non-business spheres; therefore, it is considered as suitable to investigate the topic[6].

Foremost, the role of non-business actors in business networks has been conceptually examined in two ways. First, by adopting the perspective of an extended business network (Thilenius et al., 2016; Latifi, 2013), which implies presenting something new and challenging

[5] This analysis has been based on the review of 98 recent IMP articles (2009-2020), identified through advanced research on Google Scholar, using keywords and the Boolean operators "AND" to search only for articles dealing with non-business actors within IMP studies. The articles have been assessed on the typology and number of non-business actors considered, the theoretical framework adopted, the paper's conceptual or empirical nature, the context setting, and the key IMP concepts in use.

[6] Other than the reasons provided above, addressing the non-business dimension helps in setting the context of analysis for public-private interaction. However, as business - non-business interaction has not been addressed within contributions dealing with the non-business dimension, when researching interaction involving these two spheres, a different terminology is used, that is "public-private". Also, while some studies have dealt with state actors and non-state actors interaction, it is here argued that the idea of public-private better captures interaction mechanisms involving actors from different spheres.

the assumptions on boundary-setting in the business network approach and offering further insights to the network. This view implies approaching the network as a whole, enlarging the scope of the network, and analyzing it by disentangling its various aspects. Among the reasons for extending the business network, there are the reconsiderations of aspects that have been traditionally neglected, including the existence of other vital counterparts, such as non-business actors. Second, the view of business and non-business networks as two distinct networks which are undeniably related, which meet and interact with each other and cross-over but having different features and outcomes (Mandják and Simon, 2016; Bengtson et al., 2009a).

Non-business actors have also been integrated into IMP traditional concepts, such as those of interaction and interdependence. Studies highlight the episodic nature of interaction between different actors, referring to this feature of interaction and interdependence as activated and sleeping relationships, arguing that interaction does not follow an incremental process but rather gets activated to deal with specific issues, and it is followed by a non-active phase until new issues emerge (Bengtson and Hadjikhani, 2010). Concerning interdependence, actors combine complementary resources to ideate solutions that could benefit each of them (Aarikka-Stenroos and Sandberg, 2009). Non-business actors are relevant for mobilizing valuable resources, therefore generating interdependence.

Among the contributions, key categories of non-business actors have emerged: political, research and educational, and social actors. The importance of *political actors* in business networks has been acknowledged by different studies, and there has been a focused effort in exploring this typology of actors in IMP research (Håkansson and Snehota, 2017). This category includes politicians, governments (Linné and Shih, 2013), and governmental agencies (Vildåsen and Ingemansson Havenvid, 2018) at the local, national and supranational level (Bengtson et al., 2009b; Shih, 2012; Guercini and Tunisini, 2017).

They have been directly tackled in the context of internationalization (Freire de Sousa and Figueira de Lemos, 2009; Colovic and Lamotte, 2014; Johanson and Johanson, 2015) and innovation (Linné and Shih, 2013; Leite and Bengtson, 2016). Firms' internationalization is often characterized by the lack of certain resources (as legitimacy, power, influence, knowledge of regulations, institutional framework, rules, norms, and values) that can be accessed by collaborating with non-business actors (Bengtson et al., 2009a). In the context of innovation, they play an influential role in reducing the risks and uncertainty of innovation, playing a role

as a mediator, and are actively involved in creating the technical and organizational resource interfaces needed (Linné and Shih, 2013).

Some studies set in the context of technological innovation have also included *universities* among non-business organizations. This interaction is called by the complexity of knowledge and technology (Mandják and Simon, 2016). Universities lack critical skills, like entrepreneurial skills, which are compensated by their relationships to business representatives (Eklinder-Frick et al., 2018), but they provide specific resources and know-how for companies' innovation processes (Palo, 2014). Only a few contributions in the context of non-business actors relate to universities and research centers as, often, these are not considered and classified as non-business by scholars and are considered implicitly as active nodes, thus with a hybrid nature.

Finally, *social actors* mainly refer to non-governmental organizations (Leite and Latifi, 2016), civil society (Ljung and Pahlberg, 2015), and stakeholders (Esse et al., 2012). They have been investigated in the context of sustainability and innovation. Their function is based on social legitimacy, and in providing tangible and intangible resources to help firms address sustainable issues, promote innovation, and achieve greater social impact (Leite and Latifi, 2016). Starting from how the broad non-business dimension has been accounted for in recent IMP studies, an in-depth systematic analysis on the issue of public-private interaction set in this context is conducted, as introduced in the following sections of this chapter.

3. Methodology

The main aim and contribution of this paper are to summarize and systematize the extant literature developed within IMP on public-private interaction. This section outlines the research methodology, and selection protocols developed to answer the research questions outlined in the introduction.

In order to pursue the research objective, a systematic literature review has been conducted. Concerning the sampling and screening procedure, the research design departs from the research objectives to define the conceptual boundaries that yield to the setting of inclusion and exclusion criteria to define the scope of the literature review (Ratinho et al., 2020). The articles dealing with the issue have been identified through an advanced research on Scopus

and Web of Science (WoS), in line with the rationale behind other systematic literature reviews (i.e., Lu et al., 2018; Bhimani et al., 2019).

The keywords entered have been chosen in order to encompass the publications concerning the interaction between the public and private sides in the IMP tradition. Thus, they resulted from the combination of public-private on the one hand and of IMP-related approach terms. The relationship between the IMP approach and public-private interaction has been defined using the Boolean operator "AND" to narrow the record set. Within the two sets of keywords, words have been connected through the Boolean operator "OR" to broaden our search and to indicate that any of the words it connects are acceptable. This process resulted in the following string: *"public private" OR "public private interaction" AND "network*" OR "relationship*" OR "interaction" OR "IMP" OR "Industrial Marketing and purchasing" OR "business relationship*"*. In Scopus, the research was conducted using the field "Article Title, Abstract, Keywords", while in WoS an equivalent field named "Topic" was selected (Jugend et al., 2020).

The searches have been further refined by selecting sources, that is, by choosing the *Journal of Business & Industrial Marketing* (JBIM) and *Industrial Marketing Management* (IMM), as they are the main publication outlets where IMP research is published.

In a second stage, worried that several important papers might be lost, conference proceedings and working papers have been searched (Dorasamy et al., 2013) through the IMP official website (impgroup.com), where all the contributions made within IMP are recorded, also encompassing the working papers and the conference proceedings, and through a search in the *IMP Journal*. Papers from the *IMP Journal* have been purposefully selected, as this journal was an important outlet and forum for research into business interaction until 2019 when it became the IMP Forum, hosted in the *Journal of Business & Industrial Marketing*. The criteria and the selection protocol developed for the systematic literature review are summarized in Figure 1.

The results of the research have been classified in a dataset specifying the author(s) of the article, its title, the year in which it has been published, the journal, keywords, and abstract. This search returned a total of 174 articles, which were identified and sorted manually. The filtering process was conducted by selecting relevant papers, that is, by removing from the final sample duplicates and articles with no relation to the objectives, that is not dealing with public-private interaction, or falling outside the scope of IMP studies.

The result of this process is a dataset of 32 articles (see Appendix A for the final sample). The papers have been then read through in their content and have been analyzed using the software NVivo. To approach the two research questions, the concept of interaction dimension is at the core of the analysis.

Based on previous studies on the methodological and conceptual complexity of researching business interaction (Abrahamsen, 2016), this analysis addresses the different interaction dimensions:

- *Who*: this question concerns the actors involved in interaction and focuses on the characteristics and classification of public and private actors and what is happening at the actor level. Also, it aims at understanding whether firms' propensity to engage in interaction with the public side depends on particular factors;
- *What*: this question aims at understanding what is happening in public-private interaction and to characterize it in terms of interaction features;
- *How*: this question relates to the way public and private actors interact and their intent, that is how the actors involved handle complex combinations of resources, activities, and actors;
- *Why*: this question refers to the motivations leading to public-private interaction, meaning the ascriptions or explanations of interaction.

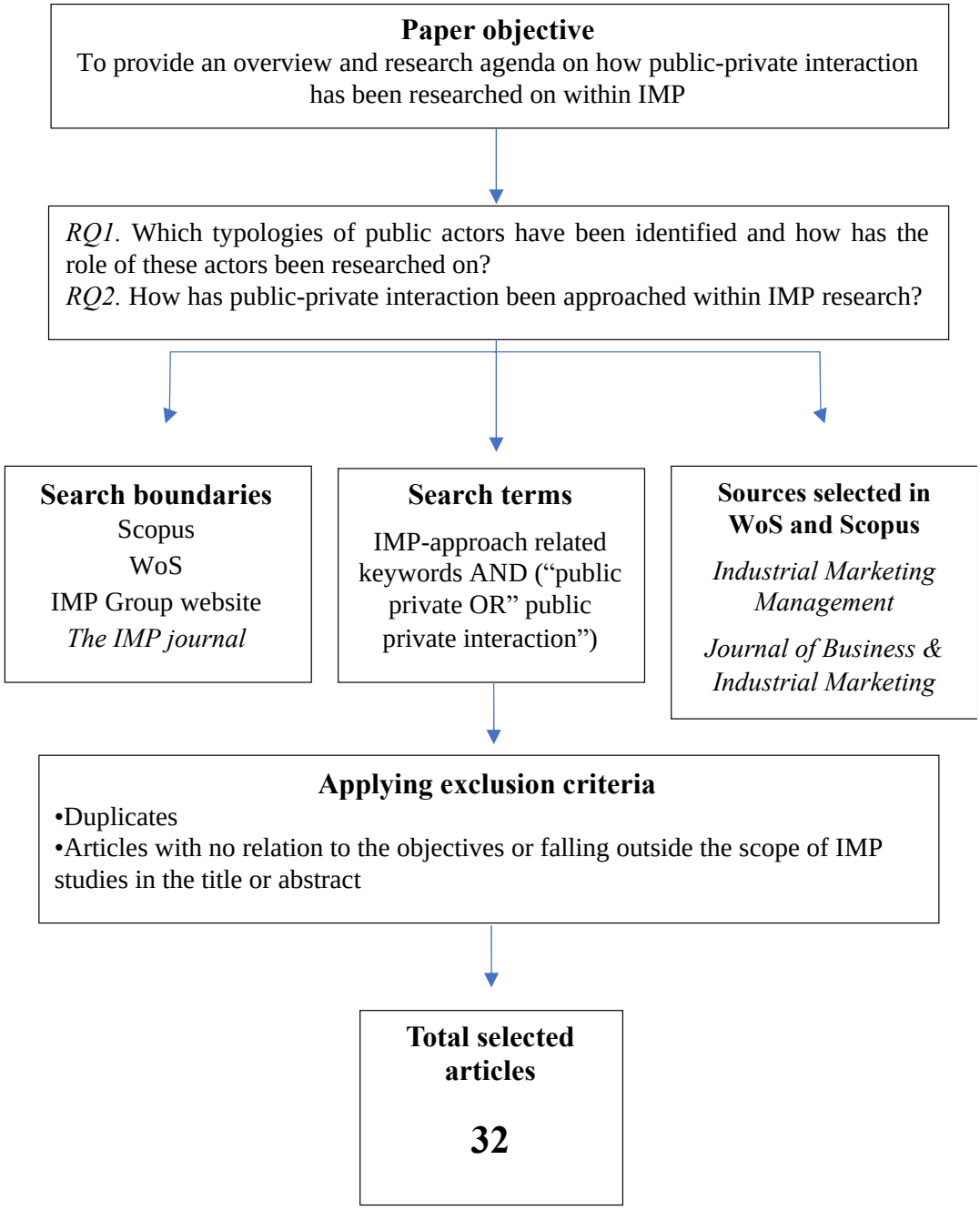

Figure 1 *Summary of the research protocol*

4. Literature review analysis

This section develops the analysis of the selected articles along two distinct paths. First, it provides a descriptive review of the articles to assess their formal characteristics, their distribution per year, the nature of the contribution, the publication outlets, and the context

setting in which they are embedded. Second, it outlines the analytical review based on the categories identified above.

4.1. Descriptive Review

Figure 2 presents the temporal distribution of articles for the final sample analyzed. The data summarized by this basic pattern shows a growing, although non-linear, trend in the number of articles published and, therefore, an emergence of research on public-private interaction, with a steep increase in 2016-2017. This suggests that the interest of scholars has considerably increased and that public-private interaction is an actual trend in practice, gaining scholarly and policymaking attention. Although it is not possible to fully explain this trend, some plausible reasons are put forward. In line with other papers (Bhimani et al., 2019), also in this case, the rationale behind the surge in the number of articles in the year 2019 might be that of leading scholars within IMP advancing knowledge in the discourse as well as specific calls for papers on the topic. This is the case of an IMP Forum Seminar held at the beginning of 2019 in Uppsala (Sweden), with a special track on "public-private interaction". Another explanation could be found in the increasing complexity that has characterized the business scenario in the last decade, which has increased public-private interaction, consequently influencing the academic debate on the topic.

There is only a low numbers article on the topic before 2016-2017, year of publication of the last IMP book, which has picked up the challenge of how to cope with the reality of the business landscape (i.e., its interactive nature) to manage it (Bocconcelli, 2017). Consistent with the assumptions made in the background analysis, only three papers have been published on the issue before 2009 (the year of the publication of the 2009 book, representing a milestone in the development of IMP thinking), that is three conference paper dealing with local authorities' abilities within public-private networks and with public-private interaction within the defense industry (Mittilä and Leppälahti, 2004; Mittilä, 2008; Ojala et al., 2008).

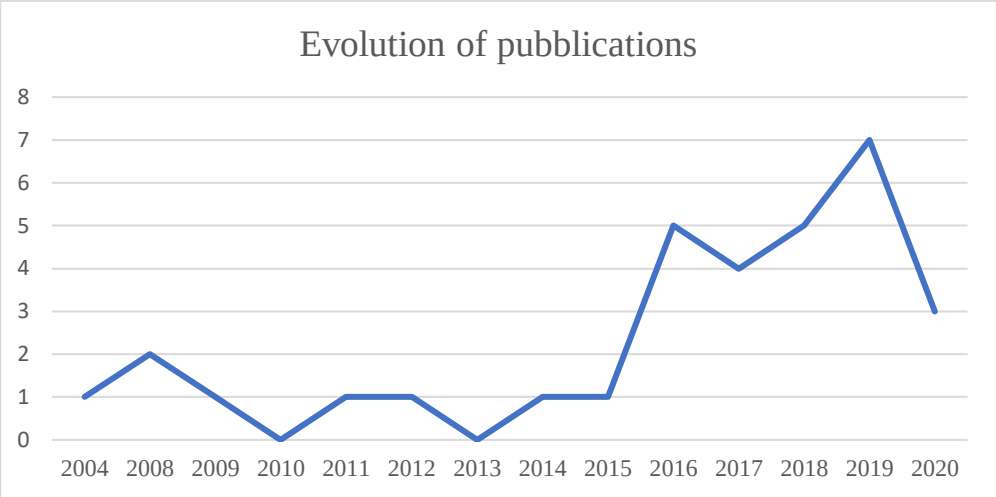

Figure 2 *Article trends by year*

Concerning the trends in publication outlets. The majority of the articles are conference papers (16), as shown in table 3. This shows the importance of conferences and Forum Seminar in spurring a debate on emerging topics.

Outlet / Nr. of papers	JBIM	IMM	IMP Journal	IMP conference proceedings
	5	8	3	16

Table 1 *Publication Outlets*

In terms of research methodologies, not surprisingly, the recent focus on the discourse is consistent with the finding that the majority of the articles are classified as empirical (27 out of 32). When it comes to the approaches used in empirical studies, all sampled contributions are based on qualitative methods, mostly on case study methodology. The final body of knowledge included one journal editorial, and four conceptual models/developments. Thus, this observation confirms what has already been presented, as the issue has a limited formalization from a conceptual point of view.

Regarding the theoretical approaches, that is, the relevant literature and approaches used by authors when investigating public-private interaction, the focus is only on contributions entailing the IMP framework, concepts, and paradigms. 21 articles out of 32 are exclusively and strictly based on the IMP approach, the remainder of the articles (11) are IMP-based but show a combination of theories or bodies of literature in order to integrate or compare them

with IMP. In this respect, it is interesting to note that reference theories span transaction cost economics, literature on ecosystems, institutional theory, co-evolutionary theory, and so on, showing the complexity of the topic, which requires the interplay of different theories and disciplines.

The collected articles have also been classified by context setting and business sectors. The reviewed papers on public-private interaction contextualized their studies in specific business sectors and industry, including healthcare, education, defense industry, construction industry, tourism, and public services. The classification by context setting and the keywords of the selected articles show an emphasis on sustainability, innovation, value creation, business models, and projects. The focus on such key themes explains and emphasizes the multifaceted features characterizing these settings, as they encompass not only the management of the business market but also of other kinds of interrelated actors somehow affecting each other in a larger network constellation.

4.2. Analytical Review

First, to get an idea of the foci of the selected articles, a word frequency query has been run on NVivo. This helped to get a first understanding of the most frequent concepts addressed in the articles. As could be expected, most of the articles deal with key IMP concepts, among which the most mentioned are actors, relationships, network, interaction, resources, and activities, which are among the 50 most frequent words. The main issues addressed within the articles concern public, private/business actors, procurement, innovation, internationalization, project, value (creation), knowledge (exchange), time, role, collaboration, cooperation, partnership, problems, interests. Based on this first understanding, how these frequent concepts have been investigated will be in focus in the next step, based on category selection.

As mentioned in the methodology section, category selection and the definition of analytical categories to classify the documents' contents were based on previous methodological indications on how to investigate interaction (Abrahamsen et al., 2016).

To critically review the selected articles, the questions summarized in Table 2 have been addressed and articles have been coded along four dimensions, following previous methodological indications from IMP studies on how to approach interaction and how to analyze it.

W-question	Interaction dimension analyzed
Who?	What is the unit of analysis when investigating public-private interaction? Who are the actors involved in the interaction? Who represents the public and private side?
What?	What happens in public-private interaction? What are the main drivers and barriers? What are the interaction mechanisms?
How?	How do actors interact? How is interaction governed? With what degree of formalization?
Why?	Which are the reasons for engaging in public-private interaction? Are there differences in motivations between public and private actors?

Table 2 *Framework for researching interaction (adapted from Abrahamsen et al., 2016)*

Recent IMP studies have accounted for the public side and its interaction with the private one by focusing on different aspects and features of interaction, such as the roles that the public actor assumes in interaction with a private counterpart and effects deriving from this kind of interaction. In public-private interaction, actors differ in terms of typology of the organization represented (public or private) in terms of objectives, decision-making processes, and culture, thus making interaction particularly complex. These kinds of heterogeneity bring benefits, but, at the same time, they might be outweighed by the challenges (Munksgaard et al., 2017; Keränen, 2017a; Dóra and Szalkai, 2020) determined by a mismatch of priorities and misperception of goals. Studies also criticize public-private interaction, accounting for its "dark side" and underlying its lack of transparency and high failure rate to meet expectations (Keränen, 2017a). Thus, the high degree of complexity of such relationships brings tensions and challenges that cannot be overlooked (Munksgaard et al., 2017; Mattsson and Andersson, 2019; Waluszewski et al., 2019).

Who

To answer the first question of this review, that is "Which typologies of public actors have been identified and how has the role of these actors been researched on?", the "who?"-dimension has been explored. While the background discussion has highlighted different dimensions of non-business actors (political, research, social), showing the multidimensionality

of actors within IMP studies, articles dealing with interaction among public and private actors mirror only to a certain extent the above findings, as the public side is often represented by the political/institutional sphere (Salmi and Heikkilä, 2015; Finke et al., 2016; Andresen et al., 2018; Kar et al., 2019; Guercini et al., 2020), as well as universities and research centers (Kronlid and Baraldi, 2020; Waluszewski et al., 2018). However, there seems to be a discrepancy between, on the one hand, how and which typology of non-business actors have been investigated in business networks and, on the other hand, who are the actors interacting in public-private interaction. Indeed, there is a clearer focus on research and education actors (Nissen et al., 2014; Kronlid and Baraldi, 2020; Waluszewski et al., 2018), which was missing, or better implicit, in studies on non-business actors. Social actors, like NGOs, which were in focus in different studies on non-business actors, are completely absent as they do not have a public nature. This typology of actors is rather declined within the public-private interaction studies as the broader civil society (Mattsson and Andersson, 2019).

On the private side, there is a variety of actors analyzed within the public-private setting. While when dealing with non-business actors in business actors, the focus was mainly on large firms, as MNEs, public-private interaction seems to arise especially within the start-up literature (Kronlid and Baraldi, 2020). In spite of this, contributions range from firms with less experience to more experienced firms (Munksgaard et al., 2017). Also, from SMEs (Kronlid and Baraldi, 2020; Waluszewski et al., 2018) to multinational companies (Salmi and Heikkilä, 2015; Finke et al., 2016; Guercini et al., 2020). However, when it comes to size, there is not a clear indication of the higher propensity to engage in public-private interaction of small or large firms, as the evidence seems to suggest that both small and large companies engage in public-private interaction. The most significant features rather concern the experience of firms in this kind of interaction as experienced firms strategize for handling relationships with public partners differently from not experienced firms (Munksgaard et al., 2017).

Another difference among firms concerns the countries where they operate, given the differences in regulations and norms (studies are set in Sweden, Denmark, Finland, Italy, Brazil, Hungary, and Russia, among others). With regard to industry, interaction is increasingly taking place in industries such as health and construction industries (i.e., Keränen, 2017a; Andresen et al., 2018).

Moreover, studies have highlighted and investigated the existence of intermediary actors having an impact on this kind of relationship and creating a network and platform from the

resources invested, which create value to all actors and produce cost-saving effects. Support from the new actors is a great basis for private firms to build relationships with the public sphere and involve sponsoring public causes. However, the new actor may also cause tensions requiring constant, coordinated management (Dóra and Szalkai, 2020).

Also, public procurement has been dealt with as an intermediary managerial role between public and private organizations, leading to triadic partnerships with changing roles (Keränen, 2017b). The study conducted by Keränen (2017a) argues that professional public purchasers intermediate between the public units in charge of the implementation of the process and the private supplier organization.

The intermediary role in this sense fulfils three functions: i) architect, seeking to attract actors; ii) lead operator, formally connecting actors; iii) structuring agents, influencing the structure of exchange relationships. All actors only become actors in interaction with others, thus highlighting the renewing nature of the network created by the entrance of the new actor. Intermediary actors have also been conceptualized as individuals carrying a supportive and necessary intermediary role in public-private nets (Salmi and Heikkilä, 2015).

Studies argue that within a centralized public procurer, there is a triadic interaction that is highly interlinked among the public purchaser, the management of the procurement implementation, and the private organization, where each actor influence the relationship by positively keeping the triad together or negatively disturbing the relationship (Keränen, 2017a).

Triadic interaction is also of concern in the studies conducted by Torvinen and Ulkuniemi (2016) and Guercini et al. (2020), who emphasize a conception of the public-private relationship as a relationship that should include the end-user, informally linked to both public and private actors, and where all of the actors and their interconnections might condition the successfulness of the procurement procedure and where the triad enable new kinds of interaction, knowledge flows and collaborations (Torvinen and Ulkuniemi, 2016).

Concerning the features of public and private actors, studies indicate the highly challenging nature of this interaction due to heterogeneity and divergence between the public and private spheres. Differences concern organizational objectives, cultures, decisional processes, organizational set-ups, and approaches. A failure in accounting for these differences leads to increasing complexity and to a higher probability of tensions. The effort needed in public-private interaction requires prioritizing and precluding activities and actors (Munksgaard et al., 2017).

These requirements have also been defined as the inclusive or exclusive mobilization of actors and activities (Ritvala and Salmi, 2012). Engaging with a public counterpart is challenging for firms in terms of resources activated, as interacting with the public side means interacting with different decision-making levels (Munksgaard et al., 2017: 83).

What

To address how public-private interaction has been explored and captured within IMP, first, different interaction mechanisms are accounted for. One crucial aspect and contribution of IMP to public-private interaction, compared to other perspectives, is that of the content of interaction. This concept implies that it is in interaction that the value of heterogeneous resources is created, that is, through the establishment of resource ties, activities link, and actor bonds (Waluszewski et al., 2019). As argued by Waluszewski et al. (2019) and Munksgaard et al. (2017), the content of interaction affects both sides of the exchange interface and creates interdependencies arising from different logics, which need to be actively dealt with in order for public-private interaction to be successful. The content of formal interaction in the short term only concerns the economic dimension, while in the long term, the interaction content relates to communication, information exchange, partnerships, training, consultancy, and support activities (Guercini et al., 2020).

What happens in interaction largely depends on the typology and degree of formalization of interaction, which will be in focus when addressing modes of interaction ("how")[7]. Moreover, interaction mechanisms are shaped by temporality and time constraints emerging when actors engage in large multi-actors' projects (Kronlid and Baraldi, 2020). The most salient time-related issues include a rather high turnover of both the participating organizations and individuals, which makes it more difficult to develop trust and continuity in inter-organizational interactions.

The impact of temporality is also apparent in the efficiency resources combinations, where the short times available to develop them and the lack of continuity make it difficult to achieve it. Project tools presented to deal with interaction mechanisms (Munksgaard et al.,

[7] It is important to note that the dimensions related to the "what" and "how" of public-private interaction are closely related as the content of interaction is influenced by the modalities, but, at the same time, this shapes the interaction mechanisms in place.

2017; Kronlid and Baraldi, 2020) first distinguish between daily interactions, which are likely more intense and rigidly governed by templates – such as deadlines and flowcharts – and long-term oriented interaction, structured and managed more flexibly. Thus, public-private interaction within projects is characterized by a combination of knowledge sharing mechanisms.

Information sharing and knowledge-related issues are central elements in public-private nets (Salmi and Heikkilä, 2015). Knowledge sharing activities take place among heterogeneous public and private actors and heterogeneity need to be dealt with through interaction, as it is important to hold a common shared knowledge base and at the same time keep complementary knowledge basis attached to tacit knowledge, that is, combining cooperation and collaboration, respectively related to sharing explicit and tacit knowledge. Tacit knowledge is mainly exchanged through close personal interaction (Munksgaard et al., 2017; Nissen et al., 2014). Tacit knowledge sharing is related to collaboration and strong linkages, while sharing of codified knowledge is related to cooperation and taskwork performed autonomously (Nissen et al., 2014). Cooperation among public and private actors leads to the development of relationships and to knowledge creation, co-creation, and exchange.

Heterogeneity among public and private actors needs to be managed and there is a need to continually re-establish a shared knowledge base when a critical incident changes or disrupts it (Nissen et al., 2014). As mentioned, heterogeneity brings benefits as it entails different knowledge and information (Nissen et al., 2014), but, at the same time, they might be outweighed by the challenges it represents, which lead to tensions and conflicts. Also, the multiplicity of interests as a strict economic reasoning, weak actor bonds, and different perceptions of the rules of the game represent additional barriers to interaction (Finke et al., 2016). On top of that, tensions arise due to the expectations that the public side has towards the private one, often considered as autonomous and able to deliver innovation, quality, and cost control since they are believed to be more exposed to competitive forces and thus acting accordingly (Waluszewski et al., 2019).

Challenges are even more emphasized in some particular contexts, such as the defense industry, where there are external reasons such as legislation, political reflections, and availability of potential suppliers (Ojala et al., 2008).

Tension is a process that requires adaptations and which is likely to emerge as a result of both structural tensions, that is emerging from organization complexity, and behavioral

strains. Tensions and ambiguity might concern whom, at which level, how to interact, and the resource dimension (Mattsson and Andersson, 2019).

How

The selected articles also provide insights into the variety of forms that public-private interaction may assume. Indeed, public-private interaction may take different forms, such as personal contacts, information exchange, technical links and ranges from cooperative agreements to robust and intense collaboration, which requires long-lasting relationships and partnerships, and from informal to formal relationships. The selected articles show a combination of formal and informal mechanisms, as well as direct and indirect mechanisms (Torvinen and Ulkuniemi, 2016; Nissen et al., 2014), which lead to a balance between different type of interaction, namely collaborative and cooperative interaction forms of sharing knowledge (Torvinen and Ulkuniemi, 2016). While collaboration is characterized by strong linkages, high levels of trust as the actors see themselves and interdependent; cooperation is characterized by autonomous and independent teams tied by more weak linkages (Nissen et al., 2014).

The degree of formality varies and/or changes over time, thus showing the dynamism of the shapes assumed by public-private interaction. Whether formality has either a positive or negative impact on relationships has also been in focus in different studies. Positive features of formality concern aspects as effectively taking care of uncertainties, conflicts, divergence of objectives and perspectives, but at the same time formality hamper the development of social elements as trust and commitment.

On the formal nature of public-private interaction, studies of Torvinen and Ulkuniemi (2016) and Howard et al. (2016) characterize public-private relationships as being *"formal and contract-driven"* (Torvinen and Ulkuniemi 2016: 60), as public-private interaction mostly happens in a context characterized by formal norms, regulations, and procedures. Public-private interaction mostly happens in the formalized context of public-private partnerships (PPP).

Within the context of public procurement, interaction is formalized, remarkably in the pre-tender phase, where the competitive setting and the requirements for equal treatment of the suppliers restrict open information exchange and socializing. As long as there is no indication of future cooperation, the suppliers too are careful in exchanging information. This kind of

short-term interaction prevents trust-building, even questioning the necessity of pre-tender phase interaction (Holma, 2019).

Other studies describe the creation of public-private network-type arrangements promoted between public and private sector organizations, which are deemed to have potential as forms of collaboration with greater flexibility where actors enter and exit (Mittilä and Lappälahti, 2004; Finke et al., 2016). These networks can be inclusive or exclusive, depending on the degree of openness to actors' cooperation (Ritvala and Salmi, 2012). In exclusive cases, longer-term cooperation takes place among selected actors, while in inclusive networks anyone making a commitment can participate. This has an impact on the alignment of goals as in the former case, goals are set through negotiation and roles are clearly defined, while in the latter they are less clear. Depending on how extensive cooperation networks are being created, paths present differences, with inclusive nets encompassing many weak ties and exclusive ones with few strong ties (Ritvala and Salmi, 2012).

Studies of Leite and Bengtson (2018) depict public-private cooperation as a complex organizational form and hybrid organizational arrangement influencing value creation. Through cooperation, relationships are built, and knowledge is shared and co-created.

This complexity has also been analyzed in the context of ecosystems (Nätti et al., 2019). In particular, this study shows the importance of adopting a dynamic and emergent process defined as "orchestration". Orchestrating network concerns taking deliberate initiatives for managing processes by creating practices and practicalities about how actors influence knowledge creation and exchange, how to influence identity, appropriability issues (when collaborations contribute to innovations), coordination and organization, like defining roles (Nätti et al., 2019).

Also, as mentioned in the previous paragraph, public-private interaction is often mediated by projects and policy efforts (Munksgaard et al., 2017; Elbe et al., 2018). Public-private interaction within projects happens on different bases and with different dynamics, as projects have peculiar characteristics (temporality, discontinuity, episodic interaction, complexity, and uniqueness) (Kronlid and Baraldi, 2020). Public-private interaction might be often spurred by policy efforts implemented to facilitate this typology of interaction. Indeed, the increased collaboration between the public and private spheres is a widely recognized policy mean to create positive outcomes within defined spatial borders. This is the case shown by the research conducted by Waluszewski et al. (2018), set in the context of Smart Specialization

policies, and by Waluszewski et al. (2019), showing the political expectation behind public-private interaction patterns. Both studies show how policies are based on the idea that policy orchestrated collaborations involving public and private sectors will lead to the achievement of benefits, which, however, do not entail only positive outcomes but also treats public and private interests.

Why

Public-private interaction has been advocated by policymakers at different levels to tackle global challenges since the complexity and intractability of social problems give rise to multi-actor cooperation. Public-private interaction is expected to achieve cost efficiency and innovation. In particular, by combining private sector innovation and financing, and sharing the risks in innovative ways, public-private interaction is expected to provide savings for the public sector and a fair deal for the private one. However, there is a divergent view of the logic and reasons behind public-private interaction and a discrepancy between expected and actual patterns of interaction. Indeed, the assumed pattern neglects interdependencies, interactions, and relationships, while interaction emerging from empirical studies shows that it is naïve to assume that public-private interaction will be uncomplicated and will easily lead to cost-effective solutions (Waluszewski et al., 2019).

Looking at how interaction is explained or perceived by the actors is another way to get an understanding of it (Abrahamsen et al., 2016). Within the selected articles, different motives for increased public-private interaction are shown. First, public-private interaction represents value creation and co-creation opportunities (Leite and Bengtson, 2018; Torvinen and Ulkuniemi, 2016). In terms of social and economic value generated, it is argued that one of the reasons for supporting public-private interaction is because it offers opportunities for value creation and co-creation. Studies conducted by Nissen et al. (2014) and Leite and Bengtson (2018) contribute to this issue, as they stress how interaction and interdependence are the prerequisites for value co-creation. Also, value co-creation occurs most explicitly in collaborative situations where the different partners participate as equals. An important source of value creation and the key to success is represented by resource complementarity. In fact, public-private interaction *"entails accessing and combining the resources, such as skills and capabilities"* (Leite and Bengtson, 2018: 187) of the different actors involved.

Complementarity is then realized when partners share their expertise, resources, know-how, and capabilities. One of the main benefits of public-private interaction is that the different actors can *"focus their efforts according to their own best competencies and knowledge"* (Torvinen and Ulkuniemi, 2016: 65).

Certainly, the reasons for interacting with the public or private side vary and depend on the perspective taken into account, either public or private. The reasons behind collaborating with private companies are mainly to be found in their supporting activities, which they are expected to perform more efficiently, with better quality, decreased costs, and increased flexibility, giving the public organizations the possibility to concentrate on their core activities (Ojala et al., 2008).

For private actors building relationships with public actors provides opportunities for adaptation based on potential partners' specific requests or for initiating contracts to develop new relationships with other potential partners in the public sector (Munksgaard et al., 2017). Even more important is using these relationships as an asset for long-term benefits.

Building relationships within projects represent a useful device for influencing decisions on upcoming projects and meeting new partners, and it allows to access developed relationships for discussing ideas and concepts. As seen above, interacting with the public side also represents an opportunity to enact knowledge creation and knowledge sharing processes. Especially through projects, private firms can collect information and knowledge, networking, and reputational benefits (Munksgaard et al., 2017; Leite and Bengtson, 2018). In this sense, the public actors' contribution mostly lies in non-tangible assets. Building up non-tangible assets is crucial for facilitating cooperation with private companies that differ significantly in terms of culture and organizational aims.

Within networks, it is often some shared objectives, that is the cohesiveness of motives (Leite and Begtson, 2018), that drive the collaboration and provide actors with motivations and horizon for their future actions. Fit development and exploitation of the partner-specific contributions is the most important building block in public-private interaction.

Table 5 provides a summary of the main results of this analysis conducted along the identified interaction dimensions to answer the research questions outlined.

W-question	Public-private interaction features
Who?	- Public actors: mainly political actors and universities - Private actors: no indications on the size of firms, but rather impact of previous experience and particular industries (health and construction) - Emergence of an intermediary role played by public actors
What?	- Idea of the content of interaction affecting both sides of the interaction interface and requiring active engagement from both parties - Interaction taking place within projects activities, shaped by temporality and time-constraints - Knowledge creation, co-creation, and sharing through cooperative and collaborative forms of interaction - Impact of heterogeneity between actors
How?	- Combination of formal and informal interaction mechanisms - Existence of inclusive and exclusive networks - Creation of hybrid arrangements - Spurred by policy measures
Why?	- Opportunities for value creation and co-creation - Efficiency and flexibility - Opportunities for adaptation and an asset for long-term benefits - Access to tangible and non-tangible resources

Table 3 *Summary of the results of the analysis*

5. Conclusions

This paper presented a literature review on the state-of-the-art of public-private research in IMP aimed at enhancing our understanding of extant literature by addressing two research questions concerning the typologies of public actors identified, their role, as well as features and mechanisms of public-private interaction.

Starting from a preliminary analysis concerning how IMP studies have tried to include actors not belonging to the category of business actors, the study originates with a recognition

of the multidimensionality of actors and of the relevance of such actors in the light of the growing complexity of the business context and recognizes the focus within recent IMP studies on policy-making related to business activities (Hoholm and Araujo, 2017; Guercini and Tunisini, 2017), which implies adopting a more comprehensive perspective taking into account also non-business objectives and non-business processes. This attention is also due to the focus on the key themes of internationalization, innovation, and sustainability, which show complex features that affect and are affected by technological, social, and institutional settings. These new modes of interaction seem to lead to new forms of interdependence, based on different rules and also on new balances of power showing different features when compared to a business setting.

The two research questions identified had the purpose of addressing the primary and leading findings of the literature on this ever-changing issue by focusing on central dimensions of interaction, that is, the unit of analysis when exploring public-private interaction (who), what happens in public-private interaction, how the public and private actors involved make sense of involving in interaction respectively with private and public actors (why).

On the first question, concerning the nature of actors engaged in this kind of interaction, a wide variety of actors belonging to the public and private side have been acknowledged, with public actors mainly being universities and research centers or pertaining to the political sphere. An interesting finding is the presence of actors not directly involved in public-private interaction, but indirectly acting as intermediaries and fulfilling different roles (Dóra and Szalkai, 2020; Keränen, 2017a; Keränen, 2017b; Salmi and Heikkilä, 2015).

The second research question concerning the interaction itself has been addressed by answering the remaining questions of the framework identified. With regard to the "what" dimension, a certain consensus regarding distinctive features of public-private interaction has been reached, including the tensions and challenges deriving from heterogeneity (Nissen et al., 2014; Finke et al., 2016; Ojala et al., 2008; Mattsson and Andersson, 2019), and finally the typology of knowledge shared and created in interaction.

The dimension related to the "how" of public-private interaction mainly addresses how such interaction is implemented. Studies have shown the high degree of formalization of such interaction, outlining the positive and negative aspects it brings (Torvinen and Ulkuniemi, 2016; Howard et al., 2016).

On the modalities of interaction, studies have shown the importance of combining both formal and informal mechanisms, as well as direct and indirect mechanisms (Torvinen and Ulkuniemi, 2016), which lead to a balance between collaborative and cooperative interaction forms of sharing knowledge (Nissen et al., 2014). Also, investigations have pointed out projects and policy initiatives as a mediation tool for public-private interaction, affecting it due to their characteristics and traits (Kronlid and Baraldi, 2020; Munksgaard et al., 2017; Elbe et al., 2018).

Finally, the "why" of engaging in public-private interaction has been a widely explored dimension in the literature. Different motives are at stake from the perspective of public and private actors. However, some aspects, such as the discrepancies between what is expected from interaction from the public side and what are the patterns of public-private interaction (Waluszewski et al., 2019), seem to be of paramount importance but still scarcely investigated.

The analysis conducted suggests that while the relevance of actors other than business actors has been recognized and problematized within the literature, research on how these actors interact is still in its infancy. This is consistent with calls for a deeper investigation on public-private interaction mechanisms (Leite and Bengtson, 2018). The breakdown of selected articles clearly shows that "how" and "what", that is, the knowledge on how interaction happens and what are interaction mechanisms, have undergone little analysis, especially in comparison with the "why", that is, the motivations, drivers and barriers of interaction.

5.1. Implications of the study

In terms of research implications, it could be argued that public-private interaction pushes IMP scholars to venture into new research contexts, crossing themes shared with different management streams, such as literature on ecosystems and institutional theory, and also with other disciplines in the social science field, as political science and sociology. This evolution has already been recognized in some of the reviewed contributions; however, the dialogue should increase in both ways: different theories and concepts could further enrich and develop the IMP framework while facing rather under-explored contexts, while the IMP approach and concepts provide useful insights to understand this typology of interaction.

Based on the discussion on public-private interaction, a summary of the state of the art of research has been presented. Adopting an IMP approach focused on interdependencies and embeddedness leads to the further problematization of the issue. In particular, some

implications for research have been raised or partly addressed by the reviewed contributions and might represent a challenge for future studies:

(i). Insights provided by Munksgaard et al. (2017) on the challenges for firms when engaging in interaction with a public counterpart raise the issue of whether researching public-private interaction implies taking a closer look not only at the management of business relationships and its challenges but also further expand the understanding on how to manage relationships involving the public side;

(ii). Different studies have introduced the role of public actors acting as intermediaries, and/or have put forward the presence of a third intermediary actor, leading to triadic relationships (Dóra and Szalkai, 2020; Keränen, 2017a; Keränen, 2017b; Salmi and Heikkilä, 2015). This discussion poses the challenge of how to account for the organizational and individual roles played by such intermediaries and what is their impact on interaction;

(iii). As public-private interaction has been often investigated as occurring within organizational arrangements like public-private innovations (PPI), partnerships (PPP), and public procurement processes, the resulting discussion need to bear in mind the influence of such formal arrangements on interaction mechanisms, value creation, and value capturing mechanisms (Leite and Bengtson, 2018);

(iv). One of the articles reviewed (Nätti et al., 2019) has brought up the challenge of orchestration within networks, defined as deliberate and purposeful activities aimed at creating practicalities, suggesting that these initiatives are undertaken by the public organizations. As orchestration is assuming increasing relevance as a factor sustaining the enacting of resources' combination and activities' link (Tunisini and Marchiori, 2020), an emerging challenge concerns understanding the categories of roles assumed for orchestration and how to use this tool to create or co-create value.

The present study has implications for firm management as, regardless of the organization's features such as size and industry, it is important to reflect on the consequences deriving from engaging in interaction with the public side. First, as discussed in the study conducted by Munksgaard et al. (2017), the burden of dealing with complex relationships requires prioritization and preclusion of interaction and activities. Second, one of the main

imperatives is understanding the internal and cultural differences and bridging them, and being aware of the social and material resources needed (Waluszewski et al., 2019). Also, it is crucial to interact at the various public organizational levels, by building an understanding of specific working procedures and needs and by adopting innovative solutions. Finally, managers should be active in the creation of knowledge sharing routines and practices, with the scope of building mechanisms to collaborate, enhancing trust and commitment, which are key elements in reinforcing ties and moderate tensions between public and private actors (Keränen, 2017a).

From the analysis, some consequences in terms of policy implications and for the public side are drawn. Understanding public-private interaction features is also extremely relevant for policymakers; therefore, as suggested by the study of Andersson and Mattsson (2018), public actors need to rethink policies so to participate in value co-creation activities and to interfere actively, that is, initiating and handling dynamics in the created interface (Waluszewski et al., 2019). Public-private interaction is often shaped by the temporality and short-term aim of the initiatives and projects underlying this interaction. In the light of this recognized barrier to the development of long-term public-private relationships, a "policy network" should be envisioned by the public side with the aim to create continuity and to promote long-term partnerships and relationships, which in turn would benefit the interaction through increased access to resources and information, reduced transaction costs, improved contract specifications but also leading to increased transparency and clearer rules and procedures.

5.2. Avenues for future research on public-private interaction

The structured literature review on public-private interaction has provided a state-of-the-art of public-private interaction research and, at the same time, has pointed at some key emerging issues. Still, this study presents some limitations which open avenue for future research.

In this sense, the keywords employed for the literature review are strictly connected to public-private interaction. As already argued, this is in line with how studies have addressed the issue and gave the possibility to account for the debate within IMP on public-private interaction. However, this excluded those contributions not containing the words "public-private interaction" but referring to specific typologies of interaction between firms and a specific public counterpart or being more focused on the public side of the interaction.

Therefore, to fully address the unique facets of different typologies of public-private interaction, articles dealing with specific categories of actors should be collected. This would help in better encompassing emerging streams of university-industry interaction and interaction with support actors, as incubators or technology transfer offices, which are gaining ground in empirical research, and to investigate how they enable or constraints the development of firms' networks (Shih and Aaboen, 2019), and how they embed into other key relationships with customers and suppliers (Baraldi et al., 2020).

An increasing focus on understanding the features of public and private actors in interaction would imply considering their articulation and internal configuration as organizations and as entities across spatial contexts – exploring the local, national and supranational dimensions, which play a key role in internationalization and innovation processes. In line with IMP goals, this could increase the proximity of research to the changing business realities, for example in social innovation projects that could involve a variety of political, research and educational, and business actors. This orientation could imply further theoretical effort in using and developing relevant concepts such as the focal actor or triads.

As mentioned, starting from the w- and h- questions on public-private interaction, emerging streams and challenges emerge, which deserves further investigation and may be considered as direction for future research.

In particular, concerning the "who" of public-private interaction, early insights on the role played by public and private actors when interacting have been provided. However, the dynamics and dynamism of these roles, as how they transition and adapt over time have still not been address.

Further, as mentioned by studies of Nissen et al. (2014), dealing with public-private interaction means coping with heterogeneous teams. This implies that there might be misalignment between individuals belonging to different organizations. Future research should be directed towards a deeper understanding of social capital within public-private interaction and of the impact of this on value creation mechanisms.

Relating to the "why" of interactions, this emerges as one of the most investigated dimensions in reviewed studies. Interdependence among actors' motivations is extremely relevant for policymakers, and future research should extensively analyze the typologies of policy tools to be implemented. A particular issue that deserves to be explored more in-depth

concerns the cohesiveness (or disjointedness) of motives for engaging in public-private interaction and its impact on value-creation mechanisms.

As the "how" question has emerged as a very relevant but under-investigated one, understanding network governance mechanisms is of paramount importance as it could provide tools to influence knowledge processes, identity, coordination, and organization.

Another issue is that, while this study has addressed these questions individually in order to provide an understanding of the different features of public-private interaction and how these have been addressed within IMP, interesting research opportunities and impactful contributions could arise from the combination of these questions. These questions are strongly interconnected; indeed, it seems plausible that the motivation to engage in such interaction may vary depending on the characteristics of the private and the public side; or that drivers and barriers differ when accounting for different industries and degrees of formalization of interaction. Preliminary indications have been proposed concerning the interconnectedness of the two dimensions of "how" and "what", since the content of interaction shapes the mechanisms of interaction (formal or informal), but at the same time, it is the modality that could shape the typology of content exchange.

Finally, conducting a preliminary analysis on the non-business dimension of business networks has highlighted that studies on non-business actors and public-private interaction dynamics seem to be two unrelated logics in the literature. Future studies should foster a dialogue and link between these two streams by making explicit how they could stimulate and contribute to each other.

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Appendix A: Table of collected papers

AUTHOR(S)	TITLE	YEAR	SOURCE
Andersson, P., Mattsson, L.-G.	Digital Transformation Supporting Public Service Innovation for Sustainable development – Business modelling interacting with "public service provision modelling"	2018	IMP conference proceeding
Andresen, E., Lundberg, H.	Networked Co-opetitive Business Model Innovation	2016	IMP conference proceeding
Andresen., E., Bjorkqvist, O., Stengard, K.	Business network and corporate sustainability view on value co-creation as part of business model innovation – a case study of district heating companies in Sweden	2018	IMP conference proceeding
Bygballe, L., Flyngansvaer, B., Harrison, D.	Recycling in the city: mobilising resources in initiating a circular economy in the construction sector	2019	IMP conference proceeding
Cova, B., Salle, R.	Shaping Projects: A Case Study of Unsolicited Proposals in Public Private Partnership	2011	IMP conference proceeding
Dóra, T.B., Szalkai, Z.	The impacts of a new type of actor as an intermediary in public-private collaboration in health-care prevention	2020	Journal of Business & Industrial Marketing
Elbe, J., Gebert Persson, S., Sjöstrand, F., Ågren, K.	Network approach to public-private organizing of destinations	2018	IMP Journal
Finke, T., Gilchrist, A., Mouzas, S.	Why companies fail to respond to climate change: Collective inaction as an outcome of barriers to interaction	2016	Industrial Marketing Management
Guercini, S., Milanesi, M., Runfola, A.	Bridges to sustainable health systems: public-private interaction for market access	2020	Journal of Business & Industrial Marketing
Holma, A.	Early buyer-supplier interaction in public procurement context: dyadic perceptions	2019	IMP conference proceeding
Howard, M., Wu, Z.H., Caldwell, N., Jia, F., Konig, C.	Performance-based contracting in the defense industry: Exploring triadic dynamics between government, OEMs and suppliers	2016	Industrial Marketing Management
Kar, A., Butler, B., Thein, H.H.	Power relationships and network evolution in a state-dominant business environment	2019	IMP conference proceeding
Keränen, O.	Dynamics of the transition process towards partnership thinking in centralized public procurement	2017	Industrial Marketing Management
Keränen, O.	Roles for developing public-private partnerships in centralized public procurement	2017	Industrial Marketing Management
Keränen, O.	Innovative public procurement practices – lessons learned from home nursing procurement	2016	IMP conference proceeding
Kronlid, C., Baraldi, E.	Time-constrained interactions in public-private collaboration projects. The case of ENABLE	2020	Journal of Business & Industrial Marketing
Leite, E., Bengtson, A.	A business network view on value creation and capture in public-private cooperation	2018	Industrial Marketing Management
Mittilä, T., Leppälahti, T.,	Local authority's ability in network context	2004	IMP conference proceeding
Mattsson, L.-G., Andersson, P.	Private-public interaction in public service innovation processes– business model challenges for a start-up EdTech firm	2019	Journal of Business & Industrial Marketing

Milanesi, M., Guercini, S.	Networks for universities' third mission and research activities	2019	IMP conference proceeding
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Torvinen, H., Ulkuniemi, P.	End-user engagement within innovative public procurement practices: A case study on public-private partnership procurement	2016	Industrial Marketing Management
Waluszewski, A., Håkansson, H., Snehota, I.	The public-private partnership (PPP) disaster of a new hospital – expected political and existing business interaction patterns	2019	Journal of Business & Industrial Marketing
Waluszewski, A., Eklinder-Frick, J., Perna, A.	Public and Private interest – The case of EU's "Smart Specialisation"	2018	IMP conference proceeding
Waluszewski, A., Snehota, I.	Editorial	2017	IMP Journal

Chapter III

The dissemination mechanisms of Industry 4.0 knowledge in traditional industrial districts: evidence from Italy [8]

Abstract

This paper examines the dissemination of Industry 4.0-related knowledge in industrial districts (IDs). It does so thanks to a qualitative case study, through which the main mechanisms of the diffusion of I4.0 knowledge, as the main factors shaping such diffusion, will be explored. The application context is an Italian ID, Pesaro, which is active in a traditional sector, namely that of furniture/woodworking machinery, representing a "periphery" of the I4.0 application context. Results show that within IDs the emergence of new players, activities, and resources, and the complexity characterizing I4.0 require a combination of traditional mechanisms with innovative ones. This combination leads to three main evolving patterns: i) the horizon of I4.0 upgrading shows blurred boundaries in terms of sectors and geographic location; ii) the I4.0 diffusion appears fragmented in terms of initiatives and projects both by firms and institutions; iii) the dissemination of I4.0 knowledge pushes ID firms and institutions to pursue deliberate initiatives leading to innovative forms of "collective" cooperation. This paper contributes to the literature on innovation in IDs and clusters, as it provides further research on I4.0, in particular, it adds to the stream of research on knowledge creation and diffusion in IDs and clusters, providing empirically-based insights into emerging local learning processes. Finally, relevant managerial and policy implications are drawn from the analysis.

Keywords: Innovation, Policy, Industry 4.0, Knowledge diffusion, Industrial districts

[8] Please note that this chapter largely presents extracts of the following article published in May 2020: Pagano, A., Carloni, E., Galvani, S., and Bocconcelli, R. (2020). The dissemination mechanisms of Industry 4.0 knowledge in traditional industrial districts: evidence from Italy. *Competitiveness Review: An International Business Journal, 31*(1), 27-53.

1. Introduction

Firms agglomeration is a relevant phenomenon for economic and industrial development. Economics and management scholars have examined the features and the evolution of industrial districts (IDs) and clusters, leading to relevant conceptual developments (Porter, 1998; Lazzeretti et al., 2014). In the last decade, a stronger effort has been placed on providing a better understanding of the evolution of IDs and clusters (Camuffo and Grandinetti, 2011; Belussi and Sedita, 2012; Fornahl et al., 2015), with a main focus on the changes in their knowledge processes (Alberti and Pizzurno, 2015), and on the opening to outside sources, especially on the effects of such opening on local knowledge circulation and exchange (Waxell and Malberg, 2007; Belussi and Sedita, 2012).

Concepts such as "local buzz" and "global pipelines" (Bathelt et al., 2004) have been adopted widely and progressively perfected in order to enhance the understanding of these processes, and are strongly affecting IDs active in traditional sectors, which might be less prompt, in terms of business and technical culture, to absorb technological innovations developed elsewhere (Parrilli, 2009; De Marchi et al., 2017).

An important role in this pattern of changes is played by the interaction between public and private actors within clusters. This interaction has been highlighted as influencing changes and innovation, thanks to the organization of synergies and to cross-fertilization processes. In particular, public actors may enhance existing ties and facilitate initiating interaction among parties (Crespin-Mazet et al., 2013).

Another key phenomenon for economic and industrial development is the emergence of the Industry 4.0 (hereafter I4.0) paradigm. I4.0 can be viewed as the forefront of technological and organizational innovations related to current advancements' exploitation of information technologies (Kagermann et al., 2013; Fitzgerald et al., 2014).

The surge of the I4.0 paradigm is pushing scholars to explore its diffusion, in terms of adoption processes in business firms (Horváth and Szabó, 2019) and of its overall impact on companies (Barrett et al., 2015; Arnold et al., 2016; Müller et al., 2018). In-depth empirical analyses of I4.0 diffusion in industrial clusters are still limited.

A few insightful recent studies have started to assess whether and how the I4.0 approach is diffused within IDs and clusters and whether its technological and organizational underpinnings could match the underlying inter-organizational processes in contemporary industrial clusters (Götz and Jankowska, 2017; Hervas-Oliver et al., 2019). This initial research

effort is mainly focused on specific institutional projects, within the policy setting, related to the introduction of I4.0, while less emphasis is placed on exploring the variety of knowledge diffusion initiatives promoted autonomously both by business and non-business actors within the ID, whose combination could generate increased awareness and interest among ID firms.

Therefore, the objective of this paper is to provide a contribution to the patterns of diffusion of I4.0 in IDs through the analysis of the main dissemination mechanisms and of the key factors shaping such processes. The main focus is on dissemination processes in IDs active in traditional industries in order to analyze whether and how the I4.0 approach is diffused in apparently culturally distant business agglomerations, representing the "periphery" of the I4.0 application context (Eder, 2019). The research question addressed in this paper is the following:

How is Industry 4.0 related-knowledge spread in IDs active in traditional industries?

Thus, this paper represents a complementary contribution in the emerging research on I4.0 diffusion in IDs (Götz and Jankowska, 2017; Hervas-Oliver et al., 2019), in the light of its focus on the main dissemination mechanisms. Such research orientation provides useful insights to the growing stream of studies on knowledge creation and on learning processes in IDs and clusters, placing emphasis on the degree of opening to outside sources of knowledge and on the main diffusion mechanisms (Belussi and Sedita, 2012; Balland et al., 2016; Maghssudipour et al., 2020).

In order to answer this explorative RQ, a qualitative research methodology based on a case-study approach is adopted. Notably, this paper is focused on the analysis of the furniture/woodworking machinery industrial district located in Pesaro, in Centre Italy. The ID under investigation has been active in a traditional sector – furniture/mechatronic – and has been greatly impacted by the economic crisis started in 2007-2008, showing a high degree of resilience. In recent years, the cluster has been characterized by various initiatives, both at the firm and institutional level, aimed to promote both technological and organizational upgrading of district firms, with an increasing focus on I4.0 solutions.

The empirical analysis relies on the ARA (Activities-Resources-Actors) model (Håkansson and Snehota, 1995) developed in the Business Network approach of the Industrial Marketing and Purchasing (IMP) group (Håkansson et al., 2009). The ARA framework allows catching the complexity of the I4.0 knowledge diffusion in our empirical setting, represented

by a traditional Italian ID. Remarkably, traditional Italian IDs have already been acknowledged as having a network-like structure based on a variety of key business relationships among different actors, playing a major role in the local diffusion of innovation (Bocconcelli et al., 2015).

Results show the upgrading in the type of knowledge dissemination mechanisms adopted in the ID. The complexity of I4.0 seems to require a combination of traditional mechanisms, shaped by the existing interaction patterns of the Pesaro ID, with innovative ones characterized by the emergence of new players, activities, and resources. These changes lead to three main evolving patterns: i) the horizon of I4.0 upgrading shows blurred boundaries in terms of sectors and geographic location; ii) the I4.0 diffusion appears fragmented in terms of initiatives and projects by both firms and institutions; iii) the dissemination of I4.0 knowledge pushes ID firms and institutions to pursue deliberate initiatives leading to innovative forms of "collective" cooperation.

The chapter is structured as follows. Section two is devoted to the analysis of the literature on knowledge and innovation diffusion in IDs and on the emergence of I4.0 and its impact on firms and IDs. In the third section, the research objective and methodology are addressed. In section four, after a brief presentation on the historical evolution of the Pesaro ID, the main findings reached through the empirical research are presented along three main phases of the diffusion and dissemination of I4.0 knowledge: i) the pioneering phase; ii) the dissemination effort; iii) the pursue of institutional upgrading. Section five proposes the results of the analysis. The last section highlights the main contribution of the study, discusses the future lines of research, and outlines the main managerial and policy implications.

2. Literature Background

2.1. Innovation processes and knowledge exchanges in industrial districts

IDs represent a relevant and complex phenomenon in industrial organization, which has been extensively studied in the economics and management fields, under various perspectives (Belussi and Pilotti, 2002; Pietrobelli and Rabellotti, 2004; Ingstrup, 2013; Lazzeretti et al., 2014; Hervas-Oliver et al., 2015). The increased interest in firms' agglomeration has spurred many streams of research – in both conceptual and empirical terms – over the themes of IDs,

clusters, and clustering processes (Speldekamp et al., 2020). Lazzeretti et al. (2014: 22) "*identify the ID as a particular kind of a more general category of clusters*". As the focus of this study is a traditional ID, the existing literature on knowledge creation and innovation in IDs is discussed and integrated with concepts deriving from the recent relevant contributions on clusters.

IDs have been defined by Becattini (1990: 39) as "*a socio-territorial entity which is characterized by the active presence of both a community of people and a population of firms in a naturally and historically bounded area*". IDs are a complex form of industrial organization, whose main elements are the local production network composed of a population of firms, the community of people sharing a feeling of belonging and common identity, the presence of the so-called "industrial atmosphere" (Marshall, 1920; Molina-Morales, 2002; Belussi and Pilotti, 2002; Boix and Galletto, 2009).

IDs are characterized by a division of labor among local firms around a specialized sector, leading to increased efficient exchanges and external economies (Marshall, 1920; Becattini, 1991). Besides firms, IDs are influenced by the behavior of other key actors, such as local institutions, training organizations, business associations, and technological centers. These actors provide resources in terms of financial, normative, and technical support (Coletti, 2010; Belussi and Sedita, 2012). A complex web of relationships as such, which includes both business and non-business actors, is embedded in strong social ties, fostering trust and a sense of community in local networks (Dei Ottati, 1994; Belussi and Pilotti, 2002), that leads to a shared identity (Staber and Sautter, 2011).

A stream of research has focused on ID's evolution processes, leading to mature stages, as well as to their decline (Belussi and Sedita, 2009; Hervas-Oliver and Albors-Garrigos, 2014; Fornahl et al., 2015). Understanding how and why they evolve has been a key concern for scholars, who have pointed out two main inter-related patterns: the opening of the ID and the incremental innovation path.

Various contributions highlight the incremental opening of the ID system due to the behavior of ID firms creating business and technological linkages with actors outside the local ID (Becattini and Rullani, 1996; Camuffo and Grandinetti, 2011, Belussi and Sedita, 2012; De Marchi and Grandinetti, 2016). This has led to a reconfiguration of local relationships, which are then combined with new emerging partnerships with other firms and organizations, often

located in other districts. This orientation has been pursued mainly by large firms, which have displayed increased autonomy in their strategic behavior.

One of the consequences has been the weakening of social ties and the reduced role of key actors, such as institutions and business associations (Camuffo and Grandinetti, 2011). A related pattern shaping the evolution of IDs concerns their technological trajectory, influenced by the type and degree of innovation, and by the learning processes in place, generated through the interaction within and outside the ID (Camuffo and Grandinetti, 2011; Belussi and Sedita, 2012; Hervas-Oliver et al., 2018).

One of the advantages possessed by IDs is their efficiency in stimulating the creation of new knowledge and in promoting local learning mechanisms (Belussi and Pilotti, 2002). Thus, IDs may be interpreted as cognitive labs or systems, as they are characterized by a high density of knowledge accumulation, elaboration, and circulation, by means of various transfer mechanisms, such as inter-organizational and interpersonal relations, observation or artifacts and actions, mobility of human resources, creation of new ventures (Becattini and Rullani, 1996; Maskell, 2001; Camuffo and Grandinetti, 2011; Grandinetti, 2011).

Various studies claim that spatial proximity in existing localized overlapping networks facilitates knowledge sharing and thus innovation in clusters (Belussi and Pilotti, 2002; Carbonara, 2004; Boix and Galletto, 2009; Alberti and Pizzurno, 2015). Local networks function as key vehicles of knowledge transfer and diffusion: being in the right place is necessary but being in the right network is of utmost importance (Boschma and Ter Wal, 2007).

However, geographical proximity is not enough *per se* to understand innovation in local industrial networks (Alberti and Pizzurno, 2015; Crespin-Mazet et al., 2013). In fact, even when they belong to the same cluster, firms might have a different degree of access to knowledge, depending on other factors: institutional, cognitive, organizational, social, resource-based, coordination proximity, and absorptive capacity (Cohen and Levinthal, 1990; Giuliani, 2005; Camuffo and Grandinetti, 2011; Crespin-Mazet et al., 2013).

Innovation is the outcome of the "*heterogenous recombination of a broader set of knowledge types*" (Alberti and Pizzurno, 2015: 270), that is, technological, managerial, and market knowledge, and thus it should be considered as a synergy of a firm's internal and external resources, that is, respectively, absorptive capacity and relational resources (Hervas-Oliver and Albors-Garrigos, 2009).

Interactive learning processes in IDs and clusters are organized in different ways, depending on the tacit or codified nature of knowledge. A distinction is made between the concept of "local buzz" and that of "global pipelines": local buzz refers to *"the learning processes taking place among actors embedded in a community by just being there"*, whereas global pipelines concerns *"the knowledge attained by investing in building channels of communications to selected providers located in outside the local milieu"* (Bathelt et al., 2004: 31).

Recent studies have shown the increasing variety and complexity of learning mechanisms and processes, which rely on a mix of emergent (informal) and deliberate (formal) knowledge structures, implemented locally and/or in connection with actors outside the ID (Belussi and Sedita, 2012). Emerging or informal structures are activated unintentionally through networking and personal contacts, while deliberate or formal structures are planned, as R&D interactions with distant partners (Belussi and Sedita, 2012; Lazzeretti and Capone, 2016).

The literature on knowledge exchange in IDs and clusters has focused on the role of specific actors, the "gatekeepers", in the local dissemination of knowledge, in light of their "*ability to access external knowledge and construct a conversion process which deciphers external knowledge and turns it into something locally understandable and useful*" (Hervas-Oliver and Albors-Garrigo, 2014: 431). Their role as brokers is concerned with searching for, absorbing, and matching internal and external sources of knowledge and then disseminating the resulting knowledge within the cluster (Giuliani and Bell, 2005; Boschma and Ter Wal, 2007; Morrison, 2008; Hervas-Oliver and Albors-Garrigos, 2014).

The role of gatekeeper can be played by leading firms within the cluster (Morrison, 2008; Belussi and Caloffi, 2018) and by institutions, research centers, universities, business associations, and knowledge providers that operate as local/global cognitive interfaces (Grandinetti, 2011).

Leader firms, which are oriented to medium-long strategic views, tend to introduce complex innovations within the cluster and to influence the decisions of the local institutional actors (Albino et al., 1998; Corò and Grandinetti, 1999; Boschma and Ter Wal, 2007; Chiarvesio et al., 2010).

On the contrary, knowledge providers and local institutions carry on activities to support the ID firms, as they offer support services and at the same time provide innovation

opportunities, acting as a repository of knowledge. Their role can be described as intermediary agents since they can act as brokers for the development of relationships between district firms and potential external exchange partners (Molina-Morales et al., 2002; Hervas-Oliver et al., 2012; Belso-Martinez, 2018).

A few studies investigate the role of universities as gatekeepers in IDs (Camuffo and Grandinetti, 2011; Capó-Vicedo et al., 2013). Then, universities, in some cases, represent key knowledge providers since they are a source of specialized and updated knowledge, thanks to their international research networks' pipelines (Muscio et al., 2012).

Innovation and learning processes in IDs are affected by the growing digitalization of business processes and inter-firm interaction (Biggiero, 2006; Hervas-Oliver et al., 2019). Digitalization questions the dichotomy of local buzz and global pipelines introduced by Bathelt et al. (2004), as buzzes have started to appear in distant networks through internet-based applications. These applications might generate a "*buzz without being there*" (Moodysson, 2008: 452).

Even if there seems to be a contradiction between firms' agglomerations promoting localized learning and new technologies, enabling worldwide dispersion of activities, it has been argued that these two patterns are not exclusive: IDs and clusters are of utmost importance because they could provide mechanisms facilitating knowledge development and dissemination. In account of that, they represent the possible answer to many challenges brought up by digitalization (Götz and Jankowska, 2017).

Finally, recent contributions highlight that the path towards digitalization in IDs and clusters could be affected by introducing I4.0-related knowledge and technologies considered a "disruptive innovation" (Hervas-Oliver et al., 2018). The next section will explore the nature of I4.0 technologies and the recent contributions in the literature on I4.0 in IDs and clusters.

2.2. The Emergence of Industry 4.0

In the contemporary business environment, I4.0 has become a buzzword. Managers and entrepreneurs are investing in I4.0, and factories are becoming "smart factories". The term "Industry 4.0" was first used by the German government in 2011, when Kagermann and colleagues authored an article about high-tech strategies to be applied in the country by 2020. In 2013, the "Industry 4.0 manifesto" was diffused by the German National Academy of

Science and Engineering (Kagermann et al., 2013). The concept of I4.0 *"is often referred to as the fourth industrial revolution and embraces a set of technological advances that are having a high impact in the current industrial landscape"* (Pereira and Romero, 2017: 1208).

Three are the main improvements that a company can achieve thanks to the introduction of I4.0 technologies: *"digitization of production-information systems for management and production planning, automation-systems for data acquisition from the production lines and using machines [and] linking manufacturing sites in a comprehensive supply chain"* (Roblek et al., 2016: 2).

Several studies investigated the achieved level of adoption of I4.0 technologies by companies (Brancati and Maresca, 2017; Digital 360 Research, 2017; Brozzi et al., 2018), showing a substantial level of diffusion, even if a higher pace of adoption is expected in the next years and, predictably, the rate of adoption in large companies will be greater than the one in smaller firms (Brancati and Maresca, 2017). However, despite an increasing rate of adoption of I4.0 technologies, these studies show a general lack of awareness about the potential business value they can generate, particularly by small firms (Osservatorio Industria 4.0, 2018; AmCham, 2018). What is still missed by firms is an overall account of the possible directions towards which the I4.0 innovation can lead them. Companies understand the relevance of the I4.0 change, but they are still not able to foresee its possible future developments.

I4.0 as a set of new technologies does not constitute a disruptive change *per se*. Nonetheless, the use of I4.0 technologies does imply a disruptive change in firms when this change is considered in relation to the set of external and internal managerial implications to achieve major business improvements (Hervas-Oliver et al., 2019). Internal changes refer mainly to changes in operations, production lines, technical and digital tools (Frank et al., 2019), while external changes concern the relationships with suppliers and customers, the integration of new subjects as consultants or KIBS, and the changing roles of firms in their networks (Hein et al., 2019; Sklyar et al., 2019a, 2019b).

In the context of IDs, it is challenging to assess the future implications of I4.0, partially because adopting disruptive innovations in IDs is extraordinarily complex due to the nature of IDs, which tend to innovate incrementally. The literature on this topic is still limited. Hervas-Oliver et al. (2019) analyze the successful implementation of a place-based project of I4.0 in the Castellon ceramic tile district. This study underlines a bottom-up approach of policies, based

on the involvement of relevant stakeholders and collective actors in decisional processes, directed to generate spillovers and I4.0 innovation at the regional level.

On the same wavelength is the work of Götz and Jankowska (2017) on formal clusters and I4.0 industrial transformation. They argue that the knowledge diffusion mechanisms in clusters could facilitate the upgrading in firms and institutions. Both studies look at empirical settings where institutional actors play a leading role in diffusing I4.0 knowledge in IDs and local clusters.

This initial stimulating research effort could be enriched by further empirical evidence on the variety of knowledge dissemination mechanisms related to I4.0 technologies and involving both business and non-business actors in IDs.

3. Research objectives and methodology

This research aims to investigate the process of diffusion of I4.0 related-knowledge within a traditional Italian ID. The explorative nature of the outlined research question, which aims to unveil the process of spreading of I4.0-related knowledge within a particular context (i.e., an ID), required the collection of rich empirical data around that cluster and, therefore, the use of a qualitative methodology.

This paper applies a single case study methodology (Yin, 2014) of an industrial cluster located in Center Italy, the Pesaro industrial district, specialized in the furniture and woodworking machinery sector. Consistent with extant work on clusters and IDs, the unit of analysis is the ID itself (Mitchell et al., 2014). The main advantage of such methodology is local groundedness which helps to overcome limitations of quantitative analysis, uncovering latent and basic social and institutional dynamics that underpin patterns of interaction (Samarra and Belussi, 2006; Wolfe and Gertler, 2004). Moreover, case study method has already been proven effective in the analysis of the specific issue under investigation in this research (Belussi and Sedita, 2012; Hervas-Oliver et al., 2019).

The cluster has been chosen according to two distinct criteria: i) its specialization in a traditional industrial sector (furniture/mechatronics); ii) available evidence of undergoing projects related to I4.0 implemented by both local institutions and businesses.

The empirical study is designed to have an overview as complete as possible on the I4.0 related-knowledge diffusion within the cluster. Different sources of data have been employed

consistently. The first data source is one-to-one, in-depth semi-structured open-ended interviews (Cavana et al., 2001). In order to select interviewees, we compiled a list of companies, institutions (universities, industry associations), professional consultants based on local and public industry documents and on two interviews with a key informant and with a representative of the local Industrial Association. Within these categories, we chose potential participants based on the preliminary information collected, and we asked them to participate in the interview process. 18 in-depth interviews have been completed during a four-month period over September 2019 and January 2020. In some cases, for the more relevant companies/organizations, different people in different positions have been interviewed in order to triangulate data and to have different perspectives (see Table 1). The interviews lasted approximately 1 hour each, and they were, in some cases, supplemented by written notes of the interviewer. All the interviews were recorded and transcribed *verbatim*.

Company/Organization/Institution	**Interviewees**
ACCENTURE Consultancy	Senior Manager
BERLONI BAGNO Furniture	Accounting Manager
BIESSE Mechatronics/woodworking machineries	Innovation Manager
	Service Marketing Assistant
	Sophia Ambassador
CLUSTER MARCHE Regional Institution	Cluster Project Manager
CONFINDUSTRIA Industrial Association	Fiscal and Financial Representative
COSMOB Furniture Consortium	General Manager
	Post-Doc Industrial Researcher (from University of Urbino)
IMAB Furniture	HR & Organization Manager
	Technical Area Manager
LC MOBILI Furniture	Purchasing and Production Director

UNIVERSITY OF URBINO	Professor of Quality Management - Tutor for a post-doc industrial position in I4.0
	Professor of Business Management - Supervisor Industrial PhD student (Biesse)
	Professor of Computer Science - Representative for Uniurb in the Stakeholders' table for INNOPROVEMENT project
	Professor of Computer Science - Expert in Machine learning and IoT
	KTO Representative
SINERGIA CONSULENZE Consultancy	Founder and Senior Partner

Table 1 *Interviewees' profile*

A second important data source is represented by the mapping of what has been labelled by the authors as knowledge dissemination "initiatives". These include all the activities prompted by different institutions (Regional Government, universities, business associations, technology centers) and businesses in order to widen and circulate information on I4.0 related-knowledge. Six typologies of dissemination initiatives have emerged: workshops and conferences; training courses; R&D projects; non-research business partnerships; industrial PhD scholarships; public tenders. This classification is based on categories used in the ID/cluster literature (Alberti and Pizzurno, 2015; Calignano et al., 2018). Each initiative has been coded in terms of promoters, duration, membership, content, and project horizon.

Dissemination initiatives were identified through official websites of the European Union, the Italian Government, as well as the websites of Regional Institutions, such as Marche Region and Cluster Marche, and of local actors, namely firms, technology centers, universities. Also, research through newspapers' articles, annual reports from local knowledge providers, projects presentations and reports, and regional guidelines released from the Regional Government has been used to map the initiatives.

Through interviews and secondary sources, it has been possible to collect and map a total of 83 dissemination initiatives (see Table 2). Each dissemination activity has been classified according to different parameters: organizers and promoters, year, participants, content, level of the initiative, speakers, and follow-up. This mapping of activities allows to have a broad picture of the process of diffusion initiatives of I4.0 knowledge in the ID.

Typology / Year	Workshops and conferences	Training courses	R&D projects	Non-research business partnerships	Industrial PhD scholarships	Public tenders
2014	1	0	0	1	0	0
2015	0	0	0	2	1	0
2016	2	1	3	3	0	0
2017	13	1	0	7	0	1
2018	13	5	4	4	1	1
2019	15	0	0	3	1	0
Total	**44**	**7**	**7**	**20**	**3**	**2**

Table 2 *Mapping of the dissemination activities*

The in-depth interviews with cluster actors and the mapping of the knowledge diffusion initiatives, along with desk-top reviews of secondary data (previous studies, media reports, official documents and internal reports, official statistical data, web-sites, newspapers' interviews), allow us to monitor the process of I4.0 knowledge diffusion over time in the 2015-2019 period, and to introduce the process perspective that is crucial to address the "how" nature of the RQ (Halinen and Törnroos, 2005). The use of difference sources enhances data reliability, due to the composition of data sources and the relevant experience of the interviewees on the issue under investigation. Interviews' content is based on theoretical considerations and asked all interviewees about their role and their perception of knowledge flows and exchange between actors within the district. All data sources have been used to generate questions to be submitted to our interviewees and in order to triangulate information and responses.

In addition, some of the interviewees have been asked to draw Network Pictures. Network pictures are graphical representations of the network of actors and relationships around a specific theme (Ramos and Ford, 2011). This research tool has proven to be particularly useful when dealing with a novel theme such as I4.0 and when different people within an organization are interviewed (Öberg, 2012).

Data analysis follows a systematic combining, that is, an abductive approach has been adopted (Dubois and Gadde, 2002) in line with the explorative nature of the case research, based on a logic of investigation aimed at matching theory and empirical observations

recursively. Systematic combining is suitable for studying a new or under-researched phenomenon while also paying attention to existing theories around the topic (La Rocca et al., 2017).

Finally, the analysis has been coded into common themes related to the diffusion of I4.0 knowledge in order to link empirical observations to theoretical knowledge. Through this process, the question of what already existed in the literature and what is novel has been consistently considered to integrate appropriate literature.

In doing this, we relied on the Actor-Resources-Activities (ARA) model, developed in the IMP approach (Håkansson and Snehota, 1995), as the main analytical framework. Then, the discussion was framed around the three layers: actor, resources, activities. The ARA model is a powerful analytical tool in the data analysis since it allows to unveil *"hidden network processes"* (Ingemansson Havenvid et al., 2016: 100), as well as interactions and relationships between relevant actors, activities, and resources that, from the IMP perspective, are the actual fuel of innovation networks (Rubach et al., 2017). Italian IDs have been recognized as network-like structures based on long-lasting business relationships, notably in the context of learning and knowledge diffusion (Bocconcelli et al., 2015). The case study under investigation has been presented in three different temporal phases (Quintens and Matthyssens, 2010).

4. Empirical findings

In this section, the main empirical findings are discussed. In the following section, a brief description of the Pesaro ID's evolution is provided. Afterward, the trajectory of diffusion and dissemination of I4.0 related-knowledge is developed along the three main phases.

4.1. Evolution of the Pesaro industrial districts

This study is centered on the Pesaro ID, in the Pesaro-Urbino province in the Marche Region, located in Centre Italy. The growth path of the Pesaro district reflects the traditional concept of ID given by literature, as it derives from the proximity of firms in the same and contiguous sector whenever they start to build a network of relationships.

Historically, the Pesaro ID arose in the second post-war period with the appearance of the first furniture firms. Between the 1950s and the 1960s, great growth followed. The first firms to populate the district were mainly small furniture-maker artisans.

Only in the late '60s, the local production of woodworking machinery originated in the same location and, from that point on, the two sectors grew together as a whole ID (Musso, 2000). The following years witnessed a constant development of the ID, with the entrance of new firms and the enlargement of the existing ones, also thanks to a series of mergers and acquisitions by the leading furniture and mechanical companies. In the 2000s, the Pesaro district was already one of the main Italian production sites for the wood-furniture sector, and 35% of the local economy was implemented around the furniture sector (Bocconcelli, 2004). Along with the growth of the economic actors in the ID, new institutional actors have been set up to support the flourishing local wood-furniture sector.

In 1983, the specialized technology center COSMOB was established as a joint initiative of local public bodies, business associations and firms, with the aim of helping local firms to gain competitiveness through the offering of technological services, innovation, and research solutions.

The district has remarkably evolved in time, showing a great dynamism and adaptation capability. The economic crisis of 2007-2008 hit hard the economy of the ID until nearly 2010-2011 and led to a significant decrease in production and turnover. Some well-known companies, as Berloni Furniture and Feba, have experienced crises, while other companies, as IMAB, have grown substantially. Many district SMEs suffered heavily in this period.

However, the overall reaction of the local companies has been positive, and, since 2014, they have been improving their performance, especially thanks to the implementation of product diversification (De Michele and Foresti, 2019). The exporting rate has experienced a great growth from 2009 on, achieving 453 million euro in 2017 (Intesa Sanpaolo, 2018).

In 2018, the Foundation Cluster Marche was established with the support of the Regional Government and the involvement of local leading manufacturing and service firms in order to upgrade the local technological and managerial competences.

In the Pesaro ID, we can identify some leading firms, which represent a focal point for the whole district in terms of innovation and growth. Among them, Biesse for the mechatronic sector (De Michele and Foresti, 2019) and IMAB and Scavolini for the furniture sector can be observed.

The ID experienced a first wave of digitalization projects in the 2014-2015 period, in line with the global trends (Fitzgerald et al., 2014). Nevertheless, the digital change has been pulled primarily by the leading local firms, which invested in digital infrastructures in those years, while SMEs have started gradually to follow the same path only in the last years, implementing their first digital projects (Intesa Sanpaolo, 2018).

Notwithstanding the overall resilience of the ID while facing the economic crisis and the market changes, the degree of cooperation and sense of belonging has decreased in the recent period. Both mechanical and furniture firms have been pursuing more autonomous technological and marketing strategies outside the ID horizon, while both local large and small firms have gradually reduced their involvement and commitment in local business associations and in collective projects.

4.2. The trajectory of diffusion and dissemination of I4.0 knowledge

4.2.1. The pioneering phase

Knowledge over I4.0 in the ID has been first introduced in the years 2015-2016 through the effort of a few local pioneers, mainly large firms, knowledge providers, and universities.

Biesse has started to discuss about I4.0 with one of its key consulting partners, Accenture, which was already involved in other innovative projects. Indeed, Accenture accumulated knowledge about I4.0 technologies, and in particular IoT applications, before cooperating with Biesse, even if in different business sectors. The Biesse CEO Assistant for Innovation underlines the leading role of Biesse in approaching I4.0, at least in the mechanical sector: *"We have been absolutely the first one, the others [competitors] followed us after one or even two years"*.

In 2016, Biesse launched an IoT project, SOPHIA, which, thanks to the installation of sensors in the machinery, allows to receive data about their performance and functioning from customers worldwide. For the design of SOPHIA project, some key competences were already available internally: *"There is no discontinuity, meaning that Biesse invested in internal digitalization for years. In the context of I4.0, Biesse found something already existing that could exactly be part of the stream, the trend of I4.0 […]. Digitization and automation are*

continuous processes in the company, the real discontinuity of I4.0 is the IoT technology" (Innovation Manager - Biesse).

Other local firms not belonging to the furniture/woodworking cluster have started early on with I4.0 projects. Benelli Armi, active in the gun sector, approached I4.0 in 2016 when the Plant Manager took part in a study tour in Stuttgart (Germany) to learn more about the I4.0 industrial model (Fabbrica Futuro, 2018). Benelli Armi started investing in I4.0, especially through the expansion of the industrial plant with space entirely dedicated to I4.0 technologies for completely automated material handling. In particular, it hosts AGV, beacon, and cobots (StartUp Grind, 2018).

Another key local firm not belonging to the furniture ID, is Schnell, which implemented I4.0 technologies already in 2016. The company invested in the adoption of a Robot called APPS with a supporting role in the production line. In the same year, Schnell contacted the Department of Computer Science of the University of Urbino *"[...] just to know more about the opportunities that could stem from I4.0 technologies. [...] They decided to contact us after they had known about Biesse and SOPHIA project. They were curious about the possible applications in their sector. This first contact did not develop further. But I know that some of our students have been hired in Schnell"* (Professor of Computer Science - Expert in Machine learning and IoT - Uniurb).

The dynamism of these companies over the I4.0 trajectory has become visible in the local ID through the press and the local business association, and other companies have started to monitor and follow their evolution. In particular, Benelli Armi has been very open to organizing business meetings and visits to its plants, involving local institutions and companies.

In addition to these high-tech companies, the two local universities, based in Ancona and Urbino, have started R&D projects and courses on I4.0-related themes. The Marche Polytechnic University (Ancona) undertook various research activities and analyses concerning I4.0 in this early phase. This is the case of research and teaching activities in the Engineering Department of the University. In this phase, the University of Urbino, which more focused on social sciences and humanities, began to establish only some contacts with local firms concerning digitalization with the contribution of researchers belonging to the Computer Science Department. The University of Urbino lacked at this time an *ad hoc* strategy with regard to I4.0 collaboration with local firms. In this phase, the only formal initiative was the launch of an Industrial PhD on the themes of I4.0 by the Department of Economics with COSMOB.

The recognition of the potential positive impact of I4.0-related technologies pushed some key local knowledge providers and technological centers to undertake activities to increase their ability to assess and exploit these new technological opportunities.

This is the case of COSMOB, a technology center operating at the international level, dedicated to the furniture sector. COSMOB has been aware of the importance of research on these themes already since 2015-2016 and undertook different initiatives. It participated in a Regional call on Made in Italy and Innovation, not explicitly addressing I4.0, but that paved the way to these themes, involving more than 40 cluster firms. Concurrently, COSMOB financed the previously mentioned PhD position on Additive Manufacturing in collaboration with the Department of Economics of the University of Urbino.

Sinergia, a local consulting company active both in management and in IT consulting, became interested in I4.0 in the same years through a business trip to Germany with Benelli Armi. This initiative made them aware of the need of promoting aggregation and collaboration with other types of institutions, for example universities and firms, to address these disrupting themes: *"We saw synergies with local universities and started to work with them in some specific areas, such as Artificial Intelligence, Robotics, Vision-Based Systems"* (Founder and Senior Partner - Sinergia).

Therefore, in this phase, the pioneer companies and organizations have become increasingly aware of the future impact and relevance of I4.0, even though they still did not have a clear plan over the selection and adoption of I4.0-related knowledge and technologies in their business processes, already implementing digital solutions. Digitalization, in combination with automation processes, has also been undertaken by some other key local furniture producers, such as Scavolini and FAB. The local Universities, instead, developed knowledge about I4.0 technologies building on their previous research projects and their extensive network of international collaborations.

4.2.2. The dissemination effort

The approval of the "National plan on Industry 4.0 2017-2020" by the Italian Ministry of Economic Development placed I4.0 at the center of the national debate on industrial policies. The plan allowed for high tax benefits for firms undertaking investments in I4.0 technologies. This opportunity raised nation-wide interest for I4.0 from industrial companies. Pesaro ID's

companies started considering the adoption of these technologies, mainly to benefit from the tax incentives.

Local institutions instead took action to apply for financial resources for the implementation of projects and initiatives, such as the establishment of Digital Innovation Hubs and Competence Centers, whose goals are the promotion in the local companies of I4.0 projects and the assistance to such companies on these projects. Local institutions and business associations undertook various initiatives to promote visibility to the government plan and to diffuse knowledge about I4.0 technologies through various workshops and seminars which have been held and involving local and national experts on I4.0.

At the regional level, the formal cluster, Cluster Marche, played a key role as promoter and organizer of labs and projects. In various events, local Universities have been involved, and this has allowed for establishing initial contacts among local ID firms and the Universities' Departments more active on I4.0. Also the Industrial Business Association promoted formal and informal initiatives to involve firms in I4.0 and stimulate awareness on these topics.

In addition, *ad hoc* training courses have been organized to support companies in becoming aware of the challenges related to the adoption of I4.0. The local Industrial Business Association organized a course in collaboration with the Polytechnic of Milan's School of Management, previously involved in a national roadshow by the National Federation of Industrial Companies. The course aimed to improve the understanding of the potential of I4.0 and to provide concrete tools for firms to increase the efficiency of production processes and systems. The course involved firms from the mechanical sector belonging to the district, as well as local knowledge providers, and aimed to provide an overall picture of both technological and managerial challenges related to I4.0.

The Marche Polytechnic University organized a course on Industry 4.0 based on an interdisciplinary approach for both students and practitioners. The University of Urbino organized a conference and a roundtable to discuss with local academics, businesses, and business associations how to exploit the opportunities of I4.0 fully. In addition, the University organized a Summer School in Project Management, having an impact on local companies active in digitalization processes. The HR & Organization Manager of IMAB reports that "*taking part to the Summer School in Project Management had a concrete impact on the company as it made us aware over the upgrading of the digital management of processes*".

The pioneering local firms further developed their path oriented towards the I4.0 approach. Biesse continued the implementation of the key project SOPHIA. During the second phase of the project, Biesse started to spread knowledge about SOPHIA through international trade fairs. The further implementation of SOPHIA made Biesse more aware of the implications of some I4.0 technologies, such as IoT, Sensoring, and Big Data. As a result, Biesse launched an Industrial PhD project in collaboration with the Department of Economics of the University of Urbino. The project started in 2018 and concerned applied research on I4.0 and servitization. For the development of the SOPHIA platform, other research institutions have been involved, like the Marche Polytechnic University and the Polytechnic University of Milan. These collaborations played a major role in *"acquiring competences in the phase of technical implementation of the project and in developing concrete ideas"* (Innovation Manager - Biesse).

COSMOB started specific projects, such as the FabLab, a digital manufacturing laboratory, with the aim of creating a connection between I4.0 enabling technologies and the local technical know-how. The FabLab is defined as "*the innovative part of the technological center*" and has been used "*as a tool to involve local businesses through the provision of services such as 3D printing and laser cutting*" (Post-Doc Industrial Researcher - University of Urbino/COSMOB).

Sinergia Consulting has strengthened its collaboration with the Marche Polytechnic University, with the aim to develop applied knowledge complementary to the core scientific and technological capabilities held by the University. Sinergia grasped the need to *"integrate existing competences and to encourage skill transfer from the university"* (Founder and Senior Partner). In this line of thought, they started an Industrial PhD scholarship in collaboration with the Marche Polytechnic University to address I4.0 and Artificial Intelligence.

In this phase, in addition to the ID pioneers, other local furniture companies have started specific projects concerning I4.0-related technologies (see Table 3).

Name of the project	Promoter	Duration of the project	Partnership members	Content	Project horizon
SOPHIA Platform	BIESSE SpA	2017 - 2021	• BIESSE • Accenture	A service platform connected to the info coming from IoT in the mechanical machinery	International
Smart Factory	IMAB	2016 - 2020	• IMAB • INTAC	Software with I4.0 Cloud for lean production	Regional
E-commerce platform and digital commerce transformation	Scavolini	2017 - ?	• Scavolini • Websolute	E-commerce platform with interactivity between producer and dealer	Local
Production Transformation	LC Spa	2019 - 2020	• LC Spa • TeamSystem Ancona	New IoT machinery for planning and implementing lean production	Regional
Integrated ERP Aliante	Paiardini	Not available	• Paiardini • Team System	ERP System together with I4.0 machinery for internal optimization	Local
REVYTA Project	Not specified	2014 - 2020	• Toscana Region • Effebi Spa • DIFE Spa • SNIAP Srl • Flashpoint Srl • Consorzio Polo Tecnologico Magona • University of Pisa - Department of Architecture	I4.0 technologies as robotics to implement a new way of fiberglass waste disposal	National
Microsoft Dynamics AX	FAB	2019 - ?	• FAB • Microsoft	ERP System for integrated information and communication in all business processes with a single workflow	International
Hi Pedini	Pedini Cucine	2018-2020	• Pedini Kitchens • Microsoft • IoMote	I4.0 kitchen with technologies as IoT and sensoring at disposition of the final customer	International

Table 3 *Main I4.0 projects promoted by Pesaro ID firms*

A common feature of these projects is the emphasis on digitalization of production, and, in some cases, there have been attempts to integrate products with I4.0 technologies. The main sources of stimuli have been the suppliers of process technologies and the IT partners, based both locally and outside the district. In most cases, the partnership for the development of an I4.0 project came from previous partnerships with the software house or consultant on other topics. All the firms involved in I4.0 projects in the ID are some of the major representative firms in the district, such as IMAB, FAB, or Scavolini. However, for these ID firms, even for the larger ones, the adoption of I4.0 technologies represented a difficult and complex challenge. Thus, other relevant ID firms, as Berloni Bagno, have not invested in I4.0 projects because of the scarcity of resources and the negative perception of the potential advantages offered by such technologies.

The emergence of awareness about I4.0 and the initial attempts to launch I4.0 projects have pushed local institutions and business associations to plan and implement the first monitoring activities. At the regional level, Cluster Marche has recently taken part in Osservatorio 4.0, a regional committee composed of business associations, trade unions, and universities, with the aim to support regional intervention and to acquire data to identify the main obstacles for the development and diffusion of I4.0, together with appropriate solutions to better allocate resources through regional industrial policies.

4.2.3. The pursue of institutional upgrading

The more recent period is characterized by a stronger effort by regional institutions in providing a framework for further promoting and supporting the development of I4.0 projects in local companies, mostly in SMEs. The Regional Government became aware that the complexity of I4.0 requires stronger coordination. This effort is based on various specific policy measures: i) the establishment of Digital Innovation Hubs (DIHs) and Competence Centers; ii) the financing of advanced projects proposed by local companies; iii) the active promotion of cooperation between firms and universities, mainly through Industrial PhD projects and multilateral R&D projects.

The stronger effort by the Regional Government received mixed feedback from local institutions and companies. On the one hand, the financial support has been welcomed in the light of the required investment scale for implementing I4.0 projects. On the other hand, the

unresolved fragmentation of coordination activities over I4.0 themes has been perceived as a negative factor for the effectiveness of the limited resources for knowledge dissemination and for promoting the awareness of the local late-comer firms, which might encounter difficulties in choosing the most appropriate institutional and business partners.

The upgrading also took place through the establishment of the Regional DIHs, that have been planned during the previous phases, when the regional Industrial Association and the regional Cluster Marche prompted a feasibility study for the creation of a digital innovation center in the Marche Region and won a European Call within Horizon 2020. DIHs should represent the main "gateway" to I4.0 for local companies. Their aim is to create a network of "territorial innovation actors", strengthen the level of knowledge on and the awareness of the opportunities offered by digitalization and I4.0, and offer consultancy, mentoring, training and assistance services for I4.0.

In addition to the upgrading of the regional and local institutional framework, local firms showed an increasing propensity to create more stable and formal networks in order to undertake I4.0 projects. On the one hand, some local cluster firms are involved in formal collaborative projects promoted by the Regional Government. This is the case of the regional platform aimed to create a laboratory of excellence to encourage collaboration between businesses and Universities on I4.0. Another project started in 2018 is INNOPROVEMENT, where a working group, which includes the cluster firm IMAB and the universities of the Marche Region, on I4.0 has been created. The representative of the Urbino University stated: *"My feeling is that there is a lot of work to do in order to address the right policies for SMEs. The main difficulties are linked to putting together the objectives of the larger firms and those of the SMEs. I believe that Universities will have a major role in this"* (Professor of Computer Science - Representative in the Stakeholders' table for INNOPROVEMENT project). On the other hand, active local firms pursue aggregations to combine complementary resources and capabilities. This is the case of Sinergia being an active member of Overlux, a formal network including local firms, also academic spin-off firms from local Universities, and companies based outside the ID. This network of companies aims at leading businesses towards I4.0 through the implementation of innovative solutions in IoT.

An emerging dissemination pattern is the "Open Factory" approach, after the recognition of the effectiveness of initiatives organized in and by innovative companies active in I4.0 projects by some of the key actors, as the Industrial Business Association and the Cluster

Marche. Indeed, Cluster Marche started to promote this mode of knowledge exchange after experiences with other partner formal clusters in Northern Italy. Promoting direct contact on-site with front-runner firms is perceived as a tool for pursuing knowledge contamination and attract furniture producers and small firms, having limited IT and technological capabilities. Firms such as Benelli Armi, even though not active in the furniture sector, have been keen on opening their offices and plants, also for a shared sense of belonging to the local territory. These initiatives, which have been proposed after careful planning by these collective actors, in various cases have prompted informal cooperation among participants, which have been monitored in their evolution.

5. Discussion of results

This section attempts to provide an answer to the RQ stated in the introduction. First, it summarizes and discusses the evolution of I4.0 knowledge dissemination along the various phases, shown in the timeline in Figure 1. Then, it examines more in-depth the dissemination process using the ARA framework and focusing on actors, activities, and resources. Lastly, it provides a summary of the distinctive dissemination patterns emerging from the empirical analysis.

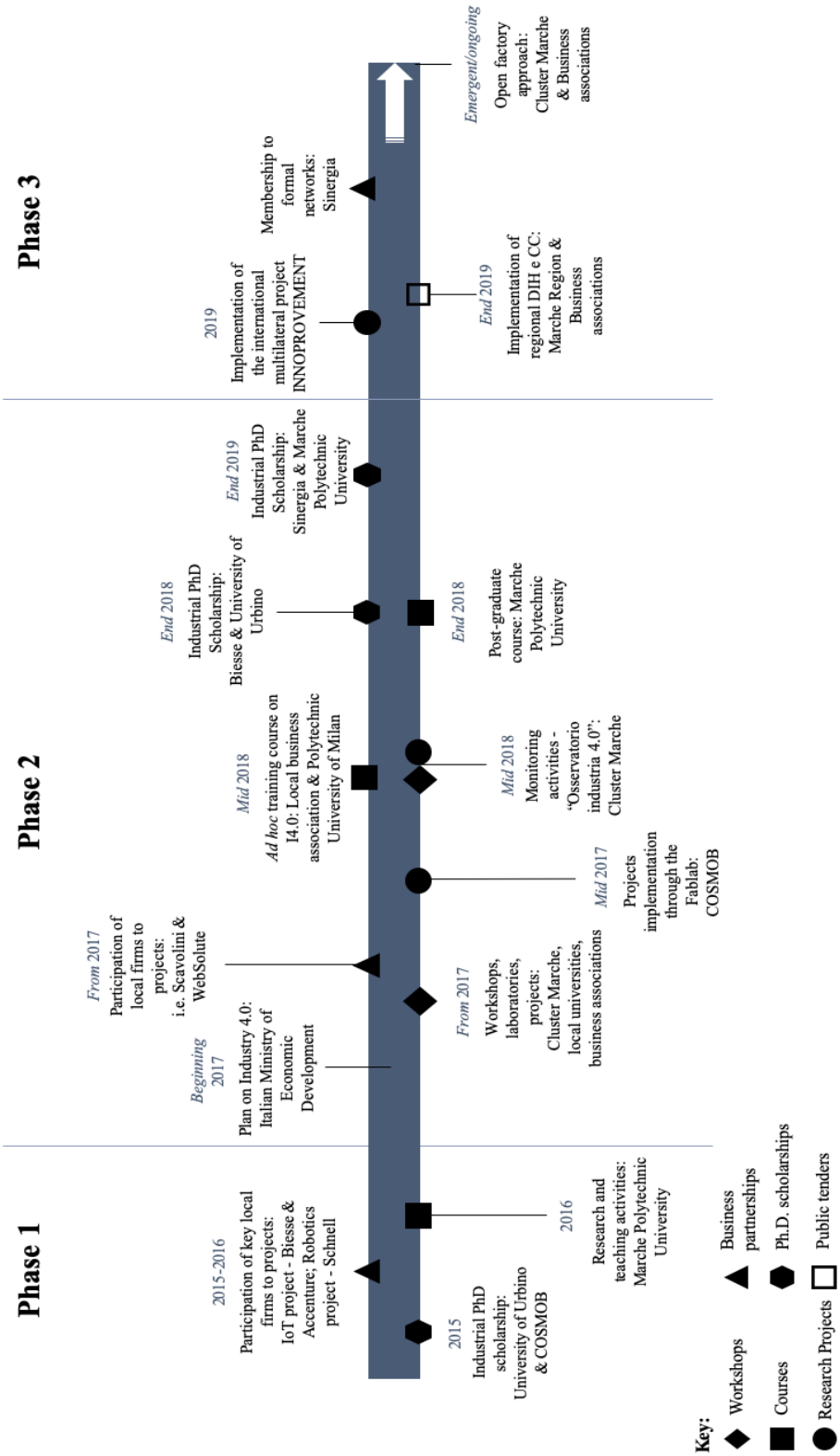

Figure 1 *Timeline of I4.0 knowledge dissemination along the three phases*

In the “pioneering phase”, knowledge concerning I4.0 has been introduced through the explorative attitude of some key local players, which have autonomously established external pipelines (Bathelt et al., 2004) and gained incremental awareness about the complexity and the possible benefits of I4.0 technologies in the medium-long term. Formal and informal interactions have been carried out with other actors, in Italy and abroad, more skilled in terms of the development of I4.0 technologies, which represent a body of knowledge to a large extent “exogenous” (Albino et al., 1998) to the Pesaro ID.

As soon as the tax incentives have been publicly announced, a variety of ID actors, firms, institutions, IT suppliers, knowledge brokers have become interested in understanding the implications of I4.0 upgrading. Since then, various types of initiatives for knowledge diffusion have been set up by institutions, business associations, and knowledge providers, with the involvement of local and nationally-based Universities and technical experts. The main goal was to stimulate the awareness of local firms on I4.0 and to accelerate the involvement of local businesses in projects related to I4.0 technologies.

After this phase, which shows a remarkable dissemination effort, a more deliberate approach emerged among both institutions and key players (Belussi and Sedita, 2012; Lazzeretti and Capone, 2016). The Regional Government supports the implementation of DIHs linked to the main local business associations in order to provide “interfacing” resources to support local firms in undertaking I4.0 projects. The most active knowledge providers establish formal networks involving local and nationally-based firms and Universities to integrate and consolidate complementary knowledge and capabilities and to undertake complex R&D projects related to I4.0. In the meanwhile, the local collective actors, business associations, and formal clusters promote an “Open Factory” approach to disseminate knowledge about I4.0 and, thus, to stimulate contamination and emulation by local firms.

The diffusion of I4.0 knowledge in the ID of Pesaro could be better understood by discussing more in-depth the behavior of key actors, the nature of activities carried out, and the relevant resources at stake in the process, following the ARA framework (Håkansson and Snehota, 1995). It could be argued that the diffusion of I4.0 knowledge in the Pesaro ID has been characterized by a combination of traditional and innovative dissemination patterns, which have been shaped by the existing structures and interaction processes characterizing the district in recent years. Table 4 outlines a distinction of traditional/new actors, activities, and resources in place along the dissemination process.

Actors	Activities	Resources
Traditional ID actors	**Traditional dissemination activities**	**Traditional resources**
• Large furniture firms • Technology suppliers • COSMOB (Technological Centre) • IT suppliers • Consulting firms • Business Associations • Regional government	• Local business interaction • Local buzz • External pipelines • Workshops/Seminars • Training courses	• Financial resources (corporate) • Furniture-making knowledge • Mechanical knowledge • IT/digital knowledge • Social ties
New actors	**New dissemination activities**	**New resources**
• Large firms in different sectors • Network alliances • Universities • Digital Innovation Hubs • Cluster initiatives (Regional Government)	• Open Factory initiatives • Industrial Ph.Ds • Multilateral research projects	• Financial resources (national and regional government programs on I4.0) • I4.0 technological knowledge • I4.0 managerial knowledge

Table 4 *Diffusion of I4.0 in the Pesaro ID – continuity and innovation in actors, activities, and resources*

Traditional ID actors have started approaching I4.0, even though with mixed attempts to disseminate related knowledge. On the one hand, large ID firms, such as Biesse and IMAB, pursued I4.0 projects following an "autonomous" approach with respect to the local technological trajectories and initiatives already in place before the spreading of I4.0 interest (Belussi and Pilotti, 2002; Morrison, 2008; Belussi and Caloffi, 2018). They have set up relationships with IT partners and Universities, developing a mix of local and national relationships (Grandinetti, 2011), without an explicit and deliberate district horizon in terms of knowledge diffusion.

On the other hand, other key traditional actors, as knowledge providers, business association, the Regional Government, have been remarkably active in their dissemination effort. Knowledge providers such as Sinergia and COSMOB have attempted to fulfil their "mission" of knowledge providers and gatekeepers (Morrison, 2008; Grandinetti, 2011) since the beginning of I4.0 diffusion in the Pesaro ID. They have actively set up relationships with other local key actors and partners outside the district (Molina-Morales et al., 2002; Belso-Martinez, 2018).

In this respect, they have been able to maintain and consolidate a central role in the local innovation setting both as providers and brokers of knowledge (Molina-Morales et al., 2002; Grandinetti, 2011; Belso-Martinez et al., 2018). Sinergia has been able to integrate business-related and technological knowledge while implementing consulting services in I4.0, while COSMOB has attempted to translate I4.0 opportunities in furniture industry-specific projects, as its FabLab project shows.

I4.0 has represented a challenge also for local business associations. Evidence shows the local business associations' active behavior in involving local firms, mainly SMEs, through innovative approaches in knowledge dissemination. These attempts have been even more difficult in the light of the long-time decreasing participation of local firms in local business associations; thus, I4.0 has represented an opportunity for local business associations to renew their role in the ID of Pesaro. I4.0 knowledge diffusion has been a strategic goal pursued by the Regional Government, engaged in promoting direct regional funding related to I4.0 projects and in the setting up of the DIHs. The institutional setting is still in-progress while being embedded in the already existing mix of policy measures and procedures supporting local innovation processes within the Smart Specialization Strategy.

In parallel, new actors have emerged as key players in the ID in relation to I4.0 knowledge diffusion processes: large firms operating in different sectors, network alliances promoted by local ID firms, local formal clusters, newly established DIHs, and Universities. Large firms not belonging to the furniture industry, such as Benelli Armi and Schnell, have been perceived by both local Institutions and firms as key successful examples of I4.0 implementation. This orientation is further promoted by the active behavior of the regional formal clusters lead by Cluster Marche, as these collective actors in the digital context tend to be *"more cross-sectoral, horizontal and less geographically concentrated"* (Götz and Jankowska, 2017: 17).

Universities have increasingly played an important role over time in the light of their specialized knowledge about I4.0 technologies (Camuffo and Grandinetti, 2011; Muscio et al., 2012; Capó-Vicedo et al., 2013). The I4.0 challenge has represented a key driver for a higher involvement and integration of local Universities into the Pesaro district if compared to the marginal role played in the past. Institutions and firms have perceived universities as sources of "global pipelines" (Benneworth and Hospers, 2007; Camuffo and Grandinetti, 2011; Muscio et al., 2012; Capó-Vicedo et al., 2013), connected with advanced I4.0 knowledge sources based

in Italy and abroad. It seems that cooperation among traditional and new actors in the Pesaro ID is contributing to developing an emerging shared "sub-identity" with regard to the I4.0 approach and technologies (Hervas-Oliver et al., 2019), as it is promoted actively by local gatekeepers engaged in I4.0 translation as Sinergia and COSMOB.

Understanding who are the key actors in the ID with regard to the I4.0-related knowledge dimension also allows considerations on interaction patterns among public and private actors. Throughout the different phases, interaction mechanisms are progressively enacted.

In the first phase, interaction mechanisms concerning the diffusion of I4.0 mainly happen among businesses (i.e., large firms and consulting firms). There is a low degree of public-private interaction, mostly among industry and university through formal arrangements such as industrial PhD scholarships or among the technological service provider COSMOB and university/firms, in the latter case mainly through project indirectly paving the way to the implementation of I4.0.

In the second phase identified, interaction is mediated through projects, training courses, and labs aimed at the diffusion of knowledge. There emerges a new type of interaction involving consulting firms and universities, exemplified by the financing of industrial PhD positions. In this phase, public actors also play a new monitoring role, and they intermediate as identifiers of obstacles concerning I4.0-related knowledge diffusion.

In the more recent period, there is a stronger effort, spanned towards the provision of a framework for interaction, involving also smaller firms, which were less active in the previous phases, and leading to the creation of formal networks.

Among the "new actors" identified, an important role is played by the creation of DIHs, which are based on informal organizational structures, prompted and facilitated public-private interaction. Indeed, the European DIH program is built upon an innovation policy aimed to promote co-participation and co-design of spatially bounded industrial strategies (Hervas-Oliver et al., 2020). Summing up, interaction occurs at multiple levels with traditional actors, hybrid ones, universities, and actors that play institutional roles.

The increased complexity of the networks of actors has implied a shift and an upgrading in the nature of dissemination activities concerning I4.0 knowledge: traditional initiatives, such as workshops, courses, and formal/informal business interactions have been integrated by "collective" projects (Fornahl et al., 2015; Hervas-Oliver et al., 2019), such as the "Open

Factory" initiatives, the Industrial PhD positions financed by the Regional Government and the multilateral research projects involving firms, collective actors and institutions of the ID and of the Marche Region. An innovative form of knowledge diffusion is the "Open Factory" approach, implemented by the local Industrial Business Association and by Cluster Marche. It represents a form of "organized buzz", a deliberate and planned attempt to foster informal interaction among firms, universities, and institutions (Belussi and Sedita, 2012). Collective actors engage in organizing the initiative, while the provision of the knowledge content and the interaction is mainly left to voluntary participants, willing to experience knowledge contamination and search for potential knowledge providers, such as consulting firms, technology centers, and Universities. An important role is played by the social underpinnings of the project, promoting, on the one hand, social recognition for innovative firms, entrepreneurs, and managers, on the other hand igniting emulation by participants (Staber, 2009; Camuffo and Grandinetti, 2011).

The upgrading of dissemination activities has been driven by a combination of the high complexity of I4.0 knowledge – requiring complementary capabilities, notably technological and managerial capabilities and aggregation of a variety of actors (Coletti, 2010; Belussi and Sedita, 2012) – and the financial support and tax incentives provided by the national and regional governments, pushing large firms to undertake large scale R&D projects and SMEs to approach in the majority of cases the first steps of the digitalization process (Hervas-Oliver et al., 2019). Funding by the National and Regional Government has been crucial for raising interest by local institutions and firms and for implementing the first R&D projects in the I4.0 context. Therefore, the monetary dimension is a key factor for explaining ID-based processes concerning I4.0 (Perna et al., 2015).

Another relevant factor is the degree of absorptive capacity of local ID firms and institutions (Cohen and Levinthal, 1990; Giuliani, 2005; Camuffo and Grandinetti, 2011). On the one hand, Universities and pioneering firms, in particular large companies and knowledge providers, have been increasingly aware of the I4.0 opportunities and implications and already had previous knowledge of the benefits and challenges of digitalization processes. On the other hand, institutions, business associations, and local SMEs have initially suffered their limited knowledge about I4.0 and have attempted to fulfil this gap through participation in training initiatives and hiring qualified personnel. Overall the knowledge brokering effort has been

initially impaired by the limited awareness and knowledge about I4.0 technological and managerial opportunities and challenges (Mittal et al., 2018).

In sum, this research shows that in the furniture ID of Pesaro, the dissemination of I4.0 knowledge has been characterized by three main interrelated patterns. First, the horizon of I4.0 upgrading, in terms of focal actors, main activities, and key resources, shows blurred boundaries with regard to sectors and geographic location (Götz and Jankowska, 2017). Most of the dissemination activities have involved firms active in different sectors and have a regional dimension, as ID firms and institutions have attempted to search for I4.0 expertise in closer geographical areas.

Second, the I4.0 diffusion shows a fragmentation of initiatives of both firms and institutions. Some firms, mainly large-sized, have often pursued autonomous paths involving selected partners (Belussi and Pilotti, 2002; Morrison, 2008; Belussi and Caloffi, 2018). Institutions, public bodies, and business associations have shown both cooperative and competitive behavior due to the conflicting objectives of diffusing a complex type of knowledge, which led to institutional collaboration and search for financial resources, leading to increased competition. This fragmentation is shaped, on the one hand, by the reduced intensity of social ties experienced in the ID community in recent years and, on the other hand, by the "explorative" orientation of the various ID actors engaged in knowledge search.

Moreover, the present analysis shows the lack of a specific policy/program targeting the Pesaro ID as such, while such programs have been implemented in other settings, as different studies on I4.0 diffusion in traditional IDs have shown (Hervas-Oliver et al., 2019).

Third, the diffusion of I4.0 knowledge, characterized by high complexity and by the integration of technological and managerial knowledge (Alberti and Pizzurno, 2015), pushed ID firms and institutions to pursue deliberate structured initiatives, allowing for informal and formal interaction (Belussi and Sedita, 2012; Lazzeretti and Capone, 2016), which in various instances implied the experimentation of new interaction processes, leading to innovative forms of "collective" cooperation (Leckel et al., 2020).

6. Conclusions

This paper has presented and discussed an empirical research over the diffusion of I4.0-related knowledge in the Pesaro ID in Italy active in a traditional industry such as the furniture

sector. This research contributes to the literature on innovation in IDs and clusters on two interrelated grounds.

First, it provides further research on I4.0 and IDs and clusters (Götz and Jankowska, 2017; Hervas-Oliver et al., 2019), developing an in-depth analysis of the variety of knowledge dissemination processes where both institutions and firms are involved, mapped through the ARA framework highlighting key actors, activities, and resources (Håkansson and Snehota, 1995).

Notably, our study on the traditional Pesaro ID points out three main patterns: i) the horizon of I4.0 upgrading shows blurred boundaries in terms of sectors, since firms active in different sectors are involved, and geographic location, reaching the regional dimension; ii) the fragmentation of I4.0 diffusion in terms of initiatives and projects by both firms and institutions; iii) the pursuit of deliberate and structured initiatives allowing for experimentation of new interaction processes, combining formal and informal exchanges (Belussi and Sedita, 2012; Lazzeretti and Capone, 2016; Leckel et al., 2020).

Second, the study corroborates previous investigation showing the role of public-private interaction in technological innovation and, particularly, in the transition towards I4.0, supporting and inducing institutional change facilitating collective action (Hervas-Oliver et al., 2019). Further, it contributes to existing studies and shed light to new insights concerning the importance of public actors both as knowledge brokers and as collective actors, who act at the border of the local and external context, thus acting as connectors of local and non-localized knowledge.

Third, this paper contributes to the stream of research on knowledge creation and diffusion in IDs and clusters, providing empirically-based insights into emerging local learning processes in IDs (Belussi and Pilotti, 2002; Camuffo and Grandinetti, 2011; Belussi and Sedita, 2012; Bocconcelli et al., 2015).

In particular, the forms of "collective cooperation" in I4.0 projects represent innovative mechanisms linking traditional ID actors to technologically advanced firms and organizations, fostering open localized learning and exploiting localized social ties. These "collective" mechanisms could represent one key driver to renew the cooperative interaction in IDs and clusters (Hervas-Oliver et al., 2019) and promote local initiatives inspired to "open innovation" logics (Leckel et al., 2020), pushed by the self-interest of those local firms available to commit time and resources (Munksgaard and Medlin, 2014) to improve their absorptive capacity, in

order to join and exploit "selected" business networks within and outside the ID (Belussi and Sedita, 2012).

Each initiative could be considered a *"temporary resource constellation and activity pattern in which the actors form a distinct logic and develop new solutions in relation to each other"* (Ingemansson Havenvid et al., 2016: 86). The analysis of innovative knowledge diffusion projects, which has linked ID/cluster studies and the IMP business network perspective, could therefore contribute to the emerging conceptual debate on "temporary spatial clusters" (Palmer et al., 2017).

This research presents some limitations. First, the empirical analysis concerns the initial phase of the spreading of I4.0 related knowledge in the Pesaro ID, which is still undergoing. Therefore, this chapter gives insights over in-progress processes and does not provide a complete *ex-post* analysis. Second, the main goal is to map the variety of dissemination processes, therefore the in-depth analysis of specific initiatives is out of the scope of this paper.

The phenomenon of I4.0 adoption in IDs and clusters deserves further empirical research and conceptual development. Future research could focus on specific and interconnected aspects that have been pointed out in this paper: the trajectory of specific I4.0 technologies, the nature, and features of key dissemination activities, the role played by new actors. Future studies could examine more in-depth the dissemination of knowledge of specific I4.0 technologies, such as IoT, AI, collaborative robotics, whose diffusion and implementation in industrial clusters might follow different trajectories (Cucculelli and Lena, 2017; Ingaldi and Ulewicz, 2019; Ivanov et al., 2020) and concern different types of actors and dissemination mechanisms.

Furthermore, additional research is needed on the implementation of key I4.0 projects and initiatives – courses, PhD programs, bilateral and multilateral R&D projects, regional programs – in IDs and their underlying interaction processes, whose features might generate different kinds of knowledge diffusion processes, in line with recent research (Götz and Jankowska, 2017; Hervas-Oliver et al., 2019).

Also, future contributions on this phenomenon could explore the role of the main actors, with a focus on those emerging firms and organizations, including collective actors (Hervas-Oliver et al., 2019), playing an innovative role in the I4.0 diffusion, such as formal clusters, Universities (Benneworth and Hospers, 2007), *ad hoc* organizations.

Since the research highlights the role of public actors in influencing the development knowledge by organizing synergies and cross-fertilization processes among local actors, analysis should be conducted on the role played by DIHs, which have been deemed in recent studies new knowledge brokers and a source of knowledge, as well as mediators of interaction between unconnected actors for knowledge sharing and for leveraging partnerships with external actors, playing thus a role of facilitators and active players (Crupi et al., 2020).

Considering future research lines, it is worth mentioning the consequences of the ongoing COVID-19 pandemic, which gives rise to different implications for the present research, as it adds a whole new dimension to the transition towards I4.0. On the one hand, it could be argued that the run to I4.0 has been dramatically accelerated and supporting business continuity has become essential. On the other hand, national funding does not answer consistently to these ongoing changes, driving firms to freeze the efforts made. At the regional level, and thanks to the framework developed over the last years, collaborative projects involving partnerships have been promoted through Competence Centers, and there have been public tenders to exploit 4.0 technology in this situation. From a methodological point of view, researchers face challenges, since the diffusion of I4.0 is still ongoing. Updates on the research will imply accounting for and interpret the even more increased discontinuity and variety in the implementation of I4.0 technologies.

The empirical research undertaken in this paper has various managerial implications. First, IDs and cluster firms should pay attention to the selection process of I4.0 knowledge providers. Local knowledge brokers could provide assistance in fostering contacts with potential partners based both inside and outside the cluster (Molina-Morales et al., 2002; Belso-Martinez, 2018). Dissemination activities in the ID represent useful networking opportunities with potential partners and for assessing the adequate type of investment in technology and organizational innovations.

Second, the evaluation and adoption of I4.0 technologies are a complex process, and as such, it requires establishing relationships also with Universities in order to develop R&D projects, hire qualified personnel, and address both the technological and managerial challenges of I4.0 effectively. Local Universities might represent adequate partners for ID firms, especially SMEs, if appropriate interaction mechanisms are in place, thus reducing the “cognitive” distance between them (de Zubielqui et al., 2015).

Third, firms in traditional IDs are required to invest in human resources in order to evaluate and exploit I4.0 technologies. While firms active in high-tech clusters might have stronger cognitive proximity with I4.0 related technologies (Götz and Jankowska, 2017), traditional cluster firms require strengthening their absorptive capacity in order to interact with key actors, both inside and outside the cluster (Becattini and Rullani, 1996; Camuffo and Grandinetti, 2011, Belussi and Sedita, 2012). Pursuing I4.0 trajectories in IDs requires "talent" in addition to technologies (Salter et al., 2000). Investment in human resources could concern upgrading technical/IT functions, introducing hybrid positions such as Innovation Managers, setting up Industrial PhD positions in cooperation with Universities.

Fourth, the technological trajectories pursued by leading firms within the ID in terms of new technologies adopted will have an impact on the other ID firms, which will have to adapt to the changes generated by the new technology and to consider the interconnectedness among their activities (Belussi and Sedita, 2012; Hervas-Oliver et al., 2018).

This research also has relevant policy implications. I4.0 technologies represent a key driver for the renewal of traditional IDs (Hervas-Oliver et al., 2019), regarding technological upgrading and localized interaction patterns. This could not be an easy task in the light of their increasingly fragmented setting in regard to business networks and social ties.

First, institutions need to be well-equipped in terms of I4.0 awareness and knowledge in order to plan and coordinate effective dissemination activities. This research has shown that coordination of dissemination activities could be impaired and slowed down by the limited expertise on I4.0 of institutions and organizations promoting them.

Second, previous knowledge of the existing needs by local businesses and of the actual interaction patterns over I4.0 in the local ID (Eklinder-Frick, 2016) could make policy measures better "nested" and "tailor-made" in the ID networks and more effective in their implementation (Hoholm and Araujo, 2017; Grashof et al., 2020), thanks to the combination of "constructed networks" and "emerging networks" (Rubach et al., 2017). As Rubach et al. (2017: 179) argue, *"there is a need to disrupt what is already happening, and at the same time mobilise support for the new element from the existing actors"*. This could help avoid fragmentation and the related frictions in the institutional effort, using the resources available efficiently and selecting the most appropriate dissemination mechanisms, thus leading to more effective "informal district networking" (Belussi and Sedita, 2012).

Stronger cooperation with local Universities and business associations could be useful in this regard (Camuffo and Grandinetti, 2011; Muscio et al., 2012; Capó-Vicedo et al., 2013). In the light of their specialized I4.0 knowledge and neutral role in the eye of local stakeholders, Universities could be placed at the core of the main dissemination projects. The involvement of firms and organizations active in I4.0 technologies could provide opportunities to plan and launch "local open innovation" projects (Leckel et al., 2020) by local institutions, able to promote interaction processes based on "collective cooperation". This open innovation process relies on close public-private cooperation, where the public side mainly acts as a facilitator of relationships through the organization of courses, initiatives, projects, as coordinator of the transfer of knowledge of ties (Crespin-Mazet et al., 2013).

Lastly, it should be highlighted that the key driver for most of the ID actors, besides the pioneering role of some large firms and institutions, has been the monetary incentive offered by the National Government and implemented by the Regional Government through its funding initiatives. Then the economic incentive certainly is important, but it should not be de-coupled by the promotion of awareness of I4.0 benefits through appropriate dissemination activities, otherwise, ID firms would risk adopting new technologies without a clear business/product strategy. This does not indicate that firms would otherwise adopt technologies implying high investment and without an impact in terms of value creation, but rather that the interest towards the incentive provided might outweigh a long-term view about the potential business value they can generate and an overall account of the possible future directions towards which the I4.0 innovation can lead them. The provision of financial assistance should be characterized by a careful and fine-grained evaluation of the quality and goals of I4.0 projects proposed by ID firms, and by continuity in the medium-long term, in order to support the required technological and organizational transformations.

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Chapter IV

Formal clusters supporting small firms' internationalization: a case of public-private interaction

Abstract

This chapter presents and discusses a case study on formal clusters' role in supporting small firms' internationalization processes. By taking a public-private interaction perspective, it aims at providing an understanding of how international business knowledge is exchanged within an internationalization project. To achieve this goal, the paper undertakes an exploratory case study of a Swedish formal cluster initiative involved in an internationalization project. The case study is analyzed through the Industrial Marketing and Purchasing (IMP) approach, relying on the Actors-Resources-Activities (ARA) framework.

The analysis highlights the role of formal clusters as supporters and "accelerators" of internationalization processes. Based on the ARA framework, the roles of the public and private actors emerge: the cluster plays the role of orchestrator, supporter, and financer, while on the businesses' side, participants assumed the role of customers, displaying various degrees of interest and commitment, deriving from heterogeneity in industry, maturity, experience, giving rise to a leader-follower pattern. Knowledge-related activities have occurred at multiple levels, inter-organizational, intra-project, inter-projects, through different timings and typologies of activity. Regarding the project's impact in terms of resources, the main resources at stake were the combination of knowledge, complementary capabilities, and financial incentives.

This paper provides novel empirical evidence and theoretical development over the phenomenon of formal clusters, and it contributes to the current debate on public-private interaction mechanisms and to the upgrading and circulation of international business knowledge.

Keywords: Clusters, International business knowledge, Knowledge exchange, Public-private interaction

1. Introduction

Over the last decades, there has been an increasing focus on understanding locally contextualized aggregations of firms – qualified as industrial districts or clusters – which are deemed important to enhance innovation and internationalization (Lazzeretti et al., 2014; Hervas-Oliver et al., 2015). Literature has widely acknowledged clusters' support to small firms' internationalization process (Chetty and Holm, 2009), arguing that clusters provide specific advantages, as supporters and connectors between the local and the global markets (Colovic and Lamotte, 2014; Felzensztein et al., 2019). SMEs see particular advantages in clusters as a way to compensate for their internal technological and organizational resource constraints (Bocconcelli and Pagano, 2015), acquiring market and product knowledge about internationalization through network relationships. International business knowledge is needed to pursue internationalization and adopt a new market entry.

Internationalization is deemed a key concept in the world economy and a fundamental part of most firms' ongoing strategies (Kowalski, 2014). While many internationalization approaches have been presented – among which the most-referred to is the Uppsala internalization framework (Johanson and Vahlne, 1977) –, in more recent studies, the importance and validity of projects as a distinct mode of internationalization has been introduced (Owusu et al., 2007).

Projects can be considered *"temporary resource constellation and activity pattern in which the actors form a distinct logic and develop new solutions in relation to each other"* (Ingemansson Havenvid et al., 2016: 86). They are characterized by time-constrained inter-organizational interaction, uniqueness, discontinuity, and complexity (Cova et al., 2002; Kronlid and Baraldi, 2020). In spite of this, it could be posited that projects are helpful in establishing long-lasting relationships (Owusu et al., 2007; Palmer et al., 2017).

While the different approaches to internationalization have emphasized different key themes, knowledge has been central to the Uppsala incremental approach as well as to the more recent rapid internationalization models, namely born globals and international new ventures (Gulanowski et al., 2018). Thus, knowledge is widely considered an essential resource for firms' internationalization processes in terms of availability of prior knowledge and search and combination with new knowledge.

Based on these convictions, cluster-related initiatives, policy efforts, and initiated projects at the national and regional levels have been settled (Obadić, 2013). Raising

prominence has been given to the emergence of "formal clusters", defined as *"geographic concentrations of actors characterized by formal governance structures and the formal membership of firms and other institutions"* (Colovic and Lamotte, 2014: 451) and as *"an organized business association, geographically and sectorally concentrated"* (Dana and Winstone, 2008: 2178).

Recently, specific projects have been activated to facilitate formal cluster firms' engagement in international markets and to boost regional development (Fourth European Cluster Policy Forum, 2019). These projects have often resulted in a strict collaboration between public and private actors and in the exchange of market and product knowledge related to internationalization.

Empirically-based studies are mainly based on projects, traditionally involving both public and private actors. However, only a few of them explicitly consider interaction between public and private actors within projects (see Kronlid and Baraldi, 2020). It is put forward that public-private interaction within projects happens on different bases and with different dynamics compared to other typologies of interaction.

As highlighted in Artto and Kujala (2008: 470), *"project-based business activities are part of all private firms and public organizations"*. Thus, projects are particularly suited for investigating inter-organizational interaction involving public and private actors. Projects traditionally involve public and private actors, including universities, regional governments, public research institutions, and enterprises. However, the literature on inter-organizational relationships has traditionally focused on long-term interaction or on repeated interaction episodes (Håkansson and Snehota, 1995; Håkansson et al., 2009) aimed to build mutual orientation, trust, and commitment. On the other hand, a blurry vision of time-constrained relationships such as those occurring within projects.

While the role of clusters within firms' internationalization has been widely investigated, less emphasis has been placed on the phenomenon of formal clusters and on how they interact with firms for internationalization, with only a few exceptions (Colovic and Lamotte, 2014). It is argued here that formal clusters might represent an advanced, more articulated form of support for small firms' internationalization, which deserves further specific research. Formal clusters in the context of internationalization can be understood as a form of control and direction for policies.

This paper aims to uncover how international business knowledge (which includes both market and product knowledge) is exchanged within an internationalization project by introducing formal cluster initiatives. Therefore, this paper seeks to provide a contribution filling a gap in the literature by analyzing an internationalization project implemented within a formal cluster organization and involving different typologies of actors.

The main research question (RQ) of the paper is the following:

How is IB knowledge exchanged in public-private interaction within a formal cluster's internationalization project?

Sub-questions can be identified along the three dimensions of the ARA (Actors - Resources - Activities) framework, developed within the Industrial Marketing and Purchasing approach (hereafter IMP) (Håkansson and Snehota, 1995; Håkansson et al., 2009). Sub questions concern the role played by the formal cluster and by firms participating in international business projects promoted by the formal cluster itself, the activities and interaction patterns created within international business projects, and the impact of this kind of interaction on formal clusters' and firms' resources development processes.

Given the pertinence of relationships and networks to the issue addressed in this paper, the IMP approach is particularly suited to understand the variety and complexity of interaction in a project for internationalization and to understand the embeddedness of international networks, which are developed beyond the geographical boundaries of a cluster.

Policy efforts and institutional projects have been settled on the geographical idea of clusters, which, however, does not account for aspects such as networks, absorptive capacity, and heterogeneity of place related-features (Alberti and Pizzurno, 2015; Giuliani, 2005; Milanesi et al., 2016).

On this line, different studies within the IMP approach have argued for the importance of interaction in a network-like structure that binds places together (Waluszewski, 2004a; Håkansson and Waluszewski, 2020). Traditionally, the focus on micro-interaction processes has been neglected in favor of a region-centric perspective (Eklinder-Frick, 2016; Eklinder-Frick and Linné, 2017). In this sense, adopting an IMP lens – having in mind studies on heavy development processes and interactions taking place in business networks – is of utmost importance to understand the embeddedness of international networks, which are developed beyond the geographical boundaries of a cluster.

Recently there has been a call for the analysis of public-private interaction (Munksgaard et al., 2017; Kronlid and Baraldi, 2020). Therefore, the adoption of the IMP conceptual and analytical framework is also in line with recent calls for pictures of the contemporary business world, which include the interaction between private companies and public bodies, and for an in-depth analysis of the features of public-private interaction (Munksgaard et al., 2017; Waluszewski et al., 2019b; Kronlid and Baraldi, 2020).

In light of the exploratory nature of the research objective, this paper adopts a qualitative methodology, developing a single case study of The Regional Innovation Internationalization Project (TRIIP), namely an international business project implemented by Future Position X (hereafter FPX). The analysis highlights the role of formal clusters as supporters and "accelerator" of internationalization processes, thus confirming the key finding of the literature on the relevance of networks in internationalization for small firms (Ciabuschi, 2006; Johanson and Vahlne, 2009; Felzensztein et al., 2019). It also sheds light on the complexity of the internationalization project within a formal cluster initiative with respect to the effects over the larger business network of firms and organizations and to the less positive and more problematic aspects of the role of formal clusters.

The paper is organized as follows. First, the cluster approach is discussed and integrated with studies within the IMP framework related to place and interaction. Then, a brief overview of existing studies on public-private interaction is introduced. Section three addresses the research methodology adopted. In section four, the project in focus is described, and the empirical findings are presented. In the fifth section, the main results of the empirical analysis are discussed. The last section outlines conclusive remarks, it highlights research limitations, it points out the main contributions and implications of the study for both policy and practitioners.

2. Background literature

2.1. Clusters, formal clusters, and internationalization processes

The literature on industrial districts and clusters has pointed out the importance of geographical proximity in fostering social interaction and cooperation in business relationships (Becattini, 1990; Dahl and Pedersen, 2004; Camuffo and Grandinetti, 2011). Studies have traditionally defined clusters as groups of firms from the same industry, based in the same place

and connected through knowledge, skills, inputs, demand, or other linkages (Porter, 1998; Delgado et al., 2016). Following those same assumptions, the policy effort has promoted cluster-based initiatives (Obadić, 2013; Calignano et al., 2018). This effort has led to the emergence of formal clusters, which can be defined as *"geographic concentrations of actors characterized by formal governance structures and the formal membership of firms and other institutions"* (Colovic and Lamotte, 2014: 451) and as *"an organized business association, geographically and sectorally concentrated"* (Dana and Winstone, 2008: 2178).

While the geographical definition of cluster gives important insights on the role of spatial proximity for relationships development within clusters and for knowledge exchange mechanisms, relying only on this approach does not provide any understandings of how interactions and thick relationships are developed across the geographical borders of clusters. In this sense, IMP studies can provide the analytical tool to catch the underlying complexities of relationships and content, as it discusses the nature of firms' agglomeration, showing that interaction is not an exception deriving from being spatially close to each other (Håkansson and Waluszewski, 2020), as firms-specific linkages have no boundaries (Eklinder-Frick and Linné, 2017). Instead of focusing on a region-centric perspective, there should be more emphasis on micro-interaction processes and on the network context, characterized by interdependencies and embeddedness beyond clear geographical boundaries (Eklinder-Frick, 2016; Guercini and Tunisini, 2017b). The specific context is deemed crucial for knowledge creation, conceived as a system of connections extending across user-producer contexts (Eklinder-Frick, 2016).

Thus, taking into consideration the space-related knowledge variations and heterogeneity of firms within spatial borders and how these give competitive advantages to actors spatially proximate – that is, accounting for the cluster approach – and combining it with the idea that place is a significant resource in the form of how resources can be combined – that is, accounting for the IMP tradition (Håkansson et al., 2006; Waluszewski, 2004a) – give a complete picture of the complex processes behind international networks embeddedness. IMP conceives space as a source deriving from ongoing local companies' dynamics (Baraldi and Strömsten, 2006; Håkansson et al., 2006) and grasps how value is generated in interaction. How each organization represents unique combinations of resources related to specific places and a unique channel to these resources (Waluszewski, 2004b) enacted in interaction need to be considered (La Rocca and Snehota, 2014).

On the impact of clusters on firms' internationalization processes, the literature suggests that one of the drivers of small firms' internationalization is developing of a set of exchange relationships in networks (Johanson and Vahlne, 2009; Snehota, 2011; Kowalski, 2014). No company controls by itself all resources and activities needed to operate, especially microenterprises. In particular, the contribution of clusters is that of providing access to specific networking opportunities and resources, including knowledge (Ciabuschi et al., 2012; Colovic and Lamotte, 2014). Networks are the primary source of an extended knowledge base, which can help to reduce uncertainty and, at the same time, facilitate the development of new knowledge (Gulanowski et al., 2018; Galdino, 2019). Knowledge concerning internationalization derives from the combination of firms' direct experience and prior knowledge with new knowledge (Fletcher et al., 2013).

Clusters are also characterized by the presence of firms acting as connectors between the cluster and global markets (Felzensztein et al., 2019), by interfirm cooperation, by support from cluster initiatives, and from the different actors in the cluster, such as research institutions, universities, specialized suppliers (Andersson et al., 2013). Hence, clusters have been defined as intermediary organizations, acting as vehicles for information, communication, and influence. So, both international and local networks appear to be of strategic importance for small firms' internationalization. Clusters are crucial in identifying international partners and opportunities, acquiring foreign market knowledge, and representing a resource themselves (Andersson et al., 2013). According to the study conducted by Colovic and Lamotte (2014), two types of actions emerge: business development in terms of foreign market expansion; and capability building in terms of international R&D cooperation. Thus, the formal cluster's primary role is "intermediation", going beyond export promotion organizations in light of their active role in relationship-building.

Studies show how clusters' features can help firms to exchange, acquire and generate new knowledge and the clusters' nature has been described as cognitive labs (Camuffo and Grandinetti, 2011), where the diversity and complexity of learning mechanisms rely on a mix of local/global and formal (or deliberate)/informal (or emergent) structures (Belussi and Sedita, 2012). Various studies underline the importance of reconciling both emergent and deliberate structures and seeing them as related to each other, being connected over time (Ingemansson Havenvid et al., 2017; Dymitrowski et al., 2019). Informal relationships are useful in internationalization to overcome institutional, economic, and social differences, to decrease

perceived uncertainty, and to provide flexibility (Dymitrowski et al., 2019). Moreover, the role of informal networking in creating and transferring knowledge is of particular importance for SMEs. Network ties between actors provide a range of knowledge exchange mechanisms, including collaboration within projects (Hjertvikrem and Fitjar, 2020).

Analyzing a specific international business project implemented by a leading formal cluster may represent a useful research setting for generating a better understanding of public-private interaction mechanisms within projects. In particular, temporary systems that occur through projects have emerged as one of the salient features of interaction. They are characterized by trust and commitment, cooperation, and communication, which play an essential role, despite such relationships' short-term nature (Kronlid and Baraldi, 2020). Projects present a trait of temporality; thus, such research can give a contribution to the growing debate on temporary spatial networks (Palmer et al., 2017), on public-private interaction mechanisms, as well as on the presence of deliberate and emergent strategies (Belussi and Sedita, 2012), contributing to establishing relationships characterized by continuity beyond the boundaries of the project (Ingemansson Havenvid et al., 2016).

2.2. Public-private interaction within projects in IMP

The contexts of clusters and projects call for intensified public-private interaction. Public-private interaction is deemed one of the most distinctive aspects of contemporary society (Welch and Wilkinson, 2004; Waluszewski et al., 2019a). Therefore, it is encouraged by policymakers at different levels (Elbe et al., 2018). What makes this type of interaction peculiar is that it is extremely uncertain, time-consuming, and the actors differ in nature (Keränen, 2017; Elbe et al., 2018).

As shown in Chapter II of this dissertation, the IMP approach has explored the importance of public actors, empirically keeping track of their shapes over time, which are influenced by the neoliberal climate, the policy trends, the wave of privatization, and the public activities' outsourcing.

For the purpose of this paper, the topic will be contextualized in the context of projects. The rationale behind this choice lies in the idea that interaction within projects is based on different conditions and dynamics given the peculiar characteristics of projects like temporality, discontinuity, episodic interaction, complexity, and uniqueness (Kronlind and Baraldi, 2020).

Projects have been defined in IMP studies as *"a temporary resource constellation and activity pattern in which the actors form a distinct logic in how to learn and develop new solutions in relation to each other"* (Ingemansson Havenvid et al., 2016: 86).

IMP empirically-based studies investigating interaction among public and private actors is mainly set in the context of projects, as *"project-based business activities are part of all private firms and public organizations"* (Artto and Kujala, 2008: 470). However, on the one hand, only a few of them explicitly address how public-private interaction is shaped in the context of projects and, on the other hand, the literature on inter-organizational relationships has traditionally investigated long-term interaction and repeated interaction episodes (Håkansson and Snehota, 1995; Håkansson et al., 2009), whose aim is the achievement of a mutual orientation, trust, and commitment.

In particular, seven main insights emerge from IMP studies on public-private interaction within projects. First, compared to other perspectives, the contribution of IMP to public-private interaction is that of the content of the exchange. Through the establishment of resource ties, activity links, and actor bonds, it is in interaction that the value of heterogeneous resources is created. The interaction patterns and interaction dimensions are affected by both sides of the exchange interface and create interdependencies arising from different logics (Wagrell and Baraldi, 2019; Håkansson and Waluszewski, 2020; Waluszewski et al., 2019a). In particular, both sides need to be aware of how building such exchange interfaces "*will be affected by the direction of historic and contemporary interaction patterns and relationships*" (Waluszewski et al., 2019a: 1122). This requires active engagement from both parties for public-private interaction to be successful and a failure of the project if interactivity and interdependence are neglected (Waluszewski et al., 2019a; Munksgaard et al., 2017). Second, the different organizational objectives, cultures, decision-making processes, organizational set-ups, and approaches might result in a different perception of the project's goals and divergent interests (Munksgaard et al., 2017). Third, this kind of interaction is particularly demanding as it implies starting relationships over and over again, with a high demand of resources spent on interaction and in getting an understanding of the counterpart's (public or private) culture and mindset, which might lead firms to *"find themselves trapped in negotiations"* (Munksgaard et al., 2017: 83) and forcing actors to prioritize and preclude certain activities and actors. Four, and related to the third point, frictions among projects' participants might be steered by the projects' settings, often characterized by high uncertainty, unpredictable interactive effects, and by a

combination of collective and self-interests of the actors involved (Ingemansson Havenvid et al., 2016; Lind et al., 2012; Munksgaard and Medlin, 2014). Arising frictions might be mitigated by the development of partnerships and continuity across projects (Crespin-Mazet et al., 2015). Five, the illustrated heterogeneity among the teams involved in projects can be considered at the same time a driver and a barrier of public-private interaction as it brings different knowledge to the project (Nissen et al., 2014). Six, on interaction mechanisms, different mechanisms lead to sharing different knowledge through a combination of formal and informal mechanisms. While formal mechanisms, mainly in place with the aim to achieve the project's objectives, related to the project's tasks, and to exchange codified knowledge (Nissen et al., 2014; Torvinen and Ulkuniemi, 2016; Mouzas and Ford, 2012), informal mechanisms are related to collaboration, strong linkages with a long-term orientation, crucial for sharing tacit knowledge (Munksgaard et al., 2017; Nissen et al., 2014). The last insight concerns the benefits that both public and private actors can exploit from participating in projects. Studies of Munksgaard et al. (2017) have shown that for private actors, building relationships with policymakers represent: i) an important device for influencing decisions on upcoming projects, ii) an opportunity for meeting new partners, initiating new contracts and opportunities for adaptations based on these potential partners' specific needs new relationships with potential partners, iii) an asset for long-term benefits and a leverage for engaging in future projects or, more in general, to access relationships with potential public partners, iv) a driver for expanding one's knowledge base as projects can be understood as a way of collecting information, knowledge, and reputation benefits (Leite and Bengtson, 2018).

In spite of the existing contributions on the topic, IMP scholars call for a deeper understanding of the public-private interaction patterns in different settings and a closer investigation of the positive and negative effects this interaction might imply. As stated by Waluszewski et al. (2019b: 2), "*The research advances achieved in past IMP research are just a tiny fraction of what we need to understand about the interactive business world and how such interactivity and interdependences affect business, organizations, politics and policy and society itself*" and by La Rocca et al. (2017: 189) *"While many studies examine interaction processes and their consequences in relation to the resource and activity layers of business relationships, [...] the actor layer […] has not gained the same attention among IMP scholars"*. The challenges to face when investigating the features of public-private interaction are little

regularity and non-linear trends characterizing relationships and the development of interaction interfaces (Ingemansson Havenvid et al., 2016; Perna et al., 2015).

It could be argued that, on the one hand, the analysis of formal cluster organizations' initiatives involving cluster firms might benefit from the public-private interaction perspective – as it is being developed in IMP recent studies – in the light of its focus on relationships and networks and on key variables as actors, activities, and resources as represented in the ARA model. On the other hand, formal cluster organizations' projects might provide a new and stimulating empirical setting for generating further knowledge on intricate patterns of public-private interaction within an IMP perspective.

3. Research methodology

This study investigates whether and how a formal cluster initiative can provide support to a firm's embedding in an international customer-supplier context by means of an internationalization project. Given the research objective's explorative nature and the research question outlined above, this paper adopts a qualitative methodology based on a single in-depth case study (Yin, 2017). This choice is consistent with methodological approaches concerning cluster studies that argue that cluster dynamics can only be captured by using qualitative research techniques and primarily through the mean of a case study (Wolfe and Gertler, 2004). Also, different empirical studies using qualitative methods employ a cluster initiative to investigate the role that formal clusters can fulfil to foster small firms' internationalization within the cluster (Andersson et al., 2013; Colovic and Lamotte, 2014; Jankowska, 2015).

The empirical setting under investigation is a cluster initiative from Sweden, FPX. Within FPX, the international business project TRIIP has been selected. The unit of analysis is a project that can be considered "*temporary resource constellation and activity pattern in which the actors form a distinct logic and develop new solutions in relation to each other*" (Ingemansson Havenvid et al., 2016: 86) and where, according to recent IMP studies, "*network relations emerge [...] and get activated*" (Manning, 2017: 1401). Therefore, accounting for a project can help understand the interactions occurring within the project and those going on across its boundaries and involving actors that play different roles and utilize different resources (Ingemansson Havenvid and Linné, 2016).

The choice of this particular formal cluster and project has been made according to distinct criteria: i) FPX adheres to the definition of formal cluster as employed by Colovic and Lamotte (2014); ii) it has been officially recognized and accredited by the Swedish government; iii) TRIIP and its activities have been identified as good practice in the context of the Interreg Europe Program[9].

The suitability of this context is mainly given by the nature of the cluster initiative, which has been initiated and it is partly owned by public actors, and by the purpose of the activities and projects implemented, which work according to market logics but at the same time have a public interest aim. Although the cluster initiative does not fully adhere to the traditional definition of public actor, given its features and the role it plays in the project in focus, it can be considered as a hybrid actor, which plays a public function within this context and works in synergy with other public actors. Thus, the cluster initiative is investigated as the public side of the public-private interface.

Different sources of data have been employed to investigate the empirical setting. The first data collection source is based on one-to-one, in-depth, semi-structured interviews (Kvale and Brinkmann, 2009) (see table 1). This typology of inquiry has been widely used in the IMP tradition to understand the complexity of relationships. Informants from the public side were selected in relation to their specific participation in the project in focus. Concerning firms, starting from interviews with the formal side of the project, informants were chosen by compiling a list starting from the information acquired from a critical preliminary meeting with informants belonging to the formal cluster.

Using the semi-structured interview type, the interview questions are designed to understand the different phases of the project, the roles played by the various actors in the project, and the interaction mechanisms adopted. In addition to interviews, secondary data have been collected through the companies' official websites and the available official documentation of the projects to integrate interviews and collected data as well as comparing data gathered from different sources. This second group of data has been used to track the phases, project interdependencies, and key facts.

[9] In this context, good practice means that the activity that has proved to be successful (i.e., has provided tangible and measurable results in achieving specific objectives) and which has the potential to be transferred to a different geographic area

Interviewed people/current position	Number of interviews	Period	Duration
Process Manager Academy and Research (FPX)	1	April 2019	1.15 hours
Operations Manager (FPX)	2	April 2019	1 hour / 1 hour
Business Coach (Movexum)	2	May 2019/June 2019	1 hour / 2.30 hours
Project Manager (Dalarna Science Park) and representative (Enterprise Europe Network-EEN)	1	May 2019	1 hour
CEO (Company 1)	1	May 2019	1 hour
CEO (Company 2)	1	August 2019	40 minutes
CEO (Company 3)	1	September 2019	1 hour
CEO (Company 4)	1	September 2019	1 hour
CEO (Company 5)	1	September 2019	40 min

Table 1 *Interviews with key informants*

Concerning data analysis, primary and secondary data have been analyzed, comparing data with concepts. A systematic combining approach has been adopted (Dubois and Gadde, 2002) to highlight the interplay between research object, methodology, and theory. Coding has been based on project phases and on relevant IMP concepts, such as the ARA framework (Håkansson and Snehota, 1995). This framework is deemed a useful analytical tool to catch the features of network-like structures based on a variety of relationships impacting each other.

To investigate the nature of actors in interaction, these are first conceived in relation to their roles. The categories addressed are public actors (the formal cluster initiative, incubator, and science park) and private actors (firms participating in the project).

To address the interaction patterns and features between the formal cluster and the firms within the project, the focus is on the activity layer of the ARA model: an effort has been made to point out functional/operational activities within the project and project management-related activities (Engwall, 2003), also taking into account formal and informal processes (Belussi and Sedita, 2012). By analyzing the single activities within the project, interaction is explored at different levels. The focus on activities also allows discovering interdependencies between activities within the same project and with other projects. This helps in understanding each

activity's efficacy compared to the others and see differences in activities implemented by different public actors in supporting SMEs' internationalization.

The last layer addresses the resource development processes deriving from interaction to understand how heterogeneous resources are activated in relation to exchanges involving different actors, acknowledging the space-related dimension.

4. Empirical findings

In this section, the case study employed for the empirical analysis is described. First, the cluster initiative is briefly introduced, and then the international business project at the core of this study will be described.

4.1. Future Position X

FPX (Future Position X) is a non-profit organization situated in Gävle (Sweden) and founded in 2006. It is Europe's leading cluster for highly qualified competence in innovative and increased use of geographic information technology. It is mainly involved with developing position-based services, media, and solutions for the future's green society and the smart city (https://fpx.se/).

The cluster cooperates and partners with "quadruple helix" actors, such as researchers, innovators, entrepreneurs, governments, municipality organizations, citizens, and stakeholders implementing projects within research, development, monitoring, and evaluation in both the private and public sector. The cluster organization's owners include the public actors *Lantmäteret* (governmental agency), Gävleborg County Council, Gävle University, Gävle municipality, and others. In addition to these, more than 200 companies participate in the projects and activities of the cluster (https://fpx.se/). In the research and academic setting, FPX works close to the universities and the educational platforms in the region. FPX has enclosed more than 15 countries in its network through its own offices, established through internationalization strategies and relationships within research projects. Their connections can be exploited to help companies with new markets, new suppliers, or gain access to new knowledge and research.

The cluster initiative is financed by the Gävleborg Region, by Vinnova (Swedish Innovation Agency), by the European Regional Development Fund, and by the Gävle *Kommun*.

The main project in which the cluster is involved is Geo Life Region, an initiative centered around services and technologies in the Gävleborg Region (Vinnova, 2014). During the implementation of the project, FPX produced an action plan identifying three practice areas (i. research and innovation; ii. entrepreneurship and commercialization; iii. competence and attractiveness) along with three platforms (i. research platform; ii. internationalization platform; iii. branding and capacity platform).

To address the practice area of "entrepreneurship and commercialization", FPX has developed an internationalization platform ensuring the support and activation of projects through the Geo Life Region initiative. To do so, FPX planned to use its cross-sectoral and cross-border organizational network model to be attractive to international players, thereby creating a broader partnership and network to attract projects, new knowledge, and new business opportunities. In this sense, creating an international innovation platform had the aim of creating access to internationalization and growth capital for the companies in the cluster's network.

Starting from this internationalization goal, FPX has run the TRIIP project to establish an investment fund to stimulate internationalization and develop models to support the companies' internationalization process. The project will be introduced in the next paragraph.

4.2. TRIIP

4.2.1. Background of the project

TRIIP is a platform to enable the internationalization process of micro-enterprises in the Swedish regions of Gävleborg, Dalarna, and Värmland, which face the challenge of achieving an international positioning. The idea came within the scope of another program, during which *"FPX grasped the difficulties of the businesses they were dealing with to penetrate international markets, and they decided to develop a project aimed at preparing companies to become international"* (Operations Manager - FPX).

As already mentioned, TRIIP is a sub-project of the Geo Life Region, approved by the EU structural funds and aimed at developing and building models to help new and innovative

companies enter the international market (Osarenkhoe and Fjellström, 2019). The budget is 2 million euros and is co-financed by the European Regional Development Fund.

The project started in 2016 and ended in 2018. It implied some mandatory requirements for firms: location in the regions of Gävleborg, Dalarna, and Värmland; status of micro-enterprises (less than ten employees and an annual turnover of less than 2 million euro).

The goal of the project was to involve at least sixty companies and get twenty of them through the whole process of the project, i.e., provide opportunities for developing new methods to create internationally competitive product packages, to analyze their export and import venture, and to establish network and contacts to various international markets (www.fpx.se/projects/triip).

Another planned final output was developing a model for the internationalization of micro-companies with a good potential for replicability to be diffused at the end of the project so that other companies could follow the successful steps for internationalization. The model could also be used by other players, with the aim to promote and stimulate companies that wish to enter an international market and to target companies that usually do not get this kind of access to activities, as existing support systems focus on more extensive and more mature companies.

FPX owned the project. It was responsible for the interaction with the participating companies, the promotion and implementation of the project activities of the development of the internationalization model. There are also other organizations involved in the project, such as the Region of Gävleborg, which is one of the financers of the cluster and which provided consultants to the projects and helped with marketing and activities in the project. Movexum, a regional incubator, provided business coaches for companies and support throughout their internationalization process. Dalarna Science Park assisted in recruiting companies for the project and business coaches and played a role in the marketing of TRIIP and the development of methodologies related to the model. The Chamber of Commerce of Central Sweden was involved in the organization of workshops as they could provide experts in different fields of business relating to internationalization. Enterprise Europe Network (EEN), the world's largest support network for SMEs with international ambitions, has been involved in the project. They have an office at Dalarna Science Park, and EEN's project manager has Dalarna Science Park as a host organization, and they work as a team. EEN had different roles as it markets the project, helps with the recruitment of companies, workshops, and coaching, and supports the

development of the model for the internationalization of micro-enterprises. Cooperation with the EEN has also helped establish an office in Gävle to create further collaboration opportunities on internationalization issues and networking.

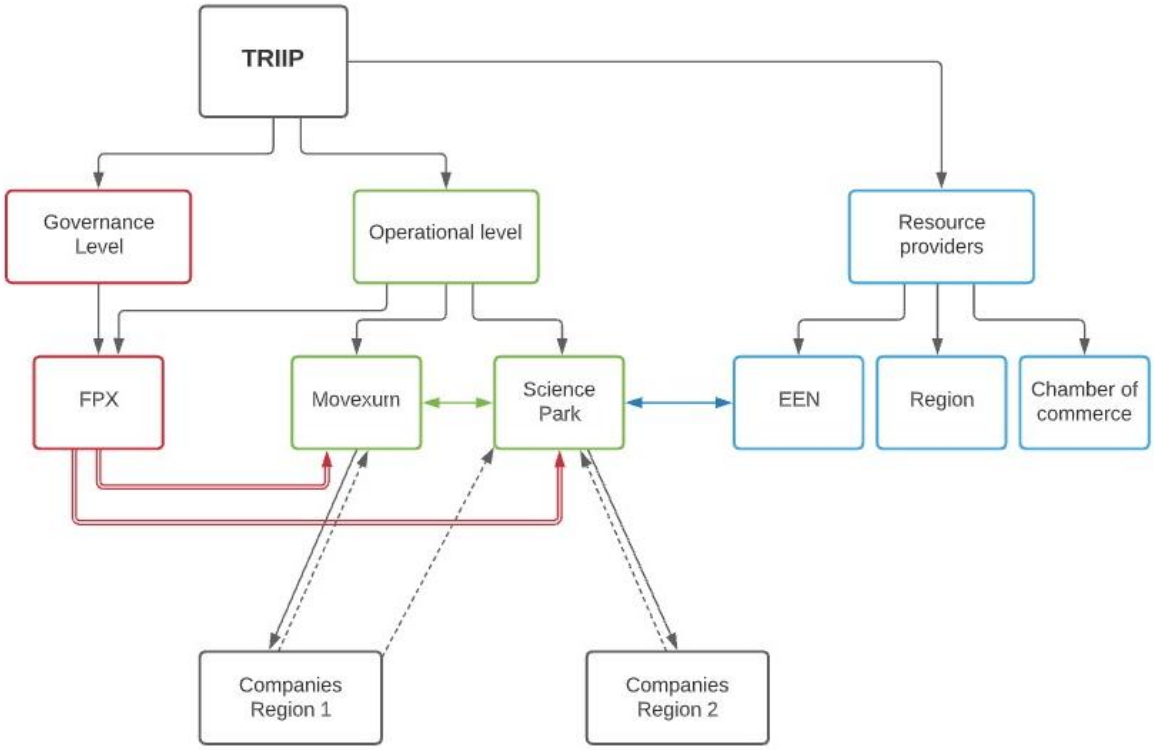

Figure 1 *The TRIIP project network*

4.2.2. Evolution of the project

Initial involvement of local firms

The project can be divided into different phases. A first phase, defined as the entry phase, consisted of informing companies and about the project and the application procedure. The project was publicized through the cluster's web page and network; various firms were aware of the TRIIP project because they were already involved in other projects within the cluster and the incubator. The application procedure consisted of a preliminary form to be filled with the companies' basic information and explanation of their current business situation, to

understand companies' self-assessment of their maturity and capacity to manage an international launch.

The cluster and the project manager would then plan a face-to-face interview to assess their readiness to get into the project and provided them with a business coach depending on the region the company is based in, respectively a coach from the regional incubator Movexum for companies from Gävleborg, and one from Dalarna Science Park for those located in Dalarna. In this phase, FPX also recruited coaches from the other public actors involved.

At the end of the entry phase, thirty-four firms from Gävleborg and Dalarna had engaged in the project. No company from the third region could be involved, as there lacked coordination between the organizations involved and *"because there was already a project running with some similar features, so the region wanted the companies for that project"* (Project Manager & Representative - Science Park & EEN). A negative aspect emerging from the selection process is *"the absence of additional selection criteria addressing, for example, particular industries so to create more synergies between participating firms and have business coaches with expertise in that fields"* (CEO company 4), even though *"having different industries helps get new insights on things and markets"* (CEO company 5).

The entry phase overlapped with the project implementation in terms of timing. In fact, companies were allowed to join the project until December 2017. According to participants, the cooperation between partners, their roles, and responsibilities should have been developed before starting the project, as this has taken valuable time from the project and delayed the actual start of activities. The entry phase had no cost applied for companies, while companies that got further accepted into the program and qualified for support had to pay a fee of 500 euro for participating in the activities of the project.

Participation in project activities

The activities planned and implemented are: i) business coaching; ii) workshops; iii) *timbank*; iv) trips; v) export lab. Business coaching was the activity at the core of the project and consisted of twenty hours that each enterprise could use to work together with their coach. These hours were mainly devoted to market analysis about firms' business strategies. After filling a self-assessment through a self-diagnosis tool, the hours were organized around the individual needs of the companies concerning the internationalization process. Firms

recognized individual coaching *"as the best and most efficient activity to get insights from an expert from outside the business and to get an appropriate preparation, to plan and research"* (CEO company 5).

Workshops were planned and carried out as the project went on. Despite the differences in terms of maturity, industry, and commitment of the participating firms, some common needs emerged at specific points of the internationalization process. These common needs could be addressed through knowledge and experience exchange among the companies.

Thus, in-between the coaching sessions, three workshops were organized in sequential order (see figure 2). Companies could meet each other and learn from experience by exchanging their ideas in groups and then having some dedicated time with the coach to work individually. The workshops involved many of the actors participating in the project: experts were provided by the incubator, by the Science Park, and by the Gävleborg Region, the Chamber of Commerce of Central Sweden, and EEN. Workshops represented a good opportunity for networking and learning, *"as they involved a small group of people and problems were faced from a practical point of view"* (CEO company 5).

However, one aspect emerging is that after each workshop, some companies decided to drop the project. Dropouts were described as a consequence of difficulties in time management from the companies, and workshops represented an opportunity for firms to realize that they were not ready to go international, as they still had to work on their product and get a strong position in the Swedish market.

The business coach described interaction in workshops as happening unexpectedly as the workshops' organizers could not predetermine a cohort of groups of companies. According to the Business coach, organizing workshops was challenging because *"the groups for the workshops were difficult to make in terms of commonalities"* and *"the scale was probably too small"*, as the workshops were organized according to geographical criteria. Thus, it could have been more useful to organize them with the other Region so as *"to distribute companies depending on their characteristics and, for example, on the nature of distributors they needed [i.e., physical distributor or possible influencer to engage in the market]"* (Business coach - Incubator).

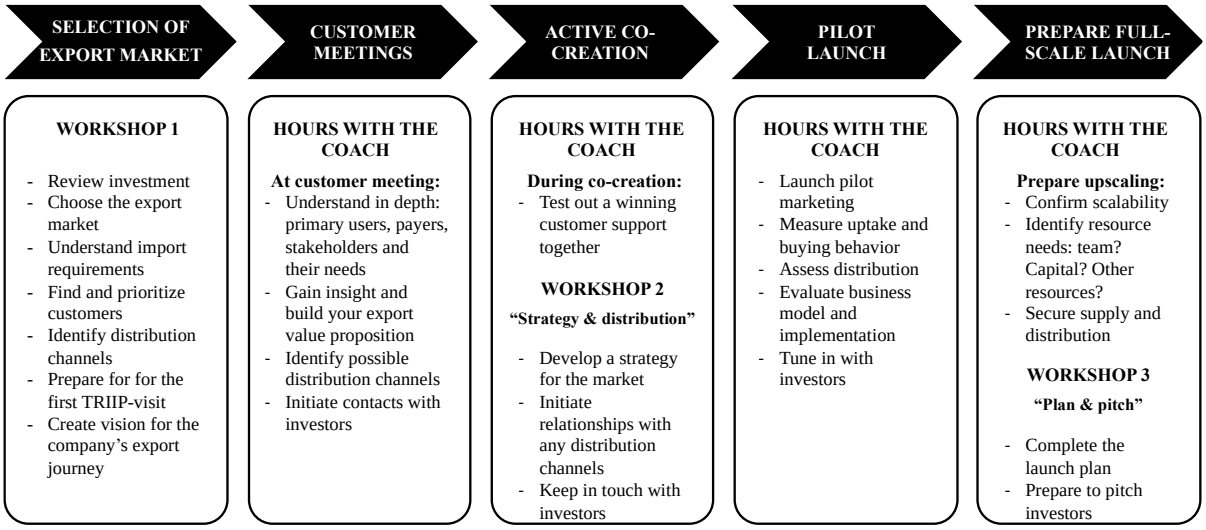

Figure 2 *Activities' process – workshops and business coaching*

The project also provided access to external consultants and experts (for example, lawyers and translators) through the *timbank*, which consisted of a pool of hours with external consultants that firms could use to get help with patents, negotiation, translation, social media management, communication, and marketing. After the approval of the company's request from the business coach, an external consultant would be identified. Companies had to write an application with their coach to submit to the cluster, which had to accept it and provide the consulting funding.

Three of the companies interviewed used the *timbank* to get a translator and a lawyer's specific help. Although they defined this help as essential for their internationalization process, one of them pointed out the downsides deriving from the process of approval: *"[one of] the reasons why we participated is the consulting time I could use for they lawyer […]. The activity was useful, but we would have needed a lawyer even without the project […] it would have been easier for us to go to a lawyer directly instead of using the timbank"* (CEO Company 4).

As part of the project and funding, the companies also had the opportunity to apply for a trip to the international market selected to meet customers, suppliers, and investors and participate in exhibitions and fairs to pitch their products. The companies organized the entire trip autonomously. They had to identify an international exhibition, fair, or meeting to attend, plan the trip, and write an application for getting funds together with the business coach. The application would then be reviewed in terms of content and consistency with the companies'

goals and managed by the cluster and by the project manager, who would check the budget and take care of the procurement process if it involved different suppliers.

One of the companies applied for the trip to take part in a trade fair in the US and defined it as *"the most important activity as it allowed getting contacts and partners. […] Participating in the tradeshow gave me a different input than what he expected on how and in which way to change his product"* (CEO Company 4). During the first trip, he had networking opportunities and *"through the support received on the spot by the business coach, we got introduced to the right contacts in China. […] We will launch a new product at a fair in Shanghai"* (CEO company 1). The importance of such activity for firms is also stated in one of the reports filled in the aftermath of the project, which describe the activity of trip and participation in the exhibition as "*a success for the company as they had the opportunity to network and pitch their products*".

Along with implementing a traditional export program, the project developed an innovative methodology through the export lab, based on the two concepts of "international incubation" and "international acceleration" that could better fit the needs and characteristics of the participants dealing with innovation. *"The export lab did not derive from an established and proved methodology, but it was rather a hypothesis based on the incubator's experience dealing with innovative products and service and from mixing this idea with the experience of other export organizations (such as Business Sweden) and with personal knowledge of the lean start-up approach"* (Business coach - Incubator).

The export lab started with a rational and logical choice of the market the company wants to enter and with a market analysis and face-to-face meetings with international customers to co-create or re-create the product with the customer (international incubation).

After the creation of the product, the business coach encouraged the company to organize a pilot launch of the product or service in a specific region of the target country to prepare for the full launch. The pilot launch gave the opportunity *"to measure customers' reactions and responses to the product or service regionally and to learn from them, as the company might need to go through several iterations until they have the perfect product for the whole target market"* (Business Coach - Incubator).

Thus, the focus of the export lab is on the learning ability of the company's team and on its capacity to challenge its idea and beliefs. After the pilot launch, companies were encouraged to evaluate the success of their product positioning and their communication strategy, to work

on it, and then to enter into the international acceleration phase and, thus, to penetrate the international market. One company dealing with sealing technology took part in the export lab successfully. The company made the rational decision to enter the North American market. Still, they had to re-create their product to fit that market's needs and then go through a technological upgrade to handle internationalization's effects. The export lab represents a success story for this company, which had the opportunity to participate in a trip to North Carolina and to attend a fair in its sector, during which they had the chance to *"sign up with one new customer […] and with one new retailer"* (Report of the company).

While some activities followed a specific path in terms of timing and management, other activities occurred throughout the project, according to the single firms' needs. This is the case of *timbank* activities and trips abroad, which required the interaction among all the actors. The companies organized autonomously the entire trip by writing an application to get funds. FPX would then review it in terms of content and consistency with the companies' goals and managed; it would check the budget and take care of the procurement process if it involved different suppliers.

This represented one of the downsides of the project. According to some of the firms' informants, they did have enough control of their activities, which implied too much reporting and bureaucracy. The Operation Manager of the cluster initiative described this process as needed as *"They need to give us motivations and explain why they need such help […] then we check the budget and examine the application to see if we can support that"*. As reported by one of the CEOs, *"With the cluster […] one gets the money easily by participating but loses control and has to comply with bureaucratic issues and reports/documents, which make things slower"* (CEO company 3). Another negative aspect highlighted by firms in dealing with such activities was time management and time perception "*as there was a discrepancy between the business' needs and the formal requirements of the project to get funding […] because we had to arrange things and communicate them months ahead, which is not possible in our business. There is an issue in the perception of timing between a business and an institution [i.e., the cluster initiative]"* (CEO company 2).

The project also encouraged some informal speeches and community meetings to share knowledge and experience and develop connections with other projects, such as Compete In, an ongoing project (2016-2021) approved within the Interreg Europe program. Like TRIIP, Compete In promoted a learning process through study visits, transfer workshops, meetings,

and other interregional events to exchange local best practices to attract investments, penetrate new markets and territories, and create international partnerships. As the Municipality of Gävle is one of the project's partners, FPX presented the TRIIP project to other European clusters companies, which could be matched with some activities and experience exchange, such as transfer workshops on good practice. This exchange was aimed at the broader goal of enhancing collaboration both among cluster initiatives and companies. Still, it did not have a direct impact on TRIIP's activities.

The aftermath of the project: final assessment and follow-ups

The last phase of the project consisted of reporting activities and follow-up both from firms to the cluster and from the cluster to the financiers and stakeholders of the project, as the two analysis seminars delivered to the Swedish Agency for Economic and Regional Growth.

The participation in the project gave firms the possibility to become a member of the cluster or the incubator and thus to enter other programs, such as the case of *"a company dealing with innovation, which could engage in the Movexum's Boost Chamber which acts as pre-intake to the incubator and represents a first step into the region start-up-community"* (Business coach - Incubator). A company within the wine industry *"could engage in another project aimed at the Asian market within Dalarna Science Park"* (Project Manager & Representative - Science Park & EEN).

Among the project's goals, there was the creation of a model for the internationalization of micro-companies with good potential for replicability. The model was supposed to be developed through the cooperation between FPX, Movexum, and Dalarna Science Park, and they started working together on an eCoach tool. However, *"the actors had a diverging idea on it, and the incubator and the science park decided not to contribute in this as there was no synergy"* (Business coach - Incubator and Project Manager & representative - Science Park & EEN). The cluster developed the tool by itself and provided companies with a model containing resources dealing with internationalization that they could access online.

Concerning the results of the projects, through the analysis of a report evaluation, project analysis seminars, and internal reports both from the cluster initiative and from the incubator, it has been possible to assess the successfulness of the project, based on a comparison between

expected results and actual outcomes, as well as on the firms' expectations at the start and the end of the project.

The project supported 55 out of 60 companies (92%), and 38 of the companies could find contacts with customers, suppliers or distribution channels, which allowed them to find international partners for their products. Firms expected that the participation in the project would contribute to a high degree to increasing the competitiveness of the company (95%), to increased understanding of the way to an international market (100%), and the creation of new jobs in the company in the longer term (90%).

After the project, the cluster organization conducted telephone interviews with 24 companies that went through almost the whole project since they participated in workshops, coaching and used expert support through the *timbank*. The reports show that the project helped companies improve or create new goods and services and develop new prototypes and new competences. For half of the interviewees, the project helped develop new prototypes and develop new competencies. For almost all interviewees, competences could be increased through participation in workshops and coaching, while only 13 companies out of 24 found *timbank* helpful. Negative results derive as it concerns the development of new infrastructures, testing or measuring equipment (0/24 companies), pilot plant (1/24 companies), business incubator (6/24 companies), as well as related to the development of spin-off to a new company (1/24 companies), new patents (1/24 companies), expansion in the region (2/24 companies).

In the aftermath of the project, the connections and interdependencies among actors and activities also emerge, such as firms' involvement in other programs of one of the public actors involved; or being in the TRIIP project and in the incubator either before or after the project. This is the case of two of the companies that had gone through the pre-incubator program before engaging in the TRIIP project. They already had some coaching a couple of years earlier, and one company that dropped the project and is currently working actively with the incubator for internationalization. Finally, there is an interdependency among public funding, as companies applied for other public innovation support.

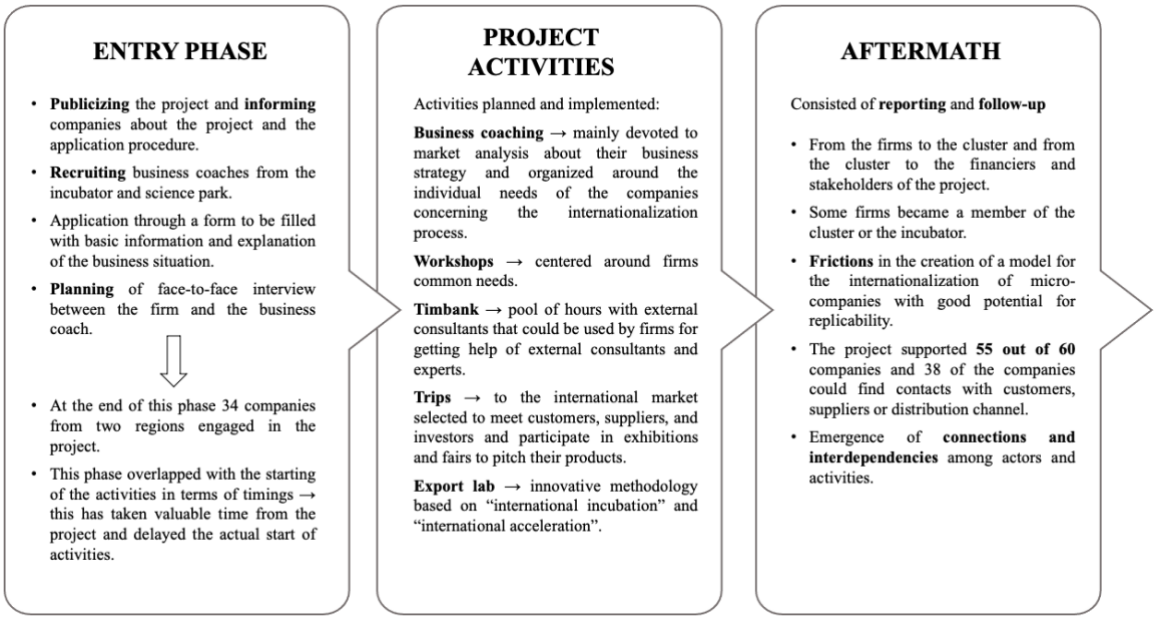

Figure 3 *Evolution of the project – phases*

5. Discussion of findings

This section attempts to provide an answer to the RQ stated in the introductory paragraph. First, it summarizes and discusses the evolution of the project along its various phases. The project's process is then better analyzed through the ARA framework, accounting for actors, activities, and resources. Lastly, it provides a summary of the main interaction patterns emerging from the analysis.

In the pre-implementation phase of the project, interaction mainly occurred indirectly through deliberate mechanisms and tools (Belussi and Sedita, 2012; Ingemansson Havenvid et al., 2017). This phase is characterized by some standardized steps concerning the application, such as pre-filled forms and standardized interviews. In some cases, informal and personal contacts have been activated to spread information about the project's start. Interaction between the cluster and the other public actors is mainly formalized through contracts and agreements (Mouzas and Ford, 2012), settled for the business coaches.

With the start of the project, both informal contacts and unintentional interactions and more structured mechanisms are in place. The project's core activities occur as planned through formal interaction mechanisms. One of the aspects emerging from formal activities, such as

workshops, concerns spontaneous informal mechanisms among the participants that may take place, giving rise to so-called deliberately emergent interaction (Ingemansson Havenvid et al., 2017). The interaction between the public and the private side happens through deliberate formal mechanisms; interaction among businesses is mostly informal and spurred by implementing more structured activities; interaction among public bodies occurs during the project through planned weekly meetings through ICT tools aimed at reporting and planning activities.

In the aftermath of the project, the tasks firms were asked to complete were reports and interviews on the project's activities to gather feedback. In this phase, informal activities go on beyond the boundaries of the project. Some companies active in similar sectors started collaborations and there are signs of continuity across the project as many companies participated in other formal activities (projects) sponsored by public actors involved in the TRIIP project.

Entry phase	Project activities	Aftermath
• Interaction is mainly indirect through deliberate mechanisms and tools • Between the cluster and firms → Standardized steps concerning the application • Sporadic informal and personal contacts • Interaction among public actors is formalized through contracts and agreements	• Combination of structured and emergent interaction • Deliberately emergent interaction • Public-private interaction happens through formal mechanisms • Business interaction is mostly informal and spurred by structured activities • Interaction among public actors is planned and aimed at reporting and planning	• Informal activities going on beyond the boundaries of the project • Sign of continuity across the project in terms of formal activities • Activities mainly aimed at reporting and gathering feedbacks

Table 2 *Summary of results on the evolution of the project*

Following the ARA framework (Håkansson and Snehota, 1995), it is possible to get a deeper understanding of the role played by key actors, of the nature of activities carried out within and beyond the project's boundaries, and of the relevant resources at stake in the process. Concerning the role of key actors, empirical findings raise various insights that deserve further

explanations. On the public actors' side, it is apparent the role of FPX as the orchestrator of the project (Andresen, 2020), which takes on many roles and is primarily acting as supporter and financer. These roles are not separate and distinct but rather coexistent (Guercini et al., 2020) and have been focused on initiating and outlining the overall project strategy, later on coordinating the project activities, as FPX enabled and constrained the government and the enactment of practices (Brunet, 2019), and then intermediating and promoting interaction (Andresen, 2020).

This study confirms previous investigations by showing how formal cluster initiatives can help firms overcome obstacles deriving from their scarce resources and limited international experience. The cluster does not merely facilitate internationalization, but it also participates actively in forming relationships with local and international partners. That is, it participated both in business development and capability building activities (Colovic and Lamotte, 2014). In doing this, FPX has been supported by other public actors: the incubator and the science park as operational partners, the other regional/national actors as providers of *ad hoc* resources in terms of experts and market knowledge. Therefore, FPX has mainly acted at the governance-level of the project, and the other organizations involved assumed a role linked to the different operational tasks.

This joint-action was also characterized by some frictions (Lind, 2015; Keränen, 2017; Munksgaard et al., 2017; Mattsson and Andersson, 2019), which led to a delay in the start of the activities and the failure in the achievement of the project's expected results.

Indeed, actors showed a high degree of synergy during the project implementation, but divergences emerged during the design of the internationalization tool, meant to be circulated in the project's aftermath. This was due to overlapping roles, competition, and divergent views on the tool's design and usefulness (Drejer and Jørgensen, 2005; Elbe et al., 2018). Consequently, two of the public actors decided not to help FPX in reaching this objective actively. The geographical division of competencies was clear from the beginning of the project, thus facilitating the process initially; however, on the other side, some overlapping roles made the project governance more difficult. Given the similar nature of the public actors involved, frictions arose from existing competition between them. Tensions could be managed and overcome only through existing personal relationships (Halinen and Salmi, 2001; Dahl and Pedersen, 2004), highlighting the importance of social capital (Bondeli et al., 2018; Cappiello et al., 2020).

One emerging aspect is the importance of the role played by the formalization of collaboration (Drejer and Jørgensen, 2005). In fact, smooth interaction among the project's participants requires clarification of divergent interests, roles, and goals from the very beginning. Formal agreements make sure that potential conflicts are dealt with, but, at the same time, they must be combined with the informality of activities, such as team-building.

On the businesses' side, firms assumed the role of project "customers", displaying various degrees of interest and commitment, resulting from their heterogeneity in industry, maturity, and previous internationalization strategies. In this sense, a leader-follower pattern can be identified (Guercini and Runfola, 2015).

The leading firm has been recognized as *"someone you could send other firms to take as an example"* and *"who participated confidently and successfully in activities related (and not) to the project"* (Business Coach-Incubator). The leading firm defined its role in the project as "learner", understanding the project as an opportunity to develop its knowledge, adapt it to a different context, and able to comprehend the changes needed in terms of product, marketing strategies, distribution channels, and communication. Leading firms were also characterized by readiness in terms of industrialization process and technological upgrade, identified as critical aspects to handle internationalization's steps successfully. Another way to illustrate the role of leading firms is based on the outcomes of their more intense activity than other firms. In fact, leaders became committed beyond the scope of formal tasks. Active leading firms were also the most engaged in managing the cross-relational network deriving from joint activities (Munksgaard and Medlin, 2014), thus having a more collective interest in mind. Their role is central in initiating network activities to involve other firms in creating a collective interest and shape network development.

However, identifying some companies as followers does not imply that they had a passive role in the project but rather that they had less knowledge and experience, which they needed to improve through interaction. Some of the participants in the project had a somewhat unclear status. This is the case of companies whose main expectation from the TRIIP project was getting access to funding and did not value "internal" relationships, but only the external networking functional to the short-term aim of finding suppliers, customers, and distributors. As pointed out by the secondary data from the project's reporting phase, more than half of the investigated firms failed in getting support in terms of relevant information to get embedded into international supplier-user networks.

Concerning the activity layer of the ARA framework, the interaction patterns among public actors and participating firms highlight three main aspects. First, project activities have been well structured in terms of content and processes, forecasting specific steps to be undertaken by the participating firms. Second, the nature and the limited resources of the small firms have been considered through various measures: an in-depth analysis of business needs, flexible involvement of participating firms in the different activities, intense bilateral support, and mentoring through dedicated resources. Third, also "collective" activities (Nissen et al., 2014), such as workshops and informal meetings, have been carried out to promote interaction and knowledge exchanges among representatives of public actors and business firms. Joining resources and connecting activities lead to developing business relationships and the network. The collective interests of firms are served by collaborating and coordinating mutual activities in a network (Munksgaard and Medlin, 2014).

The typology of interaction at the activity layer assumed different forms. It occurred individually, between the cluster and the single companies, and in groups through meetings and workshops. The choice to vary the typology of interaction resulted in different learning outcomes. While individual time allowed firms to learn directly and be tutored by their business coach, the choice of grouping firms led to other forms of interactive learning and informal knowledge exchange, in line with what already showed by previous studies (Kowalski, 2014). Therefore, the combination of structured and flexible processes, on the one hand, and formal and informal ones on the other, helped to support companies over a three year-span effort.

Concerning mechanisms enacted for the creation and exchange of IB knowledge, during the initial involvement, knowledge was dealt with through a self-diagnosis tool, and the IB knowledge level represented the first assessment for firms, which were asked to evaluate knowledge of i) the export market to invest in; ii) export customers; iii) the customer's situation in the export market.

During the project's implementation phase, workshops were organized to transfer market knowledge, manage the different phases of the internationalization process, and provide firms with the knowledge to address common needs.

Individual coaching and *timbank* also represented useful activities for the exchange of market knowledge. However, as they were face-to-face between the coach and firm, they worked under different mechanisms than workshops and were used in parallel. The coaching sessions were mostly used to drive them through their learning journey.

Product knowledge was mainly addressed in the export lab, where products were co-created with the customer. Co-creation is about the joint creation of value between the company and the international customer to better suit the context. The export lab can be defined as a learning process entailing a more active engagement of the private side in creating knowledge related to the product or service to internationalize.

Thus, the creation and exchange of market knowledge versus product knowledge require different timings and activities (Galdino et al., 2019). While the product is co-created jointly with international customers, market knowledge is a prerequisite for entering an international market and, at the same time, is likely to continue even after market introduction. This suggests that project completion criteria and project management might differ for the product versus market knowledge.

Throughout the project, the activities put in place were aimed at transferring and mobilizing knowledge needed to meet the project's objectives and creating new knowledge within and through the project. Data shows how knowledge-related activities have occurred at multiple levels. Workshops took place at the inter-organizational level when different firms gathered and worked together around common needs. Coaching has been planned at the intra-project level, where knowledge is bound up with the project managers and business coaches. Finally, at the interproject level, knowledge has been shared in the form of "good practice" among participants to different projects. Knowledge-related activities involving either the exchange or the creation of new knowledge are not independent of each other. They do not occur one after the other, but they often overlap, merge, and entail knowledge flows across organizational boundaries.

On the project's impact in terms of resources, the main resources involved were the financial incentives provided, a combination of knowledge, and complementary capabilities. The financial dimension has been crucial to raising firms' interest in the project, and, thanks to it, most of the firms involved approached the internationalization process.

So, in line with other studies (Perna et al., 2015), the monetary dimension is also a key factor throughout the project's phases. First, it has been crucial to raising the interest of microenterprises, primarily through the low participation fee and the money available for the trip. Second, it has been a reason for quitting the project, as the bureaucratic hurdles to get the project's money for the international trip has been perceived as challenging to handle for firms with few employees and where, generally, it was the owner and CEO himself/herself to be

personally involved in the project, resulting in a non-complex contact pattern among actors (Fröberg et al., 2020).

Also, access to different typologies of knowledge provided to firms during the project is one of the key resources (Gulanowski et al., 2018). TRIIP has represented a valuable experience and has been assessed as a good practice, thus embodying valuable knowledge to support small firms in international markets and helping FPX to achieve its institutional goals in terms of regional internationalization. TRIIP also endorsed FPX in gaining a stronger international reputation among European formal clusters and institutions, increasing its knowledge, and strengthening relationships with other local actors, local businesses, international institutions, and business partners.

A significant output of the project is the online internationalization tool, developed, distributed, and owned by FPX in the project's aftermath. Microenterprises could easily access different resources and materials. This has become an organizational resource for both institutional and business actors, even though its development has shown frictions among FPX and its partners. Another essential resource is the Export Lab process developed by the incubator before starting the project and successfully implemented within TRIIP. In this sense, while projects involving different actors might give access to a broader set of expertise and purposes, they also imply struggles with coordination and interfacing issues.

On the business side, participation in the project has helped small firms in further design their product or service package for international markets, gain valuable knowledge of foreign markets, and establish critical connections with foreign partners, in line with results shown by Colovic and Lamotte (2014). This knowledge was supported and facilitated by the formal cluster's internal and external networks (Andersson et al., 2013), which companies could exploit to find the spot's right contact during their trip. The external and internal relationships of FPX represented, thus, an important pool of heterogeneous resources to be actively dealt with for firms (Waluszewski et al., 2019a).

Business firms developed managerial knowledge in terms of skills, project management, and interaction with institutions and other knowledge providers and brokers. It could be argued that small firms have started to develop the first seed of relational skills, which could become a valuable asset for future involvement and interaction in similar projects (Munksgaard and Medlin, 2014). This pattern has already been shown by some firms involved in the project,

which participated in another project or applied for public innovation support from other institutions.

In sum, the research shows convergence among participating firms in recognizing that the workshops and the business trips were among the most useful activities. Workshops were deemed important to achieve internal networking and learning purposes, while the business trips were more important in terms of product feedback and external networks. Other activities were still considered important, but, as reported from one of the companies, *timbank* activities are necessary and would have been carried on even without the project.

<table>
<tr><th colspan="2">Actors</th><th>Resources</th><th>Activities</th></tr>
<tr><td rowspan="2">Public</td><td>• FPX as project orchestrator - governance level
• Movexum and Dalarna Science Park as operational partners
• Regional/national actors as providers of resources
Formal interaction characterized by synergies, frictions, competition, divergence, overlapping roles.</td><td rowspan="2">• Knowledge
• Complementary capabilities
• Financial incentive
• Export Lab
• Internationalization tool
• Cluster’s internal and external network</td><td rowspan="2">• Individual activities to learn directly and be coached
• Interactive learning and informal knowledge exchange through group activities
• Export lab aimed at developing product knowledge

Knowledge-related activities at multiple levels:
- inter-organizational level – WS
- intra-project level – coaching
- inter-project level – Compete In</td></tr>
<tr><td>Private</td><td>• Various degrees of commitment and interest deriving from heterogeneity
• Leader-follower pattern</td></tr>
</table>

Table 3 *Summary of results along the three layers of the ARA framework*

6. Conclusions

This paper presents and discusses research on formal clusters’ role in supporting small firms’ internationalization processes. By taking a public-private interaction perspective, based

on the IMP approach, it aims to understand how international business knowledge is exchanged within an internationalization project.

This research contributes to the limited literature on the increasingly relevant phenomenon of formal clusters (Colovic and Lamotte, 2014). It shows the articulated nature and behavior of a formal cluster organization within regional internationalization programs, highlighting its networked configuration in terms of different actors involved – composed by public actors and their partners – and the constellation of activities and resources, pointing out their features and interdependencies.

Interactions happening in formal clusters within projects are governed by a structure and rules of the game. It is important for actors, especially public ones, to agree on rules concerning roles and scopes of activities and define the network in order to avoid conflicts (Finke et al., 2016; Fröberg et al., 2020).

Also, the study provides some preliminary evidence of the degree of embeddedness of formal clusters internationalization projects, which could be perceived as "isolated" top-down attempts to promote business projects and ventures (Owusu et al., 2007). In this sense, this research supports literature on projects as a distinct mode of internationalization. Firms with internationalization experience perceived the cluster's support as a lack of control over the activities. They pointed out a misalignment in terms of timings and needs of the firms and in terms of the number of subjects involved, even though they could exploit the network's existing connections. In contrast, firms at their first internationalization and project participation experience perceived it as a useful tool.

Second, it contributes to the current debate on public-private interaction mechanisms, emphasizing the diversity and interrelation of such mechanisms. These include simple information channels to ensure that firms know what they can gain from the involvement with public actors and how to approach them, informal and emergent interaction, as well as more formal mechanisms, for knowledge exchange (Belussi and Sedita, 2012; Ingemansson Havenvid et al., 2017; Dymitrowski et al., 2019), such as formal agreements/contracts to manage the divergent interests and perspectives and to deal with issues concerning the management of the project, division of tasks and responsibilities. In this sense, the characteristics of high clarity and low cohesion of contracts might also be important in enhancing trust, reducing ambiguity (Guercini and Tunisini, 2017a), and improving explicit

knowledge acquisition by specifying the scope and mode of explicit knowledge transfer (Wang et al., 2020).

Thus, the variety of knowledge supporting the internationalization process of microenterprise is exchanged through a combination of formal and informal mechanisms (Drejer and Jørgensen, 2005). This provides guidelines on the organization and management of the project as, given the complexity of the public-private interface, there is a need for room for flexibility and adaptability in knowledge-related activities to ensure the dynamic creation and exchange of IB knowledge.

Third, on the upgrading and circulation of international business knowledge, the research shows that clusters' top-down activities need to be complemented by other bottom-up mechanisms. While the former can be useful for transferring market knowledge and achieving the project's expected outcomes, the latter plays a crucial role in the development of relationships and networks that go beyond the scope of the project. In terms of project implementation, improving knowledge creation and exchange activities can reduce project failures, thus making knowledge particularly relevant to successful project outcomes (de Moraes et al., 2020).

This paper has some limitations. First, the retrospective approach adopted could have hindered data collection and made it difficult to track back the different phases and relationships developed over time, given the different degrees of informants' knowledge. Second, it could be argued that accounting for the project as a unit of analysis may have been beneficial for the results but, at the same time, it might have hampered ARA outcomes, as accounting for such perspective could show players and actions only in relation to that project (Engwall, 2003). Future contributions on this phenomenon could, first, better explore the interaction patterns among public actors with overlapping and competitive roles within projects, and second, investigate within firms' dynamics in projects and how they influence/are influenced by the orchestration of public actors.

The empirical research undertaken in this paper has various implications. Managerial insights concern the management of formal cluster internationalization projects and small firms attempting to undertake innovative projects to expand foreign markets.

On the formal cluster organization side, this paper emphasizes appropriate planning and structuring of activities, which should account for their degree of embeddedness in existing local and international configurations of actors, activities/projects, and resources (Lind and

Dubois, 2008). This study emphasizes the importance of the network and relationships around the formal cluster, especially when the cluster does not control all resources and activities.

A carefully planned joint-action with identified external partners is crucial for the success of the project; however, synergies might also be backed up by frictions due to overlapping roles and competition requiring adaptation. Proposing and implementing an ambitious and complex project should fill a clear and relevant gap in the local business context. At the same time, it should promote and effectively manage all possible synergies with previous and ongoing projects developed by both public and private actors.

On the small firm side, participation in formal cluster internationalization projects could provide a wide variety of benefits, which can be exploited and transformed into newly available resources through a credible commitment in terms of time and managerial effort, thus developing appropriate relational skills. An important implication for firms concerns the degree of activities to be undertaken in terms of participation in initiatives, programs, or projects.

As to policymaking, this research confirms the role of formal cluster organizations in becoming a key actor supporting internationalization processes of small firms, other than traditional players such as export consortia and export promotion agencies. It could be argued that the mission and nature of formal clusters could offer advantages in the light of the interconnectedness of different types of formal cluster initiatives in the area of entrepreneurship, innovation, and marketing, able to provide more articulated support for small firms' internationalization projects (Colovic and Lamotte, 2014). Policymakers must be aware of the different interaction levels at the actor layers and at the expected and desired outcomes of policies that can change depending on interaction happening at the resource and activity layer (Eklinder-Frick, 2016).

Also, the projects' monetary benefit has been a strong incentive for firms to take part in the project. This aspect should be accounted for, and the public side must learn how to manage these dimensions' impact. It is essential to combine this effort with initiatives aimed at promoting commitment and an understanding of the implications of the project on a wider horizon. Otherwise, firms participate in the project without a clear objective and strategy in mind, thus jeopardizing the project's long-term goals. Thus, a more far-reaching commitment should be encouraged even beyond the scope of the project. In this study setting, firms did not understand the long-term aim of the project, as some of them had an inactive or unclear status within the project and eventually dropped because of a misalignment of their interests with

those of the cluster and of other firms. In this sense, this study shows that some of the firms involved in the internationalization project supported by a formal cluster initiative sought self-interest from the network rather than building network collective-interests. Accordingly, these firms are more selective about joining to pursue their specific self-interest goals, and they see the network as a way to access resources (Munksgaard and Medlin, 2014). Thus, relationships are entered only when actors can be created and captured (Mouzas and Ford, 2009).

Summing up, this research highlights that projects could be shaped by existing local and international configurations of actors, activities, and resources, which could hinder or facilitate the project's implementation and the achievement of its objectives (Eklinder-Frick, 2016).

Building on previous studies, this study shows that spurring interaction through a formal cluster initiative has positive outcomes; however, contextual knowledge circulation is missing. Conceptual and practical knowledge on internationalization was accessed, transferred, and exchanged between actors from varying contexts using formal and informal mechanisms without considering how its value is entangled in the specific context (Eklinder-Frick, 2016).

While the mechanisms created to facilitate public-private interaction on knowledge creation and exchange are important in terms of funding possibilities and of the organizational framework provided (Drejer and Jørgensen, 2005), it could be argued that it is not enough to promote policies and programs to create cluster initiatives for creating an arena where business, academia, and the public side could interact and share knowledge coming from a different context, without managing this new context (Eklinder-Frick, 2016).

The motives behind the creation of such an arena are to spur cooperation and collaboration, to connect actors, and to develop business opportunities leading to regional growth. Clustering processes are often built on the idea of membership and organizational structures, which are less effective in developing strong relationships but aimed at gaining the benefits of the network (Fröberg et al., 2020). Instead, efforts should be directed towards interaction between actors for creating and enacting knowledge. The created network is useful in providing an arena where actors from different sectors can interact; still, it is crucial to understand what happens undercurrent among actors, as it is in interaction that knowledge is created. Hence, rather than simply promoting cluster-based initiatives through policies and programs (Eklinder-Frick, 2016), it would be more appropriate to use networks and collective initiatives for internationalization and IB knowledge exchange.

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Chapter V

Concluding discussion and remarks

This concluding chapter provides an overview of the main findings of this dissertation. The discussions and conclusions presented at the end of each chapter provided different pictures of the context of clustering processes, knowledge, and public-private interaction. This final chapter aims to reconcile these pictures by triangulating the evidence provided by the previous chapters. To do so, first, the main findings of each paper in relation to each other and their contribution to the overarching objective of the dissertation. Second, conclusive remarks are outlined, as well as managerial and policy implications. Finally, limitations of the study are pointed out, and an agenda for future research is suggested.

1. Connecting the chapters: From the individual outputs to interlinked findings

As stated in the introductory chapter of this dissertation, this research has been motivated by an interest in learning and broadening the boundaries of knowledge on the interactive aspects of clustering processes. The objective was to provide an understanding of how knowledge flows provoke changes in clustering processes through the adoption of a public-private interaction perspective.

This thesis started with a review paper (Chapter II) with the title *"Public-private interaction: a systematic literature review and implications for researching business networks"*, which presents a discussion concerning how public-private interaction has been investigated within IMP studies. The need for such investigation lies in the fact that, although the topic has increasingly emerged in recent IMP contributions (e.g., Munksgaard et al., 2017; Waluszewski et al., 2019; Kronlid and Baraldi, 2020; Bondeli et al., 2020), it seems to lack a cohesive and comprehensive conceptual understanding of the underlying mechanisms of public-private interaction. The systematic literature review's main aim is to provide an overview of the state-of-the-art on the topic, to find the main trends and gaps in scientific research. Findings have also allowed delineating propositions for future research.

To do so, 32 articles have been identified and analyzed in depth. The analysis has been conducted along different dimensions, based on a framework developed by previous studies on how to analyze interaction (Abrahamsen et al., 2016). The review starts with a preliminary analysis concerning how IMP studies have tried to include actors not belonging to the category of business actors in business networks (Bengtson and Hadjikhani, 2010; Latifi, 2016).

By addressing the two research questions identified, findings show the features and characteristics of the variety of public and private actors and the presence of actors not directly involved in public-private interaction but indirectly acting as intermediaries and fulfilling different roles. Also, there is a shared view of the importance of combining formal and informal mechanisms and direct and indirect mechanisms (Munksgaard et al., 2017; Nissen et al., 2014). Studies also agree in outlining tensions and challenges deriving from heterogeneity among different actors (Mattsson and Andersson, 2019).

The discussion concerning the reviewed literature raises challenges and implications for future research on different interrelated theoretical and empirical grounds. For example, a deeper understanding of the role of social capital within public-private interaction, the dynamics and dynamism of the roles played by actors in interaction over time, and the need to combine the different questions concerning interaction features, which have been addressed individually within this study (who, what, how, why) emerge, among others, as future avenues for investigating this topic.

For the two empirical studies conducted, a qualitative approach has been used by adopting a single case study methodology. In order to gain a fuller picture of knowledge dynamics within clustering processes, the underlying concepts of the thesis have been delved into different contexts. While public-private interaction is "a fact" within clustering processes, the two settings of innovation and internationalization have been chosen to explore this phenomenon empirically.

Thus, in Chapter III, the paper entitled *"The dissemination mechanisms of Industry 4.0 in traditional industrial districts: evidence from Italy"* has been introduced. This first empirical paper examines the dissemination of I4.0 knowledge, exploring the main mechanisms for its spreading (Belussi and Sedita, 2012; Lazzeretti and Capone, 2016) and highlighting the main factors shaping such processes in the context of an Italian industrial district active in a traditional sector. The analysis has been conducted on the evolution of I4.0 knowledge dissemination in the industrial district. Further, analysis has been carried out along the three

dimensions of the ARA framework. Main findings concern the absence of clear sectoral and geographical boundaries in the upgrading of knowledge related to I4.0, disjointed institutional and business efforts pertaining to initiatives for the diffusion of such knowledge, and the engagement in deliberate measures leading to a combination of formal and informal initiatives.

Then, Chapter IV presents the second empirical analysis with the title *"Formal clusters supporting small firms' internationalization: a case of public-private interaction"*. This empirical paper is set in the context of an internationalization project implemented by a Swedish formal cluster initiative aimed at exchanging international business knowledge. Key results of the analysis emphasize the formal cluster's role at the governance-level as orchestrator, supporter, and accelerator, but also actively participating in relationships with local and international partners (Colovic and Lamotte, 2014; Andresen, 2020). The formal cluster has been supported by other public actors involved in the project, which have acted as providers of resources at the operational level. On the private side, firms assumed the customers' roles but played different roles depending on their degrees of interest, commitment, and heterogeneity. Knowledge-related activities aimed at spreading international business knowledge have occurred at multiple levels (inter-organizational, intra-project, inter-project), with different timings, implementing various activities (from individual coaching to trips abroad and workshops), and involving heterogeneous resources.

Other than being related to the research questions outlined in each chapter, findings from the individual chapters relate to this dissertation's general aim. Thus, they can be inserted in a broader context. Consistently with the theoretical and analytical framework adopted for the analysis of the data collected, findings are illustrated on the three interconnected layers of the ARA framework (Actors - Resources - Activities) used for analyzing inter-organizational interaction (Håkansson and Snehota, 1995). The ARA framework is the most suitable tool to conduct an integrated reading of the different outputs of this dissertation since it accounts for aspects, namely actors, activities, and resources, which have been investigated with different emphasis and foci in the previous chapters.

Actors

Concerning actors, the analysis allows for reasonings on the nature and features of actors and on the links developed among them through interaction. The analyses conducted throughout

this thesis investigate different functions of relationships, that is, dyads and networks. The dyadic relationships of actors engaged in public-private interaction and their effects on the whole network emerge in the different chapters.

Starting from the review chapter (Chapter II), evidence on the nature of public and private actors is provided, highlighting the differences among the two spheres (Munksgaard et al., 2017) and illustrating the reasons, mechanisms, and modes of interaction (Nissen et al., 2014; Leite and Bengtson, 2018). Other than dyadic interaction and networks, within this chapter, the formation of triads when dealing with public-private interaction is also accounted for. Indeed, reviewed studies have shown the existence of intermediary actors acting between public-private interaction and assuming different roles, as well as the inclusion of the end-user setting, which is informally linked to both public and private actors and which might enable new kind of interactions and knowledge flows (Dóra and Szalkai, 2020; Keränen, 2017; Salmi and Heikkilä, 2015).

In terms of dyadic relationships, Chapter III has provided evidence on relationships developed to share knowledge related to I4.0 mechanisms; in particular, this has been achieved through relationships between firms and key partners (i.e., leading firms and consulting agencies) to first pave the way towards I4.0 knowledge and then by promoting them at the network level, through various dissemination activities. Public partners have assumed different roles in interaction with businesses for innovation, among which they played the roles of knowledge gatekeepers (Morrison, 2008), of financiers (as in the case of universities) (Wagrell and Baraldi, 2019), and they acted for the identification of obstacles concerning I4.0 as well as for monitoring the activities implemented.

Chapter IV has shown the dyadic relationship occurring among public actors involved in an internationalization process, but also public-private interaction between the cluster, incubator, and the private firms involved in the project, and, finally, private-private interaction and the positive and negative effects of these relationships on the whole network. This is exemplified by one of the results of the analysis showing that frictions (Lind, 2015; Munksgaard et al., 2017) among the public actors might have undermined the success of the project's goals and its progress, thus affecting the networks of actors involved in the project.

The studies have also highlighted the emergence and importance of the institutional element as an active actor, playing different roles and interacting with individual firms and with

networks of actors. By analyzing the roles assumed and initiatives undertaken some considerations on the institutional effort's results and outcomes are drawn.

In the context of innovation (Chapter III), this element is represented by traditional actors such as technological centers, business associations, and regional governments, whose efforts have resulted in mixed outcomes and have not always led to the expected results since they do not unfailingly reflect the changes occurring at the district level and the increasing complexity of knowledge and technology, as it is the case of the business association presented in the case study. In this sense, we are witnessing the increasing roles played by actors not traditionally investigated within industrial districts, such as universities, cluster initiatives, network alliances, and also hybrid actors acting as knowledge brokers, like Digital Innovation Hubs (Camuffo and Grandinetti, 2011; Muscio et al., 2012; Capó-Vicedo et al., 2013; Benneworth and Hospers, 2007).

In the context of internationalization (Chapter IV), the study generates insights into a rather unexplored actor, that is, the formal cluster initiatives and its networked configuration (Colovic and Lamotte, 2014), composed of both public and private actors. In particular, this context emphasizes the synergies and frictions among public actors involved in an internationalization project (Munksgaard et al., 2017; Mattsson and Andersson, 2019) and their roles throughout the project (Andresen, 2020; Guercini et al., 2020). The study argues that the formal cluster represents an advanced and more articulated form of support in the context of internationalization of small firms, which might be understood as a form of control and direction for policies.

Investigated actors display different degrees of activism and dynamism; indeed, in the context of innovation, all actors belonging to the district show widespread activism even though with fragmented dynamics and in a context characterized by the emergence of few collective actors (Hervas-Oliver et al., 2019; Götz and Jankowska, 2017) attempting at engaging in organizing and directing initiatives for the purpose of I4.0-related knowledge dissemination. On the contrary, in internationalization, all efforts are concentrated in one actor, the formal cluster, which coordinates the activities and tries to engage and commit firms. The dynamism of the actor identified in the context of internationalization, that is, the formal cluster initiative, can also be discussed in terms of the role it assumes as the orchestrator of the network, or as "architect" and "leader", as defined by Andresen (2020), that is a resourceful actor, with a controlling approach who takes the initiative to act as an orchestrator and who has the ability

to initiate relationship development and manage alliances, map and influence stakeholders, initial coordination, and integration of resources.

Resources

The second layer concerns resources, and it accounts for their heterogeneity and how interaction patterns influence their development, use, and combination. Before getting to the core insights from this dimension, it is necessary to point out that, since the analysis along the three layers aims to reconcile the different ideas emerging from the previous chapters, each contribution has been placed under one of the layers of the ARA framework. However, it is necessary to go further into it and mention that knowledge, social capital, and shared identity are perceived as concepts and not as empirically defined resources, according to some IMP studies. At the same time, these concepts could also be viewed as activities. For instance, as illustrated in the introductory chapter, knowledge as such cannot be separated from the processes of creating, organizing, and using it. Therefore, it can be advanced that knowledge, understood as a contextual activity-resource coupling, could be considered powerful tools/concepts to explain the underlying dynamics of clustering processes. In the same line of reasoning, shared identity has been interpreted both as an activity and an actor feature.

However, since from a general point of view, *"various elements, tangible or intangible, material or symbolic, can be considered as resources when use can be made of them"* (Håkansson and Snehota, 1995: 132), these concepts are placed under the resource dimension for the purpose of this study.

The resources acknowledged in this research are mainly intangible assets, as knowledge, social capital, and shared identity. The first source of resources identified is place-related resources, whose effects and values depend on how firms combine them. Indeed, place represents a significant resource itself in the form of how resources can be used and combined by firms (Håkansson et al., 2006).

In particular, while the socio-material dimension is inherent in the IMP model, integrating it with the concept deriving from the social capital theory allows identifying social capital as having a resource nature and not as being strictly associated with the actor layer (Bondeli et al., 2018; Eklinder-Frick et al., 2012; Eklinder-Frick et al., 2014). The resource nature of social capital is linked to its origin in network relationships and network resources,

and it also entitles actors to each other's resources (Bondeli et al., 2018). This is to be found especially in the context of the Italian Industrial District investigated. While it is true that social capital has always been acknowledged in district studies (Becattini, 1990), intangible resources are undergoing a phase of reconfiguration and redefinition, given their dynamic nature and character (Bondeli et al., 2018). Place and place-related resources are increasingly represented as resources fostering collective intentionality processes through intangible features as social capital, fostering stability in interaction processes and reinforcing shared identity, stimulating a joint effort (Pagano et al., 2020). Therefore, this typology of resource is not playing a traditional role as represented in traditional ID studies. Social capital, in terms of developing personal and inter-organizational relationships, is not spontaneous but increasingly deriving from emerging deliberate initiatives and intentionality in relationship development.

Adopting an IMP lens to industry agglomeration processes contributes to the discourse around place, as it addresses them as a dimension in which firms' specific resources interact and are combined. Therefore clustering processes appear as deriving from such interaction, representing its causal mechanism (Eklinder-Frick and Åge, 2017). Thus, it is the utilization made by firms of place-related resources that gives rise to clustering processes.

A second resource that has been unraveled in the two contexts is knowledge. The context of technological innovation shows that the complexity of technology requires a combination of traditional resources with innovative ones, as innovation is the outcome of the recombination of heterogeneous resources in terms of technological, managerial, and market knowledge. In this sense, traditional resources refer to the already established, existing local knowledge on the specific sector, mechanical knowledge, and IT/digital knowledge, which is combined with new forms of external technological and managerial knowledge as well as innovative physical structures to disseminate I4.0-related knowledge. The context of internationalization also calls for a combination of knowledge coming from different sources. Here, knowledge relates to international business knowledge, which encompasses knowledge about the international market and product knowledge, and the dichotomy concerns existing and new knowledge. Within the two contexts, knowledge creation and sharing processes appear as a resource for organizational learning (Brix, 2017). The topic of knowledge as a resource also gives rise to a discussion on knowledge creation and knowledge sharing mechanisms, which will be in focus in the next section concerning activities.

In order to provide an enhanced interpretation of the resource layer, it is useful to borrow from the predefined categorization of resources developed within IMP, that is, the 4R model (four resources). This model originates from the Resource Interaction Approach (Baraldi et al., 2012) and it *"provides one way of classifying, mapping, and analyzing the processes of resource interaction in inter-organizational networks"* (Baraldi et al., 2012: 268). According to the categorization of resources made within this model, resources can be mainly classified into physical (products and facilities) and organizational or social resources (business units and business relationships) (Håkansson and Waluszewski, 2002b). We are particularly interested in the last category, comprising business units and business relationships. In particular, business or organizational units refer to parts of an organization, i.e., division, department, individuals, and incorporate *"the knowledge, identity and reputation of an organization"* (Baraldi et al., 2012: 268), therefore knowledge and shared identity can rightfully be encompassed within this category. In dealing with social capital, we need to refer to the last group identified within the 4R model's group of organizational and social resources, that is, business relationships. It might be argued that, since business relationships broadly encompass ties and links created by actors in interaction and mobilized by organizational unit resources (Baraldi et al., 2012), then social capital should be understood as an underlying facet of a relationship. Social capital is conceptually characterized *"as the value accrued from mutual adaptations of shared socio-material resources and specific social bonds between actors within networks or dyadic relationships"* (Eklinder-Frick and Åge, 2017: 89). Therefore, conceptually speaking, instead of considering social capital as a dimension or a part of business relationships, it can be argued that it represents a resource itself, which can only be attained through means of relationships. This implies that social capital can fittingly be considered in the category of business relationships but with a recognition of its active role in value creation and awareness of its positive and negative consequences on clustering processes. Social capital is also strictly connected to the idea of identity, as it builds upon social values that are at the basis of the development of both individual and collective identity (Eklinder-Frick et al., 2011). Organizational resources are important as resources themselves but also because they confer a meaning to physical resources in a social context (Strömsten and Håkansson, 2007).

A fundamental resource emerging from the two empirical contexts is the financial incentive (Perna et al., 2015) provided either by the National and Regional Government or by the project. In the former case, the funding provided has been coupled with corporate financial

resources already in place. It has driven the upgrading of dissemination activities of both firms and institutions, which have started to undertake larger projects and to approach the first steps of the digitalization process. In the latter case, the financial dimension has been crucial to raising firms' interest in the project and represented one of the main reasons to engage in internationalization or to quit the project. Both the analyses conducted have argued for the importance of coupling the monetary dimensions with promoting an awareness of the goals in the medium-long term and commitment to encourage a more far-reaching commitment.

Other resources were identified, such as human resources to upgrade technical functions and to be implemented introducing hybrid positions and setting up industrial Ph.D. positions in the context of technological innovation or the development of organizational resources in the form of an innovative methodology aimed to prompt the internationalization process of firms dealing with innovation or in the form of an online tool (this is the case of the Export Lab and eCoach internationalization tool).

Activities

Finally, accounting for the activity layer has given rise to an in-depth understanding of the mechanisms adopted to deal with knowledge flows within clustering processes. In particular, the main outcome from the investigation of this layer of the framework lies in the acknowledgment of the combination of formal (or deliberate) and informal (or emergent) mechanisms (Belussi and Sedita, 2012; Lazzeretti and Capone, 2016).

Indeed, the complexity of knowledge has led to an integration in the nature of activities for knowledge sharing both in the context of innovation and internationalization. The review chapter paves the way toward the empirical analyses conducted in the following chapters by arguing how the combination of formal and informal public-private interaction mechanisms impacts knowledge creation and exchange. The combination of formal and informal mechanisms, and of direct and indirect mechanisms, leads to a balance between collaborative and cooperative interaction forms, that is, between strong bonds and interdependence and weak linkages and independence of actors and resources (Nissen et al., 2014)

As mentioned, this has been further expanded and investigated in the context of technological innovation by discussing structures activated unintentionally through networking *vs.* planned interactions with distant partners. While informal activities are at the core of the

"pioneering phase" identified, more formal activities have been implemented in the last phase, labeled "the pursue of institutional upgrading".

In the context of the internationalization project, the typology of interaction at the activity layer assumed different forms, with structured activities happening among public actors through formal agreements, between public and private actors to reach the goals of the project, and more flexible mechanisms taking place within the implementation of structured activities (the so-called deliberately emergent interaction) and also informal activities going on among firms beyond the boundaries of the project (Ingemansson Havenvid et al., 2016).

The emergence of collective activities has integrated formal and informal interaction mechanisms. The combination of mechanisms, leading to forms of collective cooperation in I4.0 projects, represents an innovative instrument to link traditional industrial district's actors to technologically advanced firms and organizations. This could, in turn, provide opportunities to prompt open innovation projects (Leckel et al., 2020), based on collective action processes and strictly connected to public-private interaction (Crespin-Mazet et al., 2013). Within internationalization, collective activities have been juxtaposed with individual activities carried out within the internationalization project (as the business coaching and the pool of hours provided through the *timbank*).

Insights presented on collective activities bring up considerations on the reasons behind the actors' interest and decision to participate in collective/network activities (Munksgaard and Medlin, 2014). Indeed, these could derive from an intention to seek either self- or collective-interest or a sort of combination of these two. In particular, the study has shown that less active firms, also labeled as "followers" (Guercini and Runfola, 2015), do not perceive network activities as providing opportunities or gains. Accordingly, they are active but selective in activities to undertake and join, while active firms, identified as "leaders", are more active in all activities implemented within the network. Thus, the degree of activism and dynamism of firms shape their participation and perception of network and collective activities.

Investigating this layer in an IMP perspective has not allowed for strong parallels to be made and for extensive discussions based on existing IMP studies. Indeed, the interactive character of activities is a layer that has not attracted much attention from scholars in recent years (with a few exceptions, c.f., Dubois, 1998; Håkansson and Waluszewski, 2002a; Prenkert, 2003). In spite of this, IMP has been proved useful in integrating extant cluster literature

concerning emergent and deliberate activity structures, and the other way around, this literature can foster IMP to embrace the diversity of activities and interaction mechanisms.

As noted, even if the formal/informal dimension has been here applied in relation to the activity layer of the ARA framework, the interdependence among the three layers implies that this dual logic influences the modalities of interaction among actors and the resources involved, and, at the same time, it shapes the interaction mechanisms involved and the typology of content exchanged.

Layer of analysis	Connecting the findings from the chapters
Actors	- Dyadic and network view on public-private interaction - Institutional element - Different degrees of activism and dynamism - Collective actors
Resources	- Place-related resources - Combination of knowledge - Monetary resource - Organizational resources
Activities	- Combination of formal and informal mechanisms - Upgrade in the nature of activities for knowledge sharing - Emergence of collective actions

Table 1 *Summary of the findings of the research*

In sum, this research offers different keys to interpret clustering processes and the challenges deriving from knowledge complexity, which calls for new public-private interaction dynamics. Adopting an IMP approach has helped to analyze interaction within this context, as it has allowed gaining a more profound comprehension of networks, showing the complexity of relationships between heterogeneous actors, dynamic changes in the activity pattern, and resource combinations. While it is true that the adoption of this framework has proved to provide useful dimensions, others are left out and can be analyzed by embracing interaction process elements, like those provided by the 4R model. Therefore, as mentioned in the introductory chapter, the ARA framework is not employed with the ambition of solving or

simplifying the complexity of these topics but rather to understand the layers of complexity and their implications.

The following paragraphs present the contributions of this research in relation to the existing literature. In particular, the focus is largely placed on the arguments to interpret and position this work with regard to existing concepts.

2. Conclusions

2.1. Contributions

This research looks at the link between knowledge flows and clustering processes in a public-private interaction perspective in different contexts. Indeed, the peculiarities of knowledge flows, clustering processes, and public-private interaction are disentangled in a review chapter and two empirical analyses dealing with different aspects of this phenomenon. With a framework tightly related to the business network approach, this research strives to contribute to current knowledge and understanding in the field of clustering processes, knowledge dynamics, and public-private interaction, mainly at the conceptual but also at the empirical level. On the theoretical level, drawing from the transversal findings presented in the previous paragraph, this study allows for contributions to several research areas and the conceptual strands that lie at the core of this research.

i. Identifying new drivers for cooperation in a changing context

The first contribution is the enrichment of the extensive literature on industrial districts and clusters (Belussi and Sedita, 2012; Camuffo and Grandinetti, 2011; Fornahl et al., 2015; Lazzeretti et al., 2014, among others) through insights on the different typologies of clustering processes addressed. As stated in the introductory chapter of this dissertation, industrial districts are undergoing a phase of fragmentation, and the degree of cooperation and sense of belonging has decreased, with firms pursuing more autonomous technological and marketing strategies outside the district's horizon (Morrison, 2008; Belussi and Caloffi, 2018) and gradually reducing their involvement and commitment in local business associations and collective projects.

Although knowledge dynamics in industrial districts have received considerable attention (Halse, 2020; Lazzeretti et al., 2019), this study adds to it by presenting some key

drivers to renew cooperation within districts, such as emerging local learning processes and the promotion of initiatives inspired to open innovation logics, which originates from a combination of different types of knowledge shared through collaboration with heterogeneous actors (Crespin-Mazet et al., 2013; Leckel et al., 2020). Starting from the discussion of findings, new challenges for traditional industrial districts emerge. The emergence of new actors, complementary resources, and knowledge diffusion mechanisms redefine the idea of district and territory and actors and imply lower cohesion within the district with actors showing more fragmented attitudes and a different degree of autonomous/collective behaviors. Therefore, social capital shows its dynamic nature (Bondeli et al., 2018) while still maintaining its importance for industrial districts. This is also in line with studies on social capital, highlighting how the combination of different patterns, i.e., bridging and bonding, is a necessary condition for exploiting the potential of social capital. Combining these two patterns implies reducing the risks related to over-embeddedness within a group to leave space for interaction with outside groups in the form of looser relationships (Eklinder-Frick et al., 2011).

ii. Conceptualization of the emerging phenomenon of formal clusters

Concerning formal cluster initiatives, the research contributes to conceptualizing this emerging phenomenon, whose articulation, nature, and networked configuration have only been scarcely addressed (Colovic and Lamotte, 2014). The focus on a formal cluster initiative engaged in interaction with businesses for internationalization confirms existing findings on the interest in formal network designs for stimulating internationalization (Munksgaard and Medlin, 2014). Specifically, a comparison between the two processes of a spontaneous district and a formal initiative shows that the traditional industrial districts are composed of active and dynamic actors and are characterized by widespread but fragmented interaction, lacking a coordinating dimension which seems to be somewhat advocated; within the formal cluster initiative, the initiative itself shows great dynamism in terms of implementation and activities' coordination, aimed at involving firms in its network to undertake activities, however with diversified and fragmented results in terms of participation and commitment.

iii. Adding to the complexity of the ARA framework

The study also contributes to the ongoing theoretical and empirical debate in IMP on public-private interaction by presenting a review paper on the features of interaction and the

logic behind it and disentangling the issue in empirical contexts. The research findings extend the literature on networks by drawing attention to the multiplicity of networks in which clustering processes are embedded and how they affect and are affected by their development.

Based on the previous discussion, structured along the three dimensions of the ARA framework, contributions related to each layer emerge. Concerning actors, this research responds to the call from different scholars and journals' calls for papers (e.g., Kronlid and Baraldi, 2020; Waluszewski et al., 2019; Leite and Bengtson, 2018, among others) to provide more research, analyzing the nature and roles of actors within public-private interaction. This research answers these calls by taking the perspective of both public and private actors in interaction and contextualizing in a geographical and socio-economic context, which emphasizes how the implications for actors, activities, and resources cannot disregard the role of the context. The context includes actors, resources, and activities in place and the relationships in place. As studies of Baraldi et al. (2020) have argued, businesses are context-dependent, with "context" referring to the part of the network deemed as relevant by actors and including not only business networks but also the networks of public actors. By applying this idea, this research shows the difficulties emerging from the heterogeneous contexts, implying diverging interests, logic, and approaches they are embedded in and in which they operate. The context, which is operationalized in this study in two different clustering processes, has enabled relationships and networks to be enacted by providing access to external and internal resources (i.e., knowledge and technology) and learning opportunities. At the same time, this has shown the emergence of frictions (Chapter IV) and, in some cases, the inadequacy of actors to adapt to the ever-changing context in which they are embedded (Chapter III). The context, as addressed within the two empirical chapters, has shown the need for flexibility and adaptability in knowledge-related activities involving public and private actors, supported by a combination of formal and informal mechanisms.

Moreover, this study contributes to the actor layer by showing the networked dimension of public-private interaction. The dyadic dimension of interaction is indeed embedded in the network as the public actor may assume different configurations and roles. Therefore, in public-private interaction, the private actor does not interact with a single counterpart but with multiple public actors, taking different, sometimes overlapping, roles (Drejer and Jørgensen, 2005; Elbe et al., 2018).

On resources, the study shows the dynamism of resources. In particular, it contributes by unveiling how a mix of intangible resources (including existing and new knowledge and technologies, and human resources) is integrated by relational resources (i.e., social capital), which are in the making and undergoing a reconfiguration around nodes of dynamic collective actors.

Intangible resources (knowledge, social capital, and shared identity) are shown to have a prominent influence within clusters, but with "irregular" use of them, depending on the different types of relationships and networks each cluster firm is embedded into.

On this line of thought, the research also contributes to enriching the activity dimensions of the ARA framework by integrating concepts such as formal and informal interaction mechanisms (Belussi and Sedita, 2012). The importance of deserving more attention to interaction mechanisms, routines, and patterns answers the call made by IMP scholars (La Rocca et al., 2017), and this analysis provide evidence that IMP should embrace the diversity of activities and interaction mechanisms, also in a formal/informal way, to better understand how different interaction mechanisms (especially in public-private interaction) should be balanced (Nissen et al., 2014) and how they impact and shape the content of the exchange, the modalities of interaction, that is the formalization of interaction, and who are the actors involved.

Layer of analysis	**Lessons learned from the study**
Actors	- Networked dimension of public-private interaction - Context-dependent nature of public-private interaction
Resources	- Mix of intangible resources combined with relational resources - Relational resources within clustering processes are undergoing a phase of reconfiguration
Activities	- The combination of formal and informal mechanisms has an impact on relationships - There is a need to integrate a formal approach in the context of innovation and internationalization

Table 2 *Contributions of the study – actors, resources, and activities*

iv. Knowledge mechanisms in the light of a collective dimension

On knowledge flow dynamics, it provides indications about the combination of local and global knowledge and about knowledge sharing processes at different levels that emerge when multiple actors are involved. The study highlights how the complexity of knowledge has led to a re-evaluation and integration of knowledge sharing activities in innovation and internationalization contexts. In particular, knowledge derives not only from traditional actors but also from new actors embedded in the place but not strictly belonging to the district/cluster. This research further addresses this topic by lifting out and examining emergent collective intentionality (Schillaci and Gatti, 2011). Indeed, the two contexts under analysis provide points for discussion on the topic of collective actors and actions and argue for the importance of collective learning (Staber, 2009) within clustering processes, in the light of their ongoing reconfiguration, which implies tackling and managing this new dimension and which may generate new forms of public-private interaction (i.e., one-to-many; one-to-one; many-to-one).

Therefore, the collective dimensions introduced broadens the widely explored mechanisms of collaboration and cooperation and gives an indication of the role of organized forms of networks within this context, which become coordinators and catalysts of relationships (Schillaci and Gatti, 2011). Further, interaction among actors engaging in collective activities can create renewal and a new future for this literature stream.

From an empirical and methodological point of view, the case studies developed conducted stress, on the one hand, the importance to understand how to manage collective processes based on collective intentionality, which are assuming a relevant role within clusters due to the phase of reconfiguration that clusters and districts are undergoing. In particular, the investigation that has been conducted has given insights on the degree of activity within clusters and districts in terms of relationships to be developed, participation in initiatives, programs, and projects for firms.

On the other hand, the adoption of a qualitative case study methodology has allowed the investigation of business networks by adding an additional layer of complexity as it has tried to enlarge the boundaries of business networks by also considering interaction among public and private actors. This has allowed us to provide a better idea of what are the different dynamics and outcomes of interaction in a broader sense.

2.2. Implications

The dissertation's findings underpin and add to business networks' complexity and entail important managerial implications and policy directions. In particular, this study offers practical implications that can be translated into operational guidance for managers at the firm and cluster levels. As argued throughout the different chapters of this thesis, interaction involving actors belonging to the private and public spheres implies additional challenges and complexities. Therefore, firms need to understand and account for heterogeneity to achieve their goals and expectations of interaction. Also, the importance for firms to involve in interaction with the public side to gain tangible and intangible resources is argued. This implies that managers of cluster firms need to recognize the potential of the business networks and to be able to exploit its value and strategic capacity, which is composed of both firms' and network resources.

However, the study shows the need for firms to prioritize and preclude actions and activities, thus, establishing boundaries in their engagement and adopting an exclusive approach. Firms need to weigh the extent to which their business networks can be enriched by participating in the initiatives implemented within the cluster initiative. In fact, participating in such activities implies investing a variety of resources; therefore, careful considerations on the impact of the new business relationships developed on the existing ones should be undertaken. Indeed, building on existing studies, there has been a focus on leveraging embeddedness in various networks. However, engaging in several relationships brings a burden for actors, highlighting the "dark side" of embeddedness in multiple networks.

Guidance for cluster initiatives includes facing the challenge to stimulate cluster's firms to engage in collective goals and, as a consequence to bring to synthesis the multiple motivations of each actors, which might generate a collective- rather than self-interest in the short time. The cluster could play a purpose-built role in creating the conditions conducive to enhanced collaboration in a collective direction by targeting specific elements, such as the development of a shared identity, trust, informal interactions, and involvement, and at the same time managing these elements. Utilizing the cluster initiative for this goal could have a greater impact in light of their formal nature, which can be considered as a tool and enabler of direct policy intervention.

Additionally, these findings and discussions open avenues to policy implications. First, there seems to be a mismatch between the empirical world and model-based assumed business

interactions (Waluszewski et al., 2019). Indeed, the tool of cluster policy has often indiscriminately adopted the idea of clusters for promoting growing productivity, innovation outputs, and regional development, generally overlooking theory developments concerning clusters and networks and without looking at their specificities. This has often hindered collective learning and collaboration. It seems that policy has attempted to simplify existing studies and empirical evidence to attain a unique approach towards a "one-size-fits-all" idea.

The recent empirical and theoretical development on clusters and districts should, on the one hand, give grounds for a critical discussion and problematization of clustering processes (Ortega-Colomer et al., 2016), and, on the other, be at the basis of place-sensitive and network-sensitive policies, aimed at enhancing collaboration and strong relationships within geographical networks instead of merely creating an arena for exchange, without managing the new context (Eklinder-Frick, 2016). This implies recognizing and building on existing configurations of actors, resources, and activities to plan effective policy measures (Waluszewski, 2004).

As policies play numerous roles with respect to interaction patterns, instead of proposing a top-down approach, the process should be in reverse. The analysis of existing networks and relationships, and the issues that the policy wants to address, should represent an input on which to structure and design policies, considering interdependence and relatedness. Indeed, as widely argued by Håkansson and Waluszewski (2020), a shift from the conception of the cluster approach of the three artifacts of bounded rational actors and space-related activities and resources is required towards increasing recognition of actors' relationships, interdependent and linked activities, and heterogeneous and combined resources.

The policy instrument should also make a further effort in promoting continuity, that is, promoting wide-ranging initiatives upholding a broader horizon and aimed at avoiding jeopardizing the long-term outcomes of the policy initiative and resources' dispersion. In other words, the effects of policies should be sustainable and not drop after the end of the policy initiative. In this sense, it is of utmost importance that cluster policies are tailored and nested on the nature and features of the cluster or district they address, and there should be a differentiation between policies directed at a traditional spontaneous district and policies aimed at cluster initiatives. This implies that there is no *ex-ante* preference on the institutional mode of clustering support adopted (Fromhold-Eisebith and Eisebith, 2005), but that the one that better fits the existing relationships and networks should be preferred.

Finally, policy intervention should evaluate and target knowledge by spurring organizations' embeddedness into local and non-local knowledge networks. In fact, clustering in a place-related setting does not autonomously lead to knowledge creation and knowledge sharing. Therefore, specific policies should tackle this issue. This could be done by providing incentives aimed at supporting the development of clusters' internal and external networks, done by engaging in collaborative R&D projects, which allows interaction between public and private counterparts for knowledge sharing and accessing and pooling resources. Concerning the role of institutional actors, the study shows the need to upgrade and continuously update the knowledge and competencies of institutional actors so to provide an appropriate institutional building to the networks, for example, by developing new professional figures in order to be able to respond to the complexity that firms face.

2.3. Beyond this study: topics for future research

This study shows different shortcomings that open up to the possibility of exploring new dimensions connected to the main themes addressed in this research.

First, for the purpose of this thesis, only a few clustering processes are accounted for, that a traditional industrial district and a formal cluster initiative. The natures, features, and behaviors of these two phenomena are at the opposite ends. While it is true that by juxtaposing these two contexts, valuable insights on their functioning can be gained, at the same time, it would be important to account for other agglomeration levels, that is, other forms of clustering processes, which lie in the middle between spontaneous and formal arrangements, and which could contribute to getting a complete picture of this complex phenomenon. In other words, while models close or comparable to a top-down and a bottom-up clustering process have been presented, a hybrid configuration showing features from both the former and the latter could provide further insights and a fuller picture of clustering processes.

A second limitation relates to the two settings of the empirical chapters, which are set in the context of innovation and internationalization. While this choice is consistent with the results of the literature review, and they seem to be two suitable contexts to understand how public-private interaction unfolds, the systematic literature review also suggests another context that could be addressed to investigate public-private interaction, that is, sustainability. This context has been attracting increasing attention, evidencing the importance of clustering

processes – and of place – to approach sustainability issues and, at the same time, this context could also posit a challenge to the established perspective on clusters.

Third, in terms of processes analyzed, on the one hand, there is an ongoing process of diffusion of I4.0-related knowledge in the context of an Italian industrial district. Therefore, only the initial phases of the process have been analyzed, and future studies should be aimed at providing a complete *ex-post* analysis of the dissemination processes. As the research has been conducted in 2019 and early 2020, it does not account for the turmoil that will follow the ongoing COVID-19 pandemic, which will impact researchers in terms of challenges and implications deriving from discontinuity and variety in implementation.

On the other hand, the unit of analysis is an ended project, which has been investigated adopting a retrospective approach to track back the phases and relationships developed over time. While this has allowed us to gain a fuller picture of how the project developed and to understand the roles played by the actors involved, the interaction patterns activated, and their impact on resource development, it did not allow for the collection of data through participatory observation and participation to the activities enacted. Also, respondents' insights concerning the project's activities might have been affected by the results of the projects and by their personal judgments on the un-/successfulness of the project.

Fourth, this study has not addressed any formal public-private arrangements; while this choice addresses the call made in IMP studies to consider public-private interaction beyond the stipulation of formal contracts as interaction goes on in different stages (Mattsson and Andersson, 2019), it calls for future studies aimed at trying to shed light on how formalized public-private interactions (either through public-private partnerships or public-private innovation) are shaped in the context of clustering processes.

Finally, this dissertation has provided some preliminary evidence on emerging models of knowledge governance in clusters, heavily relying on collective intentionality processes (Schillaci and Gatti, 2011; Munksgaard and Medlin, 2014). Studies should provide evidence on the role that governance plays in managing knowledge within clusters and how governance can impact actors' participation in creating a collective vision. Researching how to spur the collective dimension is extremely challenging as it is difficult to bring back to a collective synthesis the extraordinary complexity and variety of components within clustering processes, which differ in terms of nature, role, culture, and approach, and which perceive interaction in different ways (Schillaci and Gatti, 2011). Thus, this suggests that the emergence of a collective

dimension is not automatic, and its in-depth reasons and development open avenues for future investigation. This further complicates the analysis as it gives rise to additional questions when researching interaction, such as how firms conceive the idea of collective action in relationships and networks and how they exploit collective activities implemented within clustering processes to create self-interest.

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