Industrial Marketing Management 101 (2022) 113–124

Contents lists available at ScienceDirect

Industrial Marketing Management

journal homepage: www.elsevier.com/locate/indmarman

The elusiveness of business networks—Why do science park firm tenants not collaborate with neighbors?

Jari Ruokolainen [a,c,*], Barbara Igel [b,d]

[a] Tampere University, Korkeakoulunkatu 10, FI-33720 Tampere, Finland
[b] Moscow School of Management SKOLKOVO, Novaya 100, Odintsovsky, Moscow Region 143025, Russian Federation
[c] Tampere University of Applied Sciences, Kuntokatu 3, FI-33520 Tampere, Finland
[d] Asian Institute of Technology, School of Management, Pathumthani, Thailand

ARTICLE INFO

Keywords:
Science parks
Start-ups
Incubation
Business networks

ABSTRACT

Studies contradict whether collaboration between firm tenants in science parks occurs or not. Fifteen firm tenants were interviewed in the Thailand Science Park, north of Bangkok, to understand why firm tenants do not collaborate. We addressed these current, non-collaborative business practices through the lenses of studies of proximity theories. This inductive qualitative study suggests that the set of extant non-collaborative business practices of these firm tenants prevails despite the close geographical proximity. This study recommends addressing these current, non-collaborative business practices by enhancing first the political and then the business proximities. This study is one of the first solely focusing on non-collaboration in business networks. We suggest studying the results of this research further in disciplines related to various industrial territories.

1. Introduction

Science parks are reported to provide growth opportunities for their small firm tenants (Lukeš, Longo, & Zouhar, 2019; Ng, Junker, Appel-Meulenbroek, Cloodt, & Arentze, 2020). Small companies often have insufficient resources for realizing their ideas, as they lack skilled professionals who know how to export and the capital with which to invest in growth. Small companies' solution for overcoming these problems is to collaborate with others—such as other companies, universities, or government agencies—next to their location. As science parks usually host firm tenants of various sizes located in a small geographical area that forms a community or industrial district, the building of business networks appears to exist.

This statement is echoed in the Industrial Marketing and Purchasing (IMP) literature that emphasized the need for start-up ventures to develop business networks in order to adapt operations to meet market needs (Aaboen, Dubois, & Lind, 2013; Aaboen, Laage-Hellman, Lind, Öberg, & Shih, 2016), and in the research of small communities and industrial districts that emphasized cultivating innovation and business networks (Anderson, Park, & Jack, 2007; Markusen, 1996; O'Donnell, Carson, & Gilmore, 2002). The literature presented evidence that small companies exchange information about their customers' behavior, share overload, supply resources, and assist each other, even though they compete (O'Donnell et al., 2002). Other studies have shown how a small geographic area advances social interactions inside a firm, between firms, and in a broader social context (Anderson et al., 2007).

Much of the science park literature emphasizes the importance of collaboration among firm tenants. Many studies have argued that the high-tech firms in science parks share similar characteristics and that working in the same value chain creates complementary operations and strong alliances. Science parks form small communities, usually in a small geographic area. It has been argued that companies in science parks are more likely to have relationships with nearby universities and with other firm tenants located in a science park.

Despite the overwhelming literature discussion of the benefits of the science park concept, other scholars have argued that geographic proximity is not the driving force for successful entrepreneurship in science parks. Vedovello (1997) and Salvador, Mariotti, and Conicella (2013) found that firm tenants in many science parks relatively seldomly form any supply chains to help deliver solutions to their customers. These studies contradict the benefits of start-ups collaborating with other science park firm tenants, as reported by several researchers (Bakouros, Mardas, & Varsakelis, 2002; Phillips & Yeung, 2003). Other studies on collaboration between industries and science park-based public research institutes have confirmed that the partners' proximity in their technological knowledge base and in their social relations had a

* Corresponding author at: Tampere University, Korkeakoulunkatu 10, FI-33720 Tampere, Finland.
E-mail address: jari.ruokolainen@tuni.fi (J. Ruokolainen).

https://doi.org/10.1016/j.indmarman.2021.11.011
Received 8 September 2020; Received in revised form 28 September 2021; Accepted 23 November 2021
Available online 16 December 2021

much stronger influence on the formal interactions between the firms and the research institutes, as compared to the physical proximity of their office locations (Ratchukool & Igel, 2018). A clear gap exists in understanding the actual behavior of firms located in science parks as the literature seems to contradict.

Business network theory in the IMP context focuses on various dimensions of interactions between the actors. The interaction types develop over time, leading to complex interdependencies and further collaboration. The business network interdependencies, external activities, resources, and actors are likely to have a more significant influence than the firms' intentions (Ford & Mouzas, 2013). IMP's business network theory highlights the long-term relationship and focuses on the extant relationships (Möller, 2013), but, surprisingly, does not discuss why firms do not collaborate. One rare study was found that briefly discussed the lack of trust and incompatible norms being some of the reasons for non-collaboration (Andersen, Christensen, & Damgaard, 2009), which suggests a clear gap in the IMP literature of explaining non-collaboration in business network theories.

This study aims to advance extant theory on collaboration by understanding why firm tenants in science parks do not form business networks with other firm tenants located in the same science park. We explore what factors could motivate these firms to collaborate and build business networks.

First, we explore relevant theories in the literature. Second, we explain the methodology of a qualitative study by employing an inductive research approach (Yin, 2011). Third, we report our findings of the face-to-face interviews with fifteen science park firm tenants. Fourth, this paper concludes with the lessons learned. Next, we introduce the discussion section with avenues for future studies. Finally, we present our recommendations.

2. Literature review

While extant science park literature primarily suggests the reasons for collaboration between firm tenants and has rarely explored the lack thereof, other studies of industrial districts and small business communities have reported inconsistent findings on non-collaboration between the members. As science park studies provide a relatively limited base for building theory, we expanded the literature review to other studies of territorial concepts, namely, industrial districts, and small communities. Table 1 presents an overview of collaboration studies in the various industrial territories: industrial districts, small communities, science parks, and business networks. Examining a science park's features through the theoretical lenses of industrial territories can help construct a valid theory, as stressed by the literature, that points to the importance of employing studies from various theory-building disciplines (Carlile & Christensen, 2005; Christensen & Sundahl, 2001).

This phenomenon of having unclear and sometimes even contradictory research results can be called Science Parks' Furtiveness. A similar elusiveness was found in the research of a small business community (e.g., Ruokolainen, 2014) and of industrial districts that reported inconclusive findings on collaboration among business firms (Amin & Thrift, 1992; Gray et al., 1996; Markusen, 1996; van Egeraat & Curran, 2013). In order to further explore the reasons for the lack of collaboration among science park firm tenants, the following section introduces the concept of proximity.

According to science park and small community studies, proximity plays a central role in the interaction among tenants (Anderson et al., 2007; Boschma, 2005; Cheng, van Oort, Geertman, & Hooimeijer, 2014; Etzkowitz & Leydesdorff, 2000; Vedovello, 1997). Notably, the proximity of R&D activities can create local embeddedness with broader social relations (Phillips & Yeung, 2003). Proximity is a multidimensional element, as it can consist of social, cognitive, institutional, and geographical proximities (Salvador et al., 2013). Boschma (2005) suggested that geographical proximity enhances the development of other proximities. The relational proximity forms an umbrella concept for cognitive, organizational, social, and institutional proximities (Moodysson & Jonsson, 2007). Cantù (2010) proposed considering the concept of technology and vision proximities and business relational proximity, emphasizing the attitude toward networking and the propensity to establish meta goals. Table 2 presents a summary of various proximity types found in the literature.

Different types of proximity relevant for science park firm tenants can be explored by following Markusen (1996), who categorized industrial districts into (1) Marshallian industrial, (2) Hub-and-Spoke, and (3) satellite industrial districts. The first, the Marshallian industrial district, emphasizes collaboration between competitors to share the risk, innovate, and stabilize markets. Usually, strong industrial associations and governmental organizations exist in such districts, and they provide a shared infrastructure for the industry in question. Small and locally owned companies, as well as a long-term collaboration with suppliers within the district, characterize Marshallian industrial districts. In the second, the Hub-and-Spoke district, trade is dominated by one or several large companies that suppliers surround. Collaboration between the

Table 1
Literature discussing collaboration in various industrial territories.

Literature	Key findings on collaboration	Key findings on non-collaboration	Questions
Discussions	Thesis	Antithesis	Synthesis
Science Park Studies	High tech firms in science parks with similar characteristics or working in the same value chain create strong alliances complementing each other's skills and resources (Castells, 2014; McAdam, Miller, & McAdam, 2016; Mian, Lamine, & Fayolle, 2016; Triadó-Ivern, Aparicio-Chueca, & Jaría-Chacón, 2015).	Technology firms hardly have any synergies with universities and other science park firm tenants, and interactions are mainly limited to some transactions and social events (Bakouros et al., 2002; Massey, Wield, & Wield, S. L. in T. S. and D. D., 2003; Phillips & Yeung, 2003; Vedovello, 1997).	Studies indicate non-collaboration in the science park: why do science parks' firm tenants not collaborate with neighbors?
Small Community Studies	Small communities and industrial districts cultivate innovation and business networks (Anderson et al., 2007; O'Donnell et al., 2002).	Although the Thai software industry serves the tourism industry in Phuket, they hardly collaborate due to not employing the same software technologies (e.g., Ruokolainen, 2014).	Lack of technology proximity leads to non-collaboration: is there a specific set of missing proximities that causes the non-collaboration between firms?
Industrial District Studies	Marshallian industrial districts have a knowledge-based structure and have a strong tradition of thick social interaction and strong collective consciousness (e.g., Amin & Thrift, 1992; Markusen, 1996).	Boeing is acting as Hub with an arms-length collaboration approach with its suppliers. Cork's pharmaceuticals concentration impacts on the local industry have been reported to be minimal (Gray, Golob, & Markusen, 1996; Markusen, 1996; van Egeraat & Curran, 2013).	Various proximities might explain the reasons for collaboration and non-collaboration: which types of proximities are present in each industrial district case?
Business networks studies	Business networks are needed to adapt to market needs (Aaboen et al., 2013, 2016). IMP's business network studies focus on interactions, network roles, and long-term relationships (Ford & Mouzas, 2013; Möller, 2013). Mostly extant business networks are employed.	Incompatible norms and lack of trust lead to non-collaboration in the buyer-seller relationship (Andersen et al., 2009). Non-collaboration is scantly studied.	Does a study on non-collaboration help us understand the business networks more profoundly?

Table 2
Types of proximities in the literature.

Concept	Explanation	Source
Geographical Proximity	Refers to spatial or physical distance.	(Boschma, 2005; Salvador et al., 2013)
Social Proximity	Refers to socially embedded relations such as friendship.	(Boschma, 2005; Salvador et al., 2013)
Institutional Proximity	Refers to sharing the same rules and cultural habits.	(Boschma, 2005; Salvador et al., 2013)
Cognitive Proximity	Refers to sharing the same knowledge and expertise and learning from each other.	(Boschma, 2005)
Organizational Proximity	Refers to the extent to which relations are shared in organizational arrangements.	(Boschma, 2005; Salvador et al., 2013)
Technological proximity	Refers to actors that are characterized by similar knowledge and equipment.	(Cantù, 2010)
Vision proximity	Refers to the more in-depth development of long-term relationships.	(Cantù, 2010)
Relational proximity	Refers to an umbrella concept for cognitive, organizational, social, and institutional proximities.	(Moodysson & Jonsson, 2007)
Business relational proximity	Refers to the networking attitude and the propensity to outline meta goals to enable innovative projects.	(Cantù, 2017)

Table 3
Markusen's industrial districts' relations to proximities.

Industrial district type	Characteristics	Proposed proximities needed	Examples of discussion in the literature
Marshallian	Multi-level collaboration between small and medium-sized companies, sharing risks, innovation, stabilizing markets, strong industrial associations, locally owned, long-term collaboration	Social, Institutional, Cognitive, Organizational, Technological, Vision, Business Relational Proximity	The city of London and Santa Croce (Amin & Thrift, 1992)
Hub-and-Spoke	Dominant companies, including long-term collaboration with suppliers, innovations are not shared	Geographical proximity	Seattle region (Gray et al., 1996)
Satellite industrial district	Minimal Intra District Trade	No need for proximities	Cork pharmaceuticals concentration (van Egeraat & Curran, 2013)

dominant companies and the suppliers includes long-term contracts and commitments. Hub-and-Spoke districts could be differentiated from a Marshallian industrial district by the fact that the hubs do not share their innovations with their competitors. Thirdly, companies have minimal intra-district trade in satellite industrial districts comprising externally owned and headquartered companies. Markusen's (1996) categorization of the industrial districts can be applied to this study, given that a science park can be classified as one format of an industrial district. Research has already defined a state-anchored industrial district as one that consists of types of initiatives performed by science parks (Guerrieri & Pietrobelli, 2004).

Based on Markusen's (1996) study, we propose that geographical proximity might or might not ensure collaboration between companies in geographically limited areas. Firm tenants can occupy science parks with minimal to maximum intra-district horizontal and vertical collaboration or with local universities. Science parks can be dominated by influential institutional leaders, e.g., a university or research institute (Guerrieri & Pietrobelli, 2004). In that case, a science park is dominated by a horizontal, e.g., technology or platform-driven player. If a large enterprise dominates the science park, then it can be characterized as cluster-driven. It is constructed to support the existing business of that large enterprise for its customers. The literature describes how state-anchored industrial districts turned into satellite industrial districts once a private company replaced an institution (Guerrieri & Pietrobelli, 2004). Table 3 gives an overview of various types of proximity found in different industrial district categories.

Our conceptual arguments to support the theory development start by mapping the different types of proximities to the industrial district classifications (Markusen, 1996). In the case of the Marshallian industrial district, most of the proximities are needed to generate collaboration: sharing risks, innovation, and markets reveal that a vital trust element is needed among the companies in this district and that intense social proximity exists. Cognitive, vision, and technology proximities are also needed for sharing innovations and risks. Sharing innovation and risk might mean that Cantù's Business Relational Proximity might partly exist with the networking attitude (see Table 2). The existence of the industrial associations reveals that organizational and institutional proximities are also established. Examples of the Marshallian industrial districts are the City of London and Santa Croce in Italy. Both are reported to possess a solid, knowledge-based structure and have a strong tradition of thick social interaction and strong collective consciousness (Amin & Thrift, 1992). In the Hub-and-Spoke industrial district, it seems that suppliers of the dominant companies do not need to collaborate. An example of a Hub-and-Spoke industrial district is the Seattle region, where Boeing acts as a hub that engages in vertical collaboration with its suppliers through an arm's length collaborative approach (Gray et al., 1996). The dominant companies usually require geographical proximity to ensure, for example, just-in-time deliveries for the manufacturing plant. There is no need for geographical proximity in a satellite industrial district as there is no intra-district trade. An example of a satellite industrial district is the concentration of pharmaceuticals in Cork in England, the impact of which on the local industry has been reported to be minimal (van Egeraat & Curran, 2013). A summary of the above arguments can be found in Table 3.

When applying small community and industrial district theories to study science parks, it becomes clear why collaboration between companies in a community or district is not evident nor necessarily within the strategic scope of most companies. For example, collaboration is not considered in a satellite industrial district because there is hardly any need for any proximities. However, there are also counterexamples of collaboration's crucial role in certain places, such as a Marshallian industrial district.

The literature describes how an industrial district can be transformed from one form to another. For example, a satellite industrial district can transform into a Marshallian type district by strengthening and intensifying backward and forward linkage among its SMEs (Guerrieri & Pietrobelli, 2004). This transformation entails enhancing various proximities related to the Marshallian district (see Table 3). Such proximities can enhance developing tacit group knowledge and increase the maturity level (Erden, von Krogh, & Nonaka, 2008). In order to advance this theory, it is essential to gain a deeper understanding of the reasons why collaboration does not occur in science parks and how, according to the firm tenants, this could be changed.

3. Methodology

This study employed an inductive qualitative research approach. The

justification for choosing a qualitative research design is to facilitate a holistic understanding of complex phenomena that are not readily separable from their contexts (Halinen & Törnroos, 2005; Yin, 2011, 2013). Such an approach maximizes the realism of the context at the expense of generalisability. In this study, the complexity is visible as embedded layers are discussed. The inductive approach is employed if the study aims at developing theory (Yin, 2011), which is precisely our aim.

We chose the Thailand Science Park (TSP) located next to the Bangkok metropolitan area in the vicinity of many universities and research institutes. Firm tenants represented an embedded layer in TSP. The first author of this study visited fifteen out of the 57 firm tenants in TSP in 2014 and 2015. The firm tenants were selected to obtain a mixture of large company subsidiaries, start-ups, and both Thai and foreign companies, based on their availability during the visit. After initial discussions with these firms, the original plan to explore the firm tenants' collaboration in purchasing from third parties had to be changed. It became evident that collaboration could hardly be found. Following Eisenhardt's (1989) suggestions that research questions may shift significantly during the study, we modified our research question to investigate the reasons for non-collaboration.

This setup of firm tenants gave us an excellent opportunity to study the non-collaborative behaviors from various perspectives, with samples that allowed a rich array of illustrative interviews (Yin, 2011). Two firm tenants were chosen for a more profound investigation through a case research design, which included their background and the specific context leading to the non-collaboration between them and other firm tenants in TSP. Both companies were interviewed several times during visits in 2014, 2015, and again in 2021. These two firm tenants were selected as follows. The first case represented a business failure as this firm had gone into insolvency and consequently merged with a large UK-based nanotechnology company in 2019. The second firm represented a successful business case from the perspective of revenue growth. The complementary interview conducted in 2021 confirmed this initial observation. Since their infancy, both firm tenants' histories were well known as both firm tenants were actively supported by TSP. These firm tenants' backgrounds were also discussed with TSP. The owners of these two firm tenants shared their experiences openly. Finally, a briefing event was held at the end of each visit with the TSP management to discuss and verify the interviews' initial analyses. In 2021, the first author of this study met the TSP management to discuss the results and conclusions from the earlier interviews. We agreed to conduct a new round of carrying meetings with the firm tenants that we had met in 2014 and 2015, while realizing that the ongoing severe COVID-19 pandemic in Thailand would likely limit the number of meetings made possible. Table 4 presents the dataset, the intensity of the research process, and the dataset's contribution to the research acts.

Two persons, the TSP representative and the first author of this study, conducted the interviews together. A semi-structured interview protocol was used: some questions were prepared prior to the meetings, but mostly we let the entrepreneurs tell their narrative stories (Wood, 1997). We employed questions to encourage the informant to describe their thoughts and experience liberally. First, we asked questions to let the entrepreneurs describe their firms' backgrounds, including their age, technology focus, products, sales, story, and personal background. Second, we asked about their experience of the collaboration in a large context. We focused on their collaboration experience, asking with whom they collaborate and why, including their collaboration with other firm tenants, other companies, universities, and institutes inside and outside the science park. We discussed their preferred and non-preferred business partners. Third, we also asked their recommendation concerning partnering with other firm tenants and what kind of partners they would like not to have in TSP. We shared these questions prior to the meeting, emphasizing that they were tentative and could be altered during the discussions. We believe that sharing these questions helped the informants to orient before coming to the discussions with us.

Table 4
Datasets, the research process intensity, and datasets' contribution of research acts.

Research acts and the data	Quantity Science Park		Research acts' contribution to the analysis
	Firm Tenants	Management	
Primary data Face-to-face interviews and meetings February 2014 – February 2015: Staying at the TSP campus for three weeks in February 2014 Revisit the campus and two of the firm tenants in February 2015 Remote discussions with three firm tenants and TSP management in May, June, and July 2021	Interviews and meetings with the firm tenants February 2014 - Meeting 15 firm tenants mainly at the premises of the TSP February 2015 - Two of the firm tenants were met to get an update on the latest developments and to discuss the previous interviews' findings Meetings with two of the firm tenants June and July 2021 - Updates since 2015 - Collaboration inside and outside TSP Discussion with a 3rd firm tenant as to why they did not collaborate Each meeting lasted from one to two hours Some revisits were done to verify the findings	Four meetings with the head of the TSP February 2014 - The first meeting to get descriptive data - The wrap-up meeting to present findings February 2015 - The update meeting with TSP to discuss new findings Four meetings with TSP management and its representatives in May, June, and July 2021 - Discussion on findings and backgrounds of the firm tenants Each meeting lasted from one to two hours	• Reconstructing the cases' events • Verifying cases' description • Increasing understanding • Getting background information • Obtaining additional, complementary data
Telephone discussions	Several times per week during the visits Several online meetings 2021	Several times per week during the visits Several online meetings 2021	• Verifying the cases' descriptions • Building a relationship
E-mails	About 40	About 40	• Verifying the cases' descriptions • Increasing understanding • Sharing material • Building a relationship
Secondary data	Brochures Web pages	TSP's brochures, presentation material Web pages	• Reconstructing the cases' events • Increasing understanding

We interviewed the firm tenants at the site of each firm tenant to observe them at their work. We collected the secondary material and other relevant artifacts. The first author stayed at the campus where TSP was located for three weeks in 2014 and, thus, had the possibility to eyewitness TSP and firm tenants in their natural setting. We employed a data collection method, in which the interviews were supported by ethnographers' methods (Wood, 1997). This data collection protocol supported our qualitative and inductive study approach. We employed

several data collection methods, including of primary and secondary data sources (see Table 4). Primary data collection methods consist of interviews with longitudinal follow-up. We employed triangulation to support the data collection. This study's authors also have extensive experience in studying Thai technology entrepreneurship.

The interviews' analysis was an iterative process with open and axial coding (Miles & Huberman, 1994). First, we analyzed the two cases' field data, and the write-ups from these two cases were written as advised (Eisenhardt, 1989; Miles & Huberman, 1994). Based on these two write-ups and the interviews, the initial conference paper was presented at a peer review conference in 2016. These two initial cases facilitated the remainder of the study, including coding field data from the rest of the thirteen firm tenants. The initial analysis results were compared with the extant knowledge in the literature. In some of the cases, the firm tenants were re-interviewed to clarify further the results of earlier interviews. The outcome of the interviews was discussed weekly with representatives of the science park. These activities helped to increase internal validity and generalizability (Eisenhardt, 1989).

4. Results

4.1. Thailand science park

Thailand Science Park (TSP), established in 2002 under the Ministry of Science and Technology, is located next to two well-known universities, Thammasat University and the Asian Institute of Technology, as well as houses of the National Technology and Science Agency (NSTDA). NSTDA consists of four national research centers, for metal and material sciences (MTEC), biotechnology and life science (BIOTEC), electronic and computing sciences (NECTEC), and nanotechnology (NANOTEC). About sixty local and foreign firm tenants of various backgrounds and sizes were located in the TSP between 2014 and 2015. Fig. 1 shows the campus of TSP.

4.2. Descriptive data of the sample base

Table 5 contains the descriptive statistics of fifteen interviewed firm tenants. They represented a mixture of various firm types, ranging from start-ups to subsidiaries of well-established foreign companies, covering a wide range of technologies, such as cosmetics, nano, medical, enzymes, food, and rubber. Small firm tenants have less than 50 employees working for them. Those firm tenants that are subsidiaries representing large international enterprises or large enterprises' departments or have more than 50 employees were not considered to be small firms. We also add a note if a firm tenant had less than ten employees. A firm tenant of fewer than ten employees can be called a micro firm tenant. Employment figures were based on initial information obtained in 2013. In 2021, we found that three tenants had left the TSP in 2015. In addition, representatives of three previously interviewed firms had retired and either left Thailand or had passed away. Some other tenants were unwilling to talk with us after the COVID-19 pandemic had severely disturbed their business operations.

Fig. 1. Thailand Science Park (Kanatharana, 2017).

Table 5
Descriptive data of the firm tenants.

2014/2015	Start-Up	Subsidiary or department	Origin in TSP	Foreign	Thai	Size	Technology area
Firm1		X			X	Small	Cosmetics
Firm2	X				X	Small (Micro)	Nano
Firm3		X	X		X	Small	Enzymes
Firm4				X		Large	Food
Firm5					X	Large	Rubber
Firm6	X		X			Small	Medical
Firm7	X				X	Small (Micro)	Mechatronic
Firm8	X		X		X	Small (Micro)	Position
Firm9		X			X	Large	Food
Firm10		X			X	Micro	Paper
Firm11		X	X			Large	Mechanics
Firm12		X		X		Large	Rubber
Firm13		X		X		Large	Tooling
Firm14		X		X		Large	Food
Firm15		X		X		Large	Standards

4.3. Coding and categorizing

It was clear that there were many ongoing activities between the NSTDA research institute and TSP's firm tenants at various levels. For example, TSP supported the technology start-ups with marketing, bookkeeping, searching for venture capital, and education. However, despite the overwhelming amount of evidence in the literature about collaboration and its benefits in small communities such as science parks, this study's matrix of the various connections between the firm tenants of this particular TSP turned up practically empty. It seemed that collaboration among the firm tenants in this science park represented the exception rather than the rule. Some scholars support this view, as they write that technology firms hardly have any synergy with universities and other firm tenants in science parks since their activities are mainly limited to some transactions and social events (Bakouros et al., 2002; Massey et al., 2003; Phillips & Yeung, 2003).

As there were only a few collaboration cases between the firm tenants in TSP, the focus shifted to understanding why there was non-collaboration. Extant studies give limited reasons for non-collaboration. Phillips and Yeung (2003), p. 726) give two reasons, as they write as follows: "Two out of the three pharmaceutical firms surveyed do not engage in any collaboration because there are **no matching or relevant firms**." The firm tenants were asked about the reasons for non-collaboration. In Table 6, we list seven non-collaboration reasons. The given reasons are coded and classified, in the column labeled "Ground" presenting the insights to "Non-collaboration reasons." The Ground column can be further disaggregated into two different types of reasons: (1) "Not aiming" at collaboration means that these firm tenants did not search for collaboration opportunities with other firm tenants inside TSP, and (2) "Premise did not support collaboration" means that the collaboration would be an option if the starting points for it existed.

The foreign companies tightly controlled their subsidiaries in TSP, not leaving room to collaborate with local or other companies. Some of the firm tenants were not aware of the other firm tenants' activities in TSP. They were usually surprised to see TSP firm tenants who worked in the same technology sector. In some cases, the large companies' focus was only to gain tax and business benefits that TSP gave to firm tenants in the park. It might be stated that these tax-based benefits were the driving force for many of the large companies to join TSP. Some of the small firm tenants complained about the difficulties of dealing with large companies. Small firm tenants felt they were not on the same wavelength as large firm tenants. Wilkinson, Young, and Freytag (2005) also refer to a case in which a small firm looked for other small firms in anticipation of being on the same wavelength. In several cases, the firm tenants said their business was unrelated to other TSP firm tenants' business operations. It was decided to explore this topic further and find out what these firm tenants meant by not being business-related. The firm tenants had a distinct understanding of the meaning of "business-related." Table 7 presents different categories provided by firm tenants when examples for being business-related. Ground column in Table 7 indicates what kind of collaboration firm tenants would prefer to have. Grounds can further be classified for various Ground-types in Table 7: the business-related category can display either 'the collaboration adds value' or 'the pre-requisite for the collaboration'.

In the technology-driven case of Firm10, an employee revealed that she had high hopes for meeting a new firm tenant, mainly because both had the same primary component in their products. However, the collaboration never occurred, as both firm tenants were busy with their current tasks. One of the foreign firm tenants, Firm13, explained that their interest was to create a high level of commitment and share a long-

Table 6
Non-collaboration reasons among the firm tenants in TSP.

Non-collaboration reason	Ground	Ground-type	Number of answers
No intent	This firm indicated that it joined TSP to gain benefits without any intent for collaboration	Not aiming at collaboration	1
No interest	The firm stated that they have such specific scientific knowledge that collaboration did not make any sense	Not aiming at collaboration	1
No, or scant knowledge of firm tenants	These firms did not know other firms in TSP– they had not been informed	The premise did not support collaboration	2
Not allowed	These two companies explained they were not allowed to collaborate as they were tightly controlled by the head office	The premise did not support collaboration	2
Not on the same wavelength	This small firm explained that large firms were inflexible from this firm's perspective	The premise did not support collaboration	1
No time	These firms explained that they were busy – they needed to focus on their own business	The premise did not support collaboration	3
Not business-related	These firms indicated they were not business-related, and thus they had neither direct nor short-term interest to collaborate	The premise did not support collaboration	8

Table 7
Meaning of business-related.

Business-related means	Ground	Ground-type	Source
Sales-driven	More sales: this firm explained that they were interested in selling their product to other firm tenants	Collaboration adds value	Firm3
Product development-driven	R&D support: this firm needs a partner that could support the product development	Collaboration adds values	Firm7
Cluster-driven	Customers involved: this firm expressed that its technology could be employed in customers' product development	Collaboration adds value	Firm2
Opportunities-driven	Creating partnering for future business: this firm indicated that they were willing to study various opportunities with firm tenants	Collaboration adds value	Firm9
Explorative-driven	Testing new ideas actively and learning: this firm was interested in exploring business possibilities by testing innovation	Collaboration adds value	Firm1
High-level commitment and trust-driven	Share long-term vision: this firm wanted to build a long-term vision prior to starting the business relationship	Pre-requisite for collaboration	Firm13
Platform-driven	New platforms for products: create common technology platforms together to support market entry	Collaboration adds value	Firm9
Technology-driven	Common core technologies: this firm preferred to collaborate with firms that are not competitors but have a common core technology component	Pre-requisite for collaboration	Firm10
Business case-driven	Minimize expenses and maximize benefits: this firm explained the need to build a business case to maximize the profit to justify the collaboration	Collaboration adds value	Firm4

term vision with Thai companies and government representatives prior to the collaboration. One of the small firm tenants, Firm1, explained that they were keen on working with other firm tenants to create, test, and learn together. However, this had not yet occurred. One sizeable Thai firm tenant, Firm9, explained that they were ready to study various opportunities with other firm tenants and develop common platforms. This firm tenant was one of those rare ones who collaborated with one firm tenant in TSP. In the business-case-driven case, Firm4 explained that if they could prove the business benefit, business-case-driven, then they could justify collaboration with other companies to their host company. In the sales-driven case, the firm tenant, Firm3, only saw the opportunity for collaboration via generating further sales. This firm tenant owner was straightforward in his collaboration approaches at the time of the first interview. In a cluster-driven case, the firm tenant, Firm2, was willing to have partners who could have employed his innovation in their products or developed new products with its help.

4.4. Case stories

Next, the two firm tenants' case study summaries describe their history and the entrepreneurs' thoughts on reasons and conditions for collaboration or non-collaboration among firm tenants in the TSP. They give more perspective on phenomena discussed in this study. The first write-ups of these two firm tenants were written down in 2014 and then updated during these two firm tenants' revisit in 2015.

4.4.1. Firm tenant case Innophene

The firm tenant Innophene was established in 2011 to investigate conductive ink, which the NSTDA research institute initially developed. The conductive ink is based on the use of graphene material, which is a nanoparticle. This firm tenant received a significant capital injection to start their work on top of the technology that came from NSTDA. In 2011, this firm tenant had about eight people. At the time of the first interview, this firm tenant owner felt that he was strongly supported by TSP, as the initial technology came from there, and the firm tenant was able to use NSTDA's facilities in TSP. However, he felt that his business was not related to that of any other firm tenants in TSP. He expressed that some other companies should employ this firm tenant's conductive ink to develop innovative products. He also decided to produce some conductive ink products by himself. His approach was to construct a network cluster of firm tenants inside the park to jointly learn and develop end products and new ideas. He explained that the big companies, from his point of view, were too rigid and bureaucratic. He also explained that the government organization was inflexible in its budget planning. In 2013, Innophene began to run out of capital and started to minimize its operations. The owner of the firm tenant, in 2015, reported that he had problems with the product itself, as some of the formula's components could no longer be found on the market, and they needed to redevelop the formula.

In 2021, the owner of this firm tenant reported that he merged Innophene with a large UK-based nanotechnology company. He explained that marketing his graphene products becomes more effortless as he has solid ground to lean on. He mentions that the know-how is not a question anymore as he can argue that the UK is the leading country with the research in graphene material. During the interview, he stated: *"I can explain now to potential customers that graphene material was studied originally and invented by the research institutes in the UK. After that, credibility is no more in question."* The owner also explained that this UK company was compassionate and controlled its subsidiaries' publicity outcomes tightly.

The owner of Innophene reported three attempts to sell outside TSP and one serious attempt inside TSP. None of these sales were brought to fruition. He contacted a firm tenant from Japan. The owner of Innophene explained that this firm tenant's representative politely explained the obligation to conduct the firm's R&D in Japan, where the R&D program was decided. He did not see a need for collaborative research with Innophene. The observation was that Innophene was fighting for its existence, and this Japanese firm tenant was focused on its current R&D activities. This observation confirms that there was a wavelength problem (Wilkinson et al., 2005).

In the meeting with this Japanese firm tenant's representative, he said they contacted the head office and the R&D in Japan. However, the R&D in Japan did not consider the innovation relevant to them at this point, although they saw some interest in it. This Japanese firm tenant's representative discussed with its Japanese R&D about the offerings of Innophene without any results.

4.4.2. Firm tenant case Flexoresearch

The firm tenant Flexoresearch was established in 2003, and it moved to TSP in 2006. The first product they created was an enzyme for recycling laminated paper. The enzyme was the first of its kind and somewhat innovative, and it received plenty of interest overseas. In 2015, this firm tenant had several products, including protein acquired from insects and asphalt mixed with rubber. The owner of this firm tenant was active in incubating Thai entrepreneurs, and he had a steady income from licenses. The owner explained that he acquired much help from TSP in education about marketing and bookkeeping. He explained that the use of TSP facilities, including NSTDA's laboratories, was an excellent benefit for starting his business. He explained that, regarding technology, he was not getting any help, as there was not that kind of

knowledge in TSP or NSTDA. He explained that his firm tenant was not business-related to any other firm tenants in TSP. He developed egg trays from recycled paper and tried to offer them to one of the firm tenants working in the food sector in TSP in 2014. However, in 2015, he worked directly with egg and insect farmers to sell his egg trays.

In 2021, the owner of this Flexoresearch explained that he had a good connection to the paper industry association in Thailand. He discussed actively with twelve members of that association. As a result, he did various consulting business deals prior to rolling out his main product, an enzyme removing plastic covers from paper. He also mentioned again that he tried to sell his egg trays to a firm tenant in TSP, failing to close the deal. In an earlier discussion, this firm tenant's representative highlighted his interest in collaborating with other firm tenants in TSP. Flexoresearch gained this firm tenant as a customer through a middle man after his firm left TSP. The owner of Flexoresearch highlighted that the current collaboration with this customer has nothing to do with their staying together in TSP.

Nowadays, the business of recycling paper has declined. The egg tray business continues, although it has had its ups and downs. A new business area for Flexoresearch is the recycling business related to brewery waste. According to Flexoresearch's owner, his asphalt business was discontinued because of the conflicting interest with road maintenance companies in recently industrialized countries.

5. Lessons learned

Next, we discuss the emerging theory construct for non-collaboration by linking the construct to the larger context and the discussion of the theory of industrial territories. We offer five propositions for elaborating upon our emerging construct through further research. The building of the theory process is unfolding while the following questions are answered: what reasons cause which type of non-collaboration, and why, and under what circumstances (Carlile & Christensen, 2005).

5.1. Building theory on non-collaboration

Previous studies found that subsidiaries of Japanese corporations tend to have closer relationships with their parent firms than with the local economy (Phillips & Yeung, 2003). This study proposes that Japanese companies are not the only ones with this tendency. It seems to be a typical general feature of large multinational enterprises. Management of a subsidiary of the large multinational enterprise tenant in the TSP commented as follows:

> *"The head-office controls everything, not leaving much freedom to operate locally."*

Large multinational enterprises tend to control their R&D processes tightly in terms of time and budget, not leaving much space for social or cognitive learning from other companies. Although they have local representatives from their host countries, the parent companies located in Japan, Europe, or the US are unlikely to share cognitive, institutional, or social proximities. Often, the focus and interest of large, multinational enterprises, both local and foreign, is on cost savings and gaining tax benefits. One of the manufactures having an office in the TSP stated this clearly:

> *"The reasons for us to locate our office in the TSP solely concerns tax benefits."*

Large multinational enterprises often tend to ignore local embeddedness. They seem not to contribute to the local embeddedness through their R&D knowledge and innovation networks: a subsidiary, from the perspective of large, multinational enterprises, is just a tiny cogwheel in their massive gearbox.

Accordingly, this phenomenon can be described as Large Multinational Enterprises' Non-Local Linkage. One of the notes to be given here is that this phenomenon exists prior to joining a science park community and prevails after joining it. Phillips and Yeung (2003), who studied non-local linkages of firms' R&D, also support this view. This phenomenon resembles Markusen's satellite industrial district approach (Markusen, 1996). The proposition P1, based on this discussion, subsequently follows:

P1. *Large multinational enterprises' extant non-local linkage behavior prevails if their primary driver for joining a science park consists of gaining monetary, such as tax, benefits.*

The narratives of small or start-up companies that are technology-based were diverse. Usually, these companies' local embeddedness existed when they had their roots at a local university. Small firm tenants in the TSP seemed to have valuable contacts with NSTDA and other research institutes located in the neighborhood of TSP. However, collaboration with other TSP's firm tenants rarely occurred. According to this present study, one of the reasons given was not being on the same wavelength as the large enterprises. One of the entrepreneurs commented as follows:

> *"Big companies are too rigid for us, they play politics. The Thai government's budget planning for their offices is inflexible."*

It is known that large enterprises tend to cooperate with other large enterprises (Wilkinson et al., 2005). Start-ups often perceive large enterprises as bureaucratic: they can face insolvency while waiting extended periods for decisions on their efforts (Ruokolainen, 2008). This phenomenon can be called "Missing Wavelength Between Small and Large Enterprises." Again, this is not a phenomenon specific to a science park, but it emerged as relevant while exploring the reason for non-collaboration in this present study. While this phenomenon, missing wavelength between small and large enterprises, represents one side of the coin, the phenomenon of non-linkage behavior in large multinational enterprises represents the opposite side of it. This phenomenon might be avoided if the science park puts forth more precise terms by which large enterprises may contribute to the science park's agenda. In practice, this means creating closer proximity, and focusing on social and institutional proximities among large and small tenant firms, as postulated by proposition P2.

P2. *Missing wavelength between small and large firm tenants prevails if science parks do not have clear policies to help establish closer interactions.*

The small firm tenants seemed not to collaborate with other small firm tenants in TSP. Based on this present study, the reason given was that the representatives of small firm tenants did not have time to put effort into learning from their colleagues. One of the firm tenants' representatives commented as follows:

> *"When we heard about a new firm tenant next to our office, I had high hopes of collaboration as the key substance in this new firm's and our products was the same. Cooperation never occurred as we were too busy."*

It was also mentioned that there was no interest from the technology perspective, as they did not see anything they could learn from the others. Markusen (1996) reported that small and medium-sized businesses collaborate actively in Marshallian industrial districts, e.g., they share knowledge and have strong industrial associations. It can be speculated now that if the industry has some common elements—for example, food production, tourism, or software manufacturing—then they might collaborate. However, as Ruokolainen (2014) reported, although the software industry in Thailand serves the tourism industry in Phuket, they hardly collaborate because they did not employ the same software technologies. In Singapore, the local science park does not appeal to companies with a spatial proximity rationale. None of the tenants there chose the science park due to being close to their supplier or industry. Instead, the reasons relate more to the image and excellent infrastructure than to cluster rationale (Phillips & Yeung, 2003). Based

on these aspects, it is understandable why small companies might not look for collaboration with other small companies. This phenomenon can be called "Small Companies' Tendency of Non-collaboration," as the vision and technology proximities were missing, as stated in proposition P3:

P3. *Small firm tenants' tendency of non-collaboration prevails if their science and technology basis for business does not have a shared vision or technological proximity with other firms.*

In this present study, many small firm tenants shared the observation that they were not business-related to other firm tenants in TSP (see Table 6). It can be argued that these small firm tenants did not deliberately try to avoid cooperating with other firm tenants but could not find a common agenda for collaboration. Table 7 presents the dimensions of the collaboration and whether it exists in horizontal or vertical spaces. Sales, product development, and other cluster-driven elements reveal that collaboration is preferred to be vertical toward the customer. Platform and technology-driven cases propose that the collaboration can be horizontal instead of being a part of the supply chain. Platform and technology types of collaboration may also let companies exchange information and resources related to technologies. Previous research proposes that R&D activities need a certain level of synergy among firm tenants in a science park to cross-fertilize ideas and knowledge (Phillips & Yeung, 2003). This potential for synergies, either in horizontal or vertical dimensions, can be called "Potential of Being Business-Related." The proposition P4 follows:

P4. *Science parks' firm tenants' potential of being business-related remains untapped if science parks do not develop a common agenda for collaboration.*

With this present study's help, TSP could be classified as the Hub-and-Spoke type, although the Hub, NSTDA, was not the central part of the supply chain as it did not deliver commercial products to customers. NSTDA was instead representing a horizontal knowledge center, a hub for the firm tenants in TSP. Many firm tenants actively utilized NTSDA's laboratory infrastructure. Some firm tenants commercialized innovations introduced by NSTDA. Small firm tenants were part of the Hub-and-Spoke setup of NTSDA and did not form horizontal business networks with each other. Large enterprises that focused on gaining tax benefits became part of the science park following, more or less, a satellite industrial district approach. The only form that did not seem to exist was a Marshallian industrial district, or perhaps it was merely not dominant. In a meeting in 2021 one of the TSP's representatives shared with us the following rare story that was told to her: *"While visiting in a lavatory, one of the firm tenants got help as he asked advice from another firm tenant in selecting a manufacturing machine."* The phenomenon of an overlapping setup of various non-collaborative industrial district formats in a somewhat limited geographic area can be called business isolation. The reason for this business isolation was probably the firm tenants' or their host companies' policies and processes, i.e., business practices that were also followed in a new setting of this science park. The firm tenants' policies did not include aiming at local embeddedness. In the interviews in 2021, the TSP's management confirmed that collaboration between tenants is rare. TSP's policy focused on gaining the critical mass of firm tenants by recruiting firms to join TSP. Therefore, they explain that the focus was not on clustering the firms, despite classifying them based on their technology interest. TSP management explained large firms' R&Ds seem not interested in collaboration, as they are still dominated by the close type of innovation with the focus on gaining various IPRs. However, TSP has some interest nowadays to promote open innovation approaches. Thus, they also share our observation that large firms' R&D units were not very well locally embedded. It can be concluded that the extant non-collaborative practices of the enterprises prohibited the opportunities for collaboration between the tenants to occur. Based on this observation, the following proposition P5 can be formulated:

P5. *Science parks' firm tenants bring their extant non-collaboration practices into science parks, and these practices cause business isolation between the firm tenants if they prevail.*

Proposition P5 forms the core theory of this study for non-collaboration. It is supported by the previous propositions (P1…P4) by describing under what circumstances and why the extant non-collaborative practices might occur. The non-collaborative practices in science parks consist of those same practices that occur in various industrial districts (Markusen, 1996). These practices have the same origin either in tacit or exact knowledge forms in the corporations' policies. The propositions P1 and P3 describe why the firm tenants did not collaborate. The non-collaborative taxonomy for a dyad relationship is thus as follows (see Fig. 2).

In this study, we have discussed the observation of the collaboration and non-collaboration through the Science Park, Industrial Districts, and Small Communities studies' perspectives. There are no direct reasons why these propositions would need to be limited only to concern science parks. The propositions of this study are proposed to be tested in these various industrial territories.

5.2. Extending the theory to the discussion of industrial territories

We finish our journey to construct an emerging theory of non-collaboration by linking our study of TSP firm tenants to the concept of industrial territories discussed in the literature (see Table 3). The collaboration among firms located in an industrial territory can have a political dimension. Industrial territories' firm tenants can establish trade associations to align their common interests toward government organizations (Ruokolainen, 2014). Trade associations can also advance collaboration between these associations' members (Markusen, 1996). In a small community, religious associations such as churches can generate higher profits for their business members (Honig, 1998). The political proximity concept is reflected in this study from the literature (Ceron, Splendore, Hanitzsch, & Thurman, 2019) that states that political proximity advances international trade (Umana Dajud, 2013). The proximities that deliver the political collaboration are related to the relational proximity that consists of cognitive, social, organizational, and institutional proximities (Moodysson & Jonsson, 2007). In this study, we define political proximity to include proximity between the policy-related visions of two firms.

On the other hand, a firm's collaboration can be business-related: business proximity can consist of sales, product development, belonging to the same cluster, exploration, platforms, technologies, commitments, business cases, and business vision elements (see Table 7). These dimensions of the business proximity can lead to independent or joint market entries based on the nature of collaboration.

The taxonomy for collaboration is defined in this study to consist of business and political proximities. We can create a 2×2 -matrix to show how firms are interlinked inside an industrial territory (see Fig. 3). Based on the interview findings from the fifteen firm tenants that give evidence of the absence of collaboration, the TSP is positioned in the left lower quadrant depicting relatively low levels in both political and business proximities. The Japanese firm tenant (see firm 13 in Table 7) did not collaborate with other tenants in the TSP. Still, the owner suggested the need to have political collaboration with the Thai government established prior to having business relations. A Thai firm (see firm 2 in Table 7) preferred to have transactional business relationships with other tenants in TSP. However, this firm was not very successful in building a business relationship with the other tenants. The owner did not see any value in being active in the political dimension. He stated that he did not value having frequent "coffee breaks" with the other tenants. The other industrial territories' proximities are depicted in Table 3. The city of London was discussed to have multi-dimensional collaboration (Amin & Thrift, 1992). The Seattle Region was reported mainly to be vertically transactional and dominated by Boeing (Gray

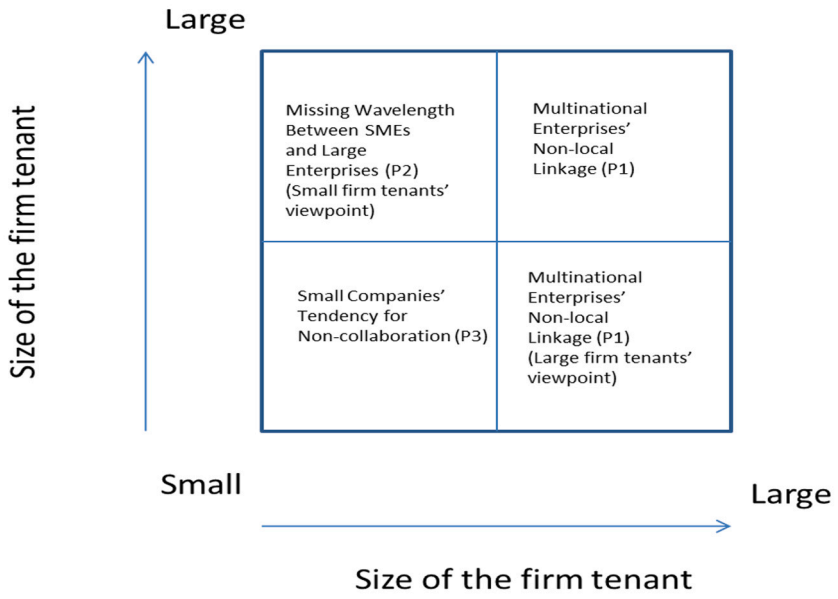

Fig. 2. Taxonomy for dyad non-collaboration in a science park.

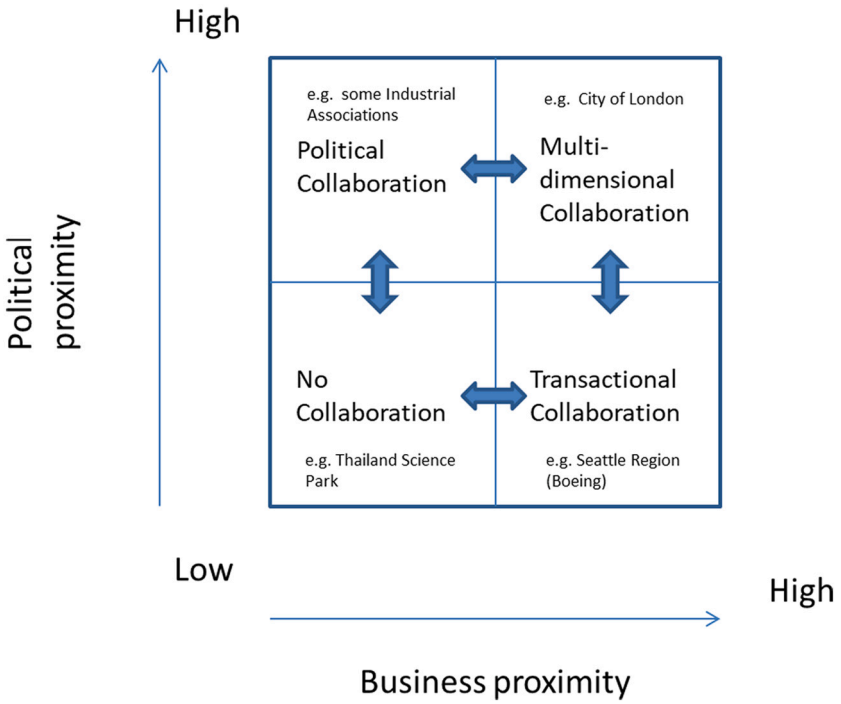

Fig. 3. Industrial territories' taxonomy for collaboration.

et al., 1996).

6. Discussion and avenues for future studies

The first research question of this study asks for the reasons of non-collaboration between firm tenants located in close geographical proximity to science parks. It is also asked what would be needed to enable the creation of business networks among such firms. This study created proposition P5 to further study why collaboration did not occur, despite the geographical proximity of the firm tenants in TSP, and then to propose a taxonomy by which to discuss non-collaboration (see Fig. 2). This study also proposes enhancing the collaboration and business networks between the firm tenants (see P1…P4). The relations of the political and business proximities were depicted (see Fig. 3).

This study includes five research propositions for future studies of the determinants of collaboration between the firm tenants in science parks, small communities, or industrial districts. By answering the research question, this study contributes to discussions on proximity, science parks, small communities, industrial districts, business networks, and thus the overall picture of industrial territories studies (see Fig. 3). Most business networks' studies have focused more on a network effect (e.g., de Resende et al., 2018; Töytäri et al., 2018) but less on why network effect does not occur as proposed by the theories. This study contributes to science park studies as it sheds additional light on "the

elusiveness of the business networks." As this is one of the most extensive studies on the reasons for non-collaboration in science parks, we bring some systematization and ideas about generating business relations between firm tenants in a science park. Future studies can use these taxonomies and concepts to investigate further the commonalities of the non-collaboration phenomenon in science parks and other similar business territories.

This study's emerging theory suggests that extant business practices continue and prevail in a new business environment, such as in a science park, if they are not adequately addressed (see P5). This study facilitates future studies on various related disciplines. This study's propositions can be generalized beyond science parks to other industrial territories discussed in this study. First, this study's concept, the "Large Enterprises' Non-Local Linkage" (see proposition P1), in the science parks can be addressed in future studies and research policies. For example, large enterprises should not use government benefits without any intention to develop local knowledge. Secondly, the concept of the "Missing Wavelengths between Small and Large Enterprises" (see proposition P2) can be employed, for example, to support further studies in science parks. One of the topics could address how to select the large enterprises present in science parks carefully. The phenomenon of "Small Companies' Non-collaboration" (see proposition P3) can also be studied further by science parks and universities: for example, how to help collaboration to mature among small companies.

The concept "Potential of Being business-related" (see P4) is new in the context of science park studies. It can be employed to investigate how to generate collaboration among the firm tenants. The concept of this study, Business Proximity that is based on the concept "Being Business-Related" (see Table 7), provides an alternative perspective to various proximity debates in the literature (Boschma, 2005; Cantù, 2010, 2017; Salvador et al., 2013; Vedovello, 1997). The concept of Business Proximity emphasizes the mutual interest in building future businesses. As a concept, it is more comprehensive than being a part of the same supply chain. It also considers aspects of horizontal collaboration, for example, opportunities for contributing jointly to platform ecosystems. Business relational proximity proposed by Cantù (2017) seems to overlap with Business Proximity, as the collaborative development of innovative projects can result from Business Proximity. However, Business Proximity may or may not be a consequence of the network attitude as emphasized by the concept of business relational proximity. Thus, the proposed Business Proximity concept contributes to the proximity discussion in the literature.

This study revealed that small and medium-sized companies located within a small geographical area do not necessarily collaborate or network. Future studies might open avenues for formulating a new type of industrial district consisting of high-tech companies specializing in their technologies without collaborating with other high-tech companies located in the same district. Such industrial districts might be attached to larger industrial geographies, such as the software industry attached to Phuket's tourism industry (Ruokolainen, 2014).

This study combined various industrial territory concept elements to create an integrative perspective that can capture the different extant industrial territory concepts. However, it might not always be self-evident that these concepts can overlap and vary their scale. This study contributes to the industrial district discussion by applying related concepts to studying the science parks.

6.1. Quality of this study and its limitation

The quality of this study can be evaluated using eight "big-tent" categories (Tracy, 2010): (1) The value of this study topic comes from the fact that literature introduces a contradicting picture of the firm tenants' collaboration in science parks. This study demonstrates that this non-collaboration topic can be generalized to the various disciplines of the industrial territories. (2) The rich rigorousness was achieved by interviewing fifteen firm tenants from various business sectors. The sizes and backgrounds of the firm tenants varied, creating a rich set of data. Two longitudinal case studies supported the interviews. The rich interview data, together with this study's methodology, increased the rigorousness of this study's results. (3) The sincerity of the study is ensured by explaining the research perspective and methodology openly. We followed the evidence-based data as we changed the study's scope from investigating firm tenants' collaboration to exploring firm tenants' non-collaboration. We also propose this study's results to be verified by further research; we created the propositions to help with that process. (4) The credibility validity of the study lies in multivocality and in employing triangulation. (5) Resonance was achieved by discussing the generalization of the results and by employing various science disciplines and field data in creating the theory. (6) The significance of this study's result was demonstrated with the introduction of policy recommendations. (7) This study's ethics included, among others, a protocol: we explained the purpose of the study for the interviewees. We also reflected on the findings with the management of the science park. (8) Meaningful coherence was achieved by discussing methods and achievements and showing the connection to the literature.

The results of this paper are based on one study in the most significant science park in Thailand. The results can vary among the science parks due to the policies applied, geographical location, and the science park community's maturity. This study's results can be country- and science park-specific to some extent. However, the current literature on science parks also presents a similar view of the performance of science parks related to their firm tenants' collaboration (Bakouros et al., 2002; Massey et al., 2003; Phillips & Yeung, 2003; Vedovello, 1997).

This study produced results that help increase the understanding of the phenomena in question, and it can provide a starting point for further research. We also suggest studying the results of this study further through the lenses of the related disciplines of small communities and industrial districts. Future studies can confirm and bring more insights to the topics with the help of the inroads created by this study.

6.2. Policy recommendations

Based on this study, we propose three policy recommendations that we believe would help enhance the performance of science parks by enabling the creation of business networks between firm tenants. In order to accomplish the recommendations, the role of a network facilitator is embedded in them. The network facilitator's role supports the development of interconnected relationships, focusing first on political and second on business agenda topics. The network facilitator's activities could include promoting co-working, the critical selection of new members, and actively introducing new members to each other (van Rijnsoever, 2020).

Recommendation 1. As this study shows, a collaboration between companies is not a prominent element in a science park, even though geographical proximity is in place. This study proved the importance of both political and business proximities. First, we recommend that the design of science parks be started by investigating their firm tenants' potential for being business-related. This recommendation means putting the focus on potential synergies and opportunities for creating business networks. It would lead gradually to the increase of local embeddedness. Future studies can shed more light on how to achieve business-relatedness (see Table 7) with the help of the various proximities (see Table 2).

Recommendation 2. One role of the universities is to provide innovations that the science parks' firm tenants can commercialize or provide complementary technologies that support these firm tenants' innovations. The universities' role could be to enhance technology development vision and develop agenda-based discussions with firm tenants' entrepreneurs about how current and future technologies should be diffused into businesses. This recommendation can be employed to create a tactic to develop business relations using vision

and technology proximities, and thereby increase synergy between the firm tenants. Creating and sharing common technology platforms could be one of the elements of how to increase technology proximities.

Recommendation 3. This third recommendation is an extension of the first two, and it is based on the maturity discussions by an article referenced earlier in this study (Erden et al., 2008). The maturity of the collaboration is enhanced in the long run if various proximities increase through the collaboration's meaningful content. The science park organization, together with universities, can enhance the growth of this maturity by providing, for example, training that is specific to the business and technology vision in question. A maturity model for science parks can be developed with future studies based on the maturity models' extant studies (Erden et al., 2008). The growth of political and business proximities can take decades. Therefore, it pays to have a maturity model to regularly assess the status of developing a science park or any industrial territories.

References

Aaboen, L., Dubois, A., & Lind, F. (2013). Strategizing as networking for new ventures. *Industrial Marketing Management, 42*(7), 1033–1041. https://doi.org/10.1016/j.indmarman.2013.07.003

Aaboen, L., Laage-Hellman, J., Lind, F., Öberg, C., & Shih, T. (2016). Exploring the roles of university spin-offs in business networks. *Industrial Marketing Management*. https://doi.org/10.1016/j.indmarman.2016.03.008

Amin, A., & Thrift, N. (1992). Neo-Marshallian nodes in global networks. *International Journal of Urban and Regional Research, 16*(4), 571–587. https://doi.org/10.1111/j.1468-2427.1992.tb00197.x

Andersen, P. H., Christensen, P. R., & Damgaard, T. (2009). Diverging expectations in buyer–seller relationships: Institutional contexts and relationship norms. *Industrial Marketing Management, 38*(7), 814–824. https://doi.org/10.1016/j.indmarman.2008.04.016

Anderson, A., Park, J., & Jack, S. (2007). Entrepreneurial social capital conceptualizing social capital in new high-tech firms. *International Small Business Journal, 25*(3), 245–272.

Bakouros, Y. L., Mardas, D. C., & Varsakelis, N. C. (2002). Science park, a high tech fantasy?: An analysis of the science parks of Greece. *Technovation, 22*(2), 123–128.

Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*(1), 61–74. https://doi.org/10.1080/0034340052000320887

Cantù, C. (2010). Exploring the role of spatial relationships to transform knowledge in a business idea—Beyond a geographic proximity. *Industrial Marketing Management, 39*(6), 887–897. https://doi.org/10.1016/j.indmarman.2010.06.008

Cantù, C. (2017). Entrepreneurial knowledge spillovers: Discovering opportunities through understanding mediated spatial relationships. *Industrial Marketing Management, 61*, 30–42. https://doi.org/10.1016/j.indmarman.2016.07.002

Carlile, P. R., & Christensen, C. M. (2005). *The cycles of theory building in management research*. Division of Research, Harvard Business School.

Castells, M. (2014). *Technopoles of the world: The making of 21st century industrial complexes*. Routledge.

Ceron, A., Splendore, S., Hanitzsch, T., & Thurman, N. (2019). Journalists and editors: Political proximity as determinant of career and autonomy. *The International Journal of Press/Politics, 24*(4), 487–507. https://doi.org/10.1177/1940161219862489

Cheng, F., van Oort, F., Geertman, S., & Hooimeijer, P. (2014). Science parks and the co-location of high-tech small- and medium-sized firms in China's Shenzhen. *Urban Studies, 51*(5), 1073–1089. https://doi.org/10.1177/0042098013493020

Christensen, C. M., & Sundahl, D. M. (2001). *The process of building theory*. Harvard Business School.

van Egeraat, C., & Curran, D. (2013). Spatial concentration in the Irish pharmaceutical industry: The role of spatial planning and agglomeration economies: Spatial concentration in the Irish pharmaceutical industry. *Tijdschrift voor Economische en Sociale Geografie, 104*(3), 338–358. https://doi.org/10.1111/tesg.12008

Eisenhardt, K. (1989). Building theories from case study research. *Academy of Management Review, 14*, 532–550 (4 SRC-GoogleScholar).

Erden, Z., von Krogh, G., & Nonaka, I. (2008). The quality of group tacit knowledge. *The Journal of Strategic Information Systems, 17*(1), 4–18. https://doi.org/10.1016/j.jsis.2008.02.002

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: From National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research Policy, 29*(2), 109–123.

Ford, D., & Mouzas, S. (2013). The theory and practice of business networking. *Industrial Marketing Management, 42*(3), 433–442. https://doi.org/10.1016/j.indmarman.2013.02.012

Gray, M., Golob, E., & Markusen, A. (1996). Big firms, long arms, wide shoulders: The 'hub-and-spoke' industrial district in the Seattle Region. *Regional Studies, 30*(7), 651–666. https://doi.org/10.1080/00343409612331349948

Guerrieri, P., & Pietrobelli, C. (2004). Industrial districts' evolution and technological regimes: Italy and Taiwan. *Technovation, 24*(11), 899–914. https://doi.org/10.1016/S0166-4972(03)00048-8

Halinen, A., & Törnroos, J.-Å. (2005). Using case methods in the study of contemporary business networks. *Journal of Business Research, 58*(9), 1285–1297. https://doi.org/10.1016/j.jbusres.2004.02.001

Honig, B. (1998). Who gets the goodies? An examination of microenterprise credit in Jamaica. *Entrepreneurship and Regional Development, 10*(4), 313–334. https://doi.org/10.1080/08985629800000018

Kanatharana, J. (2017). Thailand Science Park. https://www.slideshare.net/boinyc/thailand-science-park.

Lukeš, M., Longo, M. C., & Zouhar, J. (2019). Do business incubators really enhance entrepreneurial growth? Evidence from a large sample of innovative Italian start-ups. *Technovation, 82–83*, 25–34. https://doi.org/10.1016/j.technovation.2018.07.008

Markusen, A. (1996). Sticky places and slippery space: A typology of the industrial district. *Economic Geography, 72*, 293–313 (3 SRC-GoogleScholar).

Massey, D., Wield, D., & Wield, S. L. in T. S. and D. D.. (2003). *High-tech fantasies: Science parks in society, science and space*. Routledge.

McAdam, M., Miller, K., & McAdam, R. (2016). Situated regional university incubation: A multi-level stakeholder perspective. *Technovation, 50–51*, 69–78. https://doi.org/10.1016/j.technovation.2015.09.002

Mian, S., Lamine, W., & Fayolle, A. (2016). Technology business incubation: An overview of the state of knowledge. *Technovation, 50–51*, 1–12. https://doi.org/10.1016/j.technovation.2016.02.005

Miles, M., & Huberman, A. (1994). *Qualitative data analysis: An expanded sourcebook* (Vol. 1994). Sage.

Möller, K. (2013). Theory map of business marketing: Relationships and networks perspectives. *Industrial Marketing Management, 42*(3), 324–335. https://doi.org/10.1016/j.indmarman.2013.02.009

Moodysson, J., & Jonsson, O. (2007). Knowledge collaboration and proximity: The spatial organization of biotech innovation projects. *European Urban and Regional Studies, 14*(2), 115–131. https://doi.org/10.1177/0969776407075556

Ng, W. K. B., Junker, R., Appel-Meulenbroek, R., Cloodt, M., & Arentze, T. (2020). Perceived benefits of science park attributes among park tenants in the Netherlands. *The Journal of Technology Transfer, 45*(4), 1196–1227. https://doi.org/10.1007/s10961-019-09744-x

O'Donnell, A., Carson, D., & Gilmore, A. (2002). Competition and co-operation between small firms and their competitors. *Journal of Research in Marketing and Entrepreneurship, 4*(1), 7–15.

Phillips, S., & Yeung, H. (2003). *A place for R&D? The Singapore Science Park'. Urban Studies. 40* pp. 707–732) (4 SRC-GoogleScholar).

Ratchukool, N., & Igel, B. (2018). The effect of proximity between universities and research institutes and firms on firm innovativeness. *Asian Journal of Technology Innovation, 26*(1), 69–89. https://doi.org/10.1080/19761597.2018.1488145

de Resende, L. M. M., Volski, I., Betim, L. M., de Carvalho, G. D. G., de Barros, R., & Senger, F. P. (2018). Critical success factors in coopetition: Evidence on a business network. *Industrial Marketing Management, 68*, 177–187. https://doi.org/10.1016/j.indmarman.2017.10.013

van Rijnsoever, F. J. (2020). Meeting, mating, and intermediating: How incubators can overcome weak network problems in entrepreneurial ecosystems. *Research Policy, 49*(1), 103884. https://doi.org/10.1016/j.respol.2019.103884

Ruokolainen, J. (2008). *First customer reference [doctoral dissertation]*. Aalto Univerity.

Ruokolainen, J. (2014). *Community purchasing in a start-up of technology business. Industrial Marketing and Purchasing Conference, Bordeaux, France*.

Salvador, E., Mariotti, I., & Conicella, F. (2013). Science Park or innovation cluster? Similarities and differences in physical and virtual firms' agglomeration phenomena. *International Journal of Entrepreneurial Behavior and Research, 19*, 656–674 (6 SRC-GoogleScholar).

Töytäri, P., Turunen, T., Klein, M., Eloranta, V., Biehl, S., & Rajala, R. (2018). Aligning the mindset and capabilities within a business network for successful adoption of smart services. *Journal of Product Innovation Management, 35*(5), 763–779. https://doi.org/10.1111/jpim.12462

Tracy, S. J. (2010). Qualitative quality: Eight "big-tent" criteria for excellent qualitative research. *Qualitative Inquiry, 16*(10), 837–851. https://doi.org/10.1177/1077800410383121

Triadó-Ivern, X. M., Aparicio-Chueca, P., & Jaría-Chacón, N. (2015). Value added contributions of science parks—The case of the Barcelona Scientific Park. *International Journal of Innovation Science, 7*(2), 139–152.

Umana Dajud, C. (2013). Political proximity and international trade. *Economics and Politics*. https://doi.org/10.1111/ecpo.12013. n/a-n/a.

Vedovello, C. (1997). Science parks and university-industry interactions: Geographical proximity between the agents as a driving force. *Technovation, 17*, 491–502 (9 SRC-GoogleScholar).

Wilkinson, I., Young, L., & Freytag, P. V. (2005). Business mating: Who chooses and who gets chosen? *Industrial Marketing Management, 34*(7), 669–680. https://doi.org/10.1016/j.indmarman.2005.06.003

Wood, L. (1997). Semi-structured interviewing for user-centered design. *Interactions, 4*(2), 48–61.

Yin, R. K. (2011). *Qualitative research from start to finish*. Guilford Press.

Yin, R. K. (2013). *Case study research: Design and methods*. SAGE Publications.