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## Strategies of using social proximity and organizational proximity in product innovation

Empirical insight from the Pearl River Delta, China

**Abstract:** In this paper we investigate how the innovation behavior of firms to capitalize on social proximity with independent firms and organizational proximity with parent companies and foreign customers contributes to innovation in the Pearl River Delta (PRD), China. While traditional views often hold that Chinese firms rely heavily on organizational proximity with parent companies and foreign customers to gain access to knowledge, we aim for insights into whether localized learning mechanisms based on informal social relations have emerged in the region after more than thirty years of industrialization. Based on a questionnaire survey of 359 innovative electronics firms, this paper demonstrates that firms which use social proximity to foster innovation are emerging in the PRD, and that it is mainly applied by domestic firms as a ‘spying device’ to catch up with the latest technology and market preference in order to trigger new product ideas. Nevertheless, the achievements of product innovation performance made by applying social proximity in interactive learning are fairly small, which underpins the instability of the trust-based interactive learning between firms in the region. The results of the paper provide insight into the development stage of the regional innovation system in the Pearl River Delta, calling upon an effective governance infrastructure to be put in place to stabilize interactive learning on the local scale.

**Keywords:** social proximity, organizational proximity, *guanxi*, product innovation

### Introduction

Since the opening policy was introduced in 1978, China has seized the opportunity of the global industrial shift, and some areas along the eastern coast have experienced dramatic economic growth. The Pearl River Delta, which is located on the south-east coast of the Guangdong province, has developed into one of the biggest production sites for computers and electronics due to its advantage of low-cost and flexible production. The electronics industry in this region is very export-oriented. The region manufactures over 50 % of the world’s desktop computers and 40 % of PC components, such as PC heads, PC cases and other semi-manufactured products (see <http://www.gdiid.gd.gov.cn/gdiid/billion/lay2-3.htm>). Moreover, many domestic brands in the Pearl River Delta have rapidly developed and taken a considerable share of the global market. The literature on the regional industrial develop-

ment in latecomer countries such as China emphasizes the role of multinational enterprises and the global production network, which they have organized in the regions (DICKEN, 1976; DOLLAR, 2005; MORRISON et al., 2008; YEUNG, 2009). In the initial industrializing process which took place in the Pearl River Delta, it is indisputable that technology transfer and learning relied heavily on global lead firms. The low absorptive capacity of the young local firms in the Pearl River Delta led to the limited size and variety of knowledge and expertise on the local scale, which, as a whole, hindered the interactive learning among the firms and hence the opportunities to benefit from each other’s ideas and skills. Due to the limited expertise and know-how in the initial industrialization phase, firms had no opportunity to implement active innovation and upgrading strategies. Moreover, the abundance of cheap land and labor left no incentives to initiate risky innovation activities. However, the high-speed growth,

driven by foreign direct investment (FDI), has gradually exhausted the cheap land and labor in the Pearl River Delta, and has been greatly constrained by both internal and external factors in recent years. On the one hand, the high inflation rate, which leads to the continual pressure of rising costs, is gradually eroding the competitive edge in low-cost production. On the other hand, the export firms are faced with more trade obstacles in the developed market due to the protection of the local employment market after the financial crisis. Firms either have to meet the high standards of safety and quality in order to maintain the market share in developed countries, or they have to exploit the new market opportunities in the domestic economy. Against this background, innovation and upgrading are high on the agenda of both firms and the government. Furthermore, conditions for interactive learning and systemic innovation have developed, with the electronics firms in the Pearl River Delta having accumulated a certain amount of knowledge after thirty years of processing operations and having diversified into numerous product niches in the electronics industry. It is therefore important, at this point, to investigate whether firms are capable of exploiting and commercializing the knowledge stock through reciprocal interactive learning. The raising of this question corresponds to the literature on regional competitiveness which emerged in the 1990s arguing that the enduring competitiveness of regions lies in the socialized embedded process of knowledge production, exploitation and dissemination.

In the following it is attempted to approach this question using the concept of proximity. As MASSARD/MEHIER (2009) suggest, it provides a conceptually more sound measurement of accessibility than the concept of the externality of simply being there. Other than physical distance, relational space based on rules, contracts and informal social interaction has been taken into comprehensive consideration. By assessing the strategies and capability of firms to capitalize on social proximity via informal *guanxi*-networks to foster innovation, rather than on organizational proximity with parent companies or foreign customers, insights into the evolving production system in the Pearl River Delta from a platform driven by foreign direct investments to a regional innovation system are expected during the course of this investigation.

The use of social relations is a strategic move by firms to achieve trust and understanding among independent business partners. ZHOU et al. (2003) demonstrate that firms in the Pearl River Delta have to maintain intensive interpersonal interaction with customers due to the unreliable institutional system. Moreover, informal and continual interaction among various economic players, embedded in *guanxi*-networks, is an important method of doing business in Chinese society (LOVETT et al. 1999). Rather than simply applying informal practice in flexible production to save transaction costs and thus react quickly to market needs (NORTH 1990; MEYER et al. 2009), the capacity to capitalize further on informal social relations in order to generate and foster innovation outcome is critical for the emergence of a regional innovation system in the Pearl River Delta. However, this localized learning process based on social assets does not take place automatically and is under constant pressure of destruction. Information sharing can be reduced or biased, as each seeks to gain the most at the other's expense, especially for uncertain and risky innovation activities (CHESBROUGH/TEECE 1996). The formation and stabilization of interactive learning in the business sector depends on market conditions and should be strengthened by public initiatives and supporting infrastructure (HEIDENREICH 2004). By identifying strategic firm behavior of using proximities to foster innovation, we want to contribute to the understanding of the innovation activities in the Chinese context and shed light on the direction of policy initiatives to strengthen the interactive learning activities in the business sector of the electronics industry in the Pearl River Delta.

It should be noted that this paper does not intend to explore exclusively the role of the five proximities, i.e. geographical proximity, cognitive proximity, organizational proximity, social proximity and institutional proximity, as defined by BOSCHMA (2005). Instead, it focuses on organizational and social proximity, which are deemed to be most relevant to the previous discussion of regional development in the context of latecomer countries. Moreover, these two forms of proximity may be addressed by conscious firm strategies and can thus be achieved through the efforts of individual firms. In addition, the effect of geographical and cognitive proximity is controlled to a certain degree by placing the focus of the empirical investigation on firms belonging

to the same electronics sector and co-locating in the same mega-urban region in China.

### Organizational and social proximity in innovation – the Chinese context

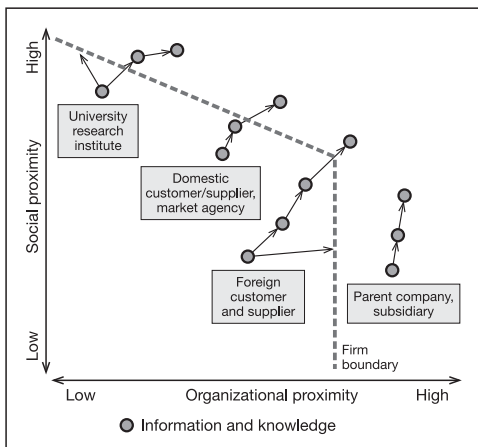
The concept of proximity developed in the 1990s by the *French School* contributes to the understanding of the mechanisms behind the interactive process of knowledge transfer (KIRAT/LUNG 1999; TORRE/GILLY 2000; TORRE/RALLET 2005; BOSCHMA 2005; MENZEL 2008). Proximity is a concept that is usually discussed with innovation, since it plays an important role in promoting the trust and understanding when undertaking complex and highly risky innovation activities. Proximity carries a plural sense. It goes beyond geographical proximity, which has a limited role without the support of other proximities. With respect to firm strategies in the Chinese context, firms can, on the one hand, rely on organizationally proximate partners, such as parent companies and foreign customers, to gain information, ideas and supported knowledge which transcend the limits of geographical proximity. On the other hand, firms can also establish trust-based social networks with geographically proximate independent business partners, such as domestic customers, univer-

sities, research institutes and market agencies, seeking information and knowledge within social proximity. How information and knowledge are transferred across firm boundaries to support the complex innovation process is shown in Fig. 1. The knowledge transfer organized within social and organizational proximity facilitates communication and strengthens cooperation owing to understanding and trust within the proximity boundary.

#### Organizational proximity

Organizational proximity refers to the sharing of reference space and knowledge that is strengthened by hierarchy and control within the same organization, such as firm, group and cooperation networks (BOSCHMA 2005). With the development of information, communication and transportation technology, simple collocation is no longer a necessary determinant for knowledge transfer. Networks, which even transcend the boundary of countries, begin to play a role as vehicles of knowledge diffusion. In the third wave of globalization in the 1980s, the bulk of foreign capital flowed to developing countries in the form of direct investment in manufacturing (DOLLAR 2005). Meanwhile, forms of network coordination involving a large number of participants have taken the place of integrated organizational boundaries at transnational corporations, which ERNST (2005) specifically described as a “global flagship network”. This network links the flagship’s own subsidiaries, affiliates and joint ventures with its subcontractors, suppliers and service providers, as well as with partners in strategic alliances (ERNST 2005, 91).

**Fig. 1:** Knowledge transfer across firm boundaries



Source: own draft

In order to reduce costs and stay flexible towards market demands, the flagship organizations, including the brand firms, contract manufacturers, first-tier suppliers and large trade companies, strengthen the core competencies and, at the same time, outsource volume manufacturing and other functions along the globally-organized, networked value chain (ERNST/KIM 2002). Three factors determine the methods, that these flagship organizations apply in order to govern the network (GEREFFI et al. 2005): the complexity of transactions, the ability to codify knowledge and the capabilities of the supply base.

New Institutional Economics relates transaction cost to the institutional environment (NORTH 1990). When the rules are not guaran-

teed by formal institutions such as laws and regulations, organizational proximity appears as a reasonable governance mode to curb the opportunist behavior of business partners, such as distorting business information, failing to fulfill commitments or malicious imitation (HENNART 1993). As a result of incomplete institutional protection, most of the firms in the developing countries conduct innovation 'in-house' instead of licensing and assigning contractual arrangements to unaffiliated firms (SCHMITZ 1995; SCHMITZ/NADVI 1999). For the global flagship that organizes production in developing countries, organizational proximity is not only conducive to reducing opportunist risk related to physical and human capital investment, but also enables the efficient downward transfer of knowledge, especially the tacit knowledge owing to the path-dependent nature of firm routine development (NELSON/WINTER 1982) towards the suppliers and subcontractors with underdeveloped technological and managerial capabilities.

Accordingly, organizational proximity provides two advantages for firms in latecomer countries. It provides them with access to knowledge, especially tacit knowledge in the advanced technological field. The flagship typically provides the organizationally proximate subsidiaries, suppliers and subcontractors with machinery, blueprints, production and quality control manuals, product and service specification and training handouts. YEUNG (2009) states the importance of external network building in acquiring capabilities in the Asian context and introduces a concept called "strategic coupling" to understand better the evolution of local and regional firms in their dynamic articulation in the global production network. MORRISON et al. (2008) also show that firms gain technological capabilities from participating in global value chains. Not only that, firms in latecomer countries also join the international production network in order to acquire tacit knowledge, which is necessary to absorb and exploit the encoded knowledge, by having the engineers and managers from foreign partners train on site. Furthermore, IVARSSON/ALVSTAM (2005) demonstrate that geographical proximity with foreign transnational corporations is crucial for local suppliers to absorb external technology through regular and ongoing interaction with their primary foreign customers.

It is possible that the suppliers upgrade and co-evolve with the buyer when the technological and organizational change enables a more sophisticated supply chain (YEUNG 2009). In 2004, *Lenovo* bought the PC operation from *IBM* and upgraded from an original equipment manufacturer (OEM) to an own brand manufacturer (OBM). In 2004, *TCL* (Shenzhen) co-established a mobile phone joint venture with *Alcatel*. In 2007, *China Electronic Cooperation* subsidiary *Sungfei* (Shenzhen) acquired the mobile phone operation from *Phillips*. These are examples of upgrading by enhancing internal absorptive capacity and strategically recognizing the coupling chances with global lead firms. However, organizational proximity alone has a limited role in upgrading and innovation. Firstly, many brand owners arrange the global strategic layout in such a way that strategic research and development (R&D), marketing and management are located in their home countries or in regions in developed countries where innovation partners and reliable institutions are available (FEINBERG/GUPTA 2004), while functions such as production, sales and logistics are located in developing countries (PAN/CHI 1999). Although the internationalization of R&D activities has grown significantly since the 1990s (OECD 1998), technology and knowledge to which domestic firms have access is still limited and mostly low-end. Secondly, global buyers tend to promote incremental product and process upgrading and oppose upgrading if this creates opportunities for suppliers to acquire a broader range of customers (HUMPHREY 2004). Consequently, the global buyers and traders might be bypassed by suppliers if the latter gain the ability to work directly with brand companies in developed countries.

In the electronics industry, there is a trend of applying fewer hierarchy relations in the global chain governance mode. Maturing technology such as module production that enables the codifying of knowledge is one of the factors behind this trend. Moreover, as long as local firms establish core competences that ensure the reciprocity of knowledge sharing, it is quite possible that they are able to capitalize on the use of social proximity to exploit knowledge and foster innovation. Social proximity can thereby be used as a complementary strategy in fostering innovation in order to overcome the shortcomings of organizational proximity.

### *Social proximity*

Social proximity relates to trust and commitment based on kinship, friendship and cooperation experience (BOSCHMA 2005). It is secured through informal daily face-to-face interaction such as meeting, chatting, eating together and joint entertainment. Trust and commitment are gradually established in the social interaction process, which contributes to interactive learning and cooperation. Social networks are not spatially bound, but can be sustained and produced by the ongoing collective interaction of players located close to each other (BOSCHMA 2005).

Social proximity does not only foster the communication of tacit knowledge which is difficult to trade in the market, but also reduces opportunist behavior through the establishment of durable relations. Social ties and relations thereby have an influence on economic outcomes (GRANOVETTER 1985). *Guanxi*, as an informal way of doing business in China, has received growing attention in the recent organizational literature (PARK/LUO 2001; RAMASAMY et al. 2006; ZHANG/ZHANG 2006). Similar to the concept of social proximity, *guanxi* refers to informal interpersonal relationships and exchanges of favors for the purpose of doing business in traditional Chinese society (LOVETT et al. 1999). PENG (2003) points out that the reciprocal and utilitarian types of *guanxi* are becoming more important than the obligatory type in times of institutional transition. In reciprocal *guanxi* between friends and colleagues in particular, the implicit rule of 'paying back favors' (Chinese: *renqing*), due to the fear of damaging one's social reputation and prestige, actually strengthens the constant social interaction through the idea of exchanging favors. In the Chinese business world today, *guanxi* plays an important role in facilitating economic exchanges and overcoming administrative costs in the face of a deficient institutional framework (PARK/LUO 2001), such as when starting the business, concluding contracts, acquiring institutional protection and responding flexibly to changing demands. However, its role in innovation has not yet been analyzed.

The changing role of *guanxi*, i.e. the Chinese way of establishing and maintaining social proximity, in business performance has important implications for the dynamic regional competitiveness. The socially and territorially

embedded, collectively interactive learning process is becoming a prominent feature of competitive industrial clusters even in a globalized era (MASKELL 1998; ASHEIM/ISAKSEN 2002). The approach of regional innovation systems assumes that the localized assets and processes are the primary source of the innovation capabilities of the firms. (COOKE et al. 1997; DOLOREUX/PARTO 2005). In a well-functioning regional innovation system, the local firms are capable of capitalizing on social proximity not only to facilitate effective knowledge transfer, but also to generate innovation outcomes. However, the prerequisite for this is that firms are willing and able to apply social proximity to foster innovation. If clustering firms all compete fiercely in identical standardized products, the regional knowledge base becomes low-level and homogeneous. Firms are often reluctant to share knowledge because the imitation cost is low and reciprocity of interaction is marginal. In this case, social proximity, such as that between customers and suppliers, can only be used as a way of sustaining a flexible and responsive production system. As a result, the role of social proximity in fostering innovation is limited, which leads to rather loose local innovation networks.

When firms are willing to undertake interactive learning and share knowledge with each other, *guanxi* helps in curbing the risk of opportunism related to innovation, which is specifically defined by STANDIFIRD/MARSHALL (2000) as the risks of asset specificity, behavioral uncertainty and environmental uncertainty. First of all, *guanxi* with managers of business partners may reduce the risk of asset specificity, which refers to the circumstance in which partners who do not own and invest specific assets switch suddenly to other partners in the process of innovation. Reciprocal *guanxi* with business partners is path-dependent to some extent, because people are less disposed to ruining the precious *guanxi* networks for quick profit. Long-term *guanxi* acts as a constraint for opportunism, and this brings mutual trust and assurance for cooperation. Secondly, *guanxi* networks with other partners can reduce the risk of behavioral uncertainty when sharing knowledge and ideas with cooperation partners. As an old Chinese saying goes, 'you will never be defeated if you know everything about your opponent'. For example, if the cooperation partner in innovation activities wants to steal ideas to develop a new product ahead of you, and the contracts

and legal systems are not able to help or cost too much, it is safer to know *ex ante* about the background, reputation and capacity of your cooperation partner through the *guanxi* network from other managers (as intermediaries) in the industry. Thirdly, *guanxi* with government officials can reduce the risk of environmental uncertainty, as innovation policies are always unsteady and vague in China. Managers and entrepreneurs cannot simply rely on government bulletins as their information channel. They actually rely more on *guanxi* when searching for and confirming information. They often obtain key information and a detailed explanation of the policies through *guanxi*. Information sorted through *guanxi* networks is more reliable and trustworthy, and thus allows for better informed decisions on investment in innovation.

However, *guanxi* networks carry the risk of a negative lock-in effect. As *guanxi* networks depend on the constant exchange of favors, they are also fragile once the exchange stops. Firms are locked in with current business partners, fearing that the destruction of the subtle *guanxi* network with a single business partner would induce the loss of all other partners who are related to this partner. In this case, firms do not act as profit-maximizing entities, but rather as *guanxi*-satisfying ones. Outdated production modes and product types might persist and are harmful for upgrading and innovation (HSU/SAXENIAN 2000).

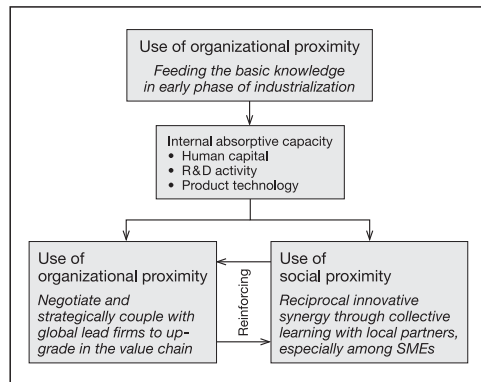
*Brief summary*

For Chinese firms, organizational proximity is of particular importance. In the early phase of development, the capability of local firms is not fully developed due to the weak industrial base, thus resulting in an ill-functioning knowledge spillover mechanism on the local scale. In this phase, hierarchy and control in the same organizational framework by the foreign parent company or OEM customer is essential for organizing production relations, and this becomes the primary source for local firms to gain codified and tacit knowledge, mostly in a passive way. However, organizational proximity in this phase is not able to trigger innovation with low-skill assembly operation around standardized products among the local firms.

With the development of the local production

system, local firms have accumulated a certain level of capability which enables them to absorb and exploit knowledge. In this case, firms can either use organizational proximity to seize the opportunities of value chain upgrading with the sophistication of the supply chain and technological diversification, or they can capitalize on social proximity to form reciprocal innovative synergy with organizationally distant partners that have diversified into specific product lines and market segments. Particularly for small and medium-sized firms, the collective learning facilitated by social proximity is essential for their survival and growth, and is also important for the development of a self-sustained local production system (CAPELLO 1999). The use of organizational and social proximity by firms is mutually reinforcing. On the one hand, the ability of local firms to use social proximity and transform it into innovative synergy and profit provides a greater incentive for foreign firms to transfer more advanced technology and activities to their organizationally proximate partners in developing countries. Moreover, this grants the local firms and governments more bargaining power to negotiate with foreign partners, which results in more stable manipulation of strategic coupling. On the other hand, new information on markets and technology that is pumped into the local system by firms using organizational proximity with geographically distant partners makes local collective learning more dynamic (BATHELT et al. 2004). This conceptual process concerning the dynamic interaction of organizational and social proximity is illustrated with Fig. 2.

**Fig. 2:** Dynamism of proximity in regional development



Source: own draft

Based on the discussion on the role of organizational proximity and social proximity as a firm strategy to foster innovation, the following hypotheses are formulated:

*Hypothesis 1:* By developing internal capacity and strategic coupling within the global production network, it is possible for firms in late-comer countries to capitalize on organizational proximity in order to foster innovation and upgrading. However, firms that rely only on a vertical hierarchy with global lead firms to foster innovation have limited potential for upgrading their position in the value chain.

*Hypothesis 2:* Most Chinese firms are engaged in *guanxi* networks, which are an ongoing mode of interaction for maintaining social proximity between business partners. Firms with limited capabilities and short-term strategies are only able to capitalize on *guanxi* for low-cost and flexible production. On the other hand, in a mature regional innovation system, firms are capable of using social proximity to facilitate the complex interaction in the innovation process and to foster the innovation outcomes.

## Data and methodology

The electronics industry in the Pearl River Delta, has been selected as the research area for this study. The empirical data used to answer the research question were taken from a standardized survey of electronics firms in the Pearl River Delta, Guangdong province, China. The industrial development in the Guangdong province is the outcome of a subtle mixture of global networks, public institutional framework and unexplored socio-cultural contexts (BELLANDI/TOMMASO 2005). In this study, survey data from the firm level are used to explore the strategies of firms to use social proximity - i.e. embedded in *guanxi* networks between independent business partners - as well as organizational proximity to global firms in fostering product innovation. In doing so, insights are expected to be gained with respect to the role of 'global pipelines' and 'local buzz' that contribute to the innovation dynamics in this region based on the previous discussion.

The company survey targeted electronics firms in four cities in the eastern part of the

Pearl River Delta, where the electronics industry is dominant (as in Shenzhen and Dongguan) or developing very quickly (as in Huizhou and Heyuan). In total, 422 electronics companies were interviewed during a three-month period from September to November 2009. Of the surveyed firms, 359 are undertaking product innovation activities. These firms are the analytical basis of this article. Among these innovating firms, 62 % are domestic firms and 38 % are wholly foreign-owned firms or joint ventures. The company survey was conducted by telephone and post. Questionnaires were addressed to CEOs or senior executives of the companies. The telephone and post method was complemented by a telephone follow-up aimed at reducing the number of unanswered questions. The response rate was 53 %.

Due to a certain amount of missing data, the sample number in the following analysis is slightly reduced. The issue of unanswered questions among the surveyed firms along with refusals led to the sample selection bias. Firms that were willing and able to answer the questionnaires completely usually had a higher level of human capital or a more formal organizational routine, which eases the understanding and communication between firms and the universities conducting the survey. Moreover, these firms were more interested in the strategic plan we promised to provide after the survey, than the firms that refused or left too many questions unanswered, which reflects their upgrading-oriented strategy. In fact, this selection bias controls for the technological level of the surveyed firms, ensuring that the innovation activities they undertake are not limited to low-value innovation and thus require more coordination and learning in the innovation process.

In order to test the hypotheses, typical innovation behavior that makes use of the two proximities in the product innovation process was firstly identified based on the theoretical discussion (Tab.1). Firms were asked to rank the importance (on a scale of 1 to 5 with increasing importance) of interaction with business partners in different aspects with regard to acquiring new innovative ideas and obtaining codified and tacit knowledge. By means of factor analysis, two dimensions of proximity for the interaction with different players were identified. The results clearly show that the firms are not only acquiring codified knowledge and tac-



**Tab. 1:** Operationalization of analysis on proximity use in product innovation

		Remarks	Explained variance of each factor	Total explained variance
New product ideas (NPI)	Internal efforts	Own development of ideas; self-absorption and learning through license purchasing and reverse engineering	15 %	60 %
	From organizationally proximate partners	Interacting with parent companies and foreign customers	12 %	
	From organizationally distant partners	Interacting with domestic customers, foreign customers, universities, research institutions and sales agents	33 %	
Obtaining codified knowledge (NPCK)	Internal efforts	Self-purchasing of equipment and software	24 %	85 %
	From organizationally proximate partners	Interacting with parent companies and foreign customers	27 %	
	From organizationally distant partners	Interacting with domestic customers and foreign customers	34 %	
Obtaining tacit knowledge (NPTK)	Active learning	Sending staff to domestic customers or leading domestic firms, foreign customers or leading foreign firms, and universities for training	44 %	74 %
	Received from organizationally proximate partners	Receiving training and know-how from people sent by parent company and foreign customers	13 %	
	Received from organizationally distant partners	Receiving training and know-how from people sent by domestic customers and foreign customers	17 %	
Interaction mode (NPInteraction)	Informal <i>guanxi</i> network	Interacting through <i>guanxi</i> , for example gaining information on the reputation and capacity of innovation partners from other business partners, relatives and friends in the innovation process	52 %	79 %
	Active searching	Searching for information on partners via internet, exhibition and sales agents in the innovation process	27 %	

Source: own survey

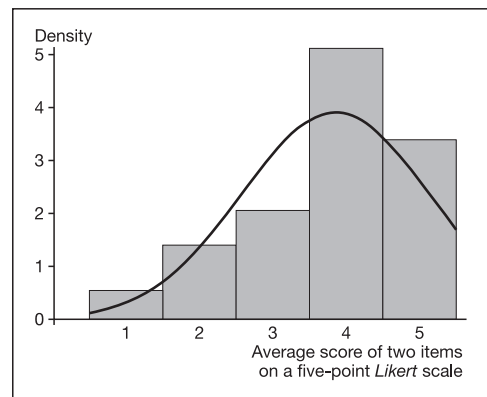
it knowledge from parent companies and foreign customers, but that they are also interacting with external partners beyond the organizational hierarchy, for example domestic customers, universities, research institutions and sales agents, to obtain new ideas and required knowledge. The organizational proximity with parent companies and foreign customers is closer than that with domestic customers and external institutes in the context of late-comer countries, as previously discussed. Also, the social proximity with domestic customers and external institutes can substitute for the lack of organizational proximity among independent firms and organizations to some degree in order to enhance trust and understanding in the innovation process. Combined with the general question pertaining to the use of social relations with all business partners (interaction mode), insight into the degree of proximity use in the innovation process can be secured.

In the empirical test, cluster analysis uses the items shown in Tab. 1 to identify different patterns of capitalizing on social and organizational proximity. In cluster analysis, there is rarely one single best solution. A good cluster analysis should firstly use as few clusters as possible, and secondly capture all statistically and empirically important clusters. We follow a four-step procedure to ensure the internal validity of the clustering result (DELMAR et al. 2003). First, hierarchical clustering with *Ward's* method and squared Euclidean distances was conducted to assess the possible clustering results. In this step, we arrived at two to six cluster solutions and derived each centroid from each cluster solution. The second step was to use the centroids derived in the first step to perform the K-means cluster. The result of the K-means cluster was compared with that of the hierarchical cluster using cross tabulation. A significant level in Lambda lower than 0.05 is considered to be able to verify the relative stability of the cluster results across samples. After running these two procedures, we settled on three clusters that are internally stable and easy to interpret from the perspective of innovation behavior with respect to the use of proximities.

We applied regression analysis to explore further the exact relationship of the use of proximities and product innovation performance by controlling for firm-specific characteristics

such as size, ownership, age and internal absorptive capacity. The dependent variable in the regression model is product innovation performance. In questionnaire data, especially in developing countries, it is always difficult to obtain an exact measurement of new products that is reliable and comparable. Therefore, we asked firms to evaluate the degree of improvement of two aspects of production innovation performance, i.e. product function expansion and product categories upgrading (on a scale of one to five with increasing degrees of improvement). The dependent variable in the regression is the average score of these two items. A shortcoming of this variable is that it has a bound value of one to five. The problem here is that it is based on a subjective evaluation, and that those firms that marked the same score might not be completely similar in their achievement. The distribution of the composite score of innovation performance is shown in Fig. 3. The censoring of the data set can be clearly seen, since there are far more cases with scores of three to five, which is to be expected in questionnaire answers because the firms all attempt to make a good impression. With this particular issue of censored data, ordinary-least-squares (OLS) regression provides inconsistent estimates of the parameters (LONG 1997). Therefore, we applied a *Tobit* regression which is unaffected by this issue. The independent variables are defined in Tab. 2.

**Fig. 3:** Histogram distribution of product innovation outcome



Source: own survey

**Tab. 2:** Independent variables in product innovation outcome regression

	<i>Indicators</i>	<i>Description</i>
Firm characteristics	Size	Defined according to Chinese firm size standard, 1 as large firms with no less 300 million Yuan sales and no less than 2000 employees, otherwise as small and medium-sized with the value of 0
	Ownership	1 as firms with foreign participation (wholly owned or joint venture), 0 as firms with 100 % domestic participation
	Age	Years since establishment of the firm
Absorptive capacity	Level of technical staff	Percentage of technical staff that have bachelor degree or above multiplied by training frequency
	Level of managerial staff	Percentage of managerial staff that have bachelor degree or above multiplied by training frequency
	CEO education	1 as CEO below bachelor degree 2 as CEO with bachelor degree 3 as CEO with graduate degree (master or doctor) 4 as CEO with bachelor or above combined with overseas experience
	Development capability	1 as having product development capability, 0 as not
	Initial product technology	Defined according to <i>International Standard Industrial Classification of all Economic Activities</i> , Rev 31, 1 as producing low-tech products when starting business, 2 as producing medium-tech products when starting business; 3 as producing high-tech products when starting business
Innovation behavior	Behavior of using different proximities	Defined by the cluster analysis in the next part; included in the model as a series of dummy variables.

1 Specific classification of products into the different levels could be referred to appendix C.

Source: own survey

## Empirical results

### *Use of proximity in innovation: the overall pattern*

The results of the cluster analysis, which differentiates between three types of innovation behavior related to the capacity of capitalizing on social and organizational proximity in the process of product innovation, are demonstrated in Tab. 3.

- *Socially embedded innovator:* Firms in this group interact frequently with external partners in combination with their internal capability. With regard to obtaining codified and tacit knowledge in the product innovation

process, firms of this kind tend to rely more on customers and use the active strategy of sending people to business partners for acquiring tacit knowledge. In the interaction process with these partners, firms in this category flexibly combine formal active searching and informal networks (*guanxi* with family members, friends and business partners) when interacting with partners in the innovation process. Although it is not possible to specify exactly which interaction method is applied by the firms when interacting with each partner (because the related matrix would be too complex to be answered by the firms), it is possible to conclude indirectly that firms in this group rely on social

**Tab. 3:** Results of cluster analysis\*

	<i>Socially embedded innovator</i>	<i>Organizationally dependent innovator</i>	<i>Lame innovator</i>
NPI_external partner	0.54	0.25	-0.32
NPI_internal	0.52	0.07	-0.31
NPCK_customer	0.60	-0.15	-0.34
NPTK_passive from customer	0.46	0.07	-0.22
NPTK_active learning	0.58	-0.12	-0.35
NPInteraction_informal	0.60	-0.06	-0.33
NPInteraction_formal searching	0.26	-0.01	-0.17
NPI_parent comp. & foreign	-0.11	1.01	-0.12
NPCK_parent comp.	-0.38	1.96	-0.27
NPCK_self purchase	-0.17	0.12	0.10
NPTK_passive from parent comp.	-0.47	2.06	-0.16
Number	104	41	171

\* Ward's method/squared Euclidean distance

Source: own survey

proximity to external partners in general during the process of product innovation to a greater degree than firms in the other two clusters. They are actually socially embedded innovators, and social proximity is not only used as a way of acquiring codified and tacit knowledge by interacting with external partners, but also as a way of triggering new product ideas, which is a feature of capable firms in a well-functioning regional innovation system.

It is worth mentioning that although these firms are already able to extend the scope of interactive learning in the innovation process to capitalize further on social proximity, they still rely on organizational proximity with foreign customers to a certain degree in order to acquire codified and tacit knowledge. This again supports the mutual reinforcing effect of social and organizational proximity. Socially active innovators tend to apply mixed strategies in using proximity to facilitate interactive learning.

- *Organizationally dependent innovator:* In contrast, organizationally dependent innovators rely heavily on organizational proximity to gain access to and absorb knowledge. They turn to their parent companies to obtain codified and tacit knowledge in the process of product innovation, i.e. in a more passive way due to the hierarchical control. The new

product ideas originate mainly from parent companies as well as from powerful foreign customers.

What is again noteworthy is that organizationally dependent innovators show a certain tendency to interact with external partners to prompt product innovation, although to a lesser degree than socially embedded innovators. However, the much lower value in informal interactions indicates that these firms are not able to capitalize on social proximity to foster innovation as well as their socially embedded counterparts. Moreover, their method of interacting with innovative partners is not characterized by any particular feature, which indicates a more passive attitude towards product innovation compared to socially embedded innovators.

- *Lame innovator:* Compared to the previous two kinds of firms, lame innovators have low values for all the indicators that are related to product innovation. Lame innovators are not actively involved in triggering new ideas of innovation, nor do they strive to search for codified and tacit knowledge, which is important for positive product innovation outcome. Moreover, they are quite vague and unsettled in their ways of interacting with partners in the innovation process. In short, they are not able to interact with external players to initiate innovation

**Tab. 4:** Difference in innovation behavior between large firms and small and medium sized enterprises (SME)

Firm ownership	Socially embedded innovator	Organizationally dependent innovator	Lame innovator	Total
Domestic firms	73 (37 %)	17 (9 %)	105 (54 %)	195
Foreign firms	31 (26 %)	23 (19 %)	66 (55 %)	120
Total	104 (33 %)	40 (13 %)	171 (54 %)	315

$\chi^2=9.434, p=0.009$

Source: own survey

and do not have the capacity to organize internal learning.

A look at the number of firms in each cluster shows that the number of lame innovators exceeds the sum of socially embedded and organizationally dependent innovators in our sample. This is proof of the immature internal absorptive capacity of most firms in the Pearl River Delta to benefit from external interaction in order to trigger innovation. However, the number of socially embedded innovators is two times higher than the number of organizationally dependent innovators. This seems to be an indication of a maturing regional innovation system in the Pearl River Delta, where some local firms are capable of benefiting from localized knowledge sources by capitalizing on informal social relations. But it also reflects the difficulty of most firms in the Pearl River Delta to ‘couple strategically’ with global firms to upgrade their position in the value chain. By studying the relocation issue of Taiwanese personal computer firms, YANG (2009) also pointed out that Taiwanese firms in the Pearl River Delta are less oriented towards the strategic coupling of local and global knowledge sources than their counterparts in the Yangtze River Delta.

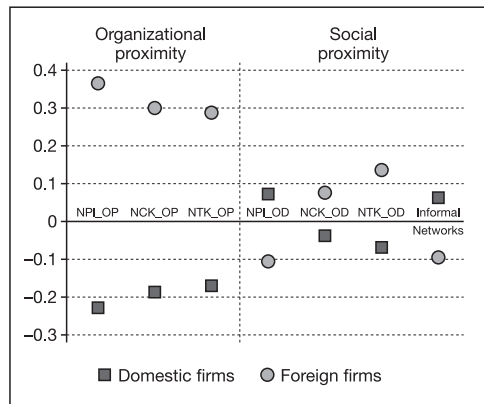
*Use of proximity in innovation: difference between domestic and foreign firms*

In the interest of a deeper insight into innovation behavior in terms of proximity use among the electronics firms in the Pearl River Delta, investigations of the domestic and foreign firms were conducted separately. Tab. 4 shows the distribution of the above-mentioned clustering groups for domestic and foreign firms. At first glance, it can be seen that the domestic and foreign firms do not differ from each other in the inclination to undertake interactive learning aiming at fostering product innovation

outcomes. However, the strategies of using proximity as a way to ensure trust and understanding in interactive learning differ between these two groups of firms. Domestic firms tend to interact with other independent business partners through the use of social proximity to gain reliable information and support, while foreign firms resort more to their organizationally proximate parent companies and foreign customers to gain access to innovation-related knowledge.

The different behavior of using proximities in different processes of product innovation between domestic and foreign firms is demonstrated in Fig. 4 more thoroughly. As shown by the left part of the figure, foreign firms use much more organizational proximity to foster innovation, especially in terms of acquiring new product ideas. The reason for foreign firms interacting more with their parent companies and foreign partners to trigger innova-

**Fig. 4:** Use of proximities for domestic and foreign firms



Source: own survey

**Tab. 5:** Tobit regression on innovation outcome

Independent variables		(1) Product innovation outcome <sup>1</sup> (average score of evaluation)	(2) Product innovation outcome <sup>1</sup> (average score of evaluation)
Constant		3.01*** (0.282) <sup>6</sup>	2.64*** (0.281)
Level of technical staff		0.0006 (0.001)	0.0006 (0.001)
Level of managerial staff		0.0008 (0.001)	0.0008 (0.001)
CEO education		0.16** (0.065)	0.16** (0.065)
Development capability		0.52*** (0.188)	0.52*** (0.188)
Initial product technology	Medium-tech vs. low-tech <sup>2</sup>	0.19 (0.174)	0.19 (0.174)
	High-tech vs. low-tech <sup>2</sup>	0.54** (0.251)	0.54** (0.251)
	Overall effect <sup>5</sup>	—* —*	—* —*
Ownership		-0.26** (0.127)	-0.26** (0.127)
Firm size		-0.12 (0.293)	-0.12 (0.293)
Firm age		0.005 (0.010)	0.005 (0.010)
Innovation behavior	Organizationally dependent vs. socially embedded <sup>3</sup>	-0.15 (0.246)	0.23 (0.234)
	Lame vs. socially embedded <sup>3</sup>	-0.37** (0.170)	0.37** (0.170)
	Overall effect <sup>5</sup>	—* —*	—* —*
Prob > chi2		0.0006	0.0006
Pseudo R square		0.047	0.047
Number of observations		233	233

1 Product innovation outcome refers to improvement in product quality, product function and product categorical upgrading

2 Initial product as low-tech as the default group, which means low-tech as 0, the other as 1

3 Socially embedded innovator as the default group, which means socially embedded innovator as 0, the other as 1

4 Lame innovator as the default group, which means lame innovator as 0, the other as 1

5 T test of whether the overall effect of the categorical variable is statistically significant

6 Standard errors in parentheses; \*p<0.10, \*\*p<0.05, \*\*\*p<0.01

Source: own survey

tion ideas as well as acquire support of machinery and technical know-how needed for product innovation is quite obvious, as firms with the participation of foreign investment (wholly foreign-owned companies or joint-ventures) are more closely included within the organizational boundaries of global lead firms.

However, it is worth noting that domestic firms, compared to foreign firms, use less so-

cial proximity in interactive learning to substitute for the lack of organizational proximity with global lead firms in terms of gaining support of machinery and technical know-how. Social proximity that is supported by informal *guanxi* networks with friends and business partners is primarily used by domestic firms to search for relevant information and ideas that are essential for innovation-related decisions. In other words, informal *guanxi* networks serve

only as a 'spying device' to catch up with the latest technology and market preferences in order to trigger new product ideas. The more underdeveloped firm capabilities of domestic firms compared to those of foreign firms, resulting in less gain from reciprocity than the cost of spillover, inhibit them from cooperating in the product innovation process to share each other's codified and tacit knowledge.

#### *Impact of proximities on product innovation performance*

The results of the *Tobit* regression with innovation performance as the dependent variable and innovation behavior and other control variables as independent variables are shown in Tab. 5. The results of the cluster analysis are used to define the innovation behavior as: 1 - socially embedded innovators, 2 - organizationally dependent innovators and 3 - lame innovators. The chi-square likelihood ratio has a p-value of 0.002, which tells us, that the model as a whole fits significantly better than an empty model.

The main focus of the research question is the impact of the use of proximity on product innovation performance. Equation 1 and equation 2 are quite similar, with the exception that the default group of each dummy variable in the innovation behavior category is adjusted to compare the impact of each type of innovation behavior on innovation performance. If control variables for firm characteristics and absorptive capacity are included in the model, socially embedded innovators possess a better product innovation outcome than lame innovators on a significant level of 0.02, while organizationally dependent innovators do not outperform the lame innovator in a significant way.

This verifies the second hypothesis that social proximity is an asset that firms are able to capitalize on in complex innovation processes. With the development of local capabilities in the Pearl River Delta after thirty years of industrialization, firms are gradually accumulating the capacity to capitalize on social proximity to foster product innovation and upgrading. Nevertheless, it also suggests that firms that apply the strategies of capitalizing on organizational proximity to foster innovation encounter the difficulty of achieving satisfied innovation outcomes. The limited potential for upgrading the position in the value chain is revealed for organizationally dependent innovators, supporting the first hypothesis.

Nevertheless, it is necessary to examine cautiously the magnitude of improvement by applying social proximity in interactive learning. The coefficients in model 1 and model 2 all point to a 0.37 degree of improvement on the average score of evaluation on production function expansion and category upgrading. To place it in a practical context, this means that applying social proximity in interactive learning promotes the innovation outcome either in function expansion or category upgrading by nearly one degree (e.g. from not significant to slightly significant or from significant to very significant). In short, the improvement made by applying social proximity compared to applying nothing is rather small. Moreover, socially embedded innovators, which interact with domestic customers and other knowledge institutions in the process of product innovation, do not differ significantly from organizationally dependent innovators in terms of product innovation performance.

The results reveal an intriguing feature of the recent development stage of the regional innovation system in the Pearl River Delta. Although socially embedded firms are emerging in this region, which altogether increases dynamic innovative synergies on the local scale, their capacity to transform this social asset fully into a high innovation performance is not yet sufficient. Recalling the results in the previous section which revealed that domestic firms are reluctant to share codified and tacit knowledge in the innovation process, this all underpins the instability of innovative synergies in emerging regions where small achievements are not sufficient to compensate for the risk and cost related to innovation activities. It might be due to the fact that trust building requires time, especially in innovation activities that are highly complex and risky and involve a high level of spillover effects. All in all, a regional innovation system is only just burgeoning in the Pearl River Delta, and calls for a stable and efficient governance infrastructure to be put in place to strengthen and stabilize interactive learning in the business sector.

#### **Discussion and conclusion**

The fact that the local firms are interested and able to capitalize on social proximity to foster innovation signifies the maturing of a regional innovation system (COOKE et al. 1997; REVILLA DIEZ 2000). Moreover, the use of organiza-

tional proximity feeds dynamism into the local production system as a way of avoiding negative lock-in effects (ASHEIM/ISAKSEN 2002; BATHELT et al. 2004). In the context of China, where low-cost is the common strategy and innovation capability is doubted, this paper provides the theoretical implications of the role of proximity in fostering innovation activities when sufficient absorptive capacity is gradually enhanced. The line of thinking that social capital is an important asset for organizing interactive learning and markets is well covered by the institutional and cultural turn in many disciplines. In new growth theory, productive new ideas are endogenously shaped by institutional contexts (ROMER 1986). The approach of innovation systems proposes that social capital induces widely spread interactive learning in the whole economy, hence creating more net wealth (LUNDVALL 2005). Likewise, the new institutionalism in economic geography also embraces the context-dependent epistemology, considering the possibility that various social institutions in places determine the evolution of the economic landscape (CLARK et al. 2003). As demonstrated by the empirical investigation in this paper, the informal *guanxi* networks in the Chinese context are important social assets that firms can take advantage of in ensuring effective interactive learning.

By examining the questionnaire data collected for the electronics industry in the Pearl River Delta, the following trends are captured in this electronics cluster. *Firstly*, as organizational proximity plays a limited role in promoting innovation, the electronics firms have extended the use of social proximity from low-cost production activities to undertake interactive learning in the product innovation process. Despite the formation of a group of socially embedded firms, the effect of social proximity in fostering fruitful interactive learning is still marginal. *Secondly*, social proximity is applied more by domestic firms than by foreign firms, especially in terms of triggering new product ideas. However, it is applied less by the domestic firms to gain support in the innovation process, such as necessary machinery and technical know-how. Altogether, social proximity not only produces marginal effects, but also has limited scope in strengthening the interactive learning in innovation, which all points to the instability of innovation synergies that is stressed in the regional competitiveness literature.

Even before the financial crisis in 2008, governments at different levels (province, city, district) in the Pearl River Delta felt that the strategy of low-cost production was losing its competitive edge and had been eagerly promoting industrial upgrading and innovation. As interactive learning processes based on social relations need stabilizing regional orders from the supporting governance infrastructure (HEIDENREICH 2004), policy focus may be devoted to widening the scope of social proximity in interactive learning and improving the effect of social proximity in fostering innovation, which has been pointed out from the empirical results as a weakness of the regional innovation system in the Pearl River Delta. Actions can be taken by means of supporting agents or organizations to foster cooperation among local players as well as with external players, institutionalizing the exchange and learning between industry and academia, regulating the domestic market which stabilizes the reciprocal learning among the firms, and providing innovation funds to resource-limited small and medium enterprises.

The theoretical literature has extensively discussed the issue of proximity and its relationship with learning and behavior, but the empirical evidence is not yet sufficient to support its role in innovation in different contexts, especially that of developing countries. This paper takes the step of measuring the use of the two most relevant proximities – organizational proximity and social proximity – in the context of China. By responding to the call of researching the knowledge transfer and learning process at global and local scales (BUNNELL/COE 2001; ASHEIM/ISAKSEN 2002; FREEMAN 2002; FROMHOLD-EISEBITH 2007) light was thrown on the role of proximity on both scales in attaining trust and understanding in the process of product innovation. However, the complementary role of organizational proximity with global partners and social proximity with local partners is not simple. As demonstrated by HUMPHREY/SCHMITZ (2002), different degrees of organizational proximity, i.e. different methods of integration into the global production system, actually influence the local upgrading strategies. Therefore, qualitative studies such as company interviews should be conducted to provide further insight into the strategic combination of different proximities to achieve the optimal innovation outcome.



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