The role social capital, knowledge exchange and the growth of indigenous knowledge-based industry in the Triple Helix system: the case of SMEs in Thailand

Nattaka Yokakul
National Science and Technology Development Agency, Thailand
nattaka@tmc.nstda.or.th

Girma Zawdie
University of Strathclyde, UK
g.zawdie@strath.ac.uk

Peter Booth
University of Strathclyde, UK
p.h.booth@strath.ac.uk

Sub-themes 3: Triple Helix ecosystems and regional development

Abstract

This paper explores the Triple Helix system as a framework for the growth of the Thai dessert industry. In this paper, SMEs are presented as carriers of indigenous knowledge. The role of indigenous knowledge in SME innovation is discussed in relation to SME efforts to cultivate indigenous knowledge to cumulatively yield what is generically known as disruptive technological innovation on the back of their experiences in incremental innovations. The paper also examines the role of social capital and knowledge exchange in promoting SME innovation and competitiveness. A questionnaire survey of technology capability development, knowledge, and social capital was used to gather data and information from 121 Thai dessert firms together with interviews with the owners or manager of 22 firms as a supplement of questionnaire survey. Multiple regression analysis was used to analyse the relationship between social capital elements and technological capability development. The results pointed out that knowledge exchange is an important element that enables firms to enhance their innovation and technological capability. In addition, a higher index of social capital results in a better knowledge transfer and exchange between firms; and also between firms and organisations in the knowledge sphere.

Key words: Triple Helix system, SMEs, social capital, indigenous knowledge and government policy

The authors would like to acknowledge the staff of the Industrial Technology Assistance Program (ITAP), National Science and Technology Development Agency (NSTDA), Thailand and all firms participating in this study for their cooperation in the field work study in Thailand, and their provision of useful information for the writing of this paper.

The role social capital, knowledge exchange and the growth of indigenous knowledge-based industry in the Triple Helix system

1. Introduction

In the long run, Schumpeter would argue, achievement of economic growth and competitiveness would be expected to turn on advances in science and technology. This is more so especially in the case of the industrial sector which offers a wider scope for the application of new ideas. Although small and medium size enterprises (SMEs) are considered to be significant as a source of innovation (OECD, 2002), their innovation performance has remained somewhat patchy at best, particularly in the context of developing countries. Much of the innovation deficiency in SMEs is said to be due to the prevalence of social capital deficit and the lack of appropriate policy provisions to remove the constraints on social capital formation and hence on the development of the culture of innovation in SME communities (Morgan, 1997; OECD, 2005b).

However, there has, of late, been growing interest in SMEs as major drivers of industrialisation in developing countries, where, generally speaking, SMEs account for a high proportion of the total number of industrial firms. Consequently, industrial policy in these countries has largely focused on technological capability building with the view to improving the innovation performance of the SME sector as a strategy for strengthening the performance of the wider economy. Most of the SMEs in developing countries are based on indigenous knowledge. These indigenous firms thrive largely on the basis of implicit knowledge; but there is a limit to which they would grow if they do not engage in knowledge exchange with other firms and organisations in the knowledge sphere. This would, therefore, make them active participants in the Triple Helix system. Indeed, where there is such transaction, the knowledge base of indigenous firms would grow, increasing the scope for firms to be creative and innovative, thereby enhancing the market appeal of their products and their disposition to business risk.

Social capital building is important for firms to build their business confidence and to position themselves as creative, innovative and competitive niche players. The importance of social capital to economic growth is widely acknowledged by scholars and policy makers. Ever since Putnam (1993) popularised the concept of ‘social capital’ in collective terms as “stock of social trust”, many have sought to explain the paucity of innovation and economic growth in terms of the absence or else the weakness of the ‘social capital’ base and the failure, in consequence, of the major social and economic actors to interact and generate innovative ideas and economic growth (Grootaert, 1998). Social capital is vital in developing an efficient market economy as it reduces the cost of transactions by removing bureaucratic red tape, improving the scope for exchange of best practice and increasing the competitiveness of industry (Fukuyama, 2000).

There is substantial evidence that give credence to the view that far from being sterile and retrograde, as it is often perceived to be, indigenous knowledge has in it the seeds, which, if properly nurtured, would be capable of generating innovation and growth (Mauro & Hardison, 1999; World Bank, 2004). This would be the result of effective acquisition, assimilation and exploitation of extra-traditional knowledge that circulates in the triple helix system of innovation.

This paper attempts to explore the relationship between social capital and technological capability development in the SME sector, with particular reference to the Thai dessert industry. The industry is selected for the significant role it plays in Thailand’s economic growth and development, especially at local and community levels. The range of activities and the social network in this sector are a reflection of the institutional context and hence of the extent of social capital and the scope for growth and technological development in this industry. The paper also examines the role of social capital and knowledge exchange in promoting SME innovation and competitiveness.

The remainder of this paper is in six parts. The first three parts discuss the role of social capital, disruptive technologies and SME innovation, and the triple helix system in developing countries. In particular, the discussion will explore the argument that weak social capital arising from the existing state of the SME sector in developing countries has consequences that are reflected in the low level of technological development and innovation. The fourth part provides research methodology and data analysis. The fifth part engages in statistical analysis to empirically investigate evidence of the relationship between social capital elements and technological capability development; and government policy and its interventions in the context of the economy of Thailand. The paper concludes in the last part with discussion of policy implications of the results of analysis.

Indigenous knowledge and innovation

In recent years, the issue of indigenous knowledge has been recognised as a key element of social and economic development, especially at rural and community levels. The significance of indigenous knowledge is well taken on board by international development organisations, such as the World Bank, the United Nations Educational Scientific and Cultural organisation (UNESCO), the United Nations Development Programme (UNDP) and the United Nations Industrial Development Organisation (UNIDO), among others. The concern now is how to promote indigenous knowledge by infusing scientific knowledge and modern technology/knowledge into it without, however, undermining the basic characteristics that define the essence of indigenous knowledge. Modern knowledge is based on scientific and technological foundation that gives it the prowess to unravel and even transform the surrounding system, however complex the socio-ecological system (Gadgil et al., 1993). Far from being destructive, the exposure of indigenous knowledge to the rigours of science and technology can be expected to bring out the transformative elements latently inherent in it. The process is rather very much in tune with Schumpeter's "gale of creative destruction".

According to Grenier of the International Development Centre (IDRC) (1998), 'indigenous knowledge' refers to *"local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area"* (p.1). Indigenous knowledge is also referred to as 'traditional' or 'local' knowledge – these being terms that are frequently used interchangeably in the literature (Ellen & Harris, 2000).

Unlike modern technology or scientific knowledge that derives from the activities of academic and research institutes, indigenous knowledge is a product of cultures, traditions, values and beliefs, generations of experiences, practices, and trial-and-error experiments that are unique to specific societies. Therefore, indigenous knowledge characteristically occurs in the form of tacit knowledge, which cannot be expected to serve as a basis for trade or knowledge exchange at local or global level since it is not documented or codified. Basically, though, tacit knowledge is orally transferred from generation to generation and from person to person through social relationships and network systems where social capital is developed through those social activities (Agrawal, 1995; World Bank, 2004). There is, therefore, reason to believe that the role of social capital in knowledge exchange and the development of innovation-prone culture is significant particularly where the operation of the market system is seriously constrained as in the case of rural communities in developing countries.

Nonaka et al. (2001) explain the creation and conversion process of tacit and explicit (codified) knowledge in four steps as shown in Figure 1. The figure helps to explain how indigenous knowledge, which is tacit in nature, can be developed and evolved through these social activities. This continuous process of knowledge creation comprises four steps, namely socialisation, externalization, combination and internationalization. Socialization promotes knowledge and experience exchange and sharing through engagement in social activities such as informal meetings, living together and interacting and discussing issues of concern. These activities generate empathy that would allow tacit knowledge to be learned and shared by observation, imitation and other informal means. The spread of tacit knowledge paves the way for its conceptualisation, so that it can be codified and externalised (traded) if found to be of any socio-economic significance. 'Externalisation' is thus a process which transforms tacit

knowledge to explicit knowledge by creating concepts in forms that can be readily understood by and exchanged with others. The next stage in the evolutionary process is 'combination'. Combination is the process that transforms explicit knowledge into more complex, but systemic, form, thus allowing explicit knowledge to be communicated, diffused and systemized. The effectiveness of this process would depend on the extent of the social network and connectedness among people for knowledge to be able to circulate widely. Finally, the 'internalization' process ensures that explicit knowledge is embedded into tacit knowledge making it more complex and dynamical. This is akin to "cross-pollination" in the knowledge exchange process. It occurs, for example, through the vehicles of manuals, procedures and programmes that are used in firms as teaching materials in training courses. The diffusion and embodying processes of explicit knowledge have a potentially regenerative effect on tacit knowledge or knowhow that result in the development of the core competency of firms.

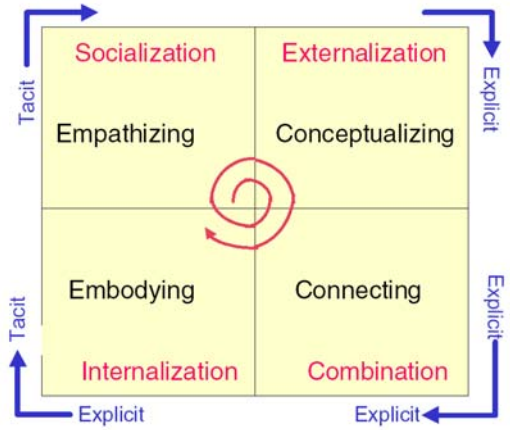

Figure 1 The continuous self-transcending process of knowledge creation

Source: Nonaka et al. (2001, p.18)

Indigenous knowledge has its own dynamics in the sense that it has continually evolved through the creativity of indigenous people in the course of their interactions with the external environment (Flavier et al., 1995). It enables local people in resolving problems arising from the social and ecological complex encountered in a wide range of economic activities such as farming, food preparation and preservation, traditional medicine and medication, human and animal health, environmental management etc. (World Bank, 1998; UNESCO, 1999). There is now growing awareness that indigenous knowledge can be invoked to provide the basis for sustainable development as it relates directly to the complexities of local socio-economic cultures and behavioural patterns; local resources and biological and ecological conditions. As such, indigenous knowledge would serve as an important information support for expediting communication and decision-making while designing, developing and implementing projects targeted at promoting rural development. But how does indigenous knowledge translate into innovation? The following part of this section will look into the concept of 'disruptive technologies', which in contrast to 'established' or 'incumbent' technologies, are based on indigenous knowledge and draw from indigenous knowledge and existing practice the ingredients that would make them uniquely innovative and competitive.

3. From indigenous knowledge to 'disruptive' technologies

The belief that indigenous knowledge is inferior to modern knowledge or existing best practice and that it should give way for the latter to thrive, however erroneous, has for long been used to establish the significance of technology transfer from 'North' to the 'South' as a strategy for development. The belief essentially draws support from the two-sector Arthur Lewis model (Lewis, 1954) in which sustainable economic growth is postulated to derive from the expansion of the modern (capitalist) sector, which is considered to be dynamic and productive, displacing the preponderant traditional sector, where the bulk of the labour force in the economy is disguisedly unemployed. The Lewis model assumes, if implicitly, that the indigenous knowledge

in the traditional sector does not have the transformative potential, and that economic growth could only be achieved by growing the modern sector through the transfer of modern technology from developed countries. The adoption of this model has led to the development of economic and social dualism, with the rural-urban gap ever widening and the conflict between the traditional and the modern ever deepening, thus resulting in the perpetuation of poverty rather than its reduction. The problem with the Lewis model is not in its support for technology transfer but in its failure to give due recognition to the significance of indigenous knowledge as a dynamic factor that could evolve by learning from knowledge borne by technologies of the modern sector.

For instance, in a study based on rural Tanzania, Mwantimwa (2008) found that integration of indigenous knowledge and modern technology can create local innovation and generate income and job opportunities for local people. With interventions from various supporting agencies, integration of tacit indigenous knowledge and knowledge embodied in modern sector technologies could lead to indigenous innovation in a wide range of rural activities, such as crop breeding, food production, pre- and post-harvest activities. When indigenous knowledge is incorporated with modern sector knowledge, it can generate innovation at grassroots level and the technology thus produced can evolve to have a wide market base (World Bank, 1998).

When adapted to existing 'best practice', indigenous knowledge offers the basis for the development of what is known as 'disruptive technology'. Disruptive technology is essentially indigenous knowledge with value added to it through integration with modern knowledge or 'best practice' associated with the 'established' or 'incumbent technology'. Disruptive technology is systematically developed on the back of indigenous knowledge but within a strategic framework that would enable it to evolve on a competitive basis in relation to globally established technology. It is the cumulative synthesis of incremental innovations arising from the integration process. Indigenous knowledge is in this context considered to be the essence of core competency of a specific location, which when strategically and innovatively developed, could give rise to technologies that are capable of effectively outperforming – hence disrupting - established or 'incumbent' technologies. This is graphically demonstrated in Figures 2 and 3, where it is shown that indigenous knowledge-based technologies could in the event of consecutive 'disruptive innovations' outperform established or mature technologies by taking away from them the size, capacity, reliability and price advantages that once gave established technologies a competitive edge in the global market (Christensen, 1997).

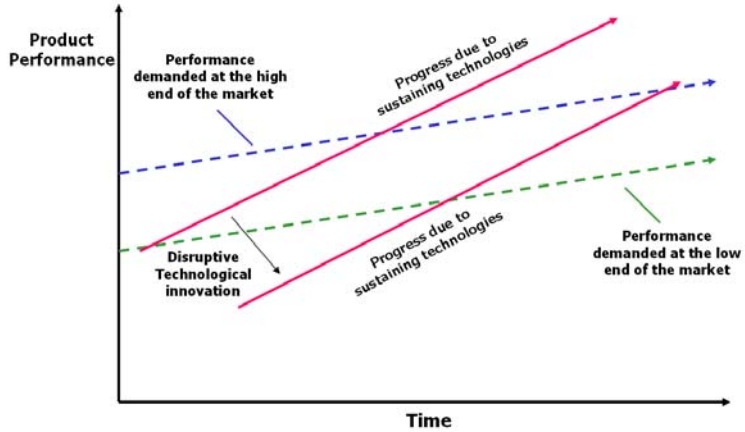

Figure 2 The impact of disruptive technological change on product performance

Source: Christensen (1997, p.12)

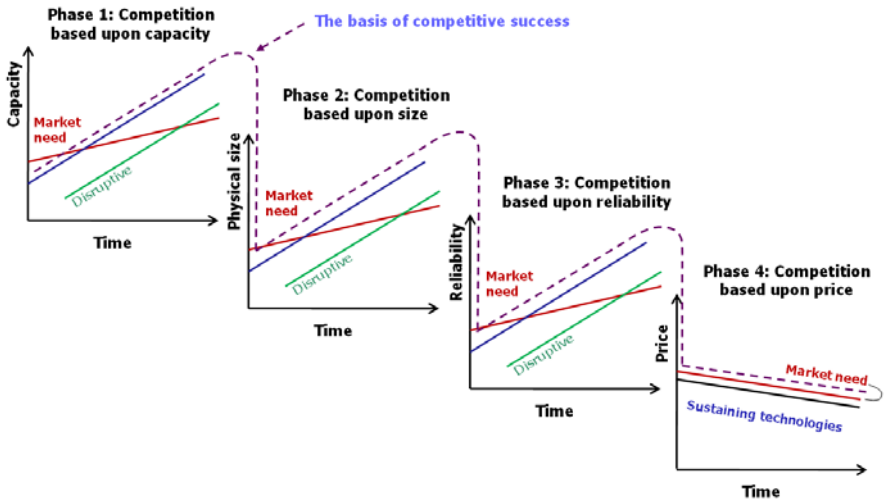

Figure 3 The basis of competitive success for Disruptive technologies

Source: Christensen (1997, p.148)

Thus, whereas indigenous knowledge is limited to specific locations or communities (Nwokeabia, 2003), 'disruptive technology' – its hybrid - has a much wider, even global appeal. An important advantage of 'disruptive technology' is that by integrating new ideas with indigenous knowledge, it offers a low cost approach of delivering goods and services that would otherwise be delivered by relatively high cost established technologies (Bower & Christensen, 1995; Christensen, 1997). Moreover, disruptive technologies involve knowledge that are readily accessible and are therefore appropriate to the conditions of rural communities. They are effective approaches to generating income and employment.

Moreover, when disruptive technologies evolve, they would achieve competitiveness on a global scale, thus challenging the dominance of established technologies, and also transcending the limitations of indigenous knowledge without, however, ignoring the significance of its basic attributes – namely, its authenticity, uniqueness and tacitness that make industries based on it to be unique global players.

As export markets grow offering market opportunities for indigenous products, indigenous knowledge-based producers would, short of learning and adapting to changing production and market circumstances, find it difficult to take advantage of these opportunities as they can't compete along key profiles like technological capability, economies of scale, reliability and price. Consequently, indigenous knowledge-based producers would either wither or be relegated to a position too remote to be of commercial and economic significance. To promote indigenous producers in a global market, technological assistance and management skills are needed to blend indigenous knowledge with ideas extracted from established technologies so as to achieve innovation at both the process and product levels of the activities of local SMEs. Littrell and Dickson (1999) provide the case of artisan groups that have evolved from being indigenous producers limited to remote rural locations to competitive entrepreneurs operating in a wider market framework. The transformation happened as a result of improvements that involved creativity and innovation in product development and marketing - in short, by growing indigenous knowledge-based SMEs from being limited local players to becoming global players based on the application of 'disruptive technologies'.

4. Social capital and SME innovation

Competitiveness of firms largely turns on their innovation performance, which is conditioned by the level of their technological capability. However, technological capability building and innovation performance of small firms, especially in developing countries, have been characteristically weak, particularly with respect to the ability to adjust to advances in knowledge and technology systems (Arnold et al., 2000). The persistence of this problem can in large part be attributed to the fact that SMEs are poorly networked between themselves and with other

agents like universities, government institutions and other industries, which means that their ability to share and gain knowledge is limited (Intarakumnerd et al., 2002).

As noted in the preceding section, SMEs provide ideal vehicles for the emergence and development of 'disruptive' technologies. These are technologies that would make SMEs innovative and competitive not only in local markets but also globally. However, the state of SMEs in developing countries would not warrant the occurrence of innovation as a systemic phenomenon short of policy interventions to make up for shortfalls in resource and networking provision. The key problem militating against the innovation prospects of SMEs in developing countries is the preponderance of the weak social capital base of the sector resulting from the fragmented and least networked nature of the sector. The weak social capital base has the effect of mitigating the innovative capability of SMEs by increasing the risk and transactions cost of innovation (Cooke & Wills, 1999). Moreover, fragmentation of the sector for lack of networking reduces the degree of competition in the sector, and the lack of competitive pressure would make SMEs reluctant to take the risk to innovate (Porter, 1990). Thus, although it may well be that SMEs provide a fertile ground for budding enterprises with the potential to innovate, it is important to note that these enterprises would be ineffective agents of innovation unless they are supported and equipped through structured policy interventions (OECD, 2005b).

Innovation is presumed to derive from a network of collaboration between actors in the innovation system. The stronger the linkage or social relations between actors in the system, the higher the probability for innovation to occur. The extent of social relations that SMEs forge with other firms and agencies and the extent to which these relations are underpinned by trust together account for what is generically referred to as the social capital of SMEs. This is important because the extent to which SMEs would grow and flourish is presumed to be contingent upon the size of social capital they have developed over time.

For Porter (1990), industrial clusters provided the basis for the development of networks between firms, and between firms and external agencies. As such, industrial clusters would have the effect of raising the level of social capital and competitiveness. Tangible factors or the conventional production factors such as financial investment, labour and other infrastructures appear to be not enough for firms to improve their technological capability and innovation (Westlund, 2005). It is argued that 'social capital' plays a key role in expediting the innovative process and technological capability development at the level of firm (Maskell, 2001).

Pierre Bourdieu (1986) is the pioneer who tried to analytically conceptualise social capital. He defined 'social capital' as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationships of mutual acquaintances or recognition" (Bourdieu, 1986, p. 248). His seminal work focused on the advantages and benefits of power functions deriving from being included in the network, and the social obligations resulting from social capital. However, he did not explicitly mention the role of trust in connection with social capital formation and development (Siisiäinen, 2000), while the broad definition of social capital in contemporary development studies considers trust to be one of the important elements contributing to the social capital complex (Coleman, 1988; Putnam, 1993; Woolcock, 1998).

Putnam (1993) explains social capital in terms of trust, norm and network – attributes that enable collaboration resulting in mutual benefits. A country with high social capital index would be expected to perform better in terms of economic growth and social well-being than one with low social capital index. Although the concept of social capital was first developed in the context of community development, it has subsequently been applied to technology and innovation (Dietz, 2000). Fountain (1997) notes the importance of social capital as an intangible factor that accelerates innovation in science and technology by stimulating interactive learning, knowledge sharing and transfer in industrial clusters and innovation network (see also Chaminade & Vang, 2006).

In relation to the National Innovation System (NIS), Arnold (2000) demonstrates the complex relationship and interaction between the NIS actors corresponding to the institutional context,

financial capital, human capital and infrastructure, which are tangible factors. However, he argues that there is more to the NIS than such tangible factors. Arnold's framework thus invokes the concept of intangible factors or social capital *a la* Putnam (1993), Cooke (1996; 1999; 2005) and Fountain (1997), as being critical for the success of NIS and regional innovation systems. Maskell (2001) identifies social capital as a key factor for the occurrence of innovation in low-technology industries, such as the furniture industry, in the form of production improvement, enhancement of delivery and product quality, skill training and diffusion through interaction with partners on the supply chain.

Unlike large firms, SMEs have limited resources at their disposal, particularly financial capital, which constrains their scope for becoming creative, innovative and competitive. On the other hand, it is argued that they could make up for this shortfall, at least in part, through the provision of social capital. This would enhance SMEs' ability to innovate through networking, thus facilitating their interactions with other firms and knowledge agencies. Social network activities increase the advantages small firms can have in terms of access to resources and knowledge from various sources including support from public agencies, and access to markets.

The sociology of SMEs in developing countries is generally conditioned by the geographical distribution of social capital and market base for the products of SMEs. To the extent that the market for SMEs is limited to specific geographically and even ethnically and culturally bounded localities, the social capital base of SME activities can for the most part be attributed to the organisational relations within the SMEs, and also to a limited extent to the SMEs' market relations. The trust level within the SMEs, particularly in the case of family businesses, would generally be expected to be high, but such trust and the social capital borne by it is likely to be knowledge-constrained in view of the limited extent of market relations. Consequently, there would be little or no scope for creativity and innovation. This situation is reinforced when ethnic or family loyalty and geographic remoteness pre-empt the scope for competition. Indigenous knowledge would in such circumstances be sterile and incapable of creativity and innovation for lack of interaction with new ideas and knowledge from outside the geographic and ethnic/family boundaries. What we have in this scenario is regionally distributed independent SMEs with no cross-boundary transactions. The absence of cross-boundary transactions means there is no scope for knowledge exchange, cooperation and hence innovation. Indigenous knowledge would be advanced through external transactions with the knowledge sphere and the use of technological infrastructures embedded in institutional players like universities R&D centres, clusters of firms in related industries and business-service networks (Feldman, 1994).

This paper draws on the significance of networking and social capital development for cultivating the indigenous knowledge base of the Thai dessert industry with the aim to improving prospects for the technological capability development and long-term growth of firms in the industry.

5. Research methodology

In this study, a questionnaire survey of technology capability development, knowledge, and social capital was used to elicit data and information from 121 Thai dessert firms. This questionnaire was developed based on the review of the relevant literature and on the feedback from a pilot study. It was sent out to 726 randomly sampled firms, 16.67% of which responded. In addition, interviews were conducted with the owners and/or managers of 22 firms as a supplement of questionnaire survey.

The questions in a social capital section were associated with the extent of social capital at the disposal of firms, including networking with other organisations, trust, frequency of contact, strength of ties, knowledge and knowledge and information sharing, transactions cost, norms, and network activities. These questions were based on the presumption that social capital facilitates interactive learning, knowledge sharing across the network, thus stimulating innovation at the firm level. Most of questions were adapted from previous studies on social capital and industrial development such as Sahakijpicharn (2007) and UNIDO (2006).

The second section intended to elicit data that would enable measurement of the technological capability development and innovation performances of the sample firms. Variables used in this part were adapted from the OSLO manual (OECD, 2005a), and Link and Bozeman (1991). For small indigenous firms, some innovation outputs such as patent and academic publications were omitted. This part also measured sales growth and employment growth as indicators for firm growth. The study also used rating scales (5-Likert scale) for attitude measurement to quantify abstract issues like social capital and degree of technological capability development. Firms were asked to provide information during the period between 2006 and 2008 about degree of technological capability development in three aspects, namely – research and development, process, and investment improvement.

The results of the questionnaire survey were analysed using statistical methods with the SPSS (Statistical Package for the Social Sciences) programme. Multiple regression analysis is used to determine the empirical relationships between indicators of technological capability development (TCD) and elements of social capital shown in Table 1 (Pallant, 2007).

6. Results and discussion

Stepwise multiple regression analysis was employed to investigate which elements of social capital were salient to TCD at industrial and firm category levels.

Table 1 Elements of social capital and variable names

Measurement items	Variable name	Measurement items	Variable name
Trust (T)		**Embeddedness (NE)**	
Trust in same industry	TSI	Amount of contact time	Cont
Trust in supply chain	TSP	Strength of ties	STie
Trust in knowledge and supporting agencies	TKI	Honest and truthful approach of relationships	HonT
Trust in relatives and friends	TRF	Norms and reciprocity	Norm
Trust in family	TFA	Knowledge and information sharing	InfoS
Generalised trust	TG	Network development	Netw
		Reduced transaction cost, repeat transaction	Trans

Values of less than 10 for variance inflationary factor (VIF) and more than 0.1 for tolerance levels are used (see Table 2) to ensure that there is no significant multicollinearity problem in the multiple regression analysis involving these variables at industry-wide level. Technological capability development (TCD) is observed to have low to moderate relationships with explanatory variables except in the case of three variables, namely 'trust in the same industry' (TSI), 'trust supply chain' (TSP), and 'amount of contact time' (Cont). Correlations among these explanatory variables and TCD at firm category are found to be less than 0.9, and importantly VIF and tolerances also confirmed no multicollinearity problem with these explanatory variables. Based on this, multiple regression was used to test the data for industry and firm category levels as shown in Table 2.

The regression models in Table 2 indicate elements of social capital having significant positive impact on technological capability development (TCD) for data aggregated at industry-wide level, with model estimates significant at 1% level. Considering standardised coefficients, the strongest predictors of the model can be ranked as follows: 'knowledge and information sharing' (InfoS) (std. β= 0.213); 'network development' (Netw) (std.β = 0.206); 'honest and truthful approach to relationships' (HonT) (std.β = 0.169); and 'trust in knowledge and supporting agencies' (TKI) (std. β = .168, $p < 0.1$). These predictors had positive effects and could explain 33.9% (Adj R^2) of the variance of TCD model.

The results pointed out that knowledge is the most important element that enables firms to enhance their innovation and technological capability. A higher index of social capital results in a better knowledge transfer and exchange between firms; and also between firms and organisations in the knowledge sphere.

Table 2 Regression analysis models of technological capability development and social capital elements at industrial and firm category levels

	Constant β_0	**TSP** β_1	**TKI** β_2	**HonT** β_3	**InfoS** β_4	**Netw** β_5	R^2	Adj R^2	**Model Sig.**
Coef.	1.027***		0.182*	0.176**	0.203*	0.168*	0.361	0.339	0.000***
Std. Coef.			(0.168)	(0.169)	(0.213)	(0.206)			
S.E.	0.354		1.00	0.088	0.106	0.093			
T-value	2.901		1.826	2.005	1.915	1.801			
Sig.	0.004		0.070	0.047	0.058	0.074			
Tolerance			0.652	0.778	0.445	0.422			
VIF			1.533	1.285	2.250	2.371			

Note: Significant at *p < 0.1 level , **p < 0.05 level , *** p < 0.01
N = 121, F-value = 16.42, DF = 120
Standardised coefficient is in ( ) for comparison between variables

The regression analyses and the survey results have provided sufficient evidences that enable us to conclude that, at industry-wide level, the degree of technological capability development increases when firms increase: 1) their trust in knowledge and support agencies; 2) honest and truthful approach to relationships; 3) knowledge and information sharing; and 4) enthusiasm for network development. These factors are the most important for creating effective networks in the Thai dessert industry. This is consistent with many other studies. For example, an increase in knowledge and information sharing between external sources and firms, and within network members results in an increase of interactive learning, knowledge accumulation (Wu & Choi, 2004). Enthusiasm for network creation speeds up network expansion, offering opportunities to meet new sources of knowledge, support systems and business development. The regression model suggested that an increase in trust in knowledge and supporting agencies would result in an increase of TCD. While Jeffrey and Kentaro (2000) found that honest and truthful approach to relationships and the extent of trust promote close relationships, facilitate effective information and knowledge exchange and collaboration by increasing social norms, fulfilling members' expectation, and curtailing the scope for free riding. A high degree of networking is useful for TCD when knowledge and information are exchanged among members along a socially constructed knowledge network.

This result supports the hypothesis that policies promoting social capital would increase the scope for indigenous knowledge to blend with codified knowledge creating new knowledge that can potentially evolve into disruptive technologies that would ultimately establish Thai dessert as global niche players. One of successful case in Thailand is a greenhouse solar drying technology developed by a faculty member of a local university in liaison with local communities engaged in dry banana production. The solar dryer has low cost of operation; meets a production standard; and is fit for purpose as it enhances the quality of the finished product, and its marketability. The technology used in this greenhouse solar dryer is not complex, being adapted from the traditional drying method used by firms and research-based variant designs developed in university labs to suit local knowledge and resource circumstances (Pattanaponsukum et al., 2007; Yuwawutto et al., 2010). Since it was introduced to local banana drying firms almost ten years ago, the greenhouse solar dryer has been recognised by many firms and has even displaced high cost dryer technologies such as hot air oven and infrared that use electric power for operation. Even though this greenhouse solar dryer is already known to be more effective and efficient than established technologies, it still has to be improved for better performance. This, however, requires cooperation and joint research between local firms and research institutes and universities.

Conclusion

The results of this study pointed out that knowledge exchange is an important element that enables firms to enhance their innovation and technological capabilities. In addition, a higher index of social capital results in a better knowledge transfer and exchange between firms; and also between firms and organisations in the knowledge sphere. The study provides an empirical and conceptual basis of the significance of traditional industry, like the Thai dessert industry, as a carrier of indigenous knowledge that can potentially be developed to establish global niche market for Thai dessert. The emerging technology would be suitable for local use. The study also underpins the importance of public intermediary organisations as policy instrument for promoting technology development and building networks that would integrate the SME sector as key players into the production sphere, and so enable it to actively interact with the knowledge and policy spheres of the political economy. Such a scheme as propounded in the Triple Helix literature is important particularly in the context of developing countries where the incidence of 'social capital deficit' is preponderant.

References

Agrawal, A. (1995). Dismantling the divide between indigenous and scientific knowledge. *Development and change, 26*(3), 413-439.

Arnold, E., Bell, M., Bessant, J., et al. (2000). *Enhancing Policy and Institutional Support for Industrial Technology Development in Thailand - The Overall Policy Framework and The Development of the Industrial Innovation System* (Vol. 1). Washington: World Bank; Science and Technology Policy Research (SPRU); Centrim - University of Brighton; Technopolis.

Bourdieu, P. (1986). The forms of capital. In J. Richardson (Ed.), *Handbook of Theory and Research for the Sociology of Education* (pp. 241-258). New York, Greenwood.

Bower, J. L., & Christensen, C. M. (1995). Disruptive Technologies: Catching the Wave. *Harvard Business Review, 73*(1), 43-53.

Chaminade, C., & Vang, J. (2006). *Upgrading in Asian clusters: Rethinking the importance of interactive-learning.* Paper presented at the Globalis: Innovation Systems for Competitiveness and Shared Prosperity in Developing Countries,4-7 October 2006, Kerala, India.

Christensen, C. M. (1997). *The innovator's dilemma: When New Technologies Cause Great Firms to Fail*. Cambridge, MA: Harvard Business School Press.

Coleman, J. S. (1988). Social Capital in the Creation of Human Capital. *The American Journal of Sociology, 94*(Supplement), s95-s120.

Cooke, P. (1996). The New Wave of Regional Innovation Networks: Analysis, characteristics and strategy *Small Business Economics, 8*, 159-171.

Cooke, P., Clifton, N., & Oleaga, M. (2005). Social Capital, Firm Embeddedness and Regional Development. *Regional Studies, 39*(8), 1065-1077.

Cooke, P., & Wills, D. (1999). Small Firm, Social Capital and the Enhancement of Business Performance Through Innovation Programmes. *Small Business Economics, 13*(3), 219-234.

Dietz, J. S. (2000). Building a social capital medel of research and development: the case of the experimental program to stimulate research competitive. *Science and Public policy, 27*(2), 137-145.

Ellen, R., & Harris, H. (2000). Introduction. In R. Ellen, P. Parkes & A. Bicker (Eds.), *Indigenous environmental knowledge and its transformations: critical anthropological perspectives*. Amsterdam: Overseas Publishers Association.

Feldman, M. P. (1994). *Technologcial infrastructure*. Dordrecht: Kluwer.

Flavier, J. M., de Jesus, A., & Navarro, C. (1995). The regional program for the promotion of indigenous knowledge in Asia. In D. M. Warren, L. J. Slikkerveer & D. Brokensha (Eds.), *The cultural dimension of development: Indigenous knowledge systems* (pp. 479-487). London: Intermediate Technology Publications.

Fountain, J. E. (1997). Social Capital: A Key Enabler of Innovation in Science and Technology. In L. M. Branscomb & J. Keller (Eds.), *Investing in Innovation: Toward A Concensus Strategy for Federal Technology Policy*. Cambridge: The MIT Press.

Fukuyama, F. (2000). *Social capital and civil society* Washington, D.C.: IMF Institute.

Gadgil, M., Berkes, F., & Folke, C. (1993). Indigenous knowledge for biodiversity conservation. *Ambio, 22*(2/3), 151-156.

Grenier, L. (1998). *Working with indigenous knowledge: a guide for reserachers*. ON, Canada: International Development Research Centre (IDRC).

Grootaert, C. (1998). *SOCIAL CAPITAL: THE MISSING LINK?* : The World Bank.

Intarakumnerd, P., Chairatana, P., & Tangchitpiboon, T. (2002). National innovation system in less successful developing countries: the case of Thailand. *Research Policy, 31*(8), 1445-1457.

Jeffrey, H. D., & Kentaro, N. (2000). Creating and managing a high-performance knowledge-sharing network: the Toyota case. *Strategic Management Journal, 21*(3), 345-367.

Lewis, W. A. (1954). Economic Development with Unlimited Supplies of Labour. *Manchester School of Economic and Social Studies, May 1954*(22), 139-191.

Link, A. N., & Bozeman, B. (1991). Innovative behavior in small-sized firms. *Small Business Economics, 3*(3), 179-184.

Littrell, M. A., & Dickson, M. A. (1999). *Social responsibility in the global market: fair trade of cultural products*. London: Sage publication.

Maskell, P. (2001). *Growth and the territorial configuration of economic activity.* Paper presented at the the DRUID Summer Conference, ,12-15 June 2001, Copenhagen.

Mauro, F., & Hardison, P. D. (1999). Traditional knowledge of indigenous and local communities: international debate and policy initiatives. *Ecological Applications, 10*(5), 1263-1269.

Morgan, K. (1997). The learning region: institutions, innovation and regional renewal. *Regional Studies, 31*(5), 491-503.

Mwantimwa, K. (2008). *The relationship of indigenous knowledge and technological innovation to poverty alleviation in Tanzania.* Paper presented at the the IV Globelics Conference,22-24 September 2008, Mexico City.

Nonaka, I., Konno, N., & Toyama, R. (2001). Emergence of "Ba": A conceptual framework for the continuous and self-transcending process of knowledge creation. In I. Nonaka & T. Nishiguchi (Eds.), *Knowledge emergence: social, technical, and evolutionary dimensions of knowledge creation* (pp. 13-52). Oxford: Oxford university press.

Nwokeabia, H. (2003). The Economics of African Indigenous Knowledge. *IK Notes, 53 (February 2003),* World Bank.

OECD. (2002). *OECD Small and Medium Enterprise Outlook*. Paris: OECD.

OECD. (2005a). *Oslo Manual: Guidelines for collecting and tnterpreting innovation data*. Paris: OECD.

OECD. (2005b). *SME and Entrepreneurship Outlook*. Paris: OECD.

Pallant, J. (2007). *SPSS Survival Manual: A step by step guide to data analysis using SPSS for Windows*. New York: McGraw-Hill.

Pattanaponsukum, J., Phromsombat, S., Khuwijitjaru, P., et al. (2007). *Intermittent drying process of dried banana.* Paper presented at the The 9th Agro-Industrial Conference,14-15 June, Bangkok, Thailand.

Porter, M. E. (1990). *The Competitive Advantage of Nations*. New York: Free Press.

Putnam, R. D. (1993). The Prosperous Community: Social Capital and Public Life. *The American Prospect, 4*(13), March 21, 1993.

Sahakijpicharn, K. (2007). *Guanxi network and business performance of Sino-Thai SMEs.* University of Wollongong, Wollongong.

Siisiäinen, M. (2000). *Two Concepts of Social Capital: Bourdieu vs. Putnam.* Paper presented at the ISTR Fourth International Conference "The Third Sector: For What and for Whom?",July 5-8, 2000, Trinity College, Dublin, Ireland.

UNESCO. (1999). Best practices on indigenous knowledge (Publication. Retrieved 17/01/2010, from UNESCO: http://www.unesco.org/most/bpikpub.htm

UNIDO. (2006). *Social capital for industrial development: operationalizing the concept*. Vienna: UNIDO.

Westlund, H. (2005). *Social capital of a knowledge-intense industry: A comparison of the biotech industry in Sweden, California and Japan*. Stockholm: ITPS, Swedish Institute for Growth Policy Studies.
Woolcock, M. (1998). Social Capital and Economic Development: Toward a Theoretical Synthesis and Policy Framework. *Theory and Society, 27*(2), 151-208.
World Bank. (1998). *Indigenous knowledge for development framework for action*: Knowledge Learning Center Africa Region.
World Bank. (2004). *Indigenous Knowledge: Local Pathways to Global Development*. African region: World Bank.
Wu, W.-P., & Choi, W. L. (2004). Transaction Cost, Social Capital and Firms' Synergy Creation in Chinese Business Networks: An Integrative Approach. *Asia Pacific Journal of Management, 21*(3), 325-343.
Yuwawutto, S., et al. (2010). A Triple Helix strategy for promoting SME development: the case of a dried banana community enterprise in Thailand. *Industry & Higher Education, 24*(3), 177-187.