Upgrading in Asian Clusters: Rethinking the Importance of Interactive Learning

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This article is concerned with unpacking the role of the cluster supporting the SMEs' move from competing on low costs to innovating in the global value chain. By comparing four clusters in different industries in Asia, we highlight significant differences in the learning paths of the clustered SMEs. The aricle contributes to current discussion on upgrading in clusters in developing countries by: (a) *providing an explanation on how localised interactive learning and thus clustering relates to upgrading;* (b) *discussing the conditions under which upgrading requires interactive learning; and* (c) *identifying the linkages between particular types of interactive learning and different upgrading strategies.*

Introduction

RECENTLY DEVELOPMENT STUDIES have witnessed a surge of interest in clustering of industrial activities as means for supporting, upgrading and, thus, generating economic growth in developing countries (Bell and Albu 1999; Caniels and Romijn 2003; Cassiolato et al. 2003; Giuliani et al. 2005a; Humphrey and Schmitz 2002; Schmitz 1999, 2004). In contrast to the traditional view of clusters as self-contained systems and the almost

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exclusive focus on local interactive learning, this new strand of literature links local cluster theories with global value chain theories (Loebis and Schmitz 2005). In other words, it links the local sources of knowledge with external sources of knowledge—especially TNCs—to explain upgrading and the access to global markets of certain clusters in developing countries (Archibugi and Pietrobelli 2003; Giuliani and Bell 2005, Giuliani et al. 2005a, 2005b; Humphrey and Schmitz 2002; Pietrobelli and Rabellotti 2004, 2006). In this context, upgrading is defined as the capacity of a firm to innovate and increase the value added of its products and processes (Humphrey and Schmitz 2002). Clusters are considered to support SMEs upgrading in global value chains to the extent that they facilitate interactive learning both with local and external sources of knowledge (Beccatini 1990; Marshall 1930; Piore and Sabel 1984; Schmitz 1999; Storper 1997). Furthermore, as industries differ in their knowledge bases and learning mechanisms (Malerba and Orsenigo 1993), the relationship between different forms of interaction and upgrading and innovation varies across industries (Giuliani et al. 2005a; Pietrobelli and Rabellotti 2006).

However, as Malmberg and Power (2005) find in a review of 100 cluster studies (including several studies of clusters in the developing world), most studies tend to *assume* the importance of interactive learning in clusters instead of actually *demonstrating* it. Hence, they argue that the theory needs to be reappraised and rewritten in light of available evidence.

This article attempts to contribute to living up to this ideal by systematically analysing *what* the elements underpinning interactive learning in the cluster are, and which particular *type* of interactive learning is especially relevant for upgrading and innovation in specific clusters and industries.

This article aims at addressing these questions by combining the most recent insights from the development cluster literature (Chaminade and Vang 2006; Vang and Asheim 2006), with a critical rethinking of the importance of interactive learning (Malmberg and Maskell 2006) in a comparative fashion based on a reinterpretation of existing cases (Mjøset 2005). This is done by opening the black box of localised interactive learning and decomposing it into two basic components: human capital and social capital and subsequently present the role of human capital, social capital and, thus interactive learning plays in four clusters in Asia.

The cases are presented only to illustrate the variety of learning paths and its relationship with upgrading and innovation.

The reminder of the article is structured as follows. In the next section we introduce the theoretical framework; taking into account the localised nature of SMEs' economic activity in general, and specifically the supposed importance of localised interactive learning. Our level of analysis is the cluster. We provide a general introduction to the concept of clusters and discuss the role of clusters as facilitators of interactive learning, emphasising the importance of human capital and social capital in that learning process in the dominant literature. Then we turn to the illustrative cases where special attention is paid to the importance of localised interactive learning in the Jepara furniture cluster, the Taiwanese flower cluster, the automotive clusters in Thailand, and the Bangalore software cluster. Finally, we turn to drawing general conclusions on innovation policies to support learning, and, thus, upgrading and innovation in different clusters of SMEs in developing countries based on these insights.

Clusters and Development

On the Concept of Cluster and its Use in Developing Countries

This section introduces the concept of cluster and the particularities of developing countries. The concept of cluster has been used with different connotations in the literature (Martin and Sunley 2003) to refer to both industrial agglomerations and industrial systems (OECD 1999, 2001; Porter 1998), and to regionally bounded economic activity or regional system (Asheim and Gertler 2004, 2005; Maskell 2001; Maskell and Malmberg 1999).[1] In this article we define cluster as geographical concentration of companies in similar or related economic activities and their supporting knowledge organisations (Porter 1998).

The relevance of clustering to enhance upgrading of SMEs has received increasing attention over recent years among academics, consultants and policy makers. The success in the 1990s of the so-called third Italy (Beccatini 1990; Piore and Sabel 1984), Baden Württemberg (Staber 1996), Silicon Valley (Cohen and Fields 1999; Saxenian 1994) and Hollywood (Scott 2005) turned their attention towards conceptualising clusters as engines for stimulating upgrading among clustered SMEs (UNIDO and UUND Program 2004).[2]

The success of clusters in the developed world diffused rapidly to developing countries (Bair and Gereffi 2001; Bell and Albu 1999) while international organisations such as the United Nations (UNIDO), the InterAmerican Development Bank and the OECD adopted the cluster approach for analytical and intervention purposes (OECD 1999, 2001; UNIDO 1997; UNIDO and UUND Program 2004).

Generally speaking, clusters in developing countries are considered to differ from those of the developed world—and certainly from the most well-functioning clusters in the developed countries—at least in the following aspects: their dynamics (exogenous versus endogenous interactive learning), their organisational set-up (often based on a strong presence of TNCs), their geographical distribution (often satellite clusters; peripheral to the core where most of the interactive learning takes place), and their position in the global value chain (low end activities), which reduces the incentives for TNCs to engage in interactive learning with SMEs.[3] This literature does not imply that cluster or Marshallian industrial districts today do not increasingly rely on TNC and that this shapes their development trajectories (Rabellotti 2003), but that the TNCs are 'inserted' later in the development trajectories where endogenous interactive learning mechanisms are established (Asheim et al. 2007).

In the developing world, the upgrading and learning dynamics of the clusters that are currently displaying positive upgrading performance measures are strongly shaped by the presence of transnational corporations (TNCs), including international buyers who influence the scope of interactive learning (Schmitz 2006; Vang and Asheim 2006).

Attending to the geographical distribution, most clusters in developing countries can be conceptualised as so-called 'satellite' clusters, that is, clusters of SMEs agglomerating in subnational areas with firms involved in similar and related industrial activities and dominated by TNCs (Markusen 1996). Often they are simply agglomerations of firms within the same industry without localised interactive learning (UNIDO 2001), or 'casual' agglomerations with occasional horizontal linkages, limited cooperation and weak local institutions (Guerrieri and Pietrobelli 2006), which in turn is taken to imply weak localised interactive learning.

Finally, clusters in developing countries usually serve the low end of the global value chain, that is, they are specialised in activities at the bottom of the value chain responding to their low competence leve. Hence,

the possibilities to benefit from interactive learning with the final customers or the TNCs are often limited.

Clusters and Upgrading

The focus of this article is on how clusters can facilitate interactive learning and thus the move from being a dependent subcontractor competing on low costs towards becoming an innovator in the global value chain competing on the basis of the provision of knowledge. In other words, we are concerned with the move from the 'low road' of competitiveness typical of small firms in developing countries (Kaplinsky 2000; Kaplinsky et al. 2002), to the 'high road', that is, with upgrading (Giuliani et al. 2005b; Humphrey and Schmitz 2000; Kaplinsky and Readman 2001; Pietrobelli and Rabellotti 2004). Upgrading is defined as the ability of the firm to make better products, make them more efficiently, or move to more skilled activities in the value chain (Pietrobelli and Rabellotti 2006). In this sense, upgrading is linked to the innovative capacity of the firm. Humphrey and Schmitz (2000) distinguish between four types of upgrading:

1. Process upgrading: Introducing changes in the organisation of production, that is, producing the same goods or services but more efficiently.
2. Product upgrading: Introducing changes in the end product. Product upgrading can be of radical or incremental nature. It can also be new to the firm, the market or the world.Functional upgrading: Acquiring new or superior functions in the value chain. That is, moving up to activities of higher added value.
3. Intersectoral upgrading: Diversifying to a different sector based on competences acquiring in a specific activity.

As any innovative process, upgrading requires the acquisition of new competences and resources, or the recombination of existing ones in new ways. It is considered the result of an interactive process when firms upgrade as a result of the continuous interaction with other organisations in the system of innovation (Archibugi and Lundvall 2001; Edquist 1997; Loasby 2001, 2002; Lundvall et al. 1992; von Hippel 1988). Interactive learning is typically defined in this article as acquiring knowledge and

competences through collaboration with other organisations. Interactive learning is considered especially relevant for SMEs and developing countries, where the amount of resources available is very limited and they are required to engage in interactive learning with all available sources of knowledge if they wish to upgrade and access international markets.

Clusters as Facilitators of Interactive Learning in Developing Countries

Clusters might facilitate interactive learning and the acquisition of competences required for upgrading. Proximity might ease the interaction with other firms and organisations, and enhance interactive learning, and this is particularly relevant for SMEs (Chaminade and Vang 2006). SMEs are more dependent on tacit knowledge and less capable of searching for and using codified knowledge than TNCs—and large firms in general—which forces them to rely more on personal and localised ways of transferring (tacit) knowledge and on learning by doing and interacting (Kaufmann and Tödtling 2002).

While several elements influence interactive learning, two seem to be underpinning the capacity of firms to engage in interactive learning with local and external sources of knowledge: human capital and social capital. The extent to which SMEs can learn through the interaction with their environment is is a function of their competences, their abilities to interact, their motivation, and the opportunities to interact.

Human capital is central in innovation studies and refers to the 'skills, education, health, and training of individuals' (Becker 1998: 1). It has long been argued that one of the most important constraints preventing firms in clusters in developing countries from upgrading and innovating is the poor supply of qualified general and subsequently industry-specific human capital,[4] The lack of human capital translates into poor general management (Kaplinsky 2005), particularly low concern with knowledge management and innovation.

Human capital is crucial for building the absorptive capacity of the firm (Cohen and Levinthal 1990; Giuliani and Bell 2005), being the ability to utilise available information and knowledge that comes from interaction with other organisations, such as other firms, users or knowledge providers (that is, research institutions). Absorptive capacity allows SMEs to take advantage of knowledge and information through collaboration, to process it and to commercialise it. Firms thus need to have the necessary

human capital to identify, acquire and transform the knowledge required for innovation and to engage in interactive learning

SMEs in developing countries usually have limited management skills, thus only limited absorptive capacity. This in turn might significantly reduce their chances to engage in interactive learning and also because there are limited incentives only for other firms to engage in collaboration with these SMEs (Giuliani and Bell 2005). Phrased differently, the lack of human capital may exclude SMEs from participating in interactive learning with other firms. This suggests that general human capital building and training targeting particular industry needs (not yet developed in this particular cluster) is needed to support interactive learning. In a systemic perspective this, however, is only a needed but not sufficient condition for interactive learning.[5]

In contrast to standard economists who tend to equate human capital formation with the fast dissemination of knowledge, the cluster literature emphasises the institutional embedding of human capital. In this context, much attention is paid to the role of **social capital**, which is defined as the glue that underpins interactive learning. 'Social capital refers to the institutions, relationships, and norms that shape the quality and quantity of a society's social interactions.... Social capital is not just the sum of the institutions which underpin a society—it is the glue that holds them together' (World Bank 2002).[6] While the literature is often not fully clear on what is meant by social capital (generalised versus group-specific, for example), it is suggested that unless there is a high degree of generalised social capital cooperation, communication, and thus interactive learning, is limited (Andersson et al. 2004; Lundvall 2005; Nooteboom 2000). The absence of social capital, therefore reduces the local firms' prospects of getting access to important knowledge, knowledge sharing and interactive learning, and hence from successfully entering upgrading strategies. As social capital is often highly localised (Putman 1993), so is interactive learning. Thus, social capital is assumed to be important to explain interactive learning in clusters of SMEs. But social capital without the sufficient level or diversity of human capital makes investment in social capital irrelevant (that is, firms would have the opportunity to share, but nothing relevant to share at all). In other words social capital is considered a necessary condition for interactive learning, but not a sufficient one.

In sum, based on insights from the literature, we might expect that human capital without social capital, as well as social capital without human capital, significantly reduces the possibilities for interactive learning, and consequently for upgrading and generating innovation. Hence, the development of complementary human and social capital are important dimensions for fostering interactive learning and upgrading. When clusters have highly developed human and social capital, they facilitate interactive learning and hence upgrading. This has lead to policy recommendations emphasising human and social capital with the aim of fostering interactive learning across industries despite paying some lip service to industry specificities. The extent to which these hypotheses and policy prescriptions are true will be discussed with the help of illustrative cases.

Clusters, Interactive Learning and Industrial Differences

Although we expect human capital and social capital to be important for interactive learning and upgrading in all industries, we expect the morphology of the interactive learning to differ by industry and institutional setting. As several authors have documented the strategies and types of knowledge generation and the knowledge bases are contingent to the industry (Asheim et al. 2003; Asheim and Gertler 2004; Breschi et al. 2000; Laursen and Salter 2004; Malerba and Orsenigo 1993; Pavitt 1984, Tunzelmann and Acha 2004). We may expect to find industry-specific differences in the importance of interactive learning for upgrading as well as in the dominant form of interactive learning from the interaction between the SMEs and the TNC, between SMEs, between SMEs and knowledge providers, or between the SMEs and the final customer.

To generate adequate policy lessons that systematically take into account the importance of specificities and contingencies of clustered SMEs in developing countries, there is a need to analyse the conditions under which particular types of interactive learning constitute an important dimension of upgrading strategies and the measures that are needed to enhance specific interactive learning in an industrial cluster.

Interactive Learning and Upgrading in a Selection of Clusters in Asia

Following Giuliani et al. (2005a), we propose four categories of clustered SMEs representing the majority of industries in developing countries:

traditional manufacturing, resource-based industries, complex product systems and specialised suppliers. Previous studies (Chaminade and Vang 2006; Giuliani et al. 2005a; Pietrobelli and Rabellotti 2006) have documented that this typology is useful for systematically identifying different patterns of innovative behavior in clustered SMEs.[7]

In this article we will analyse the Jepara furniture cluster as an example of a traditional industry in Asia. The flower industry in Taiwan will be used to illustrate the cluster dynamics and innovation strategies of a natural resource-based industry. The Thai automotive industry will be used to exemplify a complex product system (CoPS) cluster, while the Bangalore IT cluster will reveal the innovation patterns of a specialised supplier. A comparison of the four clusters is included in Table 1.

The cases are based on a combination of semi-structured interviews with local experts and secondary sources such as publications and reports. According to the purpose of this study, the criteria for selecting the case studies was the following: spatial concentration: all cases display some degree of geographical concentration/clustering of SMEs;

1. upgrading*:* the clusters have recently undergone an upgrading process or have the potential for upgrading; value chains: all clusters are inserted in global value chain; *availability of data*: all clusters were extensively documented, specially with regard to human capital and social capital, the two underpinning factors of interactive learning; andrepresentation: the clusters represent the four categories mostly dominant in developing countries.

The empirical analysis is influenced by certain limitations in the data sources, especially concerning the availability of updated data and our interpretation of the secondary sources. However, biases have been minimised by triangulating different independent data sources. The novelty of the article as compared to the existing literature is that is analyses the cases in a novel way, combining multiple sources of information. We focus on interactive learning (and on human capital and social capital as its basic components), and link it to the upgrading strategy of the local firms and their insertion in global markets. By doing so, we provide some insight to the question of *how* clustering affects upgrading through interactive learning, thus opening a promising line of research. This partly offsets the data limitation.

Table 1
Comparison of the Asian Cases

	Trditional Jepara cluster	*Resource-based Taiwan flower industry*	*CoPS automotive, Thailand*	*Specialised suppliers, software, Bangalore*
Main characteristics of the industry	Process upgrading mainly and small incremental product upgrading. Clustering facilitates organisational innovation. Most new techniques originate from machinery and chemical industries. Change comes from improvements and modifications in production methods and associated inputs, and on product design. Competition based on costs. Information flows through informal channels facilitated by the local cohesion within the cluster as well as a result of the rotation of workers among the firms in the cluster.	Importance of basic and applied research lead by public research institutes. Most upgrading is generated by suppliers (machinery, seeds, chemicals, etc.) or is the result of the cooperation with scientific institutions. Increasing importance of international sanitary and quality standards and of patents. In some cases, upgrading is the result of joint technology development and coordinated actions between firms, business associations, universities and other actors. In some others, TNCs provide the technology and knowledge required for the upgrading of the local SMEs.	Incremental process and product technologies upgrading Local SMEs are usually required to complie with international quality standards in order to participate in the network. Large assembler firms usually determine the possibilities for upgrading of the local network of subcontractors. Externalities derived from geographical concentration are scarce, as both the leader firm and the assembler operate globally. Most knowledge needed in the production process is codified.	Often small firms. Important user–producer interactions.SMEs in this category tend to concentrate geographically to gain access to the labour market and the consumers. Formal joint cooperation between SMEs is limited. Technological innovation is product upgrading although upgrading is also the result of non-technological innovation such as joint marketing initiatives or changes in the organisation. Mobility of human resources among the different firms is an important channel for knowledge diffusion across the cluster.

Specific cluster features	About 2,000 SMEs.Production goes to international markets.	Production dominated by small farms (1 ha per family).	Strongly dominated by TNC assemblers. Local SMEs are usually second and third tier	Cluster with strong presence of multinational firms, but dominated by SMEs.
Human capital	Craft industry. Knowledge acquisition is by learning by doing. There are a limited number of very qualified human resources that are shared by several SMEs and large firms. Managerial and marketing skills are needed. Firms that have upgraded have introduced organisational changes.	Knowledge is very fragmented in three groups. Producers only know about production techniques, but nothing about the market. Marketing of flowers is dominated by 'marketing''firms. Upgrading in the cluster is driven by advances in biotechnology, with researchers in labs relatively isolated from producers and markets.	Production is dominated by blue-collar workers. Competition is based on low costs, increasing quality and delivery times (just in time). Learning is limited as production is according to blueprints. Upgrading requires formal training in engineering and design.	Firms have easy access to qualified human resources. The region houses an important number of education and training institutions, therefore, technical skills are ensured. However, managerial and marketing skills could be strengthened.
Social capital & networks	Social capital is strong, based on kinship and family ties. Collective action is common, both to access machinery and to attain economies of scale.	Social capital is strong, based on Chinese values and collective action common. However, networks seem to be confined to one activity (production, research or commercialisation).	Social capital is weak. Some initiatives like the Toyota's sponsored Automobile Industry Club only reaches first tiers. Collaboration between the SMEs and collective action is almost inexistent, not even to achieve efficiency	Social capital is limited. Collective action exits, specially for marketing purposes and to a lesser extent to share technological knowledge or gain economies of scale. However, collective action has been hampered by fierce competition between the firms. Cooperation is successful when based on specialisation.

Traditional Manufacturing:The Jepara Furniture Cluster (Java, Indonesia)

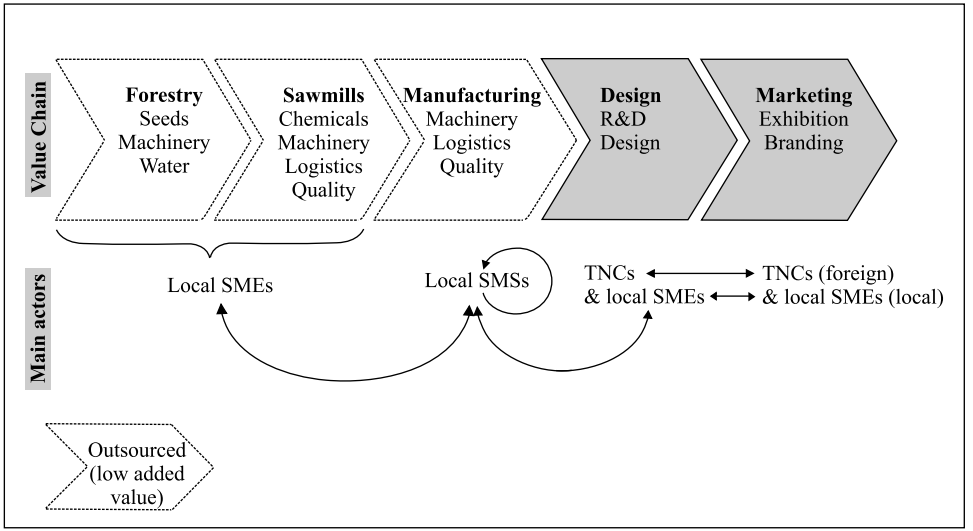
Indonesia has a very long tradition of clustering of SMEs around similar activities. Craft industries are usually geographically concentrated, emulating ancient guilds (Burger et al. 2001; Tambunan 2005;). This is also the case of the furniture cluster in Jepara. It is a large, growing cluster. Between 1997 and 2002 the number of firms in the clusters and the number of employees have doubled. In 2002 the cluster comprised approximately 3,700 firms, mostly SMEs employing over 58,000 permanent workers (Loebis and Schmitz 2005). About 70 per cent of the cluster production is exported, while the rest is sold on the domestic market. Domestic firms account for 75 per cent of the exports, while foreign firms are only responsible for 25 per cent (Berry et al. 2002).

Since the mid-1980s the cluster has been dominated by large international buyers (IKEA, for example) who 'translate' the demands of the final international customer to the local producers (Kaplinsky and Memedovic 2003) and dominate the higher-value activities (Kaplinsky and Readman 2002; Posthuma 2003). Indigenous SMEs have followed two types of upgrading strategies to access the global market (Loebis and Schmitz 2005): (*a*) reduce costs (low salaries, illegal raw materials, avoid taxes), that is, the 'low road' to competitiveness; or (*b*) compete by introducing incremental innovations in processes and products, that is, the 'high road' to competitiveness (see Figure 1). We will focus in this last form of upgrading.

Upgrading and Interactive Learning

Only a small proportion of the firms located in this cluster have opted for the second upgrading strategy, that is, product and process upgrading (Loebis and Schmitz 2005). The role of the international buyer is crucial to under-standing this type of strategy (Posthuma 2003). Two modes of interactive learning seem to be crucial to explain upgrading in some firms in the cluster: the first one is the learning taking place between the international buyer and the principal subcontractor in the cluster (usually a medium-sized local firm). The international buyer provides the local subcontractors with innovative designs and large orders. It also encourages the local firm to introduce quality standards in products as well as

FIGURE 1
Furniture Value Chain and Main Actors in Jepara, Indonesia



process, for example, by demanding that the raw materials used for the products are certified (Loebis and Schmitz 2005).

On the other hand, the principal subcontractor in the cluster usually is linked to a network of suppliers (of final products or raw material) that also have to comply with the quality standards of the international buyer. Loebis and Schmitz (ibid.) documented that these intermediate firms engage also in interactive learning with this suppliers, improving their quality and timely delivery.

The Role of Human Capital and Social Capital Supporting Interactive Learning and Upgrading

Firms that have opted to compete by introducing incremental innovations in products and processes have also introduced new managerial and organisational changes, including compliance with international quality and environmental standards (ibid.). But the majority of firms do not have the required human capital to engage in interactive learning. Only a small amount of firms in the cluster have the technical and organisational competence to engage in interactive learning and take the 'high road' to competitiveness. Competence building is basically through apprenticeship and learning by doing in general (Berry et al. 2002). Most SMEs are family based, and follow patriarchal traditions, the father of the family is usually the owner and manager. Typically, his qualifications are limited to technical knowledge about furniture crafting (domain knowledge); managerial and marketing skills are often lacking, which seriously limits the upgrading potential of the firm. There are a limited number of very skilled craftsmen who are employed by joint ventures of SMEs or larger foreign firms (Sandee 1998).

Firms that have opted to compete by introducing incremental innovations in products and processes have also introduced new managerial and organisational changes, including the compliance with international quality and environmental standards (Loebis and Schmitz 2005). These in turn have facilitated their access to privileged information and knowledge from the international buyer. That is, learning has taken place through interaction with the international buyer who has 'translated' the demands of the final customers in terms of quality and design to the local firms (Posthuma 2003), and encouraged the subcontractor to upgrade in processes and products to comply with the demands of the international market.

These subcontractors are also linked to a large network of local suppliers through very strong social capital. Often members of the same large family own different SMEs in the cluster. They participate in networks that share workers, equipment and market channels (Burger et al. 2001). Interactive learning between these horizontal networks of enterprises is usually limited due to the low competence levels of the firms involved in the network. But the link of the network with the large firm or trader that acts as a broker between the group of SMEs and the large international buyer might facilitate the acquisition of new knowledge that can be rapidly spread to other firms in the network.

Only firms that have highly developed human capital and organisational competences can adopt this upgrading strategy and get involved in interactive learning with the international buyer. Social capital, on the other hand, provides the platform to disseminate the knowledge acquired from the international buyer to other firms in the cluster.

Natural Resource-based Cluster: The Floral Industry in Taiwan

As a de jura province of China, and taking into account their limited territory, Taiwan can be considered to be a region in itself with complete de facto political autonomy from mainland China.[8] Taiwan floral industry has experienced a fast growth rate over the last decade due to a strong domestic market, and the cut flower exports, especially to Japan and the US, have also expanded (Tsai 2001).

The Taiwanese floral cluster is clearly dominated by SMEs. Growers are small in size (usually the average farm size per family is 1 hectare) due to the high cost of the land. Producer SMEs tend to cluster geographically to be able to access to machinery and greenhouse facilities shared by different producers (ibid.).

There are other main local actors in the cluster: the biotech labs, the marketing coops and the government. The distribution of flowers to the domestic and international markets is through cooperatives and cooperative marketing teams who also set the quality standards that the farmers should follow (Hsieh 2001). The marketing channel is dominated by four wholesale companies that use an auction system providing online real time information on the market. Government and biotech labs have only very recently emerged as relevant actors in the cluster.

Upgrading Strategy

In contrast to the Jepara furniture cluster, the upgrading strategy of this cluster is clearly driven by local actors and not by TNCs. The government has recently implemented a plan that aims at upgrading Taiwanese flower clusters by linking them to biotech facilities (ibid.; Rodrik 2004).[9] Until lately the Taiwanese producers relied only on 'natural' species, which could be produced on most Asian countries; hence, it was not a source of long-term competitiveness. Now they are experimenting with non-natural varieties that display particular aesthetic features and longer durability (for example, like the blue orchid) (Bradsher 2004). The adoption of this strategy is clearly government led. SMEs in the cluster could not finance research activities; nor did the Taiwanese producers initially considering investing in biotech as they did not realise the potential for upgrading this strategy.

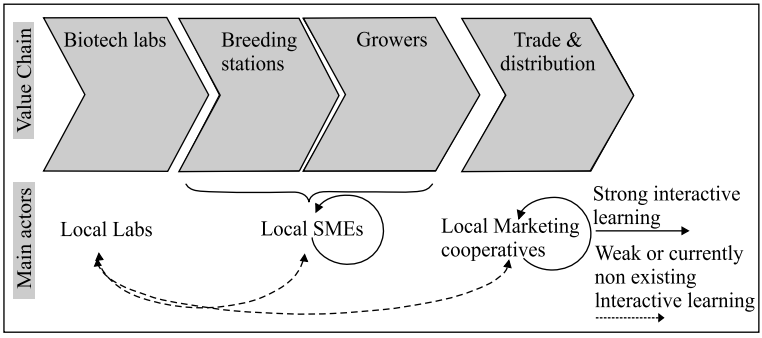
The government supports this upgrading strategy by heavily investing in building a very qualified workforce (in this particular case in biotech) and by providing the funding required for building the research infrastructure, such as the construction of greenhouse facilities explicitly targeting groups of SMEs. However, realising the full potential of this upgrading strategy is contingent to establishing the right links between the producers, the researchers and the final markets (through the marketing channels) as we will discuss next.

Although the required organisational set-up exists, the strategy seems to have some difficulties in implementation. One of the possible explanations is the lack of interactive learning and collaboration between the biotech labs, the growers and the marketing coops.[10]

Building Bocks of Interactive Learning: Human Capital and Social Capital in the Cluster

Interactive learning between biotech institutes and marketing cooperatives is needed to develop new species that can be commercialised successfully in the global market. Furthermore, biotech institutes need to engage in interactive learning with the producers to ensure that the new flowers can be nursed by the farmers. However, currently collective action is frequent but limited to one activity of the value chain (as Figure 2 shows) and hence appears fragmented.

FIGURE 1
Flower Value Chain and Main Actors in Taiwan (China)



General competence is crucial for the upgrading process, which places high demands for general skills on the growers and the knowledge providers (biotech) as the innovation strategy chosen in the cluster requires a great deal of absorptive capacity by the indigenous SMEs. In this sense, Taiwan has a privileged situation as, for example, 88.5 per cent of the population has had higher education. But social capital is weak and thus interactive learning limited.

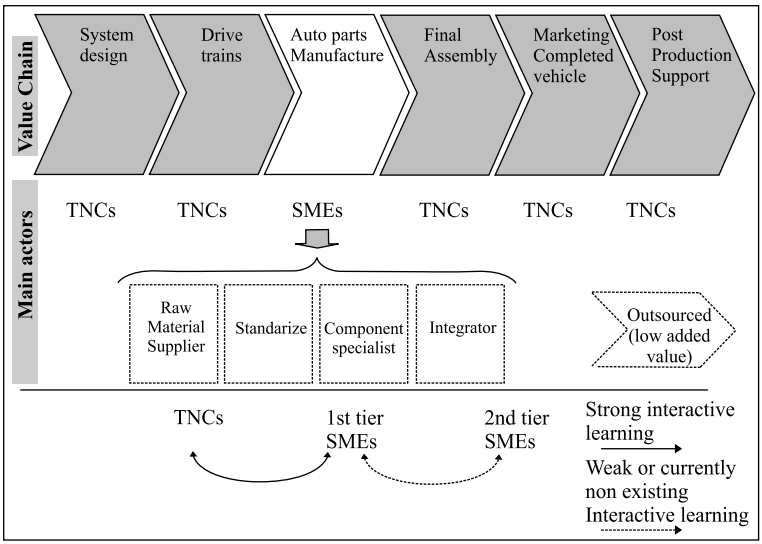
In the cluster there is a clear division of labour between three groups of actors: the researchers (biotech institutes), the growers (family-based farms) and the distributors (wholesale companies). Social capital and interaction *within* each of the groups is high. Small businesses form tight networks encompassing personal and business relationships. These networks, *guanxi*, are based on traditional Chinese social values where human relationships are closely linked to families, relatives, friends, classmates and previous colleagues (Liu 1998), but partly segmented along 'ethnic lines (for example, Hakka, Mainlander and Taiwanese). However, the interactions *between* the three groups of actors (producers, distributors or researchers) appear to be weak,[11] which seriously questions the potential success of the upgrading strategy adopted.

Complex Product Systems (CoPS):Thailand's Automobile Clusters

The Thai automobile industry—occasionally referred to as the Detroit of Asia—is considered to be the most important hub for automotive

production in Asia (Lecler 2002; Takahashi and Techakanont 2002), and has until recently at least been considered a successful case.[12] Thai automotive clusters are TNCs-centred. Most of the major assemblers are present in Thailand.[13] Around 113,000 are employed in the industry, where SME accounts for approximately 50 per cent of the employees (Chiasakul 2004). The indigenous Thai firms are mainly SMEs that act as second- and third-tier subcontractors, mainly manufacturing auto parts. The first tier consists of more than 700 companies where 40 per cent of these are owned by TNCs. Second-tier suppliers are around 1,000 in number (ibid.). These automobile clusters are important to the Thai economic and increasingly so. According to the latest WTO statistics, the automobile industry grew from 3.5 per cent of the value of the total economy in 2000 to 5.9 in 2004 (based on export measures). The export value has also grown over the same period. In 1990 the value of the export amounted to only US$ 108 million, while ten years later it had grown to US$ 2,401 million. Since then it has grown exponentially (from US$ 2,977milion in 2002 to US$ 5,713 million in 2004. Figure 3 plots the automobile value chain and the main actors in the cluster

Figure 3
Automotive Value Chain and Main Actors in the Thai Cluster



The role of SMEs in the clusters has been greatly affected by the national policy, which changed significantly after the WTO/GATT agreement. Until recently Thai SMEs played a significant role as first- or second-tier subcontractors for TNCs. Formal policies from the Thai central government stipulated that TNCs locating in Thailand had to guarantee a certain local content in the production. They were obliged to link up with local manufacturers. However, in the last few years Thai SMEs have either been reduced to third- or fourth-tier subcontractors, been bought up, or gone bankrupt.[14]

Upgrading and Interactive Learning

In this context, it is possible to distinguish between two types of SMEs and upgrading opportunities. Foreign and joint-venture firms (first-tier suppliers) seem to have preferential access to the required technology and resources through their parent companies, that is, interactive learning takes place between the assemblers and the first-tier suppliers, which happen to be, in the majority of the cases, subsidiaries or joint-venture firms. Only these SMEs receive advice about quality control, maintenance and design drawings (for example, to make dyes or tooling) and advice about project management from the assemblers (Techakanont and Terdudomtham 2004). For the vast majority of SMEs in the sector interactive learning is very limited (Techakanont 2003). Incremental innovation is only the result of in-house efforts and the improved experience of employees—learning buy doing (Techakanont and Terdudomtham 2004).

Role of Human Capital and Social Capital Supporting Interactive Learning and Upgrading

Thai firms did not use the advantage that they enjoyed during the 'local content requirement' period to develop their human capital or implement organisational forms supporting product or process upgrading. They simply produced parts according to already established production methods and blueprints, and often based on technology acquired from the TNC (Techakanont and Terdudomtham 2004). As a result, most Thai SMEs lack the human capital and organisational ability required to engage in upgrading.

Furthermore, the acquisition of these competences through the interaction with other firms in the cluster is also very limited. In the Thai automobile clusters interactive learning is limited to first-tier suppliers, whilst second- and third-tier suppliers do not connect to the network as they do not meet the quality standards (Sevilla and Soonthornthada 2000).[15] That is, collaboration based on social capital *between* Thai SMEs is not yet of much relevance as most simply do not have the competencies, knowledge and information that can create synergetic relationships.

In the current situation, Thai SMEs have to rely on knowledge acquired through interactive learning with the TNCs. This, however, is a challenging strategy, with few successes (Lall and Narula 2004; Narula and Marin 2005; Vang and Asheim 2006). The lack of human capital as well as the motivation to acquire the required technological (engineering) capabilities prevents Thai SMEs to engage in interactive learning both with TNCs and SMEs, seriously hampering their ability to upgrade.

Specialised Suppliers: Bangalore Software Cluster

Bangalore has become one of the most important software clusters outside the OECD world to the extent that it is known as 'India's Silicon Valley' (Parthasarathy 2004; Saxenian 2001). Bangalore is the centre for advanced science and military research—this was mainly for physical geographical reasons such as clean air, which was needed for military testing. For this reason, Bangalore houses several hi-tech clusters (defence, aeronautics and IT), and is considered to be the scientific and engineering centre of India in terms of research, training and manufacturing. The well-known Indian Institute of Science is based in Bangalore (Arora and Gambardella 2004, 2005). During the 1990s the easy access to qualified and relatively cheap technical human capital attracted a number of transnational corporations. Large firms such as IBM, Motorola, Hewlett-Packard, Siemens, 3M and Texas Instruments located in the area. Despite the weight of the TNC in the Bangalore IT sector, the large majority of firms are SMEs, but only 10 to 15 per cent of the revenues of the sector are from them.[16]

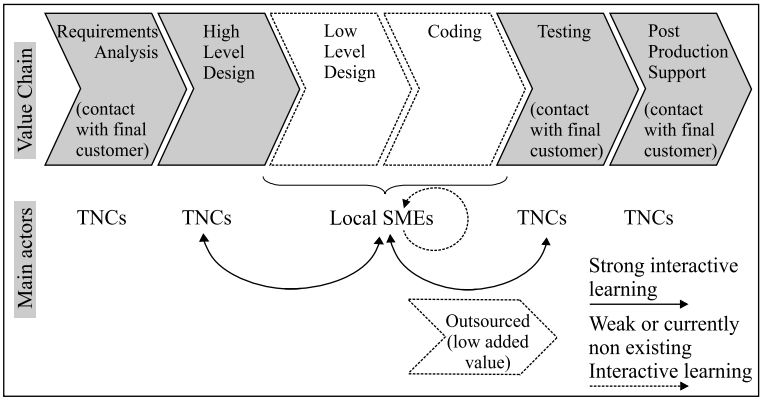
The development of this particular city-region is more shaped by the industrial development in the US than local interactive learning or other cluster effects (Vang and Asheim 2006) and regional government bodies' policies (Parthasarathy 2004; van Dijk 2003). Though it should be stressed

that Bangalore's growth until the late 1980s (when the software export boom began) relied on local (largely public sector) investments, it already had a dense organisational setting. The central government even located its public telephone company in Bangalore as well as other large hi-tech state enterprises.

Upgrading and Interactive Learning

The dynamics of the IT cluster in Bangalore are dominated by large TNCs located there. It is possible to find two types of SMEs: those tied to a TNC through a subcontracting agreement, and a limited number of independent SMEs. As subcontractors, SMEs are responsible for the low-added value activities of the value chain, as Figure 4 shows (Arora and Gambardella 2004). Frequently, SMEs undertake specific tasks for the large client firm who settles the parameters of the production and the final outcome, and tightly controls the performance of the SME. For these SMEs, which are the majority, upgrading is defined by the large firms (Nadvi 1995; Vang and Overby 2006).

FIGURE 4
Software Value Chain and Main Actors in Bangalore



Competence building in the indigenous SMEs has run parallel to their role as subcontractors of TNCs, mainly located in the US (Parthasarathy and Aoyama, forthcoming; Vang and Chaminade 2006). Several studies have documented that during the first phase US firms mainly outsourced

routine IT services to India (such as maintenance of existing code, or translating code from one programming language to another). However, this form of interactive learning was enough for some firms to acquire skills on project management, timely delivery and organisation of production according to US standards, which allowed them to start moving up the global value chain. There is emerging evidence on the move from low-cost providers to knowledge providers in certain segments of the software industry, notably embedded software (Parthasarathy and Aoyama, forthcoming). The analysis of this specific and advanced case points to the importance of engaging in interactive learning not only with TNCs, but also with other indigenous SMEs.

With the exception of these advanced firms, especially in the embedded software segment, learning through the interaction with other indigenous SMEs is quite limited. Interaction takes place fundamentally between the indigenous firms on the one hand and the TNC on the other. This interactive learning is possible, among other factors, because of the high qualification of the human resources available in the cluster.

Role of Human Capital and Social Capital Supporting Upgrading and Interactive Learning

Accessing qualified workers has not been considered as problem for the SMEs of this cluster hitherto and, in this sense, their capacity to absorb knowledge and technology generated outside the SME (absorptive capacity) is very high. There are several universities, business schools and technical schools located in the region that provide the cluster with the required supply of technically qualified labour.[17]

With the exception of embedded software, collaboration between SMEs based on social networks is limited in the IT cluster, but it exists. Interpersonal networks are based on common schooling and alumni links built around the many technical schools located in Bangalore as well as on previous working relationships (people that have previously been working together in the same firm). Consortia of SMEs have often been prone to failure due to the competitive tendencies among group members (D'Costa 2006). Evidence suggests that they have been more effective when member firms are complementing each other, and not competing. Joint action has often involved marketing of products and seldom the development of a product with the exception of the embedded software (Parthasarathy and Aoyama, forthcoming; Vang and Chaminade 2006).

But social capital transcends the regional boundaries in this cluster. The social capital of the Indian transnational community played a crucial role in establishing the IT industry (Vang and Overby 2006). To get access to orders, capital and more sophisticated knowledge, ndian firms were forced to target transnational corporations. This uncertainty allowed the Indian transnational community, who held important positions in US firms, to play a significant role in shaping outsourcing decisions.

In sum, despite there is increasing evidence that suggests that some Bangalore firms have developed a certain degree of autonomy from the lead firms in the US and Europe that has allowed them to move up the global value chain, most firms operate in the low end of the value chain.[18] The autonomy is a function of investments in human capital and new managerial strategies; hence, they can now provide all types of services from the highest end of the value chain to the bottom end. Part of the successful transformation process has been facilitated by increased cluster effect and spin-offs from the different universities located in Bangalore. However, the Indian firms engaged only to a limited extent in interactive learning compared to Silicon Valley and other similar clusters.

Innovation Policy for SMEs: Learning from the Illustrative Cases

This section aims at drawing lessons for design and implementation of cluster policies to support upgrading in Asian SMEs. The lessons are based on the illustrative cases; hence, we do not suggest they can be automatically applied to other clusters. Instead, they serve purpose of illustrating the need for a diversity of actions to support different learning and upgrading trajectories.

In this article we argue that when designing innovation policy for SMEs, policy makers need to take into account the different industry specificities and position in the global value chain of clustered SMEs. The cases illustrate that interaction will not lead to upgrading unless it is accompanied by investments in human capital and social capital. They also demonstrate that clustering does not automatically lead to interactive learning as preconditions in terms of human capital, knowledge provision and social capital exist. Notably, the firms need to have absorptive capacity and be engaged in networks that facilitate knowledge exchange. Policy makers might intervene when these two preconditions are not in

place, that is, when systemic problems (Chaminade and Edquist 2006; Edquist and Chaminade 2006) occur.

Applying the cluster approach has proven useful as a point of departure for the design of innovation policies to support SMEs upgrading. In contrast to other more atomistic approaches working with the same variables but in isolation, the cluster approach considers the links and dependencies of the different institutions and organisations. Thinking 'systemic' allows selective interventions in the weakest nodes in the system and/or on the most critical nodes. Selectivity is crucial for developing countries where financial resources are extremely scarce.

Industry and institutional contingencies dictate what are the areas in which a governmental intervention is most needed in the cluster, for example, investments in the interaction between TNCs and SMEs, or between SMES, or the supply of human capital and so forth.

In traditional industries, as illustrated by the Jepara furniture cluster in Indonesia, the major weakness for SMEs in the cluster is upgrading the local craftsmanship to meet international demands. Social capital exists, but the low qualification of human resources impedes SMEs in engaging in interactive learning, and therefore benefiting from dynamic clustering advantages. This can be solved partly if local manufacturers can link up to international buyers and international markets directly. For SMEs not possessing the skills needed for harvesting the benefits from collaborating directly or indirectly with international buyers, the government could provide information on international demands, standards and international markets, and facilitate the access to international markets. However, providing information is only one variable in the equation. SMEs also need to change their productive competences according to the demands of the global markets. Regional governments can facilitate the acquisition of new competences through training tailored to the specificities of the local industry and the global markets.

In the resource-based industry represented by the Taiwan flower industry, the weakest node constraining SMEs innovative performance is the lack of interaction between the key actors in the cluster (researchers, breeders and marketing cooperatives). Success stories like the wine and salmon production in Chile show that central in the policy interventions is the collaboration between the knowledge providers (universities and research institutions) and producers, as well as the provision of hard scientific infrastructure and qualified human capital. Local producers can

then enter international markets with a knowledge-intensive new product, creating a new niche market. The government has a crucial role to play as this strategy requires significant investments in research facilities that exceed SMEs capacity. But hard infrastructure is only one part of the system. The linkages between the knowledge infrastructure (biotech labs, for example), the producers and the markets need to be in place and SMEs need to have the knowledge to understand the possibilities of the new products (absorptive capacity).

The policies in CoPS, like the Thai automotive clusters illustrate, are highly dependent on the TNCs' willingness to provide assistance on technological upgrading and building of design competencies, as this is beyond the scope of the indigenous SMEs. When TNCs provide this type of information/assistance it is mainly to first-tier suppliers. SMEs do not play a significant role as first-tier suppliers as most indigenous SMEs do not comply with international quality standards required by the TNCs. The cases illustrate that at least two strategies are possible. One is to regulate the relationship between the TNC and the SME, for example, forcing the TNC to subcontract with indigenous SMEs. While this might seem a viable solution in the short term, it does not provide the right incentives for the SMEs to acquire new competences, as the Thai case shows. The second strategy is to focus directly on improving the competences of the indigenous SMEs. This calls for government intervention focusing on providing the needed industry-specific technical and managerial training, and the development of indigenous technologies.

Finally the policies targeting specialised suppliers, as illustrated by the Bangalore case, initially consists of building the required human capital level to engage in cost-based collaboration with TNCs. Once that this level is attained, the largest problem that the SMEs in these types of industries in Asia currently face is getting the high-value assignments that would allow them positions in higher parts of the value chain. While the SMEs might have the formally needed competencies for undertaking these activities, TNCs do know or do not yet trust their ability to undertake these activities. This prevents them from transforming their formal competencies into 'real' ones; such a transformation requires user–producer interaction. This problem is central as the SMEs cannot rely on localised lead users. In parallel, knowledge tends not to be distributed within the clusters of co-located firms. Thus, after initial phases with investments in human capital, public interventions should focus on public

procurements where the public government bodies functions as lead users (lead users demanding local interaction).

Conclusions and Further Research

This article addresses the current discussion on the link between interactive learning and upgrading in clusters linked to global value chains. It provides an analytical framework to study interactive learning in clustered SMEs that stresses the importance of the interplay between human and social capital (systemic propensity). The relevance of the framework is illustrated by applying it to the four clusters of SMEs in Asia. The analysis reviews the general assumption that clusters facilitate interactive learning and upgrading. The cases inductively allude to the diversity of types of interactive learning that exist, qualifying when they are relevant and which conditions underpin their efficient use. Additional research is needed to identify critical learning and unlearning paths in each of the industries, as well as their evolution over time. In addition, the article pays explicit attention to the transformation of SMEs from knowledge users to knowledge creators, which has tended to be ignored in the dominant literature, underpinning observed industry differences. The article also attempts to translate these insights into relevant policy measures that take the identified specificities into account.

NOTES

1. Malmberg (2003) proposes to clearly distinguish between industrial cluster and regional cluster. From our point of view, such a distinction, although valid from a theoretical point of view, has limited use in practical terms as cluster refers both to industrial and spatial agglomerations.
2. Despite its critics (Benneworth and Henry 2004; Martin and Sunley 2003), the cluster concept is a useful heuristic device for identifying geographical concentrations of industrial activities and analysing the consequences of clustering for (mostly incremental) innovation and economic development in developing countries (Bair and Gereffi 2001; Chaminade and Vang 2006; Giuliani et al. 2005a, 2005b; Pietrobelli and Rabellotti 2004).
3. To avoid misunderstandings, one obviously finds many clustered industries that are not dominated by TNCs, but those that have displayed the highest performance measures recently, such as satellite clusters in China, India, Taiwan, etc.

4. As a proxy for the lack of general human capital, one can use illiteracy rates. And adult illiteracy still reaches two digits in some countries such as Indonesia and Malaysia (World Bank 2003). Enrolment in secondary education is around 50 per cent.
5. The human capital literature has not paid sufficient attention to knowledge provision not explicitly linked to formal education (that is, the provision of knowledge products from research labs, technical institutes, etc.) despite the documented the importance these knowledge providers in the development of firms (Chaminade and Vang 2006; Laursen and Salter 2004). Knowledge providers can be directly involved in developing relevant technologies for the firms (applied technological knowledge), generating new ideas and products, and even providing technical training. In the context of developing countries, knowledge providers can thus be engaged in knowledge creating activities targeting the industry and/or SMEs' needs with the aim of reducing their dependency on TNCs as the sole sources of knowledge and technology.
6. Contrary to what is envisioned by standard economists, economic interaction is not primarily a market-based exchange of (tangible) goods by anonymous agents regulated by a complete contract (in the context of efficient contract enforcement), but the exchange relies on incomplete contracts either due to the lack of possibilities for creating complete contracts, because of the disadvantages in terms of a low degree of flexibility built into complete contracts, or because of inefficient contract enforcement, depending on the mutual trust of the partners involved in the transaction. This is especially the case for innovative activities and/or activities drawing on tacit knowledge.
7. Traditional manufacturing and natural resources-based industries are the most numerous in most Asian countries. Food and beverages, and textiles are the most important industries in terms of employment and added value in manufacturing at least in India, Indonesia, Philippines, China, Sri Lanka and Thailand. They are also characterised by a high degree of geographical concentration. Only some of the most advanced economies of the region (Korea and Singapore) are not strongly dependent on these two industries. The economic weight of the traditional manufacturing and natural resource-based industries in the area justify a deeper analysis of the innovation patterns in these two types of industries, mainly dominated by SMEs. For the most advanced countries in the region such as Singapore, Korea, Hong Kong, Singapore, Malaysia and (some parts of) India, the picture is somewhat different with a clearer dominance of specialised suppliers (such as IT manufacturers or software suppliers), and in the case of Thailand or Korea, the production of motor vehicles.
8. The Taiwanese government has settled the priorities for the economic development of the island, one of them being the biotech sector and its connections with other local industries including the floral industry.
9. This is a very new strategy whose results are yet to be seen. The analysis that follows tries to assess the potential success of this strategy, taking into account the existing linkages between the different actors at stake. In order words, we try to assess the potential for interactive learning in the cluster, giving the current availability of human and social capital.
10. Personal communication with a representative of the Taiwan Institute of Economic Research. Name withheld for confidentiality.
11. This has been confirmed by some interviews with local experts.

12. The Thai automobile industry is a clear example of a satellite cluster. Initially the production was located close to Bangkok. Diseconomies of agglomeration (ranging from increased wages and scarcity of workers to traffic congestion) resulted in the emergence of new clusters scattered around Thailand where Chonburi, Bangkok, Rayong, Samutprakarn and Pathumthani are among the most important ones (for details on the differences in their internal specialisation, see Chiasakul 2004).
13. From Japan: Toyota, Honda, Isuzu, Nissan, Mitsubishi and Hino; the US: GM, Chrysler and Ford; and Europe: BMW, Volvo, Daimler, Volkswagen, Citron and Peugeot).
14. This can be attributed to the general 'deregulation' enforced by the WTO/GATT. The Thai government interpreted the WTO/GATT agreement as entailing the dismantlement of the 'local content requirement' and a general opening of the economy to FDI. As a result, TNC subsidiaries established production in the Thai clusters and out-competed the Thai SMEs.
15. As an example, only 10 per cent of the Thai suppliers have ISO 9000, 14000 or 18000.
16. NASSCOM, http://www.nasscom.org.
17. Although recent reports (NASSCOM–McKinsey 2005) start to point out to an increase scarcity of supply of qualified human resources in the region.
18. This can be documented with fact that value per employee in India is only a fourth of that of the US, and only slightly above China's and Brazils (Arora and Gambardella 2004).

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