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Upgrading in Asian clusters: Rethinking the importance of interactive-learning

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Keywords: Clusters, upgrading, interactive learning, Asia, Indonesia, Thailand, India and Taiwan.

Upgrading in Asian clusters: Rethinking the importance of interactive-learning

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Abstract

This paper is concerned with unpacking the role of clusters in supporting the move from competing on low-costs to competing on innovation in the global value chain; special attention is paid to clustered SMEs. By comparing 4 clusters in different industries in Asia, we highlight significant *differences* in the learning paths of clustered SMEs. The paper contributes to current discussion on upgrading in clusters in developing countries by a) providing an explanation on how localized interactive learning and thus clustering relates to upgrading b) discussing under which conditions upgrading requires interactive learning and c) identifying the linkages between particular types of interactive learning and different upgrading strategies.

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1. 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 (Krishna, forthcoming, Bell and Albu 1999; Caniels and Romeijn, 2003; Cassiolato et al. 2003; Giuliani et al. 2005a; Humphrey and Schmitz 2002; Schmitz 1999 and 2004). In contrast to the traditional view of clusters as self-contained systems and the almost 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 and b; Humphrey and Schmitz, 2002; Pietrobelli and Rabellotti 2004 and 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 1936; Piore and Sabel, 1984; Schmitz, 1999; Storper 1997). Furthermore, as industries differ in their knowledge bases and learning mechanisms (Malerba and Orsenigo 2003) 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 paper attempts to live up to this ideal by systematically analyze a) *what* are the elements underpinning interactive learning in the cluster and b) which particular *type* of interactive learning is especially relevant for specific strategies in particular clusters and industries.

This paper 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). This is done by opening the black box of localized interactive learning and decomposing it into two basic components: human capital and social capital and subsequently present the role played by human capital and social capital and thus interactive learning in 4 clusters in Asia. The cases are presented only to illustrate the variety of learning paths and its relationship with upgrading and innovation and not with purposes of generalization.

The reminder of the paper is structured as follows. In the next section we introduce the theoretical framework; taking into account the localized nature of SMEs economic activity in general and specifically the supposed importance of localized 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 emphasizing 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 localized 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. Apart from holding relevancy for developing countries the identified findings attempt to contribute to the emerging field on global knowledge imbalances or the uneven distribution of innovative activities across countries and regions.

2. Clusters and development

2.1. 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 and 2005; Maskell, 2001; Maskell and Malmberg, 1999)[i]. In this paper we define cluster as geographical concentration of companies in similar or related economic activities and their supporting knowledge organisations (Porter, 2001). This broad definition allows for including spatially concentrated industries which do not (yet) engage in localized interactive learning;

analytically this proves crucial for this study as it prevents the exclusion of specific relevant clusters.

The relevance of clustering to enhance SMEs upgrading has received increasing attention over recent years both among academics, consultants and policy makers. The success in the nineties of the so-called third Italy (Beccatini, 1990; Piore and Sabel, 1984), Baden Württemberg (Stabel, 1996), Silicon Valley (Cohen and Fields 1998; Saxenian, 1994) and Hollywood (Scott 2005) turned their attention towards conceptualizing clusters as engines for stimulating upgrading among clustered SMEs (UNIDO 2004)[ii].

The success of clusters in the developed world diffused rapidly to developing countries (Albu 1997; Bair and Gereffi, 2001; Bell and Albu, 1999; Bitran 2004, Giuliani, 2004; Giuliani and Bell, 2005; Intarakumnerd and Vang, 2006; Nadvi and Schmitz, 1999; Pietrobelli and Rabellotti, 2004 and 2006; Rabellotti, 1999; Schmitz, 1995 and 1999) while international organizations such as United Nations (UNIDO), the InterAmerican Development Bank and the OECD adopted the cluster approach for analytical and intervention purposes (OECD, 1999 and 2001; UNIDO 1997 and 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 based interactive learning), their organizational 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 the SMEs.[iii]

In the developing world, the upgrading and learning dynamics of clusters are often 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). In this sense, clusters are often exogenously driven and more dependent on external sources of knowledge than those that characterise the developed world.

Attending to the geographical distribution, most clusters in developing countries can be conceptualised as so-called ‘Satellite’ clusters i.e. clusters of SMEs agglomerating in sub-national areas with firms involved in similar and related industrial activities and dominated by TNCs (Markusen, 1994). 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 usually specialized in activities at the bottom of the value chain responding to their low competence level, and hence the possibilities to benefit from interactive learning with the final customer or the TNCs are often limited.

2.2 Clusters and upgrading

The focus of this paper is on how clusters can facilitate interactive learning and thus the move from being a dependent subcontractors competing on low-costs towards becoming innovators 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" to 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: a) *Process upgrading*: introducing changes in the organization of production, i.e. producing the same goods or services but more efficiently; b) *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; c) *Functional upgrading*: acquiring new or superior functions in the value chain. That is, move up to activities of higher added value and d) *inter-sectoral 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 increasingly 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; von Hippel 1988; Loasby, 2001 and 2002; Lundvall et al. 1992). Contrary to what is commonplace in the cluster-literature this

should not lead to ignoring the importance of in-house competencies for interactive learning (see below). Interactive learning is typically defined as acquiring knowledge and competences through collaboration with other organizations. Interactive learning is considered especially relevant for SMEs and developing countries, where the amount of resources available is limited. SMEs are required to engage in interactive learning with all available sources of knowledge if they wish to upgrade and access international markets.

2.3. Clusters as facilitators of interactive learning in developing countries

Clusters are considered to facilitate interactive learning and the acquisition of competences required for upgrading. Physical proximity and derived relational proximity eases the communication with other firms and organizations and enhance interactive learning, and this is particularly relevant for SMEs (Chaminade and Vang, forthcoming 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. This forces them to rely more on personal and localised ways of transferring (tacit) knowledge and on learning-by-doing and interacting (Kaufman and Tödtling, 2002).

While several elements influence interactive learning, two elements seem to be crucial: human capital and social capital as Figure 1 shows. The extent to which SMEs can learn through the interaction with their environment is a function of their competences (in-house), their abilities to interact, their motivation and the opportunities to interact.

- INSERT FIGURE 1 AROUND HERE -

Human capital is central in innovation studies and refers to the 'skills, education, health, and training of individuals' (Becker, 1998, p. 1). Cluster studies have ignored the relation between in-house competencies and interactive learning. 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 general and subsequently industry specific human capital[iv]. The lack of human capital translates into poorly developed in-house competencies, such a weak general management skills (Kaplinsky 2005) and particularly low concern with knowledge management and innovation. Poorly developed management skills increasingly constrain the upgrading and expansion of firms which are not able to cope with the fast depreciation rate of knowledge, shorter

product cycles and lead time or growing importance of project-based organizational forms etc. (Barnard, 2006).

Human capital is also 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 through the interaction with other organisations, such as other firms, users or knowledge providers (i.e. research institutions). Absorptive capacity allows SMEs to take advantage of knowledge and information through collaboration, to process it and to commercialize 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 and limited competences in general, thus only restricted absorptive capacity. This, in turn, might significantly reduce their chances to engage in interactive learning since there are limited incentives only for other firms to collaborate 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 the particular cluster) is needed to support interactive learning. In a systemic perspective however it is only a necessary but not a sufficient condition for interactive learning[v].

In contrast to standard economists who tend to equate human capital formation with the fast dissemination of knowledge, the cluster-literature emphasizes the institutional embedding of human capital. Human capital formation/investments are not in themselves considered to generate economic development if constrained by other systemic failures[vi] In this context much attention is paid to the role of **social capital**. Social capital 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 1998; 8)[vii]. While the literature often is not fully clear about what is meant by social capital (generalized versus group specific, for example), it is suggested that unless there is a high degree of generalized social capital cooperation, communication and thus interactive learning is limited (Andersson et al 2004; Lundvall, 2005; Nooteboom, 2000) as both formal and informal interaction between firms rely on social capital for issues that cannot be contractually solved or are costly to solve contractually (Barnard, 2006). The absence of

social capital thus in turn 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 localized (Putman, 1993) so is interactive learning. Thus social capital is assumed to be important to explain interactive learning in clusters of SMEs. However in a systemic perspective 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 the 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 thus 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[viii]. This has lead to policy recommendations emphasizing 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 hypothesis's and policy prescriptions are true will be discussed in the help of the illustrative cases.

2.4. 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 propose that the morphology and importance of the interactive learning 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 specific activities in the value chain of an industry (Asheim, et al. 2003; Asheim and Gertler 2004; Breschi, Malerba and Orsenigo, 2000; Laursen and Salter 2004; Malerba and Orsenigo, 1993; Pavitt 1984, Tunzelmann and Acha 2004). Thus we expect to find industry specific differences concerning both 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, in-between SMEs, between SMEs and knowledge providers or between the SME 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 how human capital and social capital interact and facilitate interactive learning and which measures are needed to enhance specific interactive learning in an industrial cluster.

3. Interactive learning and upgrading in a selection of clusters in Asia

Following Giuliani et al. (2005) we propose four categories of clustered SMEs representing the majority of industries in developing countries: traditional manufacturing, resource-based industries, complex product systems and specialized suppliers. Previous studies (Chaminade and Vang, 2006; Giuliani, 2005; Pietrobelli and Rabellotti, 2006) have documented that this typology is useful to systematically identify different patterns of innovative behavior in clustered SMEs[ix].

In this paper we will analyse the Jepara furniture cluster as an example of a traditional industry in Asia that upgrades through the interaction with international buyers. The orchid cluster in Tainan, Taiwan will be used to illustrate the cluster dynamics and innovation strategies of a natural resource-based industry that has opted to upgrade through the collaboration with biotech research labs. The Thai automotive industry will be used to exemplify a Complex Product System (CoPS) cluster that upgrades limitedly through the interaction with international assemblers while the Bangalore IT cluster will reveal the innovation patterns of a specialized supplier that has upgraded accumulating competences particularly through the interaction with TNCs located in the cluster. A comparison of the 4 clusters is included in Table 2.

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: (1) *Spatial concentration*: all cases display some degree of geographical concentration/clustering of SMEs (2) *Upgrading:* the clusters have recently undergone an upgrading process or have the potential for upgrading (3) *Value chains*: all clusters are inserted in global value chain (4) A*vailability of data*: all clusters were extensively documented, specially with regard to human capital and social capital, the two underpinning factors of interactive learning. (5) *Representation*: clusters represent the four categories of clusters mostly dominant in developing countries.

The empirical analysis is influenced by certain limitations in the data sources, especially concerning the availability of updated information and our interpretation of the secondary sources. However, biases have been minimized by triangulating with different

independent data sources. The added value of the paper as compared to the existing literature is to analyse the cases in a novel way, combining multiple sources of information (Mjoset, 2005). 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.

3.1. Traditional manufacturing – The Jepara furniture cluster (Java, Indonesia)

Indonesia has a very long tradition of clustering of SMEs around similar activities (like stone carving in Batubulan, Bali; silver jewelery in Celuk, Bali, etc). 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. The Jepara furniture cluster in Java, Indonesia, is a large growing cluster. Between 1997 and 2002 the number of firms in the cluster and the number of employees have doubled. In 2002 the cluster comprised approximately 3700 firms, mostly SMEs employing over 58.000 permanent workers (Loebis and Schmitz, 2005). About 70 % of the cluster production is exported while the rest is sold on the domestic markets. Domestic firms account for 75% of the exports while foreign firms are only responsible for 25 % (Berry et al., 2002). The firms in the cluster have traditionally targeted the low-cost segments of the market where they compete with China and Vietnam. The industry is growing at 5-7 % yearly rates and controls 2% of the global market.

The furniture industry in Indonesia dates back to precolonial times, where furniture was produced for the royal families. In the eighties the industry profited from growth in the domestic market driven by a increasing middle class (ILO, 2004). It was only at the end of the eighties that Indonesia started targeting international markets.

The Jepara cluster has been dominated by large international buyers since the mid eighties (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). In the last few years the competitiveness of the furniture industry in Indonesia is weakening due several factors like the increasing costs of timber, petrol and electricity, reduced efficiency and scarcity in the supply of timber – with the government setting a limit on annual timber

exports to stop illegal logging). The indigenous SMEs have followed two types of strategies to access the global market (Loebis and Schmitz, 2005): i) reduce costs (low salaries, illegal raw materials, avoid taxes) i.e. the low road to competitiveness or ii) compete by introducing incremental innovations in processes and products. i.e. high road to competitiveness/upgrading (see Figure 1). We focus on the latter only.

- INSERT FIGURE 2 HERE-

Upgrading and interactive learning: Only a small proportion of the firms located in this cluster have opted for the second upgrading strategy, that is, incremental product and process upgrading (Loebis and Schmitz, 2005). This involves better designs of the furniture (including self-assembly formats demanded by the western consumer) but also improving the quality of the production, the delivery schedules and the compilation with international standards (Business Week, 2003, ILO, 2004). The role of the international buyer is essential to understand this type of strategy (Posthuma, 2003). Two modes or layers 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 size local firm). The international buyer provides the local subcontractors with innovative designs, like self-assembly furniture (of the sort commercialized by IKEA) and large orders. It also encourages the local firm to introduce quality standards in the products as well as in the process (for example that the wood used in the furniture is approved by the Forest Stewardship Council[x]) (Business Week, 2003, Loebis and Schmitz, 2005). That is, learning takes place through the interaction with the international buyer who translates the demands of the final customers in terms of quality and design to the local firms (Posthuma, 2003) and encourages the subcontractors to upgrade in processes and products to comply with the demands of the international market.

On the other hand, the principal subcontractor in the cluster usually is linked to a network of suppliers (of final products or raw material) through very strong social capital. These second layer suppliers, have also to comply with the quality standards of the international buyer (Loebis and Schmitz, 2005). 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, however, usually limited due to the low competence

level 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.

Role of human capital and social capital supporting interactive learning and upgrading: Loebis and Schmitz (2005) document that the SMEs that have opted to compete by introducing incremental innovations in products and processes have also introduced new managerial and organizational changes, including the compliance with international quality and environmental standards. Only a small amount of firms in the cluster have the technical and organizational competences to engage in interactive learning with international firms and larger subcontractors and take the "high road" to competitiveness.

But the majority of firms do not have the required human capital to engage in interactive learning. Competence building, in general, is through apprenticeship and learning-by-doing in general but also takes place when employees move from one firm to another (Berry et al. 2002). Most SMEs are family based and following 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). This is possibly one of the most important constraints to upgrading in the cluster.

Only firms that have highly developed human capital and organizational competences can adopt this upgrading strategy and get involve 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 within other firms in the cluster. But strong social capital with a limited absorptive capacity does not lead to upgrading. Phrased differently, the communication channels exist but there is not enough knowledge and absorptive capacity in the cluster to boost a general upgrading of the clustered SMEs.

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3.2. Natural resource-based - The Tainan orchid cluster, Taiwan

As a *de jura* province of China and taking into account their limited territory, Taiwan can be considered to be in itself a region with complete *de facto* political autonomy from mainland China[xi]. Taiwan floral industry has experienced a fast growth over the last decade due to a strong domestic market and the increases in cut flower exports, especially to Japan and the US (Tsai, 2001). Approximately two thirds of Taiwan's flowers are produced in the West-central lowlands near Taichung, Changhua and Nantou (Taipei Times, 2005). These areas are more sunny, less humid and provide the right climate for chrysanthemum, gladiolus, cattleya, lily, iris, gerbera and rose production, which are the main crops of flowers in Taiwan (RIRDC, 1999). Tainan concentrates half of the orchid production of Taiwan, being the main cluster of orchid production in the island (Taiwan Review, 2005)

Although Taiwan is responsible for only 2% of the global trade of flowers, it is the world's largest orchid producer, accounting for more than a half of the global sales of orchids. Taiwan exports aprox. US$ 100 million worth of orchids per year (Taiwan Review, 2005). 90% of that amount goes to Japan (ILO, 2000), being butterfly orchids the major flower export (Council of Agriculture, 2005 *cf* Taipei Times, 2005). Despite the importance of Taiwan in the global market of flowers, particularly orchids, most of the farmers target the domestic market and flowers are only exported when the domestic market demand is saturated (TiT Business, 1996).

The Taiwanese floral cluster is clearly dominated by SMEs, and this is extensive to the orchid production. Growers are small in size (usually the average farm size per family is one 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 (Tsai, 2001); that is, being able to engage in collective action.

There are other main local actors in the flower industry in Taiwan in general and in the orchid production in particular: 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). For example, Taiwanese produced flowers appear to follow the Japanese standards with stem length regarded as a premium; roses average 60 cm and Lilium 50-70 cm (RIRDC, 1999). The marketing channel is dominated by four wholesale companies that use auction systems providing on-line real

time information on the market. Taipei Flowers Auction Co. Ltd manage the auction market. The shareholding in the company comprises 40% florists and 60% growers and engages more than 2000 flower suppliers (RIRDC, 1999). Government and biotech labs have only very recently emerged as relevant actors in the cluster. In 2003 the Government started the construction of the Taiwan Orchid Plantation (TOP), the first orchid biotech park in the island entirely devoted to orchid R&D. The park is scheduled for completion in 2008 (Taiwan Review, 2005).

- INSERT FIGURE 3 HERE -

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. As indicated above, the Government has recently implemented a plan that aims at upgrading Taiwanese orchid production by linking them to bio-tech facilities (Hsieh, 2001; Rodrik, 2004)[xii]. The objective of the TOP is to support local producers by developing new varieties, upgrading yields and enhancing marketing (Taiwan Review, 2003). Until lately the Taiwanese producers relied only on 'natural' species which could be produced on most Asian countries, hence not a source of long-term competitiveness, such as Chrysanthemum, Gladiolus, Lilies or Roses. The market of Chrisanthemum, for example, has decreased steadily since the beginning of the nineties (RIRDC, 1999). Now they are experimenting with non-natural varieties which display particular aesthetic features and longer durability (e.g. 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 realize the potential for upgrading of this strategy. The government supports this upgrading strategy by heavily investing in building a very qualified workforce (in this particular case in biotech scientists) and by providing the funding required for building the research infrastructure, such as the construction of greenhouse facilities explicitly targeting groups of SMEs. Although the required organizational set-up is there, the strategy seems to have some difficulties in its implementation. One of the possible explanations is the lack of interactive learning and collaboration between the biotech-labs, the growers and the marketing coops[xiii].

Building blocks of interactive learning: human capital and social capital in the cluster: General competences for example are 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 highly developed absorptive capacity by the indigenous SMEs. In this sense, Taiwan has a privileged situation as for example 88,5% of the population has higher education.

However, realizing the full potential of the biotech-based upgrading strategy is contingent to establishing the right links between the producers, the researchers and the final markets (through the marketing channels). Interactive learning between the bio-tech institutes and the marketing cooperatives is needed to develop new species that can be commercialized successfully in the global market. Furthermore, bio-tech 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. Growers collaborate with other growers although at a very limited scale, which restricts the transfer of technical knowledge and experience among them (Taiwan Review, 2005) while the links between research institutions and industry are very weak (Development Center for Biotechnology, 2006).

In sum, although the qualification of the human capital is high, social capital formation is not conducive for collaboration across the different phases in the value chain and thus interactive learning limited and hampers growth. The interactions *between* the three groups of key actors in the upgrading strategy (producers, distributors or researchers) appear to be limited[xiv] which seriously questions the potential success of the upgrading strategy adopted.

3.3. 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 been considered a successful case[xv]. Thai automotive clusters are TNCs-centred. Most major assemblers are present in Thailand[xvi]. Around 113,000 are employed in the industry where SME accounts for approximately 50% 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% of these are owned

by TNCs. Second tier suppliers are around 1000 (Chiasakul, 2004). The Thai automobile clusters are important to the Thai economy and increasingly so. According to the latest WTO statistics (2005) the automobile industry grew from 3,5% 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 millions while ten years later it had grown to US$ 2401 millions. Since then it has grown exponentially (from US$ 2977milions in 2002 to US$ 5713 millions in 2004 (WTO 2005). Figure 3 plots the automobile value chain and the main actors in the cluster

- INSERT FIGURE 4 HERE –

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

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 (1st 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. The reasons are incentive-based; the TNCs do not have incentives to share knowledge with indigenous SMEs which display only limited potential to become relevant suppliers. Only the aforementioned SMEs receive advice about quality control, maintenance and design drawings (for example to make dies 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-by-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, implement organizational forms supporting product or process upgrading or develop managerial competencies. Most SMEs only have employees with primary or junior high school education (Intarakumnerd, 2007). They simply produced parts according to already established production methods, blueprints and – often – based on technology acquired from the TNC (Techakanont and Takahashi, 2004). As a result, most Thai SMEs lack the human capital, managerial 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 third-tier suppliers do not connect to the network as they do not meet the quality standards (Sevilla and Soonthornthada, 2000)[xviii]. That is, collaboration based on social capital *between* Thai SMEs is not yet of much relevancy as most Thai SMEs simply do not have the competencies, knowledge and information that can create synergetic relationships.

As the situation is now Thai SMEs have to rely on knowledge acquired through interactive learning with the TNCs. This however is a challenging strategy with few successes (Vang and Asheim, 2006; Lall and Narula, 2004; Narula and Marin, 2005). 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 the TNCs and the SMEs, thus seriously hampering their ability to upgrade. A large number of Thai SMEs have restricted operating capability, let alone engineering. For example, not many SMEs are able to fully run an automated production system, which requires the ability to operate CNC (Computer Numerical Control) machines. Even in the few cases where the SME has a relatively good operating capability, they lack the internal knowledge required to absorb technologies generated outside and upgrade. (Intarakumnerd, 2007).

3.4. Specialized 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). In total Bangalore hosts around 1700 IT firms and the value of software exports accounts for approximately US$ 12.200 millions in 2003-4 (Kumar and

Joseph 2005). The annual growth rates are around 30% but mainly stemming from low-end software activities; an indicator of this is that value of sales /employment is 50 (slightly higher than China and Brazil on respectively 37,6 and 45,5 but significantly lower than in US (195,3) and Japan (159,2) (Arora and Gambardella 2004). Nevertheless according Parthasarathy and Aoyama (forthcoming) R&D service exports has reached a value of US$1.66 billion and a growth rate on 17.4% respectively in 2002-03. Bangalore is responsible for1/3rd of the software exports from India. The software is mainly to the OECD countries.

Bangalore is the center 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 high-tech clusters (defense, aeronautics and IT) and is considered to be the scientific and engineering centre of India in terms of research, training and partly manufacturing. India's well-known Indian Institute of Science is based in Bangalore (Arora et al. 2004, 2005)**.**

During the nineties, the easy access to qualified and relatively cheap technical human capital attracted a number of TNCs. Large firms such as IBM, Motorola, Hewlett-Packard, Siemens, 3M, Texas, etc. located in the area. Despite the weight of the TNC in the Bangalore IT sector, the large majority of firms are SMEs but only 10-15 % of the revenues of the sector are from them (NASSCOM, 2005).

The development of this particular city-region is more shaped by macro- industrial policy in India and the industrial development in the US than local interactive learning or other cluster-effects (Vang and Asheim, 2006) and regional government bodies' policies (van Dijk, 2003; Parthasarathy, 2004) – apart from education policies. Until India dismantled their ISI-strategy the development of the IT industry was limited by constrains on import, export, inward FDI and entrepreneurship. It should be noted however that several of the largest firms were established during this epoch. Bangalore's growth until the late 1980s (when the software export boom began) relied on local (largely public sector) investments; Bangalore already had a dense organizational setting. The central government even located the public telephone company in Bangalore as well as other large high-tech state enterprises. More crucial however was the development in the US. US faced a combination of strong scarcity of IT workers and high salaries in the context of the Y2000 problem. This created incentives for outsourcing to other countries and as India dismantled the ISI-strategy it became an attractive destination due to

absolute cost advantages, a large supply of a qualified workforce and widespread proficiency in English.

Upgrading and interactive learning: The dynamics of the IT cluster in Bangalore are dominated by TNCs (either located abroad or in Bangalore). 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).

Competence building in the indigenous SMEs has run in parallel to their role as subcontractors of TNCs, mainly located in the US (Parthasarathy and Aoyama, 2006; 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 one 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, organization of production according to US standards, and so forth, that 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, 2006) and IT-service. The analysis of this specific case, points to the importance of engaging in interactive learning not only with TNCs but also with other indigenous SMEs.

- INSERT FIGURE 5 HERE -

With the exceptions of these advance firms, especially in embedded software segment (Parthasarathy and Aoyama, 2006) 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[xix] 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 labor[xx].

With the exception of the 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, 2006; 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 the Indian firms were forced to target transnational corporations. This uncertainty allowed the Indian transnational community, who held important positions in the US firms, to play a significant role in shaping the outsourcing decisions in the US firms

R&D spillovers to the IT industry from publicly financed research is and has always been highly limited; spillovers is mainly in the form of scientists moving from public research to being employed in the IT industry. In addition comes a large supply of IT candidates from public and private colleges. Accredited engineering capacity in India increased from around 60,000 in 1987-88 to around 340,000 in 2003 (Arora and Gambardella 2004),

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 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[xxi] . 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 did only to a limited extent engage in interactive learning compared to Silicon Valley and other similar clusters; rather they have relied on in-house learning.

4. Innovation Policy for SMEs – learning from the illustrative cases

This section aims at drawing lessons for the 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 paper 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 the clustered SMEs. The cases illustrate that interaction will not lead to upgrading unless it is accompanied by both investments in human capital and social capital. They also demonstrate that clustering does not automatically lead to interactive learning as pre-conditions 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. And networks are needed to exchange the different pools on knowledge and boost upgrading in the cluster. The existence of only one of the elements in the absence of the other seriously hampers upgrading as Figure 6 summarizes, thus alluding to the systemic character of interactive learning and innovation. Policy makers might intervene when these two pre-conditions are not in place, that is, when systemic problems (Chaminade and Edquist, 2006; Edquist and Chaminade, 2006) occur.

- INSERT FIGURE 6 OVER HERE –

Applying the cluster approach has proven useful as the 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

organizations. 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 e.g. 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 the SMEs in the cluster is upgrading the local craftsmanship to meet international demands. Social capital exists but the low qualification of the human resources impedes the SMEs to engage in interactive learning, 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 Tainan orchid cluster, the weakest node constraining SMEs innovative performance is the lack of interaction between the key actors in the cluster (researchers, breeders and marketing cooperatives) when the upgrading strategy is linked to research in biotech. 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 the 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 the 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 specialized suppliers as illustrated by the Bangalore case initially consists in building the required human capital level 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 are currently facing is getting the high-value assignments that would allow them position 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 trust yet the ability of the indigenous SMEs to undertake these activities. This prevents them from transforming their formal competencies into 'real' competencies; this transformation requires user-producer interaction. This problem is central as the SMEs cannot rely on localized lead users. In parallel knowledge tend 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 allowing where the public government bodies functions as lead users (lead users demanding local interaction).

Conclusions and further research

This paper addresses the current discussion on the link between interactive learning and upgrading in clusters linked to global value chains. The paper provides an analytical framework to study interactive learning in clustered SMEs that stresses the importance of considering the interplay between human and social capital (systemic propensity); the papers scope was limited to the analysis of human capital and social capital as the two

main components of interactive learning. 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 is contingent on the specificities of the industrial activities undertaken and the systemic propensities of the cluster. The cases inductively allude to the diversity of types of interactive learning that exist, the importance of in-house learning, qualifying when they are relevant and which conditions that underpin their efficient use, thus significantly modifies the general cluster-literature which has paid lip-service to the analysis of industry specificities only. 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 paper 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 the observed industry differences. The paper also attempts to translate these insights into relevant policy measures that take the identified specificities into account. Further research is needed on other systemic propensities of clusters in developing countries which were bracketed in this paper.

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[i] Malmberg (2003) proposes to clearly distinguish between industrial cluster and regional cluster. From our point of view, such distinction, although valid from a theoretical point of view has limited use in practical terms as cluster refers both to industrial and spatial agglomerations.

[ii] Despite its critics (Benneworth and Henry, 2004; Sunley and Martin, 2003) the cluster concept is a useful *heuristic device* for identifying geographical concentrations of industrial activities and analyzing the consequences of clustering for (mostly incremental) innovation and economic development in developing countries (Bair and Gereffi, 2001; Chaminade and Vang, forthcoming 2006; Giuliani et al, 2005a and b; Pietrobelli and Rabellotti, 2004)

[iii] To avoid misunderstandings one obviously finds many clustered industries which are not dominated by TNCs but those that have displayed the highest performance measures recently have been Satelite clusters in China, India, Taiwan etc.

[iv] As a proxy for the lack of general human capital one can use illiteracy-rates. And adult illiteracy still reaches the two digits in some countries such as Indonesia and Malaysia (World Bank, 2003). Enrolment in secondary education is around 50%

[v] The human capital literature has not paid sufficient attention to knowledge provision not explicitly linked to formal education (i.e. 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, forthcoming 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.

[vi] For an overview of the systemic dimensions facilitating or hampering development see Barnard (2006)

[vii] Contrary to 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.

[viii] Other factors such as institutional regulation, property rights, incentive structures, demand morphology, entry and exit costs etc. as well as strategically sensitive questions (i.e. first versus second and third mover advantages) are also central dimensions underpinning firms propensities to engage in interactive learning..

[ix] Traditional manufacturing and natural resources-based industries are the most numerous in most Asian countries (Dhungana 2003). 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 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 specialized suppliers (such as IT manufacturers or software suppliers) and in the case of Thailand or Korea, the production of motor vehicles.

[x] The Forest Stewardship Council is a German group that issues certificates of sustainable practices (Business Week, 2003)

[xi] The Taiwanese government has settled the priorities for the economic development of the island, being one of them the biotech sector and its connections with other local industries including the floral industry.

[xii] 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.

[xiii] Personal communication with a representative of the Taiwan Institute of Economic Research. Name kept secret for confidentiality reasons.

[xiv] This has been confirmed by some interviews with local experts.

[xv] 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, 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 specialization, see Chiasakul 2004).

[xvi] From Japan: Toyota, Honda, Isuzu, Nissan, Mitsubishi, Hino; US: GM, Chrysler, Ford; Europe: BMW, Volvo, Daimler, Volkswagen, Citron, and Peugeot).

[xvii] This can be attributed to the general 'deregulation' enforced by 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.

[xviii] As an example, only 10 % of the Thai suppliers have ISO 9000, 14000 or 18000.

[xix] In the interviews maintained with a number of Bangalore firms in october 2006, the scarcity of human resources was started to be considered an emerging constrain for the growth of the sector.

[xx] Although recent reports (NASSCOM-McKinsey Study, 2005) start to point out to an increase scarcity of supply of qualified human resources in the region.

[xxi] This can be documented with fact that value pr. employee in India is only a forth of that of the US and only slightly above China's and Brazils (Arora and Gambardella, 2004).

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