

The Evolution of the Electronics Industry in the SIJORI Cross-Border Region

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Abstract: In the early 1990s, Singapore, the Malaysian state of Johor, and the Indonesian island of Batam sought to leverage their proximity, differing comparative advantages, and good logistics connections to market themselves as an integrated unit. After an initial phase of enthusiasm and considerable investment from electronics multinationals, attention regarding the cross-border region waned in the wake of the Asian Financial Crisis. Using data from investment authorities in Indonesia and Malaysia, as well as a number of firm interviews, this paper traces the evolution and current status of the electronics industry in Batam and Johor.

Keywords: Electronics; Cross-Border Region; Production Network; Malaysia; Indonesia

JEL Classification: L63; O14; O30; R58



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1. Introduction

In 1991, Philips Electronics decided to open a production plant on the island of Batam, in the Indonesian province of Riau. Following persuasive marketing and investment incentives, the Dutch electronics multinational became an anchor tenant in Batamindo – a newly-inaugurated industrial park under joint Singapore-Indonesian ownership.

Whilst Philips' global headquarters is in Eindhoven, the Netherlands, the investment was made out of Singapore, which was, at that time, a major node in the multinational's regional production network for television sets and components. Capitalizing on Batam's much cheaper land and labour, the assembly of tuners was transferred from a Singapore-based plant to the new location. Following their assembly, the tuners were shipped back to Singapore and, despite having a production manager onsite, the operations in the Batam plant were also managed from the city-state.

This cross-national corporate network is emblematic of what the Singapore-Johor-Riau (SIJORI) Growth Triangle sought to promote. Launched in 1989 and originally encompassing Singapore, the Malaysian state of Johor, and the Indonesian island of Batam, the Triangle sought to market the three territories as a 'single investment destination' offering different cost structures (Grundy-War et al. 2002; Lee 1991; Smith 1997; Sparke et al. 2004; Yaw et al. 2000; Yeoh et al. 1992).

Following a burst of enthusiasm during the early 1990s (Chen & Kwan 1997; Lee 1991; Ooi 1995; Smith 1997; Thant et al. 1994; Toh & Low 1993; Yeoh et al. 1992; van Grunsven et al. 1995), joint marketing of the region took a back-seat in the wake of the Asian Financial Crisis. Since then, investment authorities in all three territories have continued to promote the advantages of proximity and cost differentials, albeit in a less concerted fashion.

Today, more than two decades on, Philips still operates a plant in Batam. However, the situation has drastically changed. Some years ago, the plant in Batamindo was closed down and operations were relocated to a newer and more inexpensive industrial park. In addition, Philips no longer assembles tuners on the island. This task has been transferred to a subsidiary in China and, instead, the facility in Batam assembles electrical household goods such as irons and hairdryers.

These developments reflect the substantial shrinkage of Philips' operations in Singapore during the 2000s, after having had a substantial presence in the city-state for over four decades (Philips Electronics Singapore 2001). As the city-state became too expensive for the assembly of household goods, gradually all of Philips Electronics production plants in Singapore closed and – as far as production/assembly is concerned – only the Batam factory remains as a legacy of the once-pivotal position

of Singapore in Philips' global and Asian production networks. As the commitment of Philips to Singapore waned, the management of the Batam plant was transferred to the Philips Indonesia office, which now oversees, not just this product portfolio, but also a broader range of activities concerning marketing the brand in Indonesia.

While it appears that substantial developments have taken place at the firm level within the SIJORI region, there has been little recent research carried out on this topic, with still less on patterns of corporate decisions regarding investments and the geographic allocation of tasks. The available literature has focussed on Singapore and its evolving policy frameworks. This line of investigation has focused on: the country's industrial regionalization strategy; asset complementarities and proximity of constituent territories; advantages for multinational corporations; and the economic implications for the city-state (How and Yeoh 2007, Pereira 2004, Yeoh et al. 2000; 2004a,b,c; 2005a,b; 2006a,b; 2007).

This literature tends to focus on the role of the Singapore state as an agent in seeking to foster higher value-added investment. Three aspects are highlighted. First, the steady encouragement by the state of MNCs to 'anchor' in the country and upgrade their operations over time. Second, the country's state-led yet market-guided intervention to assist in the creation of new economic spaces beyond its territory through the construction of industrial parks and other infrastructure. Third, various locations in close proximity with differing endowments and comparative advantage would then allow cross-border corporate networks to flourish. As Yeoh et al (2004c: 4) - following Reza 1994 - have stated: "*Investors will be presented with a packaged choice to locate the activities along their value chains in the contiguous areas, viz, Singapore can support business operations dependent on advanced technology and sophisticated services, while low value, labour-intensive industries can be located in the Riau islands. Such specialization will enable investors to retain activities in close proximity while making use of contrasting environments i.e. complementary specialization in national border territories*".

However, while policy frameworks in the constituent components of the SIJORI Cross-Border Region have evolved over time, the Philips case demonstrates that, far from being fixed, corporate strategies have also evolved. Indeed, changes in industrial structure in the various SIJORI territories may not be due to government policies. Instead, they may have their genesis in decisions taken by corporate headquarters and subsidiaries. Thus, while an understanding of institutional configurations and policy frameworks in each territory is important, it is equally necessary to analyze corporate strategies regarding what production tasks to place in each location.

Furthermore, while the initial division of labour between Singapore on one hand and Johor and Batam on the other was predicated on a core-periphery relationship, it is also possible that, over time, the division of labour between the SIJORI constituent territories has evolved in unexpected ways. The extant literature focusses on recent developments in the electronics industry in Singapore (Toh 2014; van Grunsven 2013), with relatively little available on how this sector has evolved in either Johor or Batam.

To this end, this paper will explore the development of the electronics and electrical (E&E) industry in the Singapore-Johor-Riau Cross-border Region¹ (CBR) from a corporate, industry, and evolutionary perspective linking past and present. This will be done through tracking the establishment and closure of MNC electronics subsidiaries over time, as well as assessing the extent and prevalence of upgrading and industry branching in each location.

2. Research Questions, Research Aims, and Methodology

The research questions that guide this paper are the following:

- *Overall Evolution:* How has the size and profile of the electronics industry evolved in Batam and Johor since the mid-1990s?
- *Upgrading:* Has there been any upgrading of firm operations in Johor or Batam?
- *Cross-border corporate hierarchies:* Are cross-border relations and patterns still governed by the basic tenets that prevailed in the early phase of development (i.e. Singapore – core; Johor and Batam – peripheries)?
- *Cross-border linkages:* If there has been upgrading in either Batam or Johor, has there been any reshaping of connections to Singapore? Have multinationals based in either Johor or Batam begun to ‘disconnect’ from regional control nodes based in Singapore?
- *‘Drivers’ of Evolution:* What role have the local institutional context (local supplier base; regional innovation system; local government) and corporate strategies played in helping or hindering upgrading attempts?

In pursuing these lines of inquiry, this paper aims to address a number of gaps in the available research on sub-regional industrialization in the context of cross-border ‘triangles’ or regions. First, through focussing on firms and their establishment and closure over time, this paper aims to understand how and to what extent corporate networks in the region have evolved. Second, through looking at the less-researched territories in SIJORI we aim to shed light on the increasing complexity of production (or not) in the constituent territories, as well as the evolving structure of production linking them to Singapore. Third, through connecting developments in Singapore with responses on the part of industrial authorities in Malaysia and Indonesia, we aim to establish how and whether they have understood and responded to developments in the electronics industry.

Thus, while research on SIJORI during the 2000s has looked at institutional developments and how they have sought to promote cross-border investment, this research aims to look first at corporations operating in this area - before bringing in

¹ This paper will refer to Singapore-Johor-Riau Islands as a cross-border region, as opposed to a Growth Triangle. A cross-border region (CBR) is defined as a territorial unit that comprises contiguous sub-national units from two or more nation-states (adapted from Perkmann and Sum 2002: 1). SIJORI is a special case - although it is not unique - in that one of the component units houses a capital city. This definition does not assume that: SIJORI constitutes a ‘natural’ economic territory; economic flows are ‘triangular’ in nature; borders are uniquely barriers to economic activity and trade; or that the interactions between the component units are solely economic in nature. Simply, the composite of three component territories is the unit of analysis. The term ‘Growth Triangle’ will be used when it refers to the specific trilateral government initiative or to the body of academic literature that uses this framework.

the institutional context and then analyzing their interplay.

With regard to data-gathering, the E&E industry is comprised of an ever-expanding array of products, and there is a multitude of ways of classifying the sector. In principle, we define the electronics sector as comprised of: consumer electronics; electronic components; industrial electronics; and electrical products. With some modifications, Singapore, Malaysia, and Indonesia base their industrial classification systems on the international standard (ISIC) and compile their statistics in analogous fashion.² This common classification base allows effective comparison across the various countries.

Using this common definition, the first element of our research consisted of constructing a database of the number of electronics MNCs in operation in Johor and Batam over the 1995-2012 period. Investment approvals by the relevant investment authority in each territory allowed us to track both the opening and closure of firms on a yearly basis. Beyond the quantum of firms, this process-tracing provided some insight as to the relationship between firm establishment/closures and industry trends.

For Johor, information on company-level approval or closure was obtained from the Malaysian Investment Development Authority, which vets foreign investment applications and assesses their eligibility for incentives and rebates. Using the common ISIC-based classification outlined above, the total ‘universe’ of manufacturing sector-related approvals and closures was narrowed to those in the relevant E&E sub-sectors. This was cross-checked with: records from Johor Technopark, a Johor state government-owned subsidiary that has the largest industrial land bank in the state; as well as various issues of the Johor Industry Guide, compiled by the Johor economic development corporation, JCorp.

For Batam, investment approvals and closure records from the Batam Industrial Free Zone Authority (BIFZA) were consulted. This organization, formerly named the Batam Industrial Development Authority, was established in 1973. It was initially tasked with: economic planning; building infrastructure such as industrial estates, ports, and highways; marketing and investor liaison; and handling investment applications for the entirety of Batam island. Originally under central government control, this agency is now under the Riau Islands provincial government, following decentralization measures passed in 2001. BIFZA remains the first port of call for investors and has the most comprehensive records of investment applications.

The second phase of our research consisted of surveys of MNC affiliates in both Batam and Johor to obtain necessary information regarding upgrading at the firm level. In principle, the selection of MNC subsidiaries was random. Lasting about one hour, the surveys were carried out on the premises of 40 participating firms in Johor and Batam. Comprising some 70 questions, the survey covered a range of issues, including: upgrading in terms of technology, products, and processes; the quality of local-level institutions; and corporate decision-making processes regarding the awarding of mandates to manufacture specific products.

² In Singapore, this is the Singapore Standard Industrial Classification System (SSIC); in Malaysia, it is the Malaysian Industrial Classification System (MISC), revision 3; and in Indonesia, it is the Indonesian Standard Classification of Industrial Activities (KBLI).

The third phase of our research consisted of mapping the network of subsidiaries operated in Asia by the parent companies of the subsidiaries found in Johor and Batam. This was done by compiling information from the websites of the companies included in the database. At the time of writing, work on this is still in progress, however the information gleaned to date enables some tentative conclusions to be advanced regarding prevailing trends among MNCs according to their nationality.

In compiling the database, several important methodological issues arose. First, the initial idea was to also track, through industry guides and applications for investment and diversification, the upgrading of firm-level operations. However, it soon became apparent that the data we could avail of meant significant limitations to this approach. Investment applications contained information regarding the manufacture of generic product groups, and directories did not update their product listings with any discernible regularity. Second, while the development of the database enabled the 'universe' of MNCs in each location to be established, and a substantial number of firms to be approached for face-to-face interviews, only a limited number of firms were surveyed. This was due to: difficulties contacting individual subsidiaries; low response rates; and the logistical constraints involved. Because of this limitation, the analysis below is as yet tentative.

The remainder of this paper will be structured as follows. The next section will set out a theoretical perspective on industrial evolution including upgrading and branching. Following this, the dynamics of the electronics industry in Singapore, Malaysia, and Indonesia will be examined. The subsequent section will examine recent trends in the E&E sector in Johor and Batam. This will involve focussing on: the number of firms and their corporate activities in each location; the available evidence regarding branching and upgrading into higher value-added and more technology-intensive areas; and the extent, nature, and dynamics of linkages with establishments in Singapore. The following section will analyse the 'drivers' of these trends, including developments in the institutional contexts of Johor and Batam, as well as trends in corporate decision-making regarding the acquisition of technology and awarding of corporate mandates. The final section will advance this research's main conclusions.

3. Framework: a conceptual perspective on industrial evolution, upgrading, and branching at the local level

As well as seeking to increase export earnings, many East Asian countries have endeavoured to foster a local electronics industry to boost local technological capabilities. Beyond earning foreign exchange, industries like electronics can stimulate the development of downstream activities to supply specialized parts and inputs and can also increase efficiency and productivity in other parts of the economy (Henderson 1994). While requiring distinct domain knowledge and capabilities, the manufacture of different electronics products follows an established sequence or value chain, each with varying levels of value-added.

The global production network (GPN) and global value chain (GVC) frameworks are useful for analysing the technological and geographic evolution of the electronics industry. They focus on two core ideas. The first is the territorial division of labour, where various participating regions or 'nodes' assume specific roles in the production network. These roles assume a certain position in a hierarchy of value – ranging from

core and high order, where high value-added activities and functions take place – to peripheral, low-order and subordinated, where the least value-added assembly production-oriented activities take place.

The second concept refers to the mobility of specific ‘nodes’ up or down the hierarchy of value. While production networks maintain a given hierarchy of functions according to their degree of value-added, the geographic allocation of these functions is dynamic. Thus, new locations or regions may enter a GPN as they attract investment, or established regions may be excluded. In addition, a given location may also ascend or descend the hierarchy of value-added in a GPN as it attracts or loses activities/products/processes/functions that are more advanced (Coe et al 2004; Ernst 2002; Ernst 2009; Felker 2009; Henderson et al. 2002; OECD 2013; UNCTAD 2013).

The Global Production Network and Value Chain approaches emphasize the opportunity for late-comer regions to progress from the bottom towards the middle and even higher positions. There are two ‘drivers’ for this process. The first is positive developments in a location’s endowments and competences, such as its skill base and ease of doing business. The second is ‘micro-level’ developments in firms and MNC subsidiaries, where they develop or acquire capabilities through learning or the transfer of technology or assets. In contrast, losing connections to a GPN are related to opposite trends, namely negative developments regarding a territory’s characteristics, endowments, or competences (Ernst and Kim 2002; Kim 1999a/b; Kim 2001; Lall and Urata 2003; OECD 2013; UNCTAD 2013).

Mobility in the hierarchy of production within GPNs is important, given patterns of the distribution of rewards and remuneration (Felker 2009). Regions that do not acquire greater capabilities and better assets over time may find themselves stuck in a low value-added position and/or an increasingly precarious situation as other competing ‘nodes’ increase their skill bases and technological capabilities. There is a substantial literature that deals with the role of local organizations such as government agencies, research institutes, and business associations in enabling territories to progress within GPNs (Breznitz 2005; Breznitz 2007; Lee and Saxenian 2007; Lee Keun 2010; Masuyama et al. 1997; Masuyama et al. 2001).

Some territories in Southeast Asia that have sought to attract and retain MNC operations in high-tech industries have pursued upward mobility by encouraging the MNCs that they host to acquire progressively more sophisticated value-added activities and functions over time. Although the desirable thing is for MNC subsidiaries and their wider network of supplier firms to begin to upgrade, the acquisition of technological capabilities is a time-consuming process and some territories have been less aggressive or prioritized other goals or industries.

Given that the development of an industry in a specific location is a composite of evolving comparative advantage, government policy frameworks, industrial trends and corporate decisions, these differing levels of commitment have long-term implications. Thus, an industry in a given location can evolve along several differing paths. The most obvious ones are: upgrading; stability or stagnation (relative to other competing locations); downgrading to less value-added tasks; and decline.

Having sketched the framework, we will now examine the concepts of *upgrading* and *branching*. *Upgrading* is one possible path of industry evolution. Evolutionary economics offers many insights into this notion and how it occurs. Upgrading itself can be understood at three analytical levels: industry; inter-industry; and establishment/firm.

- **Industry Level:** this involves the relative gain of higher-technology product segments (or sub-sectors) in industries, including a longer-run possibility of specialization in specific products and/or processes and/or technologies; and also a shift from the lowest position of Original Equipment Manufacturing (OEM), towards Own Design Manufacturing (ODM), and finally Own Brand Manufacturing (OBM). Using the digital storage products as an example, this would involve shifting from the assembly of disk drives to the production of storage media, a product and process involving complex technology.
- **Inter-industry Level:** this refers to the accumulation of more technologically-advanced capabilities or competencies. At this level, the concept is often related to embeddedness, attested to by the increasing quantity and technological complexity of local supply to MNC subsidiaries by domestic firms. An example would be process automation equipment supplied by local firms evolving from back-end to front-end processes.
- **Establishment/firm Level:** this transformation consists of several aspects: moving from lower to higher value-added activities regarding processes, functions, products (complexity and scope of value chain operations); satisfying the requirements of global value chains insofar as price, quality, and delivery are concerned; and – in selected cases – a transition from OEM to ODM and/or OBM. An example would be the mandate extension of a subsidiary from mere production to an additional role in product adjustment and development.

The analysis in this paper will not include the inter-industry level – i.e. links between MNC subsidiaries and local firms – as our focus of analysis is on the establishment and closure of E&E multinationals.

With respect to the evolution of local industries, evolutionary economic geography has recently suggested the notion of *branching*. This is an inter- and firm-level process whereby the configuration of an industry changes over time as some of the existing *varieties* of products dwindle and new one is introduced. This occurs when: corporations and institutions introduce a new industry to a region (and other industries withdraw); corporations withdraw products and introduce new ones; or subsidiaries/establishments producing certain products abandon the region altogether and are replaced by new ones carrying different products (Boschma and Frenken 2009).

At the firm level, the linked notion of variety refers foremost to products or product categories. Each are marked by specific technological characteristics. A new product or product line is taken to be *related* if it belongs to the same product and technology family as the territory's current products and requires human capital of a similar profile. If a new variety embodies different technology from existing product groups and generations, it may still be *related* if it builds on existing body of technology. If it does not, it may be characterized as *unrelated*. Upgrading at the firm level then can be conceptualized as local branching whereby a technologically rather unsophisticated *variety* of products or product categories is augmented (initially) and/or gradually

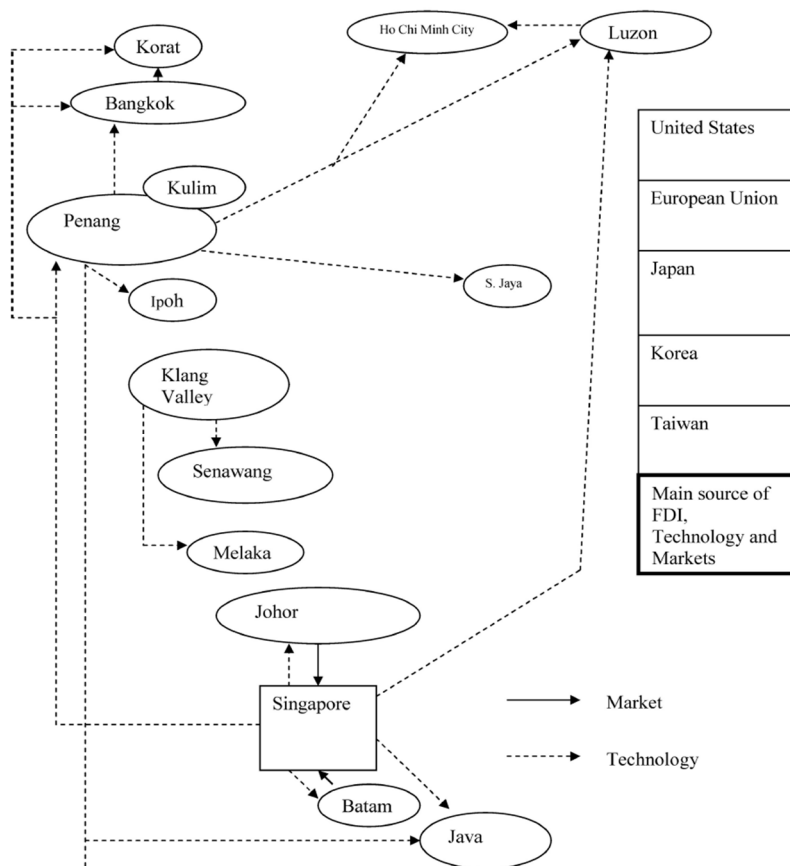
replaced by more sophisticated *variety* that may be *related* or *unrelated*.

Having laid out the conceptual framework that will guide this paper, the next section will explore the development of the E&E industry in Singapore and to other parts of the SIJORI Cross-Border Region, as well as salient developments in Malaysia and Indonesia that have influenced the industry's development in Johor and Batam.

4. The E&E industry in Southeast Asia and the SIJORI CBR

Over the past four decades, a number of economic 'spaces' or nodes in the electrical and electronics (E&E) industry have developed in Southeast Asia. From the literature on this topic, there appears to be considerable variation in the development of the E&E industry across the different locations, due to their distinct local histories, institutional contexts, policy initiatives, and firm behaviour. Given the importance of MNC affiliates as flagship firms, E&E development in the selected regions has been shaped, to a large degree, by the decisions taken by MNC headquarters regarding the awarding or rescinding of mandates to subsidiaries operating in these locations. Reflecting the collective weight of these decisions over time, the various nodes in operation across the region have come to acquire varying levels of sophistication. Rasiah (2009) provides one way of 'mapping' the various nodes in operation in the region and the relationships between them (Figure 1).

Figure 1: Spaces in the Southeast Asian Electrical and Electronics Industry



Source: Rasiah 2009

Singapore and Penang were the first complexes to develop in the region. As mentioned in the introduction, Johor and Batam began to grow rapidly in the early 1990s as ‘satellite’ developments of Singapore. This take-off should be seen against the background of the Republic’s regionalization strategy implemented in the late 1980s, which aimed for the country to ‘move up’ the value chain in a range of industries, including electrical and electronics.

Due to cost factors as well as incentives, many MNCs started to shift operations out of Singapore. On one hand, this reinforced already developed regional production networks in the industry and, on the other, contributed to the emergence of networks in new locations. These networks encompassed the cross-border subnational production space in Southeast Asia. But, they also went far beyond, extending into East Asia – particularly regions in China – as these started to rival established Southeast Asian regions as platforms for export-oriented production. In these network configurations, MNCs could capitalize on alternative locations for specific operations or product assembly, also allowing non-core spaces in cross-border sub-national regions to be ‘bypassed’.

As far as the E&E industry in the SIJORI Cross-Border Region is concerned, the territorial division of labour across its component parts became the dominant characteristic of production arrangements during the 1990s. This division of labour has been reconfirmed in a body of research published during the 1990s and first half of the 2000s.

This research confirmed SIJORI as: i) an integrated manufacturing complex; ii) an industry and corporate construct grounded in complementarity of production factors in proximity, allowing their leveraging through the establishment of corporate production networks in a confined sub-national space; iii) a strategic construct from Singapore’s perspective that allowed the retention of industries and firms in the region whilst ‘moving up’ the value chain; iv) a space where non-core parts have assumed a sub-ordinate position (Grundy-War et al. 2002; Lee 1991; Ooi 1995; Smith 1997; Sparke et al. 2004; Toh & Low 1993; Yaw et al. 2000; Yeoh et al. 1992; Yeoh et al. 2004a/b/c; van Grunsven et al. 1995).

This research also has led to better insights into the characteristics of firms and operations attracted to Johor and Batam. In terms of origin, a distinction has become noticeable between non-Singapore MNCs and emerging Singapore companies going international. In terms of operations, a distinction can be made between MNC satellite operations feeding into value/production chain operations in Singapore, and ‘stand-alone’ operations.

When combined, the following typology can be made:

- a) Non-Singapore MNCs that used Johor and Batam for cost-sensitive operations feeding into the production chain located in Singapore (e.g. the Philips tuner assembly in Batam).
- b) Singapore and non-Singapore MNC operations that have shifted out of Singapore that are now stand-alone operations but still coordinated from Singapore.
- c) Singapore and non-Singapore MNC operations originally established in Singapore, but that have now shifted offshore and only use the city-state’s logistics facilities.
- d) Stand-alone operations of Singaporean firms operating in Johor and/or Batam.

One of the core findings of recent research on the E&E industry in Singapore is that ‘moving out’ and ‘moving up’ has proceeded at a fast pace during the 2000s. Progress regarding upgrading is evident from the analysis made by Toh (2014), who used aggregate indicators and data from secondary sources to ‘map’ the evolution of the Singapore E&E industry over the past few decades.

His data suggest the following trends:

- While the share of the E&E industry in the manufacturing sector has dropped, the industry has still grown in absolute terms when measured by output and value-added.
- At the same time, there has been substantial contraction of employment, indicating that operations have shifted towards more technology-, capital- and skills-intensive operations.
- The branch/product portfolio of operations has changed significantly. During the 1980s, electronics production in the country diversified from consumer electronics and components into industrial electronics, particularly disk drives, other computer peripherals, computer systems and integrated circuits, as well as supporting industries. However, during the 1990s and especially the 2000s, a move set in towards narrowing, specialization, and more sophistication. This specialization focused on high-technology, high-precision and high-value components with semi-conductors/integrated circuits and data-storage products, esp. disk-media, rising to prominence in the production and export composition. And, within the categories mentioned, it also focussed on high-end operations.
- As production in early-developed branches – especially consumer electronics and office-equipment – was shifted out, MNCs in these branches adopted various responses. They: gradually abandoned Singapore; maintained/shifted to non-production functions; or augmented these with a higher value-added function, such as regional headquarters, procurement hubs, or design and development centres.

The analysis carried out – also recently – by van Grunsven (2013) of the development of Singapore’s ICT industry reveals that, as far as the E&E sector is concerned, the country has emerged as a centre for research and development/innovation, design, regional headquarters, and procurement over the last decade. This has been due to its: early entry into the electronics sector; high level of state capacity; and proactive targeting of advanced branches and operations in the rapidly-changing sector.

In principle, the dynamics of the Singapore E&E industry since the late 1990s could have provided several avenues for Johor and Riau/Batam to upgrade their operations. These could have included attracting three principal target groups of firms:

- MNCs in industry branches ‘abandoned’ by Singapore
- Lower-end operations offshored by MNCs in industry branches still present in Singapore, but constituting higher-end tasks for either of the two non-core locations
- Singaporean firms also affected by industry trends and rising costs

In this process, the configuration as to the types of firms and operations could change, with significant implications for the earlier established division of labour and for connections of the Johor/Batam E&E complexes to Singapore. Finally, contingent on sufficient locally-based attributes, Johor/Batam could begin to upgrade.

The latter is the focus of our subsequent empirical discussion of the Johor and Batam cases. However, before proceeding, it is worthwhile to take on board the insights provided by recent research literature. Over the past five years or so, a few studies have been undertaken on the Southeast Asian – especially the Malaysian – E&E industry, focusing on upgrading. Although these studies were of a more general scope, they do provide empirical indications as to the possibilities indicated above – especially the question of upgrading – with respect to SIJORI.

Malaysia

During the earlier part of the 2000s, Malaysia's progress up the value chain seems to have limited success. As argued by a number of scholars, this was evidenced by: the slow shift of MNCs from low- to higher-technology operations; little expansion of their roles; as well as limited entry into new technology and product areas (Ernst 2002; Henderson and Phillips 2007; Ritchie 2005; Tan 2013; Yusuf and Nabeshima 2009a/b).

Also, Malaysia experienced: limited development of local small and medium-sized firms linking with MNC establishments; underdevelopment of technological capabilities in these firms; as well as insufficient evolution of such firms from local suppliers to independent firms offering their own products and services. As a result, Malaysia was being 'left mired in mediocrity' (Ritchie 2005).

The results of more recent research suggest little change from the earlier period (Edgington and Hayter 2013; Rasiah 2007, 2009, 2010, 2012; Tan 2013; Yusuf and Nabeshima 2009a). On one hand, the findings of the authors reveal a not insignificant evolution in terms of: size and composition of firms; product(s)/product-markets and their technological contents; and of skill composition of labour. On the other hand, measured by the knowledge-intensity of operations and value-chain scope, technological catch-up has remained disappointing.

A similar observation can be made when technological capabilities in establishments (ranked from simple to complex) are taken as the yardstick. Technological capabilities may be divided into: human resources; processes; and product technology. The explanation appears to lie in the interplay of several factors, including: industry technological and regulatory developments; corporate changes; branch plant and host region endowments and strategic behaviour; and host national industry and technology policies. All these translate into corporate decision-making as to the geographical allocation of product mandates to various MNC affiliates.

Edgington and Hayter (2013) arrive at observations similar to the other scholars. While Japanese branch plants had moved beyond simple stand-alone assembly-based operations to inter-linked firm networks and upgrading production to digital consumer products, many had not progressed further to technology-intensive behaviour. This was attributed to MNC headquarters considering that the technological environment in Malaysia's industrial centres of Penang, Johor, and the Klang Valley were not developed enough to allocate branch plants in the country more sophisticated mandates. The concerns have been taken up in the current government national restructuring exercise, the New Economic Model (NEAC 2010), and suggestions for

improvement have been included in the Economic Transformation Program, which includes a chapter devoted to the electrical and electronics industry (Pemandu, Government of Malaysia 2010).

A recent account by Hutchinson (2012), specifically on Johor, suggests that this state is no exception to the national picture, leading to the observation that the 'original' division of labour in the SIJORI Growth Triangle may still prevail today.

Indonesia

As with Malaysia, Indonesia has also promoted industrialization concurrent with the acquisition of local technological capabilities. Up until the Asian Financial Crisis, however, Indonesia still pursued a dual track industrial policy, seeking to boost export-oriented industrialization, whilst protecting certain strategic sectors such as aviation. Since the Crisis, the pursuit of local technological capabilities has declined, with no concrete technology policy in place (Lipsey and Sjöholm 2011).

In recent years, Indonesia has focussed on exporting primary products, with relatively little diversification of exports or end-markets (Basri et al. 2011). Due to the structural factors outlined above, as well as varying regulations regarding FDI, Indonesia has received less flows of foreign investment relative to its Southeast Asian neighbours. In 2009, the country's stock of inward FDI as a percentage of GDP stood at 13.5%, roughly one third the level of Malaysia (Lipsey and Sjöholm 2011).

At present, Indonesia lags behind Malaysia and Thailand, producing a much smaller amount of high-technology exports than either. Relative to other Southeast Asian export-oriented countries, firms in high-technology sectors are much lower down the value chain, pursuing only basic changes in production processes and having very limited innovative capacities. Most high-tech production facilities operate in a vacuum, with few linkages between multi-national corporations and local firms (Thee 2006).

Structural issues associated with the pursuit of more value-added activities include: a relatively low level of expenditure on education, particularly of a tertiary nature; low levels of spending on research and development, inadequate spending on technology development; and insufficient capital for small and medium enterprises (Thee 2006; Frankema and Lindblad 2006).

Due to Indonesia's limited electronics base, Batam has traditionally been one of the industry's leading centres. The influx of foreign capital into Batam following the relaxation of equity restrictions on foreign ownership in 1990 meant that, by 1991, the island was already producing more than 50 percent of the country's exports of components and parts (Thee and Pangestu 1993). An analysis by van Grunsven finds that operations in the late 1990s were almost entirely low-skill in nature (1998). A recent paper by Miyamoto (2011) discusses the labour market characteristics of Japanese-affiliated firms on Batam Island and compares these over time. It does not suggest major structural change of MNC operations away from a focus on low-value assembly work.

With this context as a backdrop, we scrutinize the evolution of the E&E industry in Johor and Batam, focussing on the elements laid out above, and from a perspective of the ‘commitment’ of enterprises to specific locations in light of changing circumstances.

5. The Batam and Johor Electrical and Electronics Industry Revisited: an Empirical View ³

As mentioned above, using investment approvals from relevant authorities such as the Malaysian Industrial Development Authority and the Batam Indonesia Free Zone Authority, a database containing firm entries and exits for the electronics sector overall and by sub-sector was developed for the period 1995-2012. The following paragraphs will compare and contrast the overall findings as they relate to each location.

Overall Trends in Batam and Johor

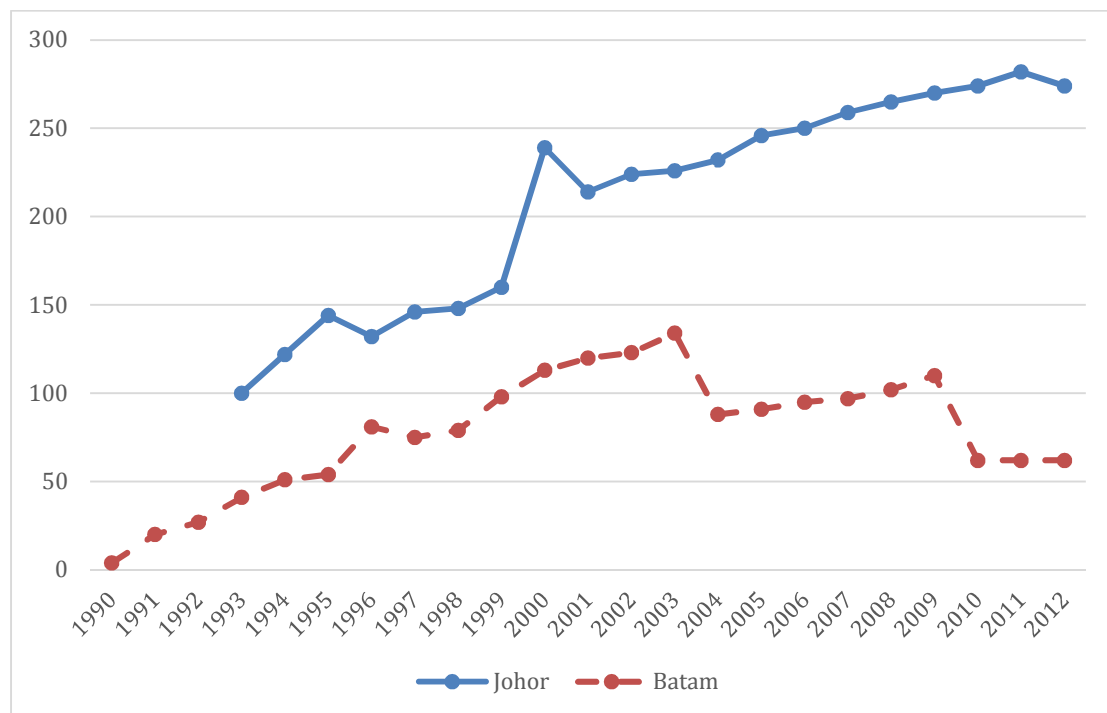
Given its proximity to Singapore, well-developed logistics connections, considerable number of industrial parks, and the potential demand from electronics MNCs seeking to leave Singapore for lower-cost environments, one would think that Batam had an unbeatable business proposition.

However, with regard to the electronics industry, despite an initial period of rapid growth, our analysis of its evolution reveals less-positive dynamics in recent years (Figure 2). In the early period of Batam’s ‘take-off’, the number of E&E subsidiaries increased quickly and consistently from four in 1990 to a peak of 134 in 2003. This trend was very robust, continuing its upward trend through the Asian Financial Crisis and the 2000-01 downturn in the electronics sector.

However, from 2004 onwards, the number of electronics MNCs in Batam began to decrease. Between 2003 and 2004, the number of E&E subsidiaries declined substantially to under 90 firms. Over the next six years, the number of firms experienced a modest increase to reach 110 in 2009. However, in 2010, the number of firms dropped by almost 50 percent, to slightly above 60, where it stayed steady until 2012. Thus, in this year, there were only 62 electronics MNCs in operation on the island, less than half the number eight years before.

³ The authors acknowledge the research assistance provided by four Dutch Master students in Economic Geography, enrolled in the Department of Human Geography and Planning, Utrecht University, the Netherlands: Catherine Visch, Stan van Oerle, Mathijs van Campenhout and Jasper de Graaf. See van Oerle and Visch 2014, and van Campenhout and de Graaf 2013.

Figure 2: Electronics MNCs in Batam and Johor



Source: own data, 1994 data for Johor is interpolated

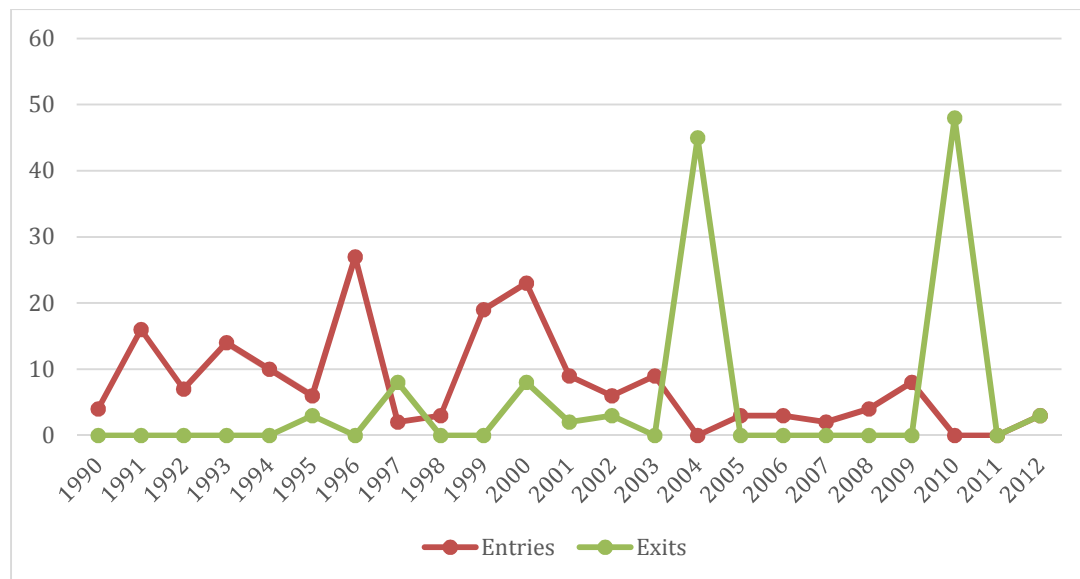
Looking northwards to Johor, the E&E industry has shown a different and more positive evolutionary path. In 1993, there were 100 electronics subsidiaries in operation in Johor – more than double the corresponding figure in Batam. Following an increase in 1995 to around 150 firms, the number remained fairly flat until 1999, potentially due to the fall-out of the Asian Financial Crisis. However, in 2000 the number of MNC affiliates increased substantially to almost 240, before dropping to some 210 firms the following year – most likely due to the 2000-01 global downturn in the electronics industry. However, since 2001, the number of firms climbed steadily until 2011, when it reached 282. In 2012, the MNC population experienced a slight down-turn, falling to 274 firms. In comparative terms, by 2012, Johor’s base of electronics MNCs was more than four times the size of Batam’s.

Firm Entry and Exit in Batam and Johor

Turning to firm entry and exit, it stands to reason that a given firm cluster would have significant numbers of entry and exit, given the electronics industry’s cyclical nature and high volatility. Batam and Johor are no exception.

With regard to Batam, a total of 196 firms were in operation on the island at some point during the 1990-2012 period, of which only 62 are currently in operation – indicating a survival rate of under 33%. From 1990-2003, firm entries were sustained, with significant increases in 1996 and 1999-2000. With regard to firm exits, they were relatively small, with slight increases in 1997 and 2000. 2003 was a crucial year, as after this the level of firm entries was very small. Firm exits, for their part, were also relatively low for most of this period - with two notable exceptions, 2004 and 2010, when 45 and 48 firms left, respectively (Figure 3).

Figure 3: Firm Entries and Exits in Batam, 1990-2012



Source: own data

Table 1 contains a breakdown of the information available regarding nationality and date of arrival for the 62 firms in Batam in 2012. Turning now to the age of the current MNC base, it is noteworthy that one third were already in operation in 1995 and almost sixty percent have been in operation for at least ten years. This stands to reason given the very low numbers of firm entries after 2003. Thus, the current stock of MNC subsidiaries is comprised largely of mature firms that have maintained locational commitment, throughout two cycles of firm departures.

With regard to the nationality of the firms, Japanese constitute the largest contingent, comprising one third of current tenants. Singaporean MNCs constitute the second-largest contingent, with 13 firms, followed by affiliates from the USA and Germany respectively.

However, there are differences in the time of arrival across the various nationalities. Japanese MNCs constituted the largest sub-group of firms in 1995. Indeed, more than half of all Japanese firms (11) in Batam in 2012 date from this initial period. Following this, the number of Japanese firms arriving (and staying) dropped. Firms from Singapore, the USA and Germany have, in general, arrived at a fairly steady rhythm over time. Singapore, for its part, had a slight increase in arrivals to Batam in the 2000-2002 period, when five firms arrived, up from the normal rate of 1-3 firms per period.

Table 1: Breakdown of Batam’s Current Tenants by date of Arrival and Nationality

Cohort	Total Number	Main nationalities
Present in 1995	21 (33.8%)	Japanese (11); USA (3); Germany (2); Singapore (2)
1996-1999	4 (6.5%)	Japanese (2); Germany (1); Singapore (1)
2000-2002	11 (17.7%)	Singapore (5); Japanese (3)
2003-2006	9 (14.5%)	Singapore (3); Japanese (2); USA (2); Germany (1)
2006-2012	17 (27.4%)	Singapore (2); Japanese (2); USA (2)
1995-2012	62	Japan (20); Singapore (13); USA (7); Germany (5); No data (11)

Source: own data

Turning to the composition of the electronics industry in Batam, it can be roughly divided into five branches: consumer electronics; audio and video equipment; electronic components for autos; printed circuit boards (PCB); and other components and parts (cables, wires, wire harnesses, sensors, connectors, etc.). More than 90 percent of subsidiaries are involved in manufacturing and/or (sub-) assembly activities. Some of the MNC affiliates are also involved in ancillary activities such as testing, plastic injection, packaging and trading activities.

Over time, the technological composition has gradually shifted from a domination of the consumer electronics branch to a larger role of the electronic components branch, although this shift is not very evident. If we look at entries and exits over time with respect to operations, no clear evolutionary trend can be discerned. The only significant exception would be the growth of the contract electronics manufacturing sub-sector, which has grown in recent years with the arrival of the two global players Sanmina-SCI and Flextronics.

Table 2 shows the most important companies in a number of branches. It can be seen that the same companies feature in the different periods.

To the extent that branch evolution has occurred, it has taken place within already established subsidiaries that apparently have changed product portfolio/mandate somewhat. These changes have hardly involved upgrading, casting doubt on any progression within the international division of labour for Batam, or any benefit derived from Singapore’s evolving offshoring practices.

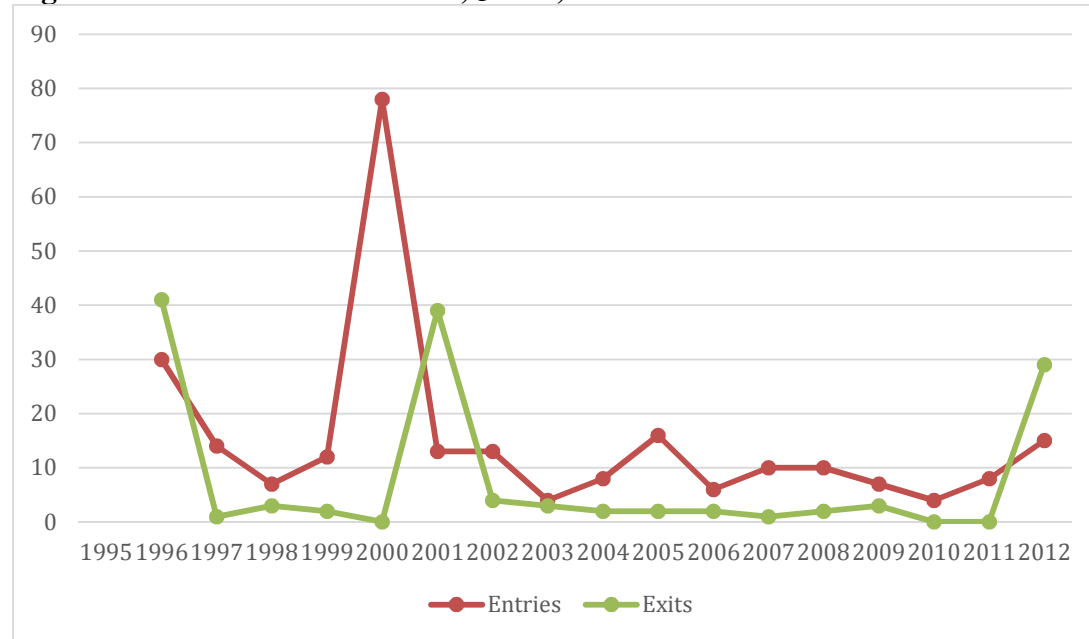
Turning northwards, a total of 409 establishments had a presence in Johor over the 1995-2012 period and, of these, 274 were in operation in 2012. Like Batam, this indicates a significant level of entry and exit, but a notably higher retention rate of 67%. Unlike Batam, the number of firm arrivals has largely remained slightly higher than firm exits, resulting in a steady increase in the number of firms over time (Figure 4). There was, however, one notable jump in 2000, when 78 firms established operations. However, this peak was nullified somewhat by 39 firms closing down the following year – most likely due to the 2001 slow-down in the electronics industry. For the remainder of the period, the number of firm exits remained smaller than the number of firm entries, with the exception of 2012, when 27 firms left and only 15 arrived.

Table 2: Important firms in Batam's E&E industry

Branch	1994	2003	2012
Consumer electronics	Casio, Epson, Ex Batam, Fujitec, Kyocera, Panasonic, Philips, Sanyo Energy, TEC Electronics Indonesia, Thomson, Varta Microbatteries	Casio, Epson, Ex Batam, Fujitec, Hitachi, Kyocera, Panasonic, Philips, Sanyo Energy, Siemens, Sony, TEC Electronics Indonesia, Thomson, Varta Microbatteries	Epson, Ex Batam, Fujitec, Panasonic, Philips, Sanyo Energy, Siemens, TEC Electronics Indonesia, Varta Microbatteries
Electronic components (audio and video equipment, automotive parts, printed circuit board (PCB))	Nidec (electric motors), Schneider Electric (energy control), Seagate (HDD)	ABB (energy control), Getronics (measurement and control), Infineon Technologies (semiconductors), Nidec (electric motors), Schneider Electric (energy control), Seagate (HDD), Yokogawa (measurement and control)	Epcos (sensors), Getronics (measurement and control), Infineon Technologies (semiconductors), Nidec (electric motors), Schneider Electric (energy control), Xenon Technologies (flash light), Yokogawa (measurement and control)
Contract Electronics Manufacturing	Leo Industries, Surya Teknologi	Beyonics Manufacturing, Leo Industries, Sanmina-SCI, Surya Teknologi	Beyonics Manufacturing, Flextronics Technology, Leo Industries, Sanmina-SCI, Surya Teknologi

Source: own data

Figure 4: Firm Entries and Exits, Johor, 1996-2012



Source: own data

Turning now to the nationality of the firms that have established a presence in Johor, Japanese and Singaporean firms are by far the most numerous, 105 and 97 respectively (Table 3). Between them, the two countries account for half of the entire number of firms that have established operations in Johor at one time or another. Other significant nationalities include: the United States; Japanese-Malaysian joint ventures; Malaysian, Taiwanese, and British.

Table 3: Breakdown of all firms investing in Johor by nationality and tenure

Nationality	Number	Average Tenure (in years)
Japan	105	12.7
Singapore	97	9.3
USA	34	8.8
Japan/Malaysian	25	10.7
Malaysian	22	6.0
Taiwan	12	6.7
United Kingdom	10	6
Total	409	9.7

Source: own data, firms w/ no recorded nationality (46)

The average tenure of MNC affiliates in Johor was 9.7 years. The Japanese and Japanese-Malaysian joint ventures had the longest tenures, both above an average of ten years. Singaporean and operations from the USA had tenures slightly under the total average, but they remained significantly longer than those of the other nationalities.

With regard to the current group of tenants, approximately one quarter (76) of the 274 firms currently in operation were already in Johor in 1995. And, seventy percent (191) were in operation on or before 2002 meaning that, like Batam, the firm cluster is relatively mature.

Table 4: Breakdown of Johor’s Current Tenants by date of Arrival and Nationality

Cohort	Total Number	Main nationalities
Present in 1995	76 (27.7%)	Japanese (39); Singapore (17); USA (5); Japanese-Malaysian (4)
1996-1999	51 (18.6%)	Japanese (19); Singapore (9); Japanese-Malaysian (7); USA (5)
2000-2002	64 (23.3%)	Singapore (24); Japanese (12); Taiwan (4); USA (4)
2003-2006	28 (10.2%)	Singapore (5); USA (5)
2006-2012	55 (20.1%)	Singapore (19); Japanese (6); USA (6); Malaysia (3); Japanese-Malaysian (2)
1995-2012	274	Japanese (76); Singapore (74); USA (25); Japanese-Malaysian (13)

Source: own data; firms with no data on nationality (40)

With regard to the nationality of the current tenants, Japanese and Singaporean operations are the two largest groups, with affiliates from the USA and Japanese-Malaysian joint ventures numbering third and fourth respectively. In contrast to Batam, the proportion of European MNCs is proportionately smaller, with virtually no German MNCs. However, the relatively large number of Japanese joint ventures with local enterprises is of note and has no equivalent in Batam.

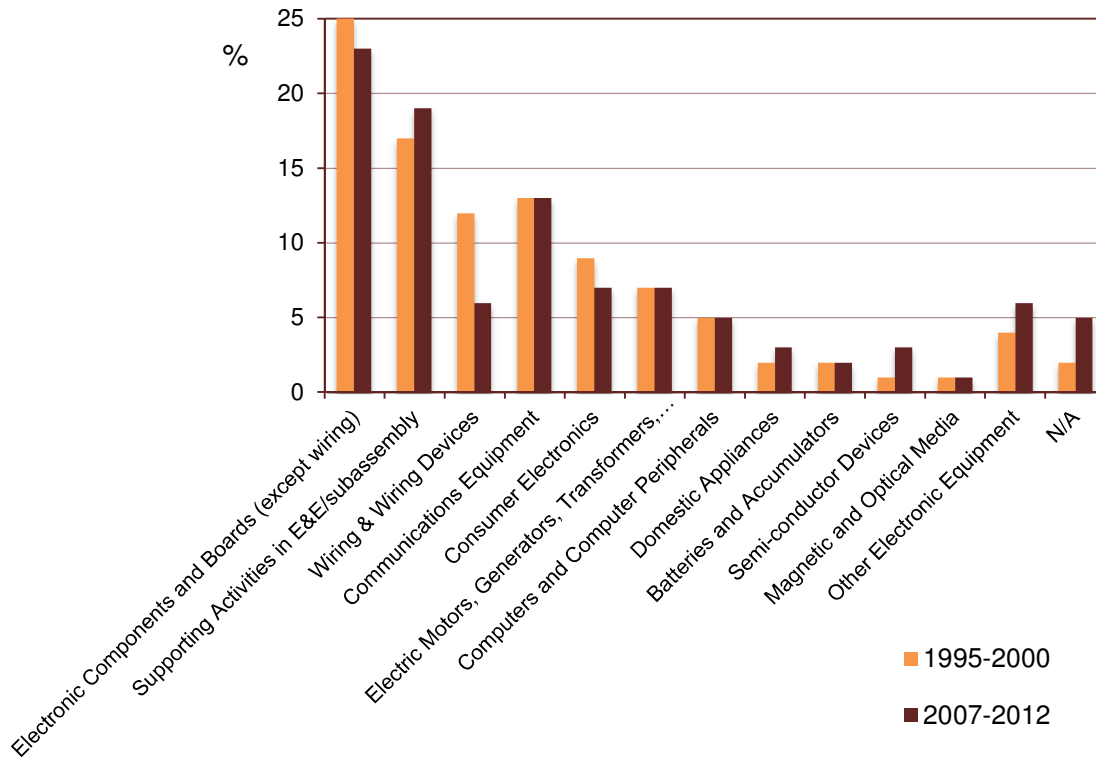
Insofar as date of arrival, as in Batam, the Japanese were the largest community in 1995. However, the number of Singaporean firms, while smaller, was still notable. While this pattern stayed constant in the late 1990s, it reversed after 2000. The number of Singaporean firms increased notably, while Japanese investment fell markedly and, in 2003-2006, was inexistent. Over 2006-2012, this trend was even more marked, with the number of Singapore firms (19) vastly outnumbering the other groups. In contrast, pattern of investment from the USA are constant over time.

What can be said about branching? If the subsidiaries present in the last five years (2007-2012) are compared with those operating in the late 1990s (1995-2000), is it possible to discern replacement of branches or the development of new branches marked by more sophisticated operations? If so, can this be linked with exit and entry of subsidiaries of new companies, and/or with *in situ* operational changes in plants that maintain a presence in the region?

Figures 5 and 6 show the findings as to the industry branches in which the various subsidiaries were active. Figure Five shows no significant differences between the two groups of subsidiaries, suggesting that early-developed branches were still very much ‘alive’ at the last point of measurement. It is also suggested that there has not been any significant shift in the branch structure. Furthermore, Johor is weak in the more sophisticated branches where Singapore is currently specializing. Indeed,

branches that have shown significant attrition in Singapore do *not* show substantial gain in Johor, leading to the tentative observation that, like Batam, Johor has not managed to capture product ‘spaces’ being vacated by firms based in Singapore.

Figure 5: E&E firms present in Johor during 1995-2000 and 2007-2012 by product category



Source: own data

It should be noted here that there could be possible data distortions. MIDA data only mention the initial product of a subsidiary as declared by the investor. In addition, information in company listings compiled by TPM Technopark from Johor was found to be updated in a rather unsystematic way. However, we believe that this distortion is not such as to significantly affect the validity of the information.

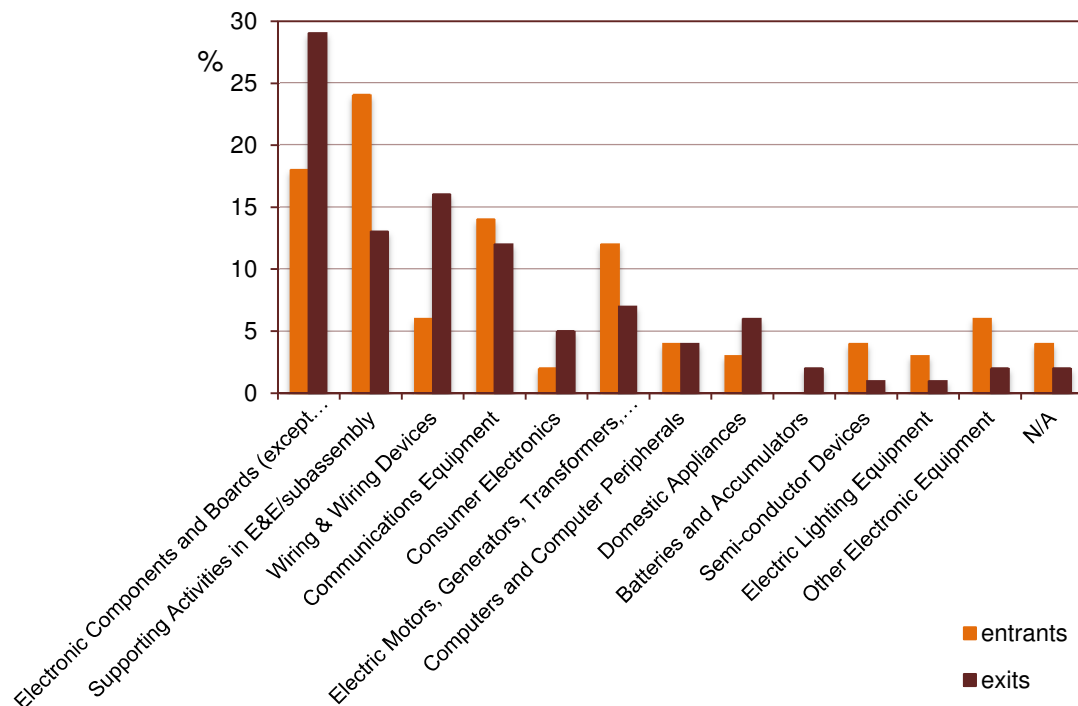
To check on this, we looked more specifically into the branch characteristics of subsidiaries that entered and exited respectively during the most recent period, 2007-2012. Information as to entering subsidiaries (in total 55 cases) referred to the initial product/operations as recorded by MIDA. For exiting subsidiaries (in total 59 cases), it referred to the last known (from the sources) product/operation prior to exit.⁴ The findings are shown in Figure Six. The differences observed are consistent with branch dynamics as shown in Figure Five. The overall picture appears to corroborate the observations made above.

⁴ The total of 59 exits exceeds entries in this case as, in the analytical methodology, double or multiple counting has been applied here as to those exiting subsidiaries that had multiple products/operations in the prior period or had changed product/operation after establishment some time before exiting.

One noteworthy change seen in the composition of firms is the increasing number of subsidiaries engaged in sub-assembly and other supporting production for activities located in either Johor or elsewhere. As we will show later on, this may be connected with a larger role over time of Singapore companies. In contrast, components and boards, wiring/wiring devices, and – less expected – consumer electronics and domestic appliances are much more prominent amongst exits. Stated otherwise, subsidiaries in these branches have been more ‘prone’ to exit, diminishing the role of these branches in the overall structure.

Thus, it may be derived that Johor’s E&E industry structure has been moving away from an emphasis on component manufacturing. However, overall the changes as yet have not been fundamental enough as to bring about a discernable trend towards upgrading. On the basis of the branching information available, we suggest that product ‘spaces’ gradually abandoned by Singapore have not moved *en masse* to Johor. Yet, some upgrading of the E&E industry structure has taken place. But, it cannot be stated categorically whether this is associated with repositioning vis-à-vis other regions or simply reflects general industry trends.

Figure 6: Industrial composition of (a) subsidiaries that were present in 2012 and entered during 2007-2012, (b) subsidiaries that were present in 2007 and exited during 2007-2012



Source: own data

In situ subsidiary evolution

Turning to the results of the company surveys, our original intention was to meet at least one-third of the operating subsidiaries in each location. Due to the logistical issues detailed above, this was not possible. A total of 40 subsidiaries were interviewed across the two locations. The salient findings are detailed below, and special consideration will be paid to a small group of firms with facilities in all three SIJORI territories.

Batam

Thirteen electronics-producing MNC subsidiaries in operation on the island were interviewed. While representing only one-fifth of the total number of firms in Batam, they are fairly representative regarding their tenure, and also include a number of long-term firms that have demonstrated considerable locational ‘commitment’.

Their nationalities and names are as follows:

- **Singapore:** Atech Electronics; Leonix; Awatronics; Jovan Technologies; and Sanwa Engineering
- **Japan:** Epson; Sumitomo Wiring Systems; and Yokogawa
- **Germany:** Epcos; and Infineon Technologies
- **Others:** China (Amber Karya); France (Schneider Electric); and Switzerland (Cicor ESG Panatec).

Of the thirteen subsidiaries, eight are green-field investments, while five are acquisitions or conversions of subsidiaries that were already located in Batam. The three Japanese subsidiaries are all green-field investments established in the early 1990s (1990, 1991, 1995). Four out of five Singaporean subsidiaries are green-field investments established in the 2000s (2002; 2003 (2); and 2008). One Singaporean subsidiary is an acquisition of another firm established in 1993. With regard to the German MNCs, Infineon Technologies is a green-field investment established in 1996 and Epcos is a brown-field investment.⁵ The other three firms – Amber Karya (2012), Schneider Electric (1991) and Cicor ESG Panatec (2000) – were affiliates already present in Batam when their parent companies were bought by another firm.

The size of the subsidiaries varies substantially. The number of employees ranges from fifteen to 3200, with an average of 1067. The two German subsidiaries have a relatively large workforce with 1950 and 3000 employees, respectively. The Japanese subsidiaries also have a large workforce, but with more variation (350, 1400, 3200). The Singaporean subsidiaries are much smaller compared to the non-Singapore subsidiaries: 15, 60 and 174 workers respectively. However, Jovan Technologies is a notable exception, with 1200 workers. As regards the other nationalities, Schneider Electric employed 1080 workers; and Amber Karya and Cicor ESG Panatec were in the middle range with 250 and 432 workers each.

While the overall trend in Batam has been for firms to relocate, ten of the thirteen subsidiaries interviewed have increased their production output since arriving. Of the

⁵ Epcos results from renaming an already existing TDK plant in 2008, upon TDK’s acquiring control of the entire Epcos company. The previously operating TDK plant used to handle Epcos outsourced component production.

remainder, Infineon Technologies has maintained stable output since establishment, and only Amber Karya and Leonix experienced a decrease. In employment terms, a majority, or eight firms, did not ramp up their number of workers. However, only in two cases (Sanwa Engineering and Yokogawa Manufacturing) did employment decrease. In one case, this was through the introduction of labour-saving production processes and, in another, through the shift of assembly to China through outsourcing. Thus, in aggregate, the firms interviewed have kept their employment numbers steady, but increased output since their establishment.

With respect to plant evolution, the following findings emerged from the interviews:

- **Mix and nature of functions:** most subsidiaries did not show significant development as to the nature and composition of functions performed; only in three cases was there enough evidence to talk of upgrading.
- **Product portfolio:** responding firms indicate that they still largely produce components and parts rather than full products. About half of the subsidiaries (7) indicate they have had a change in the product portfolio since the start of operation, while the other half (6) state that they have continuously produced the same products from the start. Some of the subsidiaries that did undergo changes diversified their product portfolio. Model substitutions commonly have taken place, including in subsidiaries that indicate no change in the portfolio. This reflects, first, the regular introduction of new generations of (final) products and, second, a shift from lower-end to high-end products in a few cases. Such substitutions involve a shift from low- to higher-technological complexity. Yet, all this is a reflection of the evolution of company products and embedded technologies, rather than the shifting roles of the subsidiary. Only a few subsidiaries have experienced a radical change in the product portfolio and have started to produce a completely different product. The majority of subsidiaries use production processes that do not require a significant part of their workforce to be skilled. As to a link between industry branch and portfolio changes, there is no clear link with the branch they currently operate in.
- **Automation:** while the size of employment would suggest production processes emphasizing labour input, many subsidiaries have substantially invested in machinery – leading to significantly increased levels of automation. And, most subsidiaries indicated that automation levels will increase in the years to come. Thus, process characteristics have definitely changed to higher levels of sophistication. However, respondents did still indicate that, in many cases, parts of the production process continue to be carried out more efficiently with the use of labour rather than of machines.
- **Production processes and technology acquisition:** in most cases, new technologies have reached the Batam subsidiary as they have been developed. Most of the time these new technologies are distributed by the company headquarters, either directly (for Singapore companies) or via regional headquarters and a higher-ranked subsidiary in the Asian region. Only in a few cases has process technology development occurred through the initiative of the Batam subsidiary in response to client demands or other circumstances. For the most part, subsidiaries have negligible research and development activities.
- **High-end production capabilities:** consistent with their product and technology positioning, less than half of the subsidiaries claimed to have high-end production capabilities of a ‘good’ or ‘very good’ level. Indeed, over half of the subsidiaries stated high-end production capabilities were irrelevant for them. In part, this

reflects the limited operational scope, or the – self-proclaimed – status as middle-range Original Equipment Manufacturer. In contrast, only a minority of subsidiaries are engaged in Own Brand Manufacturer production, which would require more in the way of R&D. The capabilities of most subsidiaries have not progressed, probably at the cost of not being eligible for high-end operations within the company network. Most subsidiaries invest in in-house labour training, as most new employees have hardly any education and experience. However, high turnover renders further training with a view to pushing subsidiary capabilities to a higher level rather risky, and increasingly a waste of resources.

Johor

With regard to Johor, 27 interviews were conducted with MNC subsidiaries present in the state. While a larger number than that carried out in Batam, this only represents about 10 percent of the total number of firms.

The nationalities and names of the firms are as follows:

- **Japan:** Funai; Han Tong Spring; Hitachi Cable; Hitachi Koki; Kami; Kyocera; Kyotech; Mitsubishi Electric; Mitsumi; Panasonic; Seii Manufacturing; Seiko; Sharp; Shinyei Kaisha; Sumitomo; and Taiko
- **Singapore:** Beyonics Precision Machining; Nestronics; Qbonics; ST Microelectronics; PNE Electrical; ITG Electronics; and T&G Electronics
- **Switzerland/Malaysia:** Escatec Mechatronics
- **Taiwan:** Yeh Brother
- **China:** Shima

Some two-thirds have Japan as country of origin, while 7 establishments originated from Singapore. The majority have had a presence in Johor for 10 years or more; only five have been present less than 10 years. Fourteen of the 27 subsidiaries are an original equipment manufacturer, two are original design manufacturers and two are original brand manufacturers. In one case, the MNC subsidiary combines OEM and ODM. Over 60% of the establishments are green-field investments, while 30% are acquisitions or a joint venture. A few are a combination.⁶

The following observations can be made arising from the interview findings:

- **Mix and nature of functions:** like Batam, the functions carried out by the subsidiaries have tended to remain fairly static. First, most subsidiaries have maintained production at the same level. Second, only 4 out of the 27 subsidiaries have significantly upgraded functions since they started operations in Johor. That said, a minority (10 out of 27) have gained some additional functions like low-level R&D, procurement and marketing. In contrast, only one lost functions.
- **Product portfolio:** a little over half the subsidiaries experienced a change in the product portfolio during the period 1995 to 2012, especially after 2000. These changes are overwhelmingly related to the substitution of products, due to the parent company deciding to phase out old generation products and allocate manufacture of new products to the plant. While a dynamic process, this is not necessarily upgrading, as it does not imply the Johor subsidiary ‘winning’

⁶ ITG Electronics (fully owned by In-Tec Global, based in Singapore) consists of several plants located in the same industrial park; one was acquired after which a new green-field plant was built next to it.

production that is relatively higher end in the company portfolio. Generally, changes reflect corporate and industry developments. A majority of the subsidiaries that experienced product portfolio changes, however, perceive such changes as moving in a higher-end direction, as products become more complex. A handful of subsidiaries indicated that upgrading has taken place over time as the product portfolio truly had changed from low-end to higher end, from lower to higher complexity and from less to more specialized. Another handful of subsidiaries indicated some upgrading over time as a higher end product portfolio was combined with either more complexity or more specialization.

- **Automation:** there is no relation between changes of functions and changes of the product portfolio. Yet, firms indicating changes stated that this was paralleled by the acquisition of capabilities and was accompanied by increasing sophistication in production processes. The latter implies, in most cases, a higher relative level of automation as well as technologies allowing greater flexibility and diversity. Such changes are treasured, as many subsidiaries are contract producers and thus have more to offer to clients.
- **Production processes and technology acquisition:** as in Batam, automation equipment and introduction of new technologies is usually arranged through the parent company and/or regional headquarters. However, it must be noted that our findings indicate that – all in all – production processes have not evolved such as to require a clearly different composition of the work force with larger share of technicians and engineers. In-house training of production workers is quite prevalent and is reflective of a shortage of skilled workers.
- **High-end production capabilities:** research and development (or design and development) performed in the Johor subsidiaries is mostly at a low level and does not contribute much to the stature of the establishments within their corporate hierarchies. In less than 10 of the 27 subsidiaries has the level of R&D has increased to a point where additional engineering staff is necessary. While some of the subsidiaries have obtained a somewhat stronger R&D profile, as product portfolio/mix and processes have changed, new technologies have reached the Johor subsidiary in most cases from outside, as is the case in Batam.

Linkage to Singapore

The survey findings on industry and subsidiary evolution do not indicate a clear trend of upgrading in terms of branches, products and processes in either Batam or Johor. This suggests that the roles of both regions in E&E industry operations and in corporate networks have not substantially changed over time, resulting in a rather persistent international division of labour.

Given this, are the linkages between firms in Batam and Johor to their Singaporean counterparts as strong as in the early phase of cross-border investment, and what does this imply about the possibilities of upgrading within the international division of labour?

Batam

The Wong and Ng 2009 report on the past and current development of Batam and other Riau Islands deals extensively with linkages to Singapore. They use a range of measures, including: perceived importance of proximity to Singapore as a factor in

locating operations in Batam; ranking of Singapore as the destination country for sales, origin of supplies, and location for key value chain activities; as well as business relationships and R&D collaborations with Singapore companies and institutions for resource needs (Wong & Ng 2009, p. 42). On most measures, linkages were found to be rather strong and important, especially the first two (Wong & Ng 2009, pp. 44-90). This reflects the fact that Batam subsidiaries are generally overseen from Singapore, while, in a substantial number of cases, the investment has been done through the Singapore RHQ or subsidiary. It should be noted that the presentation of findings by Wong and Ng does not differentiate by industry or local/foreign ownership. As such it is not possible to single out foreign-owned E&E establishments.

Moving to our own research, the wider corporate network of 50 out of the 62 MNCs present in Batam were traced. This produced the following relevant findings:

- Of these 50 MNCs, only 7 have other subsidiaries elsewhere in Indonesia.
- ALL have a significant presence in Singapore, in the form of other subsidiaries (performing manufacturing, sales, and/or R&D), a regional headquarters, or corporate headquarters. This is particularly the case for Singapore companies.
- MNCs choose Singapore to locate higher order parts of the value chain.
- In most cases, as noted earlier for subsidiaries at large, the Batam operations are attached to and coordinated from a Singapore establishment.

The interview findings are very much in line with the conclusions of the Wong/Ng 2009 report. Most subsidiaries consider the proximity to, and the connectivity with, Singapore as the key asset for their Batam operations as they have a (R)HQ, R&D/D&D facility, associated subsidiaries and/or distribution centre in Singapore. Singapore is the main source of supporting services. For subsidiaries with a less clear corporate link, Singapore remains important. All subsidiaries first ship their products to Singapore, before shipping them to other locations worldwide.

Johor

With regard to Johor, there is no other recent research that considered linkages of foreign-invested establishments with Singapore. A survey carried out in 2006 states that 41% of all E&E companies in Johor originate from Japan, followed by Singapore, Malaysia and the United States (RMA Perunding Bersatu 2006).

An analysis of firm entries and exits from Table Four shows that the country of origin of incoming firms has changed over time, with proportionately fewer Japanese firms and an increasing number of Singaporean firms. As such, this finding tends to indicate that linkage with Singapore has not just been maintained, but also become stronger.

Yet, when the wider Asian corporate network of the company is considered, some nuancing seems warranted. Here the network of the companies of the interviewed subsidiaries will be considered (this restriction is necessary as this has not been analysed yet for the entire population of subsidiaries). We list the following relevant findings:

- These MNCs have networks that span the entire region, but the networks of Singapore companies are (as yet) much less extensive than MNCs of other nationalities.
- Obviously, ALL Singapore subsidiaries have a presence in Singapore, in the form of headquarters (performing sales, and/or R&D); the headquarter establishment may also be a production centre or there is an additional – separate – production establishment in Singapore that usually caters to final production or to more advanced products.
- Not all non-Singapore MNCs have a presence in Singapore; on the contrary, about two-thirds of these MNCs do not have operations in Singapore. Therefore, in just under half of the cases (12 out of 27), the Johor subsidiary(ies) are not attached to and coordinated from a Singapore establishment.

Thus, the interview findings do reveal a number of stand-alone operations, which is in contrast to the original core-periphery structure upon which the Growth Triangle was predicated. We cannot say with any certainty whether the parent companies did have a presence in Singapore earlier but closed this down, or never had had any presence here.⁷ Furthermore, while foreign MNCs were observed to be the main drivers in the early phase, it seems that linkages with Singapore are becoming more associated with Singaporean companies. Singapore companies continue to see proximity to, and the connectivity with, the city-state as one of the key assets of the cross-border Johor region. Strikingly, at least insofar as the E&E sector is concerned, Singaporean corporations seem to have a preference for the southern Johor region over Riau.

Interestingly, a small number of MNCs (including Singaporean companies) have operations in all three spaces of the SIJORI Cross-Border Region, or in the two non-core spaces (Batam and Johor) and no longer in Singapore. We analyse three cases with a view to exploring the patterns of operations and current international ‘division of labour’ between the regions.

Some cases of multiple presence

A first interesting case is Epcos, which is a manufacturer of electronic components, modules and systems, operating from Munich, Germany. The company was established as Epcos AG in 1999 as a spin-off from Siemens Matsushita Components. In 2008, TDK Corporation acquired a controlling stake in the company. After complete acquisition by TDK in late 2009, the TDK-EPC Corporation was established in Japan. Since then, Epcos also produces under the brand-name TDK and vice versa. After the formation of the corporation, some TDK plants were renamed Epcos, while the reverse also happened to some Epcos plants.

Epcos has facilities in Singapore, Johor and Batam. The Johor and Batam facilities were originally established by TDK and date from the early phase of the Growth Triangle. Production in each of these plants specializes on a specific part of the portfolio: the Batam plant produces sensors; the Johor plant produces surge arresters; and the Singapore facility produced surface acoustic wave components. Above handling the highest value-added aspect of production, the subsidiary in Singapore

⁷ This information will be available at a later stage, once a Singapore E&E company database has been constructed.

also oversees operations in Johor and Batam on behalf of the TDK-EPC headquarters in Tokyo. In addition, TDK operates a number of facilities in Singapore and Malaysia, but these are organizationally separate from TDK-EPC.

A second case is *Beyonics Technology Ltd*, a Singaporean company that provides advanced contract-manufacturing services to original equipment manufacturers in computer storage devices, medical devices, and electronics communication products. It is also a manufacturer of precision machining parts for the hard disk drive, electronics, and automotive industry. The contract manufacturing services include: printed circuit board assembly; full turnkey system assembly; testing; packing and distribution; as well as manufacturing of plastics injection mould parts and precision stamping parts. The precision machining services include the design and fabrication of tools, aluminium die-casting and precision machining. One of its main clients is Seagate.

The various product segments are located in four manufacturing countries: Singapore, China (previously Thailand), Malaysia and Indonesia. The company operates two plants in Singapore, but most of the production has been shifted cross-border. No less than four plants are located in southern Johor (Tampoi, Kulai, Senai and Kota Tinggi), each specializing in one part of the portfolio of services. These were opened in the first half of the 2000s. In 2007, the company established an additional contract electronics manufacturing plant in Batam. To oversee all plants located outside Singapore, a separate entity was formed (Beyonics International), but housed in the Singapore headquarters.

Our last case is *Escatec Mechatronics*, a Swiss-owned but now Malaysian-registered provider of electronics solutions. This company was amongst the early occupants of industrial parks in the region; it came to Singapore in 1974 but expanded thereafter to Penang (1983) and Johor Bahru (1990). Initially, operations focused on rather simple contract manufacturing of diverse products for a range of foreign clients. Subsequent expansion saw the establishment of a factory in Riau, performing the same function. As operations became more sophisticated and diversified (it started to include also mechatronic design and manufacturing, as well as assembly of medical devices) expansion focused on Penang, where four plants were located at the end of the 2000s. In view of this, Escatec decided to close down all its operations in Singapore, from where all operations in Johor and Riau, as well as in Penang, had been coordinated. The regional headquarters function was shifted to Penang, which currently oversees plants in Johor and Riau. Thus, Escatec Mechatronics is one of the group of subsidiaries that has evolved from being established in the core area to operations in the non-core area of the CBR only.

While the number of cases discussed is too small to make stark generalizations, they do warrant a few observations. The first is that there is a great deal of differentiation as to the background of companies' operations in the Cross-Border Region. With regard to Epcos, the production links arose due to mergers and takeovers. In the other cases, these were green-field investments. Second, there are substantial dynamics which, in some case, alter the position and roles of core and non-core regions over time. Third, the early division of labour driven by resource complementarity is still visible in some companies currently operating in several parts of the CBR. However,

increasingly the division of labour has become related to product differentiation rather than steps in a production process.

6. 'Drivers' of Evolution

Theoretical work on global production networks emphasize two 'drivers' for upgrading or evolution. They are: a region's institutional context, in the form of government agencies, research institutes, and business associations, which can promote upgrading through effective generation and circulation of knowledge; and micro-level developments in firms as they acquire capabilities and technology.

Below we will scrutinize developments in the institutional environments of Batam and Johor, as well as discernable trends in corporate networks to see what roles they have played in the different evolutionary trends witnessed. We do this mindful of the fact that the electrical and electronics industry is characterized by: internal technological heterogeneity and differential pace of technological change. Thus, the local institutional contexts and corporate decisions can explain only part – at best – of the trends witnessed in the two locations.

Local Institutional Contexts

In this section, information from the surveys with the MNCs is evaluated in light of the following questions:

- How do the institutional contexts in the two territories compare, and have they had any discernible effect on the evolution of the E&E industry in either location?
- Have the local environments changed at all and, if so, do these changes matter?

In the early phase of its development, Batam's major asset for the electronics MNCs was – besides well-organized industrial parks and proximity to Singapore – its **labour supply**, which was ample and relatively low-cost. It is probably in this area that the most fundamental change has taken place, in conjunction with political and governance changes in Indonesia over the 2000s.

Following the end of the New Order in 1998, significant decentralization reforms were legislated in 1999 and implemented in 2001. Indonesia went from having one of the world's most centralized political systems to one of the most decentralized. At present, foreign affairs, defence, security, religion, justice, and monetary and fiscal authority are the only remaining responsibilities assigned to the centre. Under this framework, municipal governments have received the lion's share of government duties and responsibilities (Buehler 2010).

However, while local governments are now responsible for implementing a wide range of policies, their fiscal arrangements have not followed suit. At present, the central government raises the bulk of all public revenue, much of which it then distributes to sub-national governments to cover staff costs. As a result, sub-national governments have little incentive to raise their own revenue or, indeed, provide public goods to support investment and economic development (Shah, Qibthiyah, and Dita 2011).

Under Indonesia's current governance framework, setting the minimum wage has been decentralized to the provincial level, with considerable input from local governments. What has transpired in this complex process – amongst others – has been repeated concessions to organized labour on a yearly basis. This has come in the form of significant minimum wage increases. As to Batam, the minimum wage doubled between 2009 and 2013 (from about a little over 1 million Rp to 2 million Rp) with a further increase to 2.2 million Rp in 2014 (Van Campenhout and de Graaf 2013).

For a number of years, the minimum wage in Batam was the highest in Indonesia, the Jakarta region excepted. Wide media reporting over the years, as well as some key informant interviews, suggest that the trends in the overall evolution of the E&E industry in Batam (decreasing entry and substantial exit) can be associated with, on the one hand, the losses incurred by frequent interruption of production because of strikes and, on the other hand, labour costs becoming prohibitive for Batam as a production location.⁸

In view of these developments, it is surprising that – going by the survey findings – subsidiaries that have retained a presence in Batam are not so negative about the local labour-force. While all consider labour availability and costs as 'important' or 'very important', the large majority judge their quality in Batam as 'neutral' or 'good'. Explanations for this could lie in other factors rendering the issue less urgent, such as: the nature of the operations currently undertaken on the island; the cost-quality ratio of labour offered by other competing locations; and the option to engage in production automation to reduce dependence on labour.

Actually, the interviewed firms were more bothered by the cost of labour and its relatively static skill level (reflecting little change in the quality of education and education infrastructure). Yet, findings here were mixed, with about half of the subsidiaries rating labour skills as good. It was apparent that many interviewed subsidiaries evaluated the local environment from the perspective of current operations rather than upgrading potential. Labour skills emerged as a factor that has prohibited some subsidiaries from moving towards higher-end operations and upgrading, but not others. That said, the impression gained is that most subsidiaries did and do not have such intention.

However, the process automation option adds complexity to this. Whether labour cost-riven or product development-driven, it has rendered labour issues less pressing. As we have shown earlier, the current stock of E&E subsidiaries in Batam can be labelled as 'long term stayers'. This raises the question as to what the source of their continued locational commitment is, as they have undertaken limited upgrading and do not have significant plans to pursue upgrading in the future. Subsidiaries did not indicate a significant base of **local supplier firms** that could help in such an endeavour. In addition, subsidiaries showed little enthusiasm about the quality of the **physical infrastructure** and of the **living environment**.

⁸ Interviews with: senior manager from an industrial park, Batam, 12 February 2014; representative of a local business association, Batam, 22 May, 2013; economic analyst, Batam, 22 May 2013.

As to **local government**, efficiency, pro-activeness and interaction potential were deemed important by firms; a majority of subsidiaries rated these aspects as ‘neutral’ or ‘bad’ in Batam. This may not be surprising in view of the increased complexity of governance in Indonesia, which often implies negotiating with various layers of government. Our findings are in line with the rather low appreciation of, and satisfaction with, the regional environment as well as various other competitiveness factors in the company survey conducted by Wong and Ng (2009).

The institutional factors indicated above appear to contribute also to little significant change (to the better) as to administrative and bureaucratic *modus of operandi*, hindering effective and pro-active monitoring of industry development on the ground. Information gleaned from some key informant interviews may shed additional light on this. Informants related problems arising from: slow investment approvals; an overlap of responsibilities between the Batam municipal and Riau provincial governments; a current policy focus on traditional agricultural pursuits such as farming and fishing.⁹

With regard to **Singapore**, most subsidiaries considered the proximity to the city-state to be an important asset. While Batam still offers cost advantages, Singapore can supply a wide range of services lacking in the former. Although we have not verified this, it may be suggested that, for the group of ‘stayers’, linkages with Singapore have been and remain more strong and essential for their operation than for the group that has exited over the past 5-10 years. The outcome is apparently double: the advantage still makes Singapore the preferred location for higher-end operations; and while the linkage in proximity underlies the logic of Batam operations it also *hinders* rather than facilitates their upgrading.

Turning to Johor, many similar trends are apparent. With regard to **labour**, subsidiaries rate this attribute as ‘important’ to ‘very important’. Interestingly, scores on their quality are significantly lower than for Batam. This reflects, in part, the tightness of the labour market that set in some time ago. The government has addressed this by allowing firms to recruit foreign labour (at favourable conditions). While this has, to an extent, relieved the issue of the labour shortage, most foreign labour that has entered is rather low-skilled. On the domestic front, labour market and education policies have done little to significantly improve skills of domestic labour (World Bank 2013). And, to the extent that they have, there has been and is substantial siphoning off in the middle and higher end of the labour market by companies in Singapore recruiting personnel in Johor.¹⁰

This situation provides little incentive for subsidiaries to engage in worker upgrading schemes. More recently introduced minimum wages complicates matters further. As these do not differentiate between sectors and industries, employment preferences of local labour have led to a tendency of workers to gravitate towards non-

⁹ Interviews with: senior manager from an industrial park, Batam, 12 February 2014; representative of a local business association, Batam, 22 May, 2013; economic analyst, Batam, 22 May 2013; provincial government employees, Batam, 12 February, 2014.

¹⁰ This is corroborated by key informant interviews with: senior manager from a large local E&E manufacturer, Johor Bahru, 17 May 2010; senior manager from a large manufacturing multinational, Gelang Petah, 18 May 2010; senior representatives from a local business association, 28 April 2010; and members of an SME working group from a local business association, Tebrau, 22 April 2010.

manufacturing jobs. As to these human capital issues, it is noteworthy that there is nuance here in subsidiary *evaluation* according to degree and type of upgrading. Subsidiaries that are in the category ‘no upgrading’ evaluate these aspects significantly more negatively.

With regard to the **local technology base** (a regional innovation system with opportunities for technology cooperation with other firms, technology research and educational institutions, government technology programs), subsidiaries here rated the importance of the technology base even lower than that of labour.

In line with Batam, while the importance attached to the local supply base is the same as to the technology base, evaluation of the former by MNC subsidiaries in Johor is better, although variable. The supplier base of firms is rated lower for their diversity than for their quality, which could hinder some subsidiaries from diversifying.

In terms of both importance and evaluation, **infrastructure** (esp. physical and ICT) and connectivity rank highly as elements of the regional environment for upgrading, more than Johor’s infrastructure *per se*. The high evaluation is primarily based on the **easy access to Singapore’s** infrastructure and facilities for international connection. In cases where the parent company is located in Singapore, proximity works against, rather than encourages, upgrading. For non-Singapore MNC subsidiaries whose parent company retains operations in Singapore, it appears that proximity does not necessarily hinder upgrading.

Government and governance dynamics in Johor have been virtually the opposite compared to Riau/Batam. In 2006, the Malaysian government launched the Iskandar Malaysia region, which is an economic corridor in the southern part of Johor that explicitly aims to tie in to Singapore’s economic needs. While accompanied with considerable federal funds for physical infrastructure, the corridor’s establishment has added complexity, as its regulatory agency sits in-between the federal and state government bureaucracies (Hutchinson 2014).

In general, the picture that emerged from our study is that MNC subsidiaries judge the local government context in Johor to be somewhat better than Batam. Those subsidiaries that have already upgraded operations rate the government fairly well. In this respect, there is no significant differentiation between federal and state institutions. Subsidiaries apparently are not hindered by the federalization of regional governance; however their appreciation of federal government is more related to agencies like the Malaysian Investment Development Authority that is responsible for setting the system of investment concessions and incentives, and disbursing these to investors.

As of yet, the effects of Iskandar Malaysia’s establishment on the composition and availability of labour has yet to have an impact. However, this may become more evident in the future as a number of new developments in the field of education – the setting up of campuses by foreign educational institutions start to bear fruit.

Another observation is in order. In Malaysia, subsidiaries in the manufacturing industry, E&E included, operate in an environment whereby institutions perceive manufacturing industry development as ‘one priority among many’ (Hutchinson

2012). In the case of Johor (and Malaysia at large), a close linkage has developed between ethnic policies and factors – Bumiputera development – and bureaucratic incentive structures. Thus, both federal and state government policies have supported local entrepreneurship in a range of sectors including shipping, hotels, medical services, and training. Where they do support manufacturing, it is usually through state-owned enterprises – largely bypassing the local and predominantly-Chinese manufacturing sector (Hutchinson 2012).

For the time being, notwithstanding institutional introspection surrounding the ‘Middle Income Trap’ and Economic Transformation officially laid down in the Economic and Government Transformation Programmes (Pemandu 2012), no fundamental change in governance principles are evident. Rather than moving the institutional configuration and outlook in a different direction, the federalization of regional governance has pushed regional governance deeper into long-standing tenets that, for many, are a hindrance to fundamental economic upgrading.

Subsidiary and headquarter/corporate network

This next section looks at the potential importance of subsidiary-level factors and corporate networks in affecting upgrading trajectories – including competition between affiliates of the same multinational corporation to attract and retain higher value-added operations.

As to Batam, given their relatively low position within their own corporate networks of affiliates, it was not surprising to find that many subsidiaries show a low level of autonomy and initiative with respect to developing their own operations. Besides rather extensive operations in Singapore, companies of which the Batam subsidiary is part have developed an extensive corporate network of subsidiaries (and external collaborative production arrangements) in the Asian region.

Indeed, the 50 MNCs (of the 62 that could be analysed) own, in total, 573 subsidiaries dispersed over seventeen countries in the Asia-Pacific region. Besides Singapore, Malaysia, Japan, China, Hong Kong, India, Philippines, Taiwan, Korea, Thailand, and Vietnam were the most significant locations. Japanese MNCs have the most extensive networks of subsidiaries, collectively owning 386 subsidiaries in the Asia-Pacific region (67% of the total), including Japan.

Singapore ‘MNCs’ have a less extensive regional network than non-Singaporean MNCs and their network is still more often governed by geographical proximity, with Indonesia and Malaysia being the most frequent locations. Given that the headquarters of Singapore ‘MNCs’ do not have so many locational options for their subsidiaries, it appears that the role of the regional network is less important than the environmental attributes of a specific location in determining upgrading potential. And, the main reason for limited upgrading for the firms in Batam is the decision of the headquarters to retain higher-end operations in the home country.

As to other MNCs, in principle, locational options for the higher-end part of the portfolio or operations are wider. Therefore it is interesting to consider perceptions by subsidiaries of the level of competition between different affiliates for investment and company charters for more complex operations (although headquarters are a more

proper source of information as to the process of the distribution and allocation of charters in the company).

If the idea of locational commitment combined with limited upgrading derived from linkages with Singapore holds, one would expect low perceived competition from other subsidiaries where existing operations are concerned, and more so as to the possibility of ‘winning’ mandates for higher-end work. This is in view of the top-down corporate decision making processes that make the headquarters consider other subsidiaries for the allocation of higher-end activities.

Indeed, many subsidiaries indicated that their relationship with other subsidiaries is one of ‘complementarity’ and ‘collaboration’ rather than ‘competition.’ Subsidiaries relate this to the different responsibilities regarding the corporate product portfolio and/or different geographical markets served. Many subsidiaries, especially those that are part of a large company, regard relationships with other subsidiaries as ‘important’ as they are aware of the relevance of position in the corporate network as to the charter that is allocated.

Furthermore, many subsidiaries are aware that while the Batam operations are not central for headquarters, quantitative performance and quality are important considerations for decision-making. Capabilities are geared to the current product portfolio tasks and subsidiaries generally prioritize quantitative targets and quality benchmarks - which underpin their ability to achieve the set performance standards. Beyond that, they are aware that capabilities to win higher-end charters may develop in other subsidiaries as the emphasis in the Batam subsidiary is on absorbing technology rather than contributing to its creation for the firm.

A somewhat similar story can be told for Johor – albeit with certain nuances. In this case, we found more variation amongst subsidiaries as to the level of autonomy and own initiative with respect to developing their operations. This variation correlates with the level and types of upgrading undertaken by the various subsidiaries. Those without upgrading showed the least autonomy and initiative.

As put forward above, Johor subsidiaries show diversity as to their links with Singapore (e.g., stand-alone subsidiaries versus Singapore companies). Beyond Singapore, many companies of which the Johor subsidiary is part have developed a rather extensive corporate network of subsidiaries (and external collaborative production arrangements) in the Asian region. This is especially the case for Japanese companies.

Again, Singapore ‘MNCs’ have a less extensive regional network than non-Singaporean MNCs and their network is still more often governed by geographical proximity. Given that the headquarters of Singapore ‘MNCs’ do not have so many locational options, the role of the regional network appears less important than environmental attributes of Johor vis-à-vis Singapore in determining upgrading trajectories.

As to other MNCs, perceptions by subsidiaries of the level of competition with other regional subsidiaries of the company should differ somewhat relative to Batam – given the differences in upgrading characteristics. Although a fair share of

subsidiaries indicated that their relationship with other subsidiaries in the current situation is one of ‘complementarity’ and ‘collaboration’ rather than ‘competition’, there is indeed a higher occurrence of subsidiaries indicating the latter compared with the Batam subsidiaries.

Furthermore, there is indeed variance within the Johor group according to level/type of upgrading: subsidiaries that did not experience upgrading more often mentioned ‘complementary’ and ‘neutral’ as to their relationship with other subsidiaries of the company. Again, these subsidiaries relate this to the different responsibilities as to the corporate product portfolio and/or different geographical markets served. And again, many subsidiaries observe that, as to the charter that is allocated by the headquarters, historical performance and quality are most decisive.

However, while these are important operational yardsticks, many do not look at regional endowments – or the lack thereof – as constituting either a boon or a hindrance in this regard. It was evident that many subsidiaries conceive of capabilities as having to underpin their ability to achieve the set performance standards in relation to the allocated product portfolio tasks. Generally, subsidiaries that have not upgraded hardly think of opportunities beyond day-to-day production.

While the above lends some support to the importance of corporate networks in influencing *in situ* subsidiary evolution, evidence is not very strong. We were not told of instances where the Batam or Johor subsidiary was not allocated a charter for new products because of the availability of an alternative subsidiary at an alternative location to carry out the same function.

7. Conclusion

This research has sought to fill a void related to the neglect of corporate behaviour in the available information on sub-regional industrialization in the context of cross-border regions or ‘Triangles’. It has also addressed the lack of documentation of processes of industrial evolution in the SIJORI Cross-Border Region.

Through the lens of the electrical and electronics industry and its constituent firms in the territories of the SIJORI CBR, we have sought to answer a number of questions. The paragraphs below will summarize the results of our research.

Overall Evolution

Both the core region as well as the non-core regions have been affected by changes in the global economic industry. Several general observations can be made.

First, global industry changes have had different impacts in the two non-core regions of Johor and Batam. Over the last twenty years, the E&E industry in Johor has grown quickly and consistently. This is not the case for Batam. Following an initial boom period of ten years, the subsequent ten years have been characterised by sustained attrition. While at its peak, Batam’s group of E&E firms was never more than two-thirds the size of its Johorean equivalent, by 2012 it was only one-quarter the size of its northern counterpart.

Second, both firm groupings are comprised of older firms that set up more than ten years ago. However, this 'maturity' is even more marked in the case of Batam, which has had fewer arrivals than departures of late. That said, firm surveys with about a quarter of MNCs on the island indicate that many firms that have stayed, have actually kept employment numbers stable and ramped up output. This means that the island could continue to enjoy sustained support from a group of 'committed' firms.

Third, in both territories, Japanese and Singaporean MNCs are the two largest communities. In Johor and Batam, Japanese firms were the pioneers, making up the bulk of the early arrivals. And, in both cases, the number of Japanese firms arriving has decreased in recent years. However, the pattern observed with regard to Singaporean firms is different in the two non-core locations. In Batam, firm arrivals from the city-state have been steady over time, with the exception of a small surge in arrivals in 2000-02. In Johor, firm arrivals from Singapore ramped up in 2000-02, and since then have remained relatively high, making the city-state the prime source of investment. Also of note in Johor is the presence of a number of joint ventures between Japanese and local firms, as well as a number of Malaysian-owned MNCs. There is no equivalent in Batam.

Fourth, data issues preclude definitive conclusions being made about evolution in the composition of the electronics sector in either location. That said, available evidence seems to indicate a slight shift away from consumer electronics towards electronics components in Batam. Given the generalized attrition in the ranks of Batam's MNCs, this could simply mean that the components sub-sector has proven more resistant and thus increased in relative terms. The other discernible characteristic is the arrival of two global CEM firms in Batam. With regards to Johor, we see a relative decrease in the importance of electronics components production as well as consumer electronics. And, we see an increase in the number of firms involved in semiconductor device production, as well as sub-assembly activities. The last sub-sector is most likely connected to the influx of smaller, Singaporean firms. While a welcome development in the face of the departure of Japanese MNCs, this new development may not have positive implications for the generalized complexity of operations undertaken in Johor.

Upgrading

Turning to firm surveys, available information indicates very limited progress towards upgrading.

With regard to Batam, only a minority of firms (3 out of 13 interviewed) have upgraded in a significant way. Most firms continue to produce parts as opposed to finished products, and there has been relatively little diversification or change in product portfolios. One significant trend has been the phasing out of production of older models and their replacement with newer equivalents. However, this does not represent upgrading, but merely 'keeping pace' with industry developments and overall technological capabilities within the corporate network.

The situation in Johor is also not overwhelmingly positive, but does have some interesting developments. Only four out of the 27 firms surveyed have upgraded

significantly. That said, 10 firms have taken on some additional functions since arriving, including low-level R&D, procurement and marketing. As with Batam, a majority of respondents indicated that increasingly complex production processes were related to substituting older models with newer equivalents – and did not constitute upgrading *per se*. That said, a subgroup of firms indicated considerable movement towards greater complexity and specialization in their production processes.

With regard to automation, a significant firms in both locations have moved in this direction. In Batam, this has been a significant trend among respondents, explaining the dual phenomenon of stable employment numbers and ramped up production. While this can be interpreted as a positive development, our survey findings indicate that this option has been undertaken by firms in response to skill shortages. In addition, in neither Batam or Johor have automation processes been accompanied by a structural shift in worker profile, with skilled workers and engineers remaining in the minority.

Regarding production processes and the acquisition of technology, firms in both locations indicate that technology is acquired by their headquarters and subsequently distributed to subsidiaries. And, subsidiaries in Batam and Johor report that they do not have high-end production capabilities. Indeed, most subsidiaries in Batam indicated that higher level capabilities were ‘irrelevant’ for them. In contrast, the picture in Johor is more mixed. R&D capabilities – albeit low level – are more prevalent, and in some cases have required additional engineering staff.

Cross-border corporate hierarchies and linkages

The original conceptualization of the Growth Triangle placed Singapore at the centre of the regional division of labour, assuming the most complex and value-added tasks. For their part, Batam and Johor, being later entrants to the industry and having a comparative advantage in labour-intensive production, occupied less value-added production ‘spaces’. In the past twenty years, there have been a number of developments that have called this original conceptualization into question.

Recent literature on developments in the E&E industry in Singapore indicate a move towards greater specialisation and complexity. In particular, the output and value-added of the semiconductor sub-sector has increased substantially and other product ‘spaces’, notably consumer electronics have shrunk. However, an analysis of the current composition of production in Batam and Johor does not indicate that either location has moved into or sought to capitalize on this development. Thus, while the city-state has progressed up the value-chain, it has not been accompanied in the same fashion by the other territories. Very broadly, these two territories are engaged in the same production tasks as at the outset, with some additional value-added being undertaken by firms based in Johor.

This is not to say that Batam and Johor are not ‘linked’ into Singapore. Indeed, all of Batam’s MNCs are firmly wedded to global production networks that pass through and are embedded in Singapore. While Johor is, in general, also very much connected to Singapore, the picture is more complex. Broadly, three patterns can be discerned. First, a group of MNCs has retained the traditional model of a higher-end facility in

Singapore coordinating one or more production-oriented affiliates in Johor. Second, some MNCs have closed down their operations in Singapore, but retained their existing facilities in Johor. Third, a new cohort of Singaporean firms have moved across the border and established production facilities in Johor. Available evidence indicates that these firms tend to be smaller and have regional – as opposed to global – reach.

'Drivers' of Evolution

With regard to the 'drivers' of evolution or upgrading, firm surveys indicated slightly different dynamics in Batam and Johor.

Regarding the local institutional context and its role in promoting and facilitating upgrading, firms in the two locations raised concerns about: the availability and quality of labour; the local supplier base; and the functioning of a regional innovation system driven by local universities, research institutes, credit providers, and business associations. Thus, the immediate environment in both locations is not conducive to MNC subsidiaries seeking to upgrade or sub-contract more value-added tasks to local firms.

For its part, Johor does emerge more favourably as regards the quality of its physical environment, although this seems more to do with its land-based (and more flexible) links to Singapore. In addition, the Malaysian state received more favourable evaluations regarding the quality of its government, both national and local. In contrast, respondents in Batam were less positive about the quality of their regional government, particularly as regards responsiveness and handling of industrial relations.

With regard to the role of individual subsidiaries on one hand and corporate networks on the other in driving upgrading, MNCs subsidiaries in Batam reported low levels of autonomy and initiative. They reported little competition with other subsidiaries to attract or retain corporate mandates for new products and associated investments in technology. Thus, individual subsidiaries were in a passive position, accepting the company charters that they were awarded and then, subsequently, striving to incorporate the associated changes in production and master new technology.

The picture emerging from Johor is a little bit more positive. Respondents recorded a wider variation in terms of their autonomy and initiative, with a little bit more room for agency and entrepreneurship at the firm level. Consequently, subsidiaries were more likely to categorize their relationships with other firms in the corporate network as 'competitive', rather than 'collaborative'. In addition, given that Singaporean firms are a larger component of investments in Johor and that they, being smaller, have lower levels of competition for product mandates, this means greater potential for firms based here to upgrade.

Future Implications

What does the future hold for the E&E industry in these two non-core territories of the SIJORI CBR? The answers to these questions seem to be different according to whether one takes a Riau/Batam or Johor perspective.

With regard to Batam, industry trends over the last ten years are cause for serious concern. Above and beyond the overall attrition of the base of MNC subsidiaries, there has been little in the way of upgrading or significant developments in product portfolios. Furthermore, the local institutional context is not conducive for risk-taking and learning, and the current position of Batam-based subsidiaries within their own corporate networks entails little autonomy. That said, survey responses indicate that, for a significant number of firms, employment has remained steady and investments have been made in automation to ramp up production. Thus, barring a critical juncture, it is likely that Batam will continue to constitute a production base for those firms that have already made sizeable investments on the island.

Turning northward, prospects seem better for Johor, given discernible developments in the industry, firm numbers, sub-sectoral composition, and the local institutional context. Firm arrivals have been generally steady, and the Malaysian state now has a substantial base of subsidiaries. Of note is the proportionately greater number of Singaporean firms who are moving to establish facilities in Johor. This movement of firms has compensated for, to a large degree, the relocation of Japanese firms that has affected both locations. This change in composition has been mirrored by a slight decrease in the importance of consumer electronics and semiconductor-producing firms and an increase in sub-assembly activities. While an important mitigating factor, this new development may imply a greater prevalence of less technologically-demanding sub-assembly activities.

Relative to Batam, firm surveys have revealed somewhat more progress regarding product mandates, upgrading, and technology acquisition. In addition, the position of Johor-based subsidiaries within their own corporate hierarchies seems to allow more autonomy and entrepreneurship. Regarding linkages to Singapore, the picture is considerably more diverse than originally anticipated, with three different 'models' of firm networks. The original core-periphery pattern has been maintained for a number of MNCs. In addition, two other patterns have become more prevalent: MNCs who have closed operations in Johor but retained them in Singapore; Singaporean large firms who have opened new facilities in Johor.

Given the above, it is possible that, in the near future, the Triangle construct will be effectively replaced by a Singapore-Johor binary relationship of considerable depth and complexity, complemented by a small detachment of 'committed' firms retaining production in Batam.

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