


The evolution of the electronics industry on Batam Island (Riau Islands Province, Indonesia): an evolutionary trajectory contributing to regional resilience?

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Abstract While extensively studied in the 1990s, research on the electrical and electronics (E&E) industry in Singapore and the proximate areas of Indonesia has dwindled. Focusing on the E&E sector in the island of Batam (Riau Islands Province, Indonesia), we examine the industry's recent evolution, in particular its 'robustness'—its durability and capacity to adapt to adverse events. As to the explanatory factors accounting for its robustness, we evaluate the role of agency as opposed to conventional approaches that focus on structure. Our findings show that, in Batam, the E&E industry's robustness has started to suffer. While there is evidence that structural factors are at work, we argue that agency in the form of institutionally-embedded perspectives and behaviour of actors at the sub-national level also plays a role. Because the promotion of economic diversification through investment in new sectors is easier and more lucrative than upgrading and deepening of firm capabilities in

existing sectors, agents privilege the former at the cost of the latter. At the end of the day, regional resilience is undermined, rather than reinforced as evinced by the recent atrophy of Batam's E&E industry.

Keywords Electronics · Regional resilience · Robustness · Adaptiveness · Adaptation · Agency · Batam · Singapore

Introduction

In past decades, sub-national regions in Southeast Asia have pursued export-oriented industrialization to diversify their economies and boost growth. As part of this strategy, multinational corporations (MNCs) were enticed to relocate production to these locations by incentives, specialized infrastructure, and lower factor costs such as land and labour. In many cases, investments were in the electrical and electronics (E&E) industry that, due to its scale and employment needs, became the dominant economic activity in these regions.

While new and technology-intensive activities are always welcomed, the debate on regional economic development in Southeast Asia has evolved. Beyond simply seeking to attract investment, downturns in the E&E and other export-oriented sectors have generated an interest in promoting sectoral 'diversity' as a means of maintaining income growth and ensuring economic resilience at the regional level. Consequently, this has become a topic of enquiry in regional studies,

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economic geography and related disciplines. The conceptual foundation of the study of diversity and its implications for resilience has been enriched by the evolutionary approach, which has contributed concepts such as ‘branching’.

This article seeks to contribute to the understanding of regional resilience in the Southeast Asian context by analysing the development of a specific location. We consider the export industrialization path of Indonesia’s Riau Islands Province, especially the island of Batam. Situated a mere 20 km from Singapore, the island grew and thrived by attracting spillover activity from the city–state due to its lower labour and land costs. Our focus is the evolution of the E&E industry over the past quarter-century. Dominating the industrial structure of the island at the time, this industry was well covered in the literature in the 1990s, due to interest in: Singapore’s ‘spatial fixes’ for declining competitiveness; industrial regionalization; and the ‘SiJoRi’ Growth Triangle. The Growth Triangle is a concept used by the governments of Singapore, Malaysia, and Indonesia to market the city–state and the bordering areas of Johor in Malaysia as well as the Riau Islands as an integrated ‘package’.

In the wake of recent global downturns, attention has shifted from tracking the growth of the E&E industry to analysing production network resilience (Obashi 2009) and industry robustness (Rasiah 2009; Rasiah et al. 2014). However, the analysis has been macro—including a macro-regional scope—and the perspective limited to establishing the effects of these downturns. No attempts have been made so far to ‘map’ and interpret the development of the industry in the region, notwithstanding substantial structural change in Singapore.

The research reported here attempts to fill this void. Set within a view of the sub-national region as a complex adaptive system, this article will explore two angles. The first one is the ‘robustness’ of the regional economy, especially in terms of the evolutionary trajectory of its dominant industry. Here, robustness refers to the industry’s durability and positive adaptation in response to—or in anticipation of—adverse events. The second one is receiving renewed attention in resilience studies and concerns the role of agency in relation to the institutional environment within which the industry evolves to explain the trajectory—as opposed to ‘structure’.

We demonstrate that the recent trajectory of the E&E industry in Batam raises questions about its

robustness. In particular, through analysing firm behaviour, we argue that—beyond industrial structure and external events—the institutionally-embedded behaviour of decision-makers explains current developments, particularly the attrition of the E&E sector. In particular, in focusing on ‘diversity’ at the regional level, policy-makers in Batam have not paid sufficient attention to encouraging the E&E industry to adapt and acquire deeper capabilities. We argue that this is due to the incentive structure embedded in the local institutional environment, particularly its governance arrangements, which have recently undergone significant shifts. We conclude that, without a significant emphasis on positive adaptation, in particular encouraging technological deepening, the robustness of the E&E sector is jeopardized and the quality of growth will remain mediocre at best.

The article proceeds as follows. In the second section, we frame our industry and regional analysis with reference to recent theoretical work on the evolutionary trajectories of industry, as well as economic resilience and robustness. The third section provides an overview of Batam, its economic development, and the E&E industry. The fourth section details our methodology and sets out the recent evolution of the E&E industry. The fifth section discusses the determinants of the industry’s trajectory. The last section concludes.

Theoretical framework

A core idea in the literature on regional resilience is the ability to adjust to, withstand, or anticipate adverse events. Framing the region as a complex adaptive system, Boschma (2015) sets out the concept of ‘adaptive capacity’. This refers to the ability of a region to reconfigure its socio-economic and institutional structures to develop new industries. This is different from the concept of ‘adaptation’, which refers to the tendency of individual industries to change in response to changing circumstances.

The incorporation of ‘robustness’ and ‘agency’ into this framing of the region requires shifting the scope of analysis in three ways. First, from the region to an individual industry within it; second, from the initial ‘creation’ of an industry to its subsequent evolutionary trajectory; and third, from merely tracing the industry’s evolution to uncovering its underlying determinants.

As to the first two aspects, the principle industry evolution model featuring in resilience, path-dependence, and local innovation systems literature proposes four phases in the development of an industry in a given region (Martin and Simmie 2008; Simmie and Martin 2010). In the first, ‘pre-formation’ stage, there are stimuli for a new industry, which constitutes a window of opportunity. Regional fundamentals such as its policy environment and labour force, as well as the corporate objectives of potential MNC investors, determine whether the opportunity can be grasped. If this succeeds, the industry enters the second phase—called ‘creation’—where a nucleus of firms emerges. With the increase of mass, other firms are formed or attracted by reputable first-movers and the industry is established, entering the third phase—termed ‘positive lock-in’. External competition, ossification, or other circumstances may cause the industry to lose momentum, and enter ‘stasis’ or ‘decay’. This fourth phase is evident as key firms downsize, move out of the region, and/or close.

However, the last phase is not inevitable. Decay will not set in if firms evolve positively through deepening or renewing operations, or the industry develops new branches (Martin 2010). ‘Reinvention’ may occur if regional externalities are dynamic enough to maintain the attractiveness of the region to firms.

These four stages are set out in Fig. 1. The development of the trajectory (Y-axis) can be measured by indicators such as the number of firms; total number of workers; output; and value-added. We hold

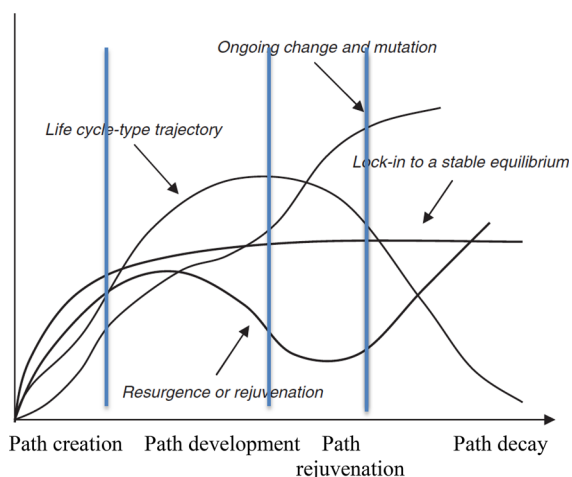


Fig. 1 Alternative industry trajectories. *Source:* Martin (2010)

an industry trajectory to be robust if it maintains growth for an extended period, and internal change reveals positive adaptation through mutation (involving renewal, substitution, and deepening of capabilities). An industry trajectory contributes to regional resilience if it shows features of robustness, thus positively contributing to diversity. These include durability and adaptation. For regions, structures that allow positive industry trajectory dynamics (adaptation) are important, next to opportunities for the creation of new growth paths/industries (adaptiveness).

As to the third aspect of our conceptual ‘reframing’, namely the underlying determinants of an industry’s evolution, the prevailing consensus privileges the importance of structural factors. In evolutionary economic geographic literature, reference is made to the following elements: source; initial structure; external conditioning factors; fundamentals; externalities; absorptive capacity; local technological system; and distance from other regions with other endowments (Boschma 2015; Martin and Sunley 2006, 2015; Martin and Simmie 2008; Martin 2010; Simmie et al. 2008; Simmie and Martin 2010). Those most relevant to an overall interpretative framework of industry evolutionary trajectories are briefly elaborated below.

As to source of a new industry, the literature refers to *inter alia* indigenous creation; technologically related diversification; and transplantation from elsewhere (Martin and Sunley 2006). Evolutionary economic geographic thinking emphasizes the first two sources. However, in Southeast Asian regions, transplantation has been the dominant source as investments by multinational companies have been the main driver (Felker 2009). While regions can benefit from Foreign Direct Investment, it also ‘exposes’ them to changing corporate strategies and locational ‘preferences’, as companies respond to changing circumstances and the differential development of local environments (Edgington and Hayter 2013).

As to initial structure, one key aspect is the composition of the industry in question—particularly the degree of dominance of flagship firms and the degree of specialization within the different ‘branches’ of the industry—i.e. narrowly-specialized versus broader sub-sectors. A narrow branch structure could leave the industry vulnerable to adverse events hitting the dominant branches. Second, a continued focus on processes that emphasize easily replicable production factors, rather than on branch upgrading

makes the industry sensitive to outside competition. A third aspect is the functions that an industry performs in a region. A focus on a single low value-adding function (like assembly) or, conversely, a diverse portfolio—including high value-added operations like research and development—affects the vulnerability of the industry.

External factors include: market development; the speed of technological change in the industry; national development objectives influencing priorities at the regional level; and jurisdiction at the regional level over factor markets such as land and labour. Whether national or regional, the public policy regime and level of state activism influence other fundamentals and externalities. These include the orientation and institutional ‘embedding’ of entrepreneurial culture, the education system and learning institutions, as well as infrastructure. Externalities pertain to the development of the knowledge base, technology system, labour skills, finance, and business organization. Government activism directed to their ‘creation’ and proper functioning often determines the absorptive capacity of firms, crucial for robust industry evolution.

However, while useful for understanding the birth and evolution of a particular industry, the structural view does not factor in the role of agency. The latter is explicitly brought in by Martin and Sunley (2015). Set within a longstanding line of thinking in regional studies oriented towards institutional action and agency in general (Martin and Sunley 2006), Bristow and Healy (2014a, b) argue that underlying many of the structural elements discussed above is the operation of agency by multiple actors such as firms, policy makers, labour, consumers, and civil society. A dominant role is performed by government, which privileges a focus on state intervention. The behaviour of agents and their outcomes shape the perceptions firms have about their operating environment. In the case of MNC subsidiaries, these are often communicated to corporate headquarters, affecting the locational commitment of firms (Edgington and Hayter 2013).

In the following sections, we explore the influence of agency in influencing the trajectory of the E&E sector in Batam. Agency should be considered from several angles. First, who the agents are and which of them is dominant. Second, the room that regional or local agents have to devise and implement interventions and the approach they take. Third, the disposition

of dominant agents as a reflection of the wider institutional, and especially socio-cultural, embedding (Bristow and Healy 2014a, b; Martin and Sunley 2015).

As to the first, Bristow and Healy (2014a) distinguish between individual action derived from compartmentalized interests, and collective action where inclusiveness and common interest drive networked governance across agents. The latter type of action assumes little power asymmetry. However, more often there are differential and competing interests and asymmetries in power relations between government and other agents. These may translate into differential influence on institutions. Next to public agencies and other formal institutions, there are private agents, comprising: individual businesses; business organizations; worker organizations; and other civil society organizations. A proper conceptualization of agency requires that even the government is not depicted as a unitary actor—but rather as layered, with shifts in responsibilities and jurisdictions.

As to the second angle, behaviour can be: anticipation, leading to proactive intervention; reaction entailing ad hoc responses to events; and transformation, entailing reconfiguration of behaviour in response to new challenges or opportunities. In this respect, agent competition and collaboration matters through their influence on regional agenda. When powerful coalitions form, these may become agenda setting—privileging certain adaptive and adaptation processes above others. This may not necessarily promote positive industry evolution through anticipation.

Shifts in the structure of autonomy that agents enjoy may have far-reaching implications. Centralization or decentralization implies a repositioning of the sub-national level. In the former case, the national level penetrates the sub-national, often through a visible institutional presence. In the latter case, there is retreat of the national, with greater jurisdiction being granted to the sub-national. Such shifts influence not only the organizational structure of agents, but—equally important—agendas and behaviour.

Here, the third angle enters. Agents operate within and from socio-culturally, politically, economically influenced incentive and opportunity systems. A specific incentive system may prompt the power elite and policy makers to pursue diversification through encouraging the creation of various industries. While showing ‘adaptiveness’, there may be a downside to

this. This could be harm to ‘adaptation’ as industrial focus, critical mass and depth are lost. Doing many things may not lead to excellence in any aspect of the region’s economy, as a result of which local industries are more likely to stagnate and/or decline (Boschma 2015). Industry evolution can be influenced negatively by a biased trade-off between ‘adaptiveness’ and ‘adaptation’ towards the former.

The tension between ‘adaptiveness’ and ‘adaptation’ may be enhanced by government agencies’ ideas regarding a given industry and its perceived stability or maturity. Ideas may be shaped by perception rather than information-based knowledge and communication with relevant actors, as well as value judgements relating to organizational goals (Bristow and Healy 2014a). Furthermore, these goals may be skewed toward short-term reactive interventions that encourage more of the same, due to electoral considerations. This may then encourage ‘more of the same’, with neglect of long-run prospective interventions that stimulate reorientation and depth.

The role of agency has already been given (renewed) attention in recent research into the evolution of Southeast Asian (export) manufacturing. Its consideration has been mainly in relation to mutation in the forms of industrial upgrading and advancing in—global and/or regional—production networks (Albada 2015; Intarakumnerd et al. 2015; Rasiah et al. 2015; Rasiah and Shan 2015). Electronics has been one of the industries on which research has focused. From the studies of Albada (2015), Intarakumnerd et al. (2015) and Rasiah and Shan (2015) it clearly emerges that host-site proactive institutional action in the forms of targeted support to firms and the creation of a stimulating local environment plays a large role in the development of firm-level capabilities and positive industry trajectory evolution. Here we build on the insights of these studies.

Having framed our scrutiny of the evolutionary trajectories of the export industrialization path, and specifically of the E&E industry in our study area, we now turn to a brief discussion of the research setting.

The E&E industry in the SiJoRi cross-border region: from pre-formation to development

Over the past four decades, a number of E&E industry ‘spaces’ have developed in Southeast Asia. With MNC

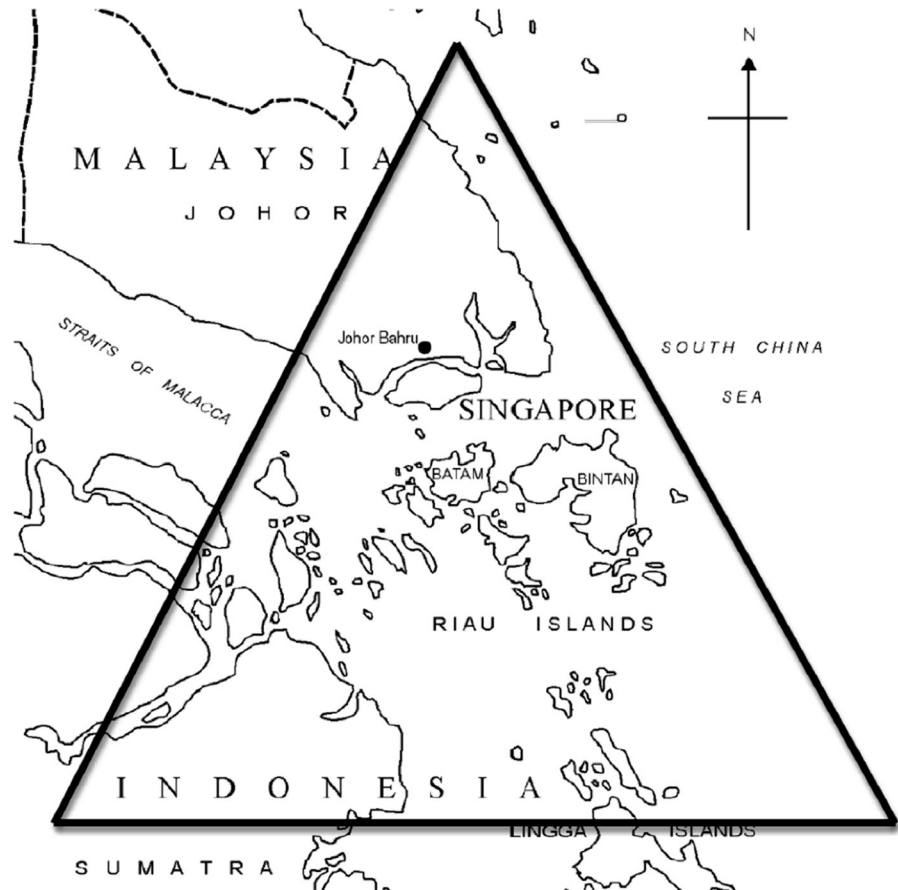
affiliates as flagship firms, these ‘spaces’ have been significantly shaped by the decisions of headquarters regarding location and mandates to subsidiaries. Reflecting the collective weight of these decisions over time, the various ‘spaces’ across the region have developed in different points in time and acquired varying levels of sophistication. Following the ‘mapping’ by Rasiah (2009), Singapore was amongst the first complexes to develop, during the 1970s and 1980s. As far as the Riau Islands, specifically Batam, is concerned, this period was its ‘pre-formation’ stage. Its industry path shifted towards ‘creation’ in the early 1990s, when two trends coalesced. The first is that MNCs started to shift operations out of Singapore. The second is that industrial policies in Batam changed.

The firm and industry shift to Batam occurred in tandem with Singapore’s adoption of a regionalization strategy. There is a sizeable literature on this strategy, delving into the role of the Singapore state in fostering higher value-added investment (How and Yeoh 2007; Pereira 2004; Yeoh et al. 2000; 2004a, b, c; Yeoh and Wong 2005a, b; 2006a, b). Three aspects are highlighted. The first is the state’s assistance in producing a ‘spatial fix’ to compensate for adverse cost factors through the creation of new economic spaces beyond its territory involving the construction of industrial parks. The second is the extension of Singapore’s economic space through the creation of a cross-border investment region intended to be another ‘spatial fix’. The third is the state-encouragement of MNCs to maintain ‘anchors’ in the country and upgrade operations.

Regionalization reinforced emerging regional production networks in the industry. It also contributed to the emergence of such cross-border networks, reaching into Singapore’s neighbouring sub-national regions of southern Johor and the Riau Islands. The targeting of these two locations in the early 1990s was formalized through the Singapore-peddled construct of the Singapore–Johor–Riau (SiJoRi) ‘Growth Triangle’ as an extended economic space (Fig. 2). The logic of the Singapore state was simple yet compelling: locations in close proximity with differing endowments and comparative advantage would allow cross-border corporate networks to flourish (Grundy-Warr et al. 1999; Lee 1991; Smith 1997; Sparke et al. 2004; Yaw et al. 2000; Yeoh et al. 1992; 2004c).

The Triangle was labelled a win–win formula, with major advantages for MNCs; and positive economic implications for Singapore as well as neighbouring

Fig. 2 The Singapore–Johor–Riau growth triangle.
Source: Sparke et al. (2004)



regions such as Johor and the Riau Islands that would have found it difficult to create an export manufacturing growth path without this catalyst. Indonesia endorsed this logic for a time as it accepted complementarity with Singapore and low-tech operations with a high intensity of low-cost labour as the most viable industrialization path. It became more firmly adopted as other development strategies failed to produce results, namely the country's ambition to develop Batam Island into a high-technology production centre (Smith 1998). Thus, important liberalization measures were introduced in 1989. One hundred percent foreign ownership was allowed in Batam, with the stipulation that 5% ownership be divested after 5 years. In addition, foreign firms were allowed to establish and operate industrial estates in Indonesia (Pangestu 1991). This was followed by a formal bilateral agreement signed by Singapore and Indonesia to jointly develop and market Riau Province. This included commitments to: improve the accessibility of the islands to Singaporeans; simplify the tax

system; promote tourism; and cooperate in the provision of water supply, transportation, and infrastructure development (Wong and Ng 2009a, b).

The first industrial estate on Batam, the Batamindo Industrial Park, was completed in 1992. Established as a joint venture between three Indonesian concerns and two Singaporean government-linked corporations, this 320 ha flagship development signalled cooperation between the two countries (Parsonage 1992). Other—smaller—industrial estates were built on the island in later years, managed by diverse companies.

Thus, Batam began to grow in the 1990s as 'satellite' development of Singapore, propelled by important investment flows (Smith 1997). Growth continued in the early 2000s, with a significant contribution of (Japanese) firms operating in the E&E industry (van Grunsven and Hutchinson 2014). However, after the initial growth burst, joint marketing of the region took a backseat. The Asian Financial Crisis and its aftermath had far-reaching implications

for Indonesia. First, after 1998, bilateral relations with Singapore were less consistently positive, with occasional periods of disagreement (Hamilton-Hart 2009). Second, Indonesia underwent deep political reforms and also proceeded to embark on a far-reaching decentralization process (Crouch 2010). As part of this process, a new entity, the Riau Islands Province, comprised of Batam and Bintan as well as a number of other islands, was carved out of the larger province of Riau in 2004 (Long 2013).

As far as the E&E industry is concerned, the territorial division of labour between SiJoRi's component parts was established during the initial period. This was confirmed in research carried out during the 1990s and early 2000s (Grundy-Warr et al. 1999; Lee 1991; Ooi 1995; Smith 1997; Sparke et al. 2004; Toh and Low 1993; Yaw et al. 2000; Yeoh et al. 1992; 2004a, b, c; van Grunsven et al. 1995). This research led to better insights into the characteristics of firms and operations attracted to Batam. In terms of origin, a distinction became noticeable between non-Singapore MNCs and Singapore companies expanding overseas. A further distinction could be made between MNC satellite operations feeding into production chain operations in Singapore, and 'stand-alone' operations.

The evolution of Singapore's E&E industry, spanning the 1990s until the early 2010s, provides further context to our research. The analysis made by Toh (2014), who used aggregate indicators and data from secondary sources to 'map' this evolution, clearly reveals upgrading. The industry has grown in absolute terms, measured by output and value-added. Concurrently employment has contracted, indicating that operations have become more technology- and capital-intensive. The industry's branch composition has changed significantly during the 1980s, as production diversified from consumer electronics to industrial electronics, particularly disk drives, other computer peripherals, computer systems, integrated circuits, and components. However, during the 1990s and especially the 2000s, narrowing, specialization, and more sophistication became evident as the industry focused increasingly on high-end operations concerning high-technology, high-precision components with semi-conductors and data-storage products, especially disk-media, rising to prominence. As production in early-developed branches was shifted out, MNCs adopted one of several strategies: gradually abandoning Singapore; maintaining non-production functions; or

augmenting production functions with a higher value-added function—such as regional headquarters, procurement hubs, or design and development centres. Van Grunsven's (2013) analysis of the development of Singapore's ICT industry reveals that the country has emerged as a centre for research and development/innovation, design, regional headquarters, and procurement.

The above account suggests ample opportunity for the industry in Batam to develop by targeting three groups of firms: MNCs in industry branches 'abandoned' by Singapore; lower to middle-end operations offshored by MNCs in industry branches still present in Singapore; and Singaporean firms also affected by industry trends and rising costs. In this process, the configuration of firms and operations could change, with implications for the earlier established division of labour as well as connections of the Batam E&E complex to Singapore. Finally, contingent on locally-based endowments and relationships between the regions, Batam could begin to upgrade.

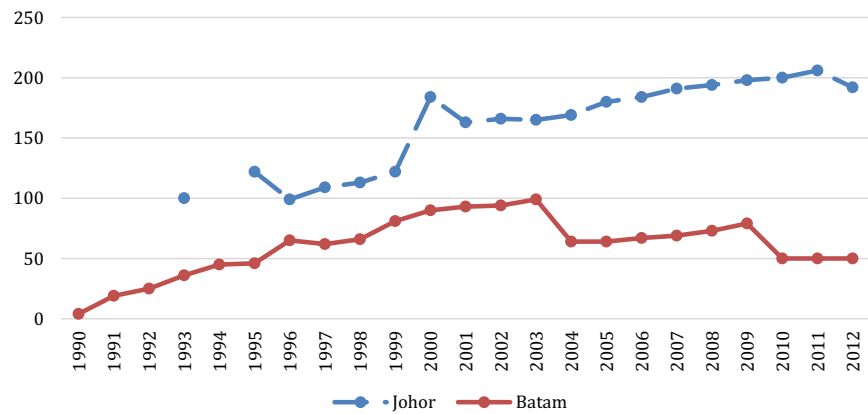
Methodological notes

In tandem with the Growth Triangle's declining visibility, research on the E&E industry connecting the three regions has dwindled. This research gauges whether and how the industry in Batam has been reconfigured as a result of the following: firm entry and exit; evolving corporate strategies; in situ establishment changes; and institutional contexts at the regional level.

To do this, the following four steps were carried out. First, a longitudinal data-set spanning 1990–2013 was constructed by collating all data from the Batam Indonesia Free Zone Authority (BIFZA) on the establishment and closure of E&E firms, as well as their nationality.¹ This was cross-checked with information available from industrial estate management companies. Second, changes in the composition of the electronics sector were tracked over time. Based on product portfolio information and BIFZA records, the total 'universe' of establishments in available years was categorized into rather detailed E&E 'branches'.

¹ Established in 1973, BIFZA remains the first port of call for investors in Batam and has the most comprehensive records of investment applications.

Fig. 3 Electronics firms in Batam and Johor. *Source:* own data



To our knowledge, this is the only such dataset to have been compiled. Third, the prevalence of upgrading among the firms present in Batam was evaluated through structured interviews with firms, as well as by mapping the reach and location of MNC networks in the region. Regarding the interviews, these were carried out on the premises of 13 firms and covered issues such as: development in terms of technology, products, and processes; the quality of local-level institutions; and corporate decision-making regarding the awarding of mandates to manufacture specific products. The mapping of MNC networks was done through compiling information from the websites of the E&E companies that have had a presence in Batam. Fourth, a number of interviews have been conducted with local industry development experts, representatives of industrial estate management companies, and of national, provincial, and municipal government agencies. This was done to shed light on prevailing attitudes of policy-makers to regional economic development, specifically the tension between ‘adaptiveness’ through regional diversification and ‘adaptation’ through technological deepening.

The trajectory of the E&E industry in Batam

Given its proximity to Singapore, well-developed logistics connections, industrial parks, and potential demand from MNCs seeking to leave Singapore for lower-cost environments, one would think that Batam has an unbeatable business proposition. However, following an initial period of growth, the E&E

industry’s recent evolution has not been positive. This stands in contrast to Johor, which is also dependent on investment from Singapore-based firms (Fig. 3). Following the ‘creation’ phase of the E&E industry, Batam’s number of subsidiaries increased consistently from four in 1990 to a peak of 99 in 2003. This trend was robust, continuing upward through the Asian Financial Crisis and the 2000–2001 global electronics downturn. However, between 2003 and 2004 the number of E&E subsidiaries declined substantially to 64 firms. While over the next 6 years the number of firms experienced an increase again to reach 79 in 2009, in 2010 there was a drop to 50, where it stayed steady until 2012. Thus, in this year, the number of electronics MNCs in operation on the island was half of that 9 years before.

This industry-level evolution seems to match an overall trend for Batam’s export manufacturing sector. Data on tenancy in the BatamIndo Industrial Park shows an increase from around 60 firms in 1994 to close to 100 in the peak year of 2001; since then 30 firms have left.² While relocation from the park to cheaper locations elsewhere on the island has played a role, this cannot fully account for the downturn.

More than half of all E&E firms that have established operations in Batam since 1990 have originated from either Singapore or Japan (Table 1). It should be noted that a significant number of non-Singaporean firms in Batam invested through their Singapore subsidiary. The length of firms’ tenure

² Interviews with three senior managers from BatamIndo Industrial Park, Muka Kuning, 12 February, 2014.

Table 1 Breakdown of all firms investing in Batam by nationality and tenure

Nationality	Number	Average tenure (years)
Singapore	39	9.2
Japan	27	13.2
USA	12	10.8
Japan/Singapore	11	12.9
Indonesia	6	8.3
Total	131	10.3

Source: own data, firms w/incomplete data (21)

varies by nationality, with Japanese firms showing the longest average tenure.

The figures show significant entry and exit over time. A total of 131 firms were in operation at some point during the 1990–2012 period. As only 50 are currently in operation, the survival rate is somewhat under 40%.³ From 1990–2003, firm entries were sustained, with significant increases in 1996 and 1999–2000. Firm exits were relatively small, with slight increases in 1997 and 2000. 2003 was a crucial year, as after this, firm entries were small in number. Firm exits were relatively low for most of this period, with two notable exceptions. In 2004 and 2010, 35 and 29 firms left, respectively (Fig. 4).

Table 2 contains a breakdown of nationality and date of arrival for the 50 firms in 2012. As to the age of the current MNC base, notably 40 % were already in operation in 1995 and almost two-thirds have been in operation for at least 10 years. This stands to reason, given the low numbers of entries after 2003. Thus, the stock of MNC subsidiaries comprises mature firms that have maintained locational commitment throughout two waves of firm departure. Japanese firms comprise one-third of current tenants; Singaporean MNCs constitute the second-largest contingent, with ten firms, followed by affiliates from the USA and Germany, respectively.

Japanese MNCs constituted the largest sub-group in 1995. Indeed, more than half of all Japanese firms (11) 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 arrived at a fairly steady rhythm

over time. Singapore, for its part, had a slight increase in arrivals in the 2000–2002 period, when five firms arrived, up from the normal rate of 1–3 firms per period.

Turning to the branch composition of the E&E industry in Batam, it can be divided into five: consumer electronics; audio and video equipment; electronic components for autos; printed circuit boards; and other components and parts (cables, wires, etc.). More than 90 % of subsidiaries are involved in manufacturing/assembly activities. Some branch evolution has taken place. Going by the number of firms, over time the composition has somewhat shifted from a domination of consumer electronics to a larger role of components. Contract manufacturing has grown in recent years with the arrival of some global players. Within already established subsidiaries, product portfolio has changed somewhat. Overall, however, branch evolution has not been marked. In addition, changes have hardly involved upgrading—casting doubt on any progression within the international division of labour for Batam, in particular the move into production ‘spaces’ being vacated by Singaporean firms or Singapore-based MNCs.

In situ subsidiary evolution

The salient findings from the company interviews regarding upgrading at the firm level are detailed below. The thirteen MNC subsidiaries in operation on the island that were interviewed represent one-quarter of the total number of firms currently in operation. As such, they are representative regarding origin and tenure, and also include long-term firms that have demonstrated considerable locational ‘commitment’. Eight are green-field investments, while five are acquisitions or conversions of subsidiaries that were already located in Batam (Table 3). The Japanese subsidiaries are all green-field investments established in the first half of the 1990s. Most Singaporean subsidiaries are green-field investments established in the 2000s while one is an acquisition of another firm established in 1993. With regard to the German MNCs, one is a green-field investment established in 1996 and another is a brown-field investment. The other three acquisitions were affiliates already present when their parent companies were bought over by another company.

³ There are an additional 21 firms recorded; however insufficient information was available on these to confirm them as E&E company. The account here omits these additional firms.

Fig. 4 Firm entries and exits in Batam, 1990–2012.
Source: own data

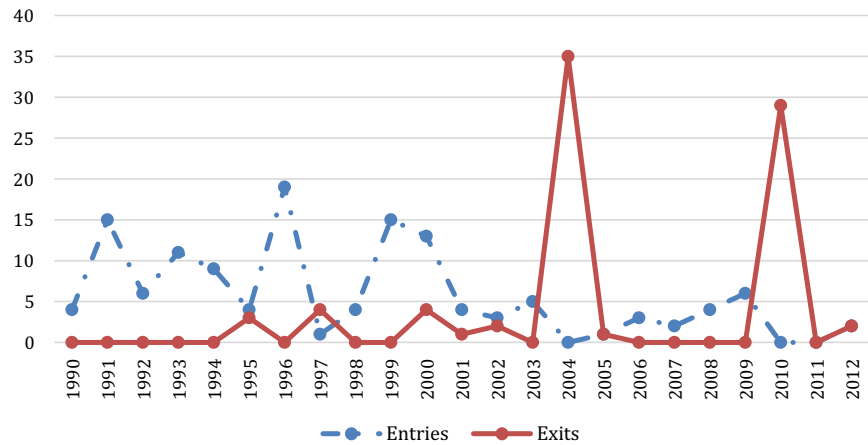


Table 2 Breakdown of Batam's current tenants by date of arrival and nationality

Cohort	Total number	Main nationalities
1990–1995	20 (40 %)	Japan 11, USA 3, Germany 2
1996–1999	4 (8 %)	Japan 2, Singapore 1, Germany 1
2000–2004	9 (18 %)	Singapore 5, USA 1, Japan 1, Malaysia 1, Indonesia 1
2005–2009	15 (30 %)	Singapore 4, India 1, Japan 3, USA 1, Germany 2
2010–2012	2 (4 %)	USA, Switzerland 1
Total	50	

Source: own data

Table 3 Salient characteristics of surveyed firms

	Nationality	Date of establishment	Greenfield or acquisition	Sub-sector	Employees
1	Switzerland	2000/2010	Acquisition	Assembly services	432
2	China	2009/2012	Acquisition	Wiring assembly	250
3	Germany	1996	Greenfield	Production of semiconductor components	1950
4	Germany/ Japan	1992/2008	Acquisition	Production of sensors	3000
5	France	1992	Acquisition	Production of connectors	1050
6	Japan	1992	Greenfield	Production of printers/scanners/cartridges	3200
7	Japan	1993	Greenfield	Production of wire harnesses and wiring assembly	1400
8	Japan	1995	Greenfield	Assembly of control systems	350
9	Singapore	2002	Greenfield	PCB assembly	174
10	Singapore	2008	Greenfield	PCB assembly	15
11	Singapore	2003	Greenfield	PCB assembly	60
12	Singapore	1993	Acquisition	Assembly services	900
13	Singapore	2003	Greenfield	Production of connectors	1200

Source: own data

The size of the subsidiaries varies substantially, with the number of employees ranging from fifteen to 3200, with an average of 1067. On average, German and Japanese MNCs tend to be bigger than their Singaporean equivalents. Contrasting with the overall trend in Batam, ten of the thirteen subsidiaries have increased output since arriving. Of the remainder, one has maintained stable output, and only two experienced a decrease. In employment terms, a majority, or eight firms, did not ramp up their number of workers. However, only in two cases did employment decrease. Thus, in aggregate, the firms interviewed have kept employment numbers steady, but increased output since establishment.

As to plant evolution, most subsidiaries did not show a significant development of functions performed. Only in three cases was there enough evidence of upgrading. The firms still largely produce components and parts rather than full products. About half of the subsidiaries (7) experienced a change in their product portfolio since the start of operation, while the other half (6) have 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 is implied in the regular introduction of new generations of (final) products, in a few cases shifting products from lower-end to higher-end, and from low- to higher-technological complexity. Yet, all this reflects the evolution of company products and embedded technologies, rather than a shift in the role of the subsidiary in question. Only a few subsidiaries experienced radical change in their product portfolio and started to produce a completely different product. The majority of subsidiaries use processes that do not require their workforce to be skilled. There is no discernible pattern between industry branch and changes in product portfolio.

While employment size suggests processes relying on labour, many subsidiaries have invested to increase levels of automation. And, most subsidiaries indicated they intend to increase automation levels in the future. While processes have changed to higher levels of sophistication, many respondents indicated that parts of the production process are still carried out more efficiently with the use of labour rather than machines. In most cases, new technologies have reached the Batam subsidiary from other parts of the corporate

network, rather than being developed locally. Mostly these are distributed by the company headquarters, regional headquarters, or a higher-ranked subsidiary in the Asian region. Only in a few cases has process technology been developed through the initiative of the Batam subsidiary in response to client demands. Subsidiaries have negligible research and development activities. Last, consistent with 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 that high-end production capabilities were irrelevant for them.

Towards an interpretation of the E&E industry’s trajectory

Batam has been one of the E&E industry’s leading centres in Indonesia. The influx of foreign capital following relaxation of restrictions on foreign ownership in 1989 meant that, by 1991, the island was producing more than 50 % of the country’s exports of electronic components and parts (Thee and Pangestu 1993). However, the industry’s decline and its lack of ‘adaptation’ indicate that the trajectory of the E&E industry in Batam is not robust.

This is consistent with other research findings. Van Grunsven (1998) found that operations in Batam in the late 1990s were almost entirely low-skill in nature. Labour market characteristics of Japanese-affiliated firms on Batam Island (Miyamoto 2011), suggest little change over time of MNC operations away from low-value assembly work. The situation is compounded by national realities such as: failure to develop high-technology industry (Smith 1998); lack of pursuit of local technological capabilities (Lipsev and Sjöholm 2011); and focus on exporting primary products, with relatively little diversification of exports or end-markets (Basri and Hill 2011).

Of course, Batam has been affected by global changes in the E&E industry. However, it is imperative to analyse the lack of robustness beyond this. Is agency at the sub-national level independently or in conjunction with ‘structural’ factors helpful in understanding the trajectory of the E&E industry? Corporate locational evolution and decision-making are core aspects to consider. In addition, institutional dynamics, in large part externally conditioned, in conjunction

with policy makers' incentives, policy decisions, as well as prevailing perceptions and behaviour and their impact on regional fundamentals are key issues to consider in an explanatory account.

In the phase of the E&E industry's creation, Batam's principle asset for the electronics MNCs was—besides Singapore's involvement in infrastructure construction on the island and proximity to the city–state—labour supply, which was ample and low-cost. However, political and governance changes in Indonesia over the 2000s have caused a fundamental change in this area. Following the end of the New Order, decentralization reforms were legislated in 1999 and implemented in 2001. Indonesia went from one of the world's most centralized political systems to one of its most decentralized (Shah et al. 2012). Direct elections were established for provincial and local governments, and these levels of government received the lion's share of government duties and responsibilities (Buehler 2010). One of the prerogatives that have been decentralized to the provincial level, with considerable input from local governments, is the setting of the minimum wage (Comola and de Mello 2009). In addition, post-New Order liberalization measures led to a profusion of new organizations. A low threshold for the establishment of labour unions and allowing more than one union at the plant level resulted in a 'fragmented' labour movement. In addition, the movement has become highly politicized, with labour leaders establishing connections with political parties (Caraway 2012).

In this new context, the local political elite is aware that they are held more accountable than before and that (re-)election requires serving constituencies in a satisfactory way. Due to this, repeated concessions to organized labour on a yearly basis have transpired, in the form of significant minimum wage increases. Between 2009 and 2013, this doubled (from about a little over 1 million Rp to 2 million Rp) with a further increase to 2.2 million Rp in 2013 (Van Campenhout and de Graaf 2013). Furthermore, the annual negotiations, periodic demonstrations, and work 'slow-downs' have affected investor sentiment, particularly those based in Singapore. Indeed, in 2012, Japanese firms voiced their collective frustration with the unpredictability inherent in wage negotiations (*Riau Bulletin*, 15 November 2012).

In the absence of skilled labour and of a technology infrastructure (see below), upgrading was not

attractive. Instead—as evidenced by media reporting over the years, as well as key informant interviews—firms decided to exit and new arrivals decreased as Batam became less attractive as a production location.⁴

Another outcome of decentralization has been an opaque division of responsibilities as well as relations between institutions, resulting in vague perception and misinterpretations as to—demarcation of—mandates. As a legacy of the New Order era, the provincial government perceives BIFZA's mandate as related to industrial development. This thus being a 'national affair', the province does not consider industrial development a core responsibility. It utilizes its new empowerment in local economic development to pursue activities that are 'traditional', have a larger 'cultural fit', and with which local elites have more affinity. As a result, recent policy frameworks have privileged cultural sub-nationalism and the promotion of small-scale and traditional economic pursuit such as fishing and small-holder farming (Provinsi Kepulauan Riau 2013; Hutchinson 2015). This new emphasis has been to the consternation of both local and national investors.⁵

On the other hand BIFZA considers investment generation as the core of its mandate. Therefore its main activities are: investment promotion; improvement of procedures; land development; and improvement of the investment environment. Its predecessor, the Batam Industrial Development Authority (BIDA) was a national agency. BIFZA's status is less clear: the appointment of its head rests with the province, but the organization reports to the national parliament.⁶ In carrying out its work, the incentive structure of the Agency's employees is dominated by a growth target set by Parliament.⁷ The result is a continuous search for new avenues to attract investment, expressed in the

⁴ Interviews with: senior managers from BatamIndo Industrial Park, Muka Kuning, 12 February 2014; representative of a local business association, Muka Kuning, 22 May 2013; an economic analyst, Batam Centre, 22 May 2013.

⁵ 'Instead of talking about fishing, which is less than five percent of the economy, let's talk about manufacturing and make it grow'. Interview with a business association representative, Muka Kuning, 22 May 2013.

⁶ Interviews with senior BIFZA managers, Batam Centre, 27 March 2015.

⁷ Interviews with senior BIFZA managers, Batam Centre, 27 March 2015.

desire to diversify the industries in operation. The arrival of new industries such as ship-building and repair, tyre making, fishing gear manufacturing and oil refining is considered a very positive development—regardless of the implications this has for existing industries such as the E&E sector.⁸ This is particularly grave when the shortage of skilled labour is taken into account.

This has been compounded by conflicts between Jakarta, the provincial government, and the local business association over the leadership of BIFZA. Following a period of negotiations, the existing head initially appointed by Jakarta was retained, with a deputy named by the governor.⁹ Tensions have arisen between the provincial government and the Batam municipal government, leading to uncertainty over land rights, zoning regulations, and approval and permit procedures (*Riau Bulletin*, 2 December 2011).

This underlying anti-growth behaviour is enabled by the new fiscal relationship between the central government on one hand and the provincial and local governments on the other. The central government still raises the bulk of public revenue, much of which it then distributes to sub-national governments to cover staff costs (Fadliya and McLeod 2010). As a result, sub-national governments have little incentive to raise own revenue or, indeed, provide public goods to support economic development (Hutchinson 2015).

Not unexpectedly, the fundamentals and externalities have hardly developed in a direction conducive to upgrading. Batam still lacks labour skills and a technology or support infrastructure to allow the island to engage in some competition with Singapore. This is another aspect whereby Singapore's proximity is disadvantageous, as the city–state has been successful while policy-makers in Batam have shown little inclination to invest in an appropriate and well-functioning technology and innovation system.

Features and biases indicated above have hindered pro-active and effective monitoring of industry development on the ground and coordinated pursuing of industrial policy, including upgrading. Instead, there is

a predominant perception in the bureaucracy and amongst higher-ranking decision-makers that 'all is well' in the area of industrial development. Despite a downward trajectory in the E&E industry over the last 10 years, decision-makers—but not managers of industrial estates—appear ill-informed about developments on the ground.¹⁰ This is the more striking, given the frequent reporting of the media on labour disruptions, wage increases, and firm closures.

In relation to the above, opinions of foreign firms regarding their host region are revealing. Going by the survey findings, at first sight establishments are not so negative about the local labour force. However, as with opinions expressed on other items, the possibility of bias should be noted, as only subsidiaries retaining a presence on the island are included. Production automation to reduce dependence on labour has rendered labour costs less urgent. However, firms were bothered by the cost of labour in relation to static skills (reflecting little change in the quality of education and training infrastructure) impeding not only further productivity gains but also the potential upgrading of operations. Subsidiaries did not indicate a local supply structure that could help in such an endeavour; neither did they show enthusiasm about the physical infrastructure, or the overall environment for innovation. As to the efficiency, pro-activeness of and interaction potential with regional government, a majority of subsidiaries rated these as 'neutral' or 'bad'. Our findings are in line with those of a company survey conducted by Wong and Ng (2009a, b) and Wong et al. (2009a) that showed rather low appreciation of, and satisfaction with, the regional environment as well as various other competitiveness factors.

The lack of bureaucratic action has turned out to be harmful to the development of the E&E industry. Overall, the absorption capacity for technologically more advanced operations has remained low. This brings into play the corporate locational commitment to Batam as revealed by a shift in position of the region in corporate locational networks. In line with findings of Edgington and Hayter (2013) for several regions in

⁸ Interviews with: senior industrial estate manager, July 19, 2012; senior BIFZA managers, Batam Centre, 12 February 2014 and 27 March 2015.

⁹ Interviews with: political observers A and B, Batam, 22 May 2013; email communication with political observer A, 22 September 2014.

¹⁰ Interviews with: managers of Batamindo Industrial Park, Muka Kuning, 12 February 2014; private sector representative, Muka Kuning, 22 May, 2013; senior BIFZA executives, Batam Centre, 12 February 2014; and senior managers of the Riau Islands Provincial Government planning department, Tanjungpinang, 11 June 2013.

Table 4 Asia–Pacific corporate network of firms based in Batam

Nationality of firm	No.	RHQ in Singapore	Est. in Asia Pacific	Est. in Singapore	Est. in China	Est. in SE Asia (incl. S'pore)	Est. elsewhere
France	1		14	1	1	6	7
Germany	4	1	66	5	12	28	26
Germany/Japan	1		12	1	6	3	3
Netherlands	1	1	8	1	2	5	1
Switzerland	1	1	5	2	1	4	
USA	7	1	64	11	26	28	10
Japan	18	3	370	20	91	115	164
Malaysia	2		5	1		5	
Singapore	14		50	20	7	43	
China	1	1	3	1	1	2	
Total	50	8	597	63	147	239	211

Source: own data

Malaysia, all in all, the factors discussed in the above have weakened position of Batam affiliates within their own corporate networks—as evidenced the rather static profile of operations as well as firm closures.

Many of the companies to which the establishments belong have built a rather extensive regional network (Table 4). The companies combined have some 600 establishments in the Asia Pacific region. Japanese MNCs operating in Batam have extensive networks of subsidiaries, collectively owning 370 subsidiaries in the Asia–Pacific region, including Japan. Singapore ‘MNCs’ have a less extensive regional network than non-Singaporean MNCs and their networks are still more often governed by geographical proximity, with Indonesia and Malaysia being the most frequent offshore locations.

New, technologically more challenging, mandates are allocated to establishments in the network that are better placed. While interviewed establishments tend to depict inter-establishment and parent-subsidiary relations as cooperation and collaboration, they also acknowledge (reluctantly) that they compete with other affiliates of the same corporation for higher value-added operations. In addition, they are not well placed. This results from limited autonomy and initiative taken, given the non-conducive local conditions and lack of regional endowments. Many subsidiaries are aware that the Batam operations are not central for headquarters, and competencies to win higher-end charters are developed in other subsidiaries. The only exception seems to be subsidiaries

of Singapore companies that often are the first offshore initiative of the parent company and therefore have a more important position.

Generally, Batam subsidiaries appear to focus on quantitative performance and quality. 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. For stayers, this seems to constitute one source of continued locational commitment of parents, at least for the time being. Another still relevant source seems to be proximity to Singapore. While Batam still offers cost advantages, Singapore can supply a wide range of services lacking in the former. Although we have not yet 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 high-end operations; and while the linkage in proximity still underlies the logic of Batam operations it also unhelpful to their upgrading, as well as evolution of the industry at large.

On the basis of the above, we suggest a schematic model as depicted in the figure below (Fig. 5). It combines elements from both the structure and agency perspectives. Follow-up research should be directed to the further testing of the elements of the model, as well as their interrelationships.

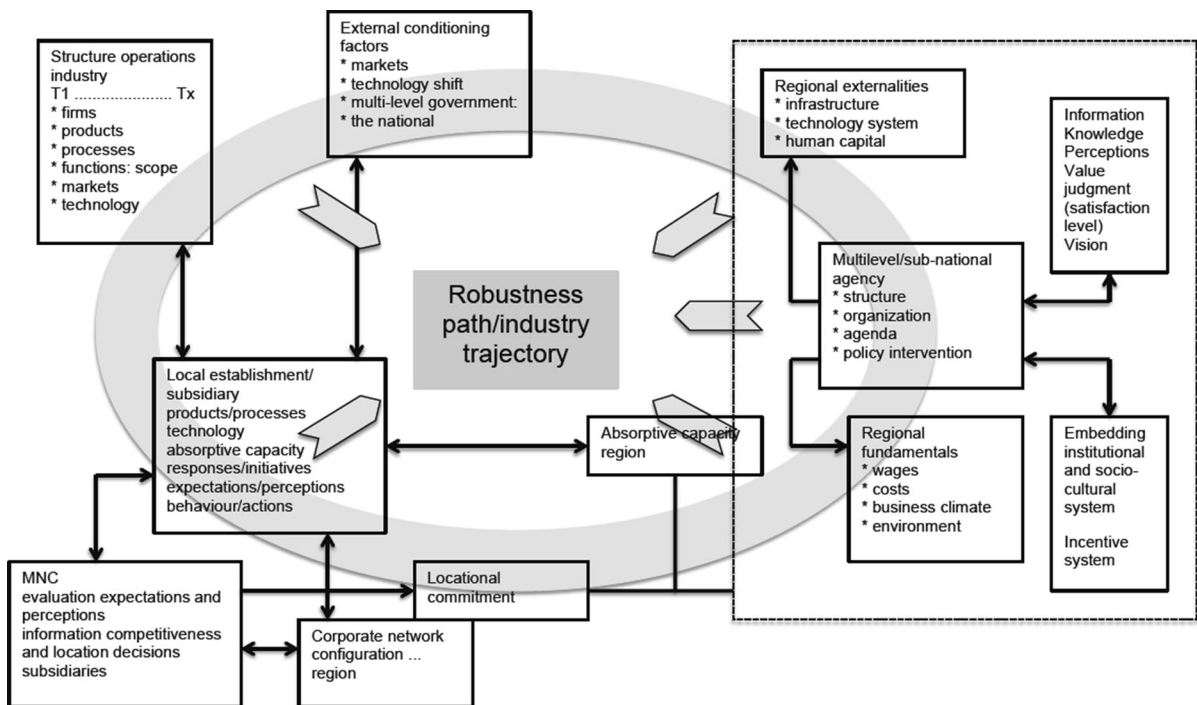


Fig. 5 Interpretative framework of SiJoRi E&E industry development trajectory

Conclusion

This research aims to address a gap in knowledge regarding the recent evolution of the E&E industry in the erstwhile SIJORI Growth Triangle. Focusing on the E&E industry and its constituent firms in Batam Island, we have empirically scrutinized its recent evolution and particularly its robustness. Based on the database of firm arrivals and departures that we constructed, we have found that, following an initial period of growth, the E&E industry has been on a downward trajectory. Despite weathering the Asian Financial Crisis, the industry in Batam has been in decline since 2003, due to few firm arrivals and two marked episodes of firm departures. In addition to depleting numbers, the E&E industry in Batam has not developed any new branches. Indeed, available evidence indicates that the number and nature of the branches has largely remained the same. There has been some attrition in the consumer electronics branch, and an increase in the relative importance of the component and contract electronics manufacturing sub-sectors. However, given the vacating of lower-end product ‘spaces’ in Singapore, it is striking that the

industry in Batam has not captured more of this outward movement.

The survey with firms operating in Batam also revealed that they occupy the lower and least value-added rungs within their own corporate hierarchies. Higher-end capabilities are largely irrelevant for them, and new technology and capabilities are acquired elsewhere. While some committed ‘stayers’ have automated production processes, this was due to the shortage of skilled labour, rather than an intrinsic desire to upgrade *per se*.

Against the background of little innovation, inexistent educational and technological infrastructure, and lack of skilled human capital, the E&E industry has not achieved a significant level of robustness. As to what the future may hold for the E&E industry, trends over the last 12 years are cause for concern. At least for ‘stayer’ firms, employment has remained steady and investments have been made in automation to ramp up production. Batam will, for some time, continue to constitute a production base for those firms that have made sizeable investments on the island. But, the current position of Batam-based subsidiaries within their own corporate networks seems to be weakening.

Barring a critical juncture, Batam seems firmly on the trajectory of path ‘decay’. Structural factors such as the source of investment and the external environment have undeniably played a role. However, this article has also explored the potential influence of agency on the E&E industry’s trajectory. The state of affairs as outlined in the above is due, in large part, to the local institutional environment. Indonesia’s changed political environment has had far-reaching implications. Beyond a more fluid environment with contested jurisdictions, the incentive structures offered by the country’s decentralization measures do not reward provincial and local government initiative. Hence, much needed investments in developing the local innovation system have not been forthcoming. In addition, Indonesia’s more conflictual industrial relations system has affected Batam’s primary asset—its labour. Thus the core observation of recent studies into the development of capabilities, upgrading and production network advancement of industries in Southeast Asian export manufacturing complexes, namely that the institutional context matters (Intarakumnerd et al. 2015, Rasiah and Shan 2015, Rasiah et al. 2015), is driven home by the findings of this study.

The situation is heightened by a prevailing penchant among policy-makers towards ‘adaptiveness’, namely fostering the establishment of new industries as opposed to ‘adaptation’—seeking to deepen the technological capabilities and rootedness of existing industries. Boschma’s argument (2015) that robustness may be at stake when ‘adaptiveness’ of the region is pursued in such a way as to hinder ‘adaptation’ is equally corroborated in this study. Industry robustness matters for regional resilience. Consequently, policy makers better start to shift their priorities.

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Compliance with ethical standards

This manuscript has been prepared with the usual ethical standards in mind. The article reports on part of a research project that encompasses several sub-national regions in the Singapore–Johor–Riau Growth Triangle. A manuscript that deals with the Johor part of the cross-border region has been prepared as well

and has been submitted to another Journal. Inevitably there are some overlaps as to the two manuscripts.

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