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IT Services in the Manufacturing Process of Electronic Firms in Penang Industrial Complexes: Trends and Implications for Policy

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ABSTRACT

Malaysia is one of the major nations of electronic industry in the world. Currently, economic globalization has exposed this Malaysian industrial sector to competition, which is intense and global in character. This situation has influences the capability of firms to plan production based on new perspective. Affected firms thus implement several strategies to upgrade their competitiveness at the global scale through product upgrading and this is very much related to the capacity arising from the producer services sector. The electronic industries are strongly dependent on efficiency in IT in terms of successful product development and their innovation performance. The main reason is that electronic product life cycle is so short and need to develop new products in a very short time. Based on this situation, this article aims to examine the relationship between the producers' services in particular of IT services in the electronic firms in the Penang Industrial Areas as the major contributor in manufacturing electronic production of Malaysia. The main objective of this article is allow researcher to investigate the links between IT services in pre and post production stages and to promote a thorough understanding of the role of the services, which in turn may contribute to government input to formulate the proactive policies needed by the community of this sector. By using research methods such as face-to-face interviews and questionnaire survey and focusing on IT component, a total of 30 electronic firms in Penang industrial area indicate that industrial upgrading efforts in the manufacturing sector in Penang industrial areas could be achieved through the integration of advanced producer services components especially IT in the production process. In the final analysis, such evidences would help industrial upgrading efforts of the government.

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INTRODUCTION

In the global economic nowadays, the main component for economic of the country with export-orientated is by depending on the industrial competitiveness. This is because, in this era of globalization competition between the firms or industries is not based on the factor of extra comparative value acquired but also influence by the capability to compete and survive in the industry (Hayter, 1997). Competitiveness of the firms or industries in the local or international next will generate and become the decider for the competitiveness of the country (Fauziah et al., 2011) . In continuous of that, to strengthen the competitive forces of the country, two main factors which is human resources, sciences and technology need to be upgrade and widen their usage especially in the context of production of the products that have the short life cycle such as electronic's products. Apart from that, the widespread of both mechanisms in the production process will increase the productivity, help in production of products with extra added value and indirectly strengthen the industrial competitiveness especially in the industrial area in Pulau Pinang that is well known as the 'Silicon Valley of Malaysia'.

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Research Areas and Methodology of the Study:

This research was conducted in Penang Industrial Areas. Penang situated in the mainland on the south west of Peninsular Malaysia, is the second smallest state in Malaysia. It consists of two physical entities which are Penang and Seberang Prai (refer to Figure 1). Penang industrial area can be divided into industrial estates, tecnoplex area and Free Industrial Zone (FIZ). More specifically, it is represented by FIZ and technoplex area in Bayan Lepas as well as Mak Mandin, Prai, Seberang Jaya, Bukit Minyak and Bukit Tengah industrial areas. The Penang Industrial Area especially the Free Industrial Zones (FIZ) in Bayan Lepas as well as the technoplex area are situated in metropolitan area and near the Bayan Lepas International Airport, which gives these area the advantages to develop rapidly. The first industrial area in Penang, which is Mak Mandin, was opened in 1964, followed by FIZ in Bayan Lepas in 1972. The opening of free industrial zone has marked the beginning of exposing Penang economy to the world economic flows. The first R&D based Penang Strategic Development Plan (PSDP1) and the second (PSDP2), which were reviewed by the state government, have outlined several aims especially in the efforts to produce industry developed society through manufacturing industrial sector.



Fig. 1: Free Industrial Zones in Penang.

The Penang Industrial area is a establish industrial in terms of electronic production in the northern region of Peninsular Malaysia. Operating firms, particularly in FIZ Bayan Lepas and Technoplex area practice manufacturing based production compared to the product assembling activities. This is in line with the aim of the study that tries to explore the roles of IT service components in the production of products especially in the pre (before) and post (after) phases of production, which are applied by firms focusing on the product manufacturing activities.

This research using the research method such as face-to-face interviews and questionnaire survey and focus on IT in the electronic firms in industrial areas in Pulau Pinang. A total of 30 firms were interviewed and fill up the questionnaire from a total of 95 electronic firms. The period of data collection was from January 2002 to April 2002. Since, this was a descriptive study mean and percentages were largely used in this study.

RESULTS AND DISCUSSION

The emerging world economy and the globalization process have had a significant impact on industrial upgrading among electronic firm. The globalization of economic activities is creating many new opportunities and challenges for these firms because this process not only changes the production of product but more than that this process need firm to restructuring the mode of production as well. In the wake of the process of economic globalization, manufacturing firms in particular electronic have focused their development efforts on expanding their international activities and improving their comparative advantage.

This article begins by reviewing important theoretical perspectives on producer services and manufacturing nexus. It then proceeds to analyses which stages (process) in the production chain is most difficult from the perspectives of firm and why need to isolate. Manufacturing firm's have been extremely efficient and responsive to market demand. The article focuses at the component of IT services, these being one of the most important producer services playing a key role in the manufacturing process. The article will provide empirical evidence on the impact of IT component at pre and post process and also their impact on government efforts. The component of IT like production engineering, industrial design are specialist technical services supplied for the manufacturing sector. Arguably, this article is centrally concerned with understanding the relationship between producer services and manufacturing sector and suggests that it needs to be reconsidered in relation to on going and important changes in the production process that are as important for firm as the key source for competitiveness and innovation. Since 1970s rapid changes in the nature of the world production particularly with the development of information technology, globalization process has precipitated a reorganization of the global production.

In Malaysia, the potential for the producer services sector to grow with the manufacturing sector has been started identified by the Manufacturing Plus Plus strategy of the Second Industrial Master Plan (IMP2). Meanwhile the Industrial Master Plan 2 (1996-2005) introduced a concern to develop an integrated industrial development through the regional clusters approach. The expansion of industrialization process in Malaysia has been highly influenced by IT component as a part of manufacturing process. The industrial supporting industry which is now gaining more importance in terms of subcontracting for high technology products and high value added services. The Second Industrial Master Plan (IMP2) was formulated to focus on manufacturing strategies and on the cluster based industrial development approach. This is being implemented to enhance industrial linkages and increase productivity and competitiveness and nexus from other sector including services sector. 'Manufacturing Plus Plus Strategy highlights the full integration of manufacturing process through the value chain in order to enhance industrial linkages, increasing productivity and competitiveness. The IMP2 does not only realize the importance of industrial growth but also the innovation element of the industries and firm, which is fundamental to the current economic development in the globalise world.

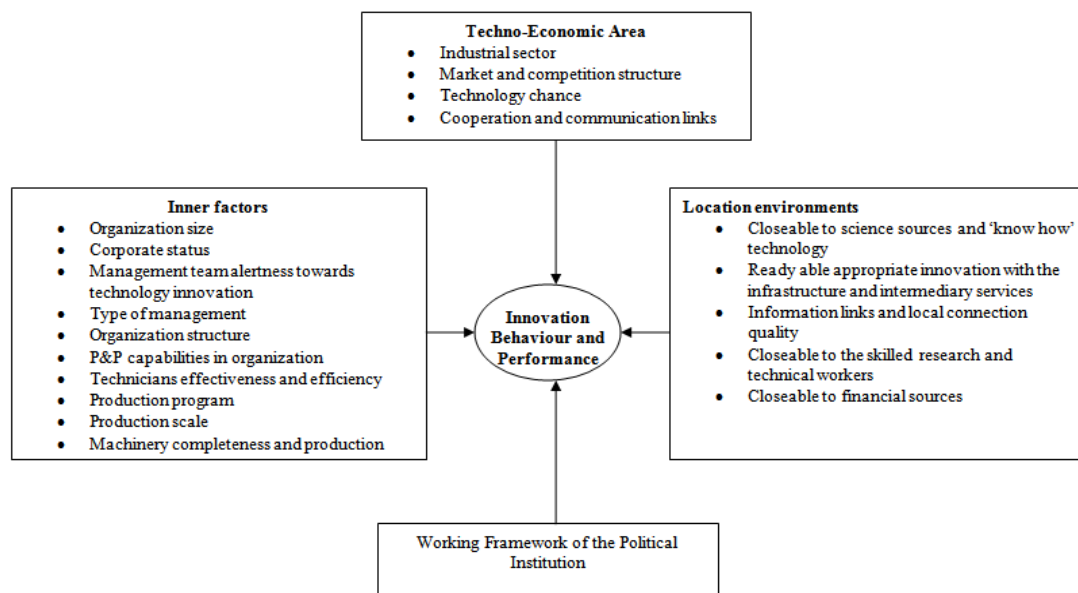
Research linking the electronic firm and producer services in particular IT services has never been done in Malaysian before the potential for the producer services sector to grow of the Second Industrial Master Plan (IMP2). Arguably, Malaysia has to improve and maintain standard of the production to make sure efficiency in the global competitive market. Looking at what has been happening to the electronic firms in terms of how component IT procured still a lot of things need to be done for the manufacturing firms in Malaysia in particular in Penang industrial areas to catch up with the competitors and most importantly to produce such a competitive high value product that is comparable to that of the rest in the industry worldwide. Empirical work is needed to establish how component of IT are participating in and shaping the production process at pre and post production stages. Component of IT services from the perspectives of manufacturing process in order to assess the effectiveness of the "Manufacturing Plus Plus" strategy is a very pertinent research theme in the light of the above mentioned development. In a globalise economy, knowledge and explore the incorporation of service inputs in the manufacturing process in order to assess the effectiveness production because using this particular services is very critical.

Majority of the production workers in industrial area in Pulau Pinang are intensified based on knowledge (63.4%). This is based on vast of the workers are creative, exposed to current practicals and have power to make a decisions in certain things and matters. Meanwhile, repetitive works either done by workers or machinery still being practice by the firms in the research areas especially the firms that run the production operation that based on assembly. By looking at the production operation's firms, the strategy in production is highly tended to change to industrial sector that intensified on capital and high technology. Moreover, there are firms being interviewed reported that basically the production workers that involved in the process of product's production are technicians and not done by the production's operators themselves as usually seen.

The main production's operation firms in Pulau Pinang runs the assembly activities (50%), followed by production (43.3%) and 6.7% involved in services that focused on development process R&D and repairing the product. Firms that involved in assembly and production in Pulau Pinang are balance because when look up closely, their production operations are changing from assembly towards production activities especially in the production of certain components. There is the need to explain that the production operation runs by the

subsidiary firms from most of the research respondents only involved in the making of certain components only and not the whole production aspect. Meanwhile, usually the production operation's firms composed of two main activities. There is unique in the production operation that runs by two production's firms in industrial area in Pulau Pinang. Both firms run the operation based on services and not involved the production of the final product like other firms. The production operation of the firms are make up from the activities (1) developing the process R&D like the mould production, tool and dies especially the firms that operating close to the nearby industrial areas and (2) offer the services of repairing the telecommunication products from whole Asia Pacific. Firms that involved in offering the services of repairing the products to the whole users in Asia Pacific is the only one of that kind operating in Malaysia. The specification such as that has become the attraction for their users in the Asia Pacific to use the services provided. This phenomenon gives a clue for a valuable discussion due to its different and unique production operation.

There are no firms that function fully as the marketing centre especially the Japan's firms because this responsibility is taken over by the main offices. For instance, most of the Japan's subsidiary firms that operate in the research area only run the installation activities up to 80% completion and send the products back to the main offices for the next steps before being marketed. However, the harsh competitions in the industrial electronic sectors currently, forcing the main offices to give permission for the subsidiary firms to doing the marketing operations regarding the final products produced. However, the focus on this aspect become less crucial compared to the main activities, which is production or installation of the components. This is because the diversity of the responsibilities hand to subsidiary firms requires an effective production planning, so that the product can fulfil the JIT concept, hence ensuring the product competitiveness can be maintained in the market. For that reason, specification of the production of certain products in subsidiary firms usually decided by the natural comparative benefits that stated by the main offices. However, the comparative benefits will change in harmony to the change in the technology. In the nutshell, the selection of the process in the production system depends on few factors; that is (1) type and quantity of the products produced, (2) capability to obtain the resources and matters needed, (3) life cycle or product overlasting and (4) production phylosophy that practicing by one organization (Zainal Abidin, 1999: 22). Apart from that, the selection any of the production system usually from the combination of few factors (Figure 2). The good and precise selection process that compromised with the production desired is utmost important because it will affects the cost, product performance and also the implications on the safety and the degree of the pollution towards the natural overallly (Zainal Abidin, 1999).



Source: Fischer in Bertuglia *et al.*, 1995: 152

Fig. 2: Main Category of Innovation Measurement Process.

High Technology Electronics Industries and IT Component:

The uses of the IT services component by the research firms in the product's production is due to realization of the efforts to achieve the production industrialization that is unwavering and more dynamic in future. In this context, the relationships between both sectors become the critical elements in influencing the development of the global production industries. This is because it encourages de-centre of the global production chain, rearrangement of the sub-contract activities and arising the new chain of corporate's organization that is greatest and stable (Amin and Thrift, 1994). However, the effort to study the relationship or intergration between

production in industrial sectors with the IT services component need to be elaborate based on criteria and rightful authority of the corporate TNCs' firms because it will decide the control of the trend of the production activities, strategy and sub-contract policy that happen based on the motif, type of the components needed most, apart from how the decision making process being done in the relationship of the industrial chain. For that reason, the next part will focus on this phenomenon based on the type of firm's rightful authority because it will reveal the diversity of the control type, trend, desirability, and limitation within the studied firms.

The Need of IT in the Electronic Firm:

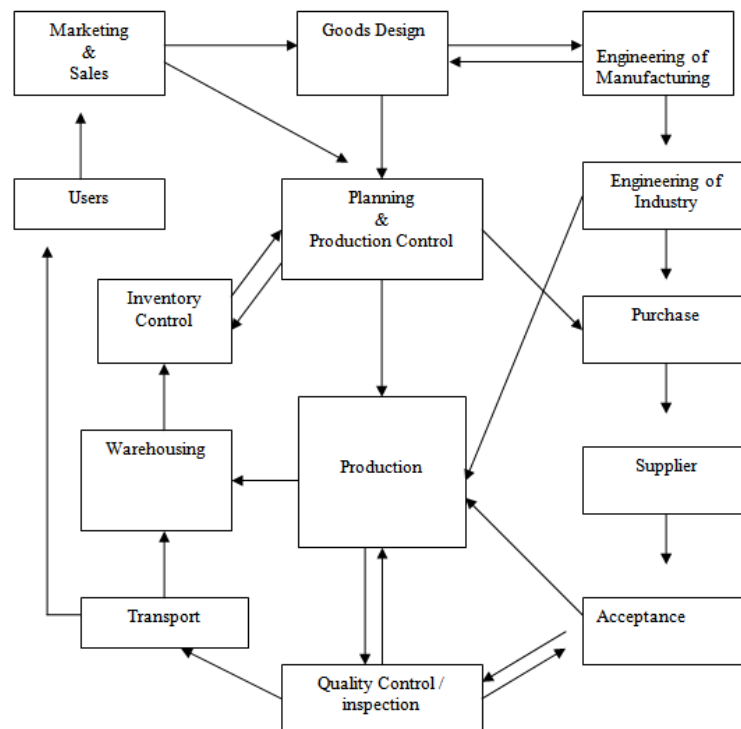
Many empirical studies done before reveal the importance of the IT in influencing the innovation and quality of the products produced, hence deciding the performance achieved by one firm wholly. Although the benefits of both components of the services are recognized, but from 30 firms studied in the Pulau Pinang industrial area, only 18 firms (60%) developed by themselves the IT services component that is needed neither in before nor current production of the products (Table 1 and Table 2), and two of them are firms that produce wafer.

The concept of developing themselves the R&D component services that are referring in this study involved two main stages, that is (1) develop wholly by the R&D unit in the firms or (2) firms develop extra valuable activities upon the provided infrastructures by main offices or their customers that is general and easy in their characteristics. In other words, stage (2) shows that the firms involved in the effort to develop the process, not the product. The involvement of the firms either in the development process or product have to be identified because it is two different stages and involve the very critical decision. As such, firms that develop the P&P component here refer to both research areas that compose of the two situations as explained in (1) and (2). However, most of the firms that being studied are more exposed to the activity in the stage (2). This shown that the main criteria the firms being studied in both areas is the habit of acquiring the R&D and IT component services from outside to produce the process rather than product. In addition, the cycle of the production process showing the complex chains because it needs to taking care also the diversity of the judgement and relationship that exist (Figure 3).

Table 1: IT Component Needed by The Electronics Firm at Pre Process Based On Degree of Importants: Penang Industrial Areas (%).

IT COMPONENT	Degree of Importants							
	Very Important		Important		Unimportant		Not applicable	
	N	%	N	%	N	%	N	%
Data Processing	30	27.6	30	27.6	30	13.8	30	31.0
Information Management System	30	37.9	30	27.6	30	10.3	30	24.1
Electronic Data Interchange	30	17.2	30	31.0	30	13.8	30	37.9

Source: Questionnaire, Fieldwork September 2002



Source: Zainal Abidin, 1999: 13

Fig. 3: Cycle of Manufacturing Process.

Table 2: IT Component Needed by The Electronics Firm at Post Process Based On Degree of Importants: Penang Industrial Areas (%).

IT COMPONENT	Degree of Importants							
	Very Important		Important		Unimportant		Not applicable	
	N	%	N	%	N	%	N	%
Data Processing	30	24.1	30	20.7	30	10.3	30	44.8
Information Management System	30	34.5	30	34.5	30	10.3	30	20.7
Electronic Data Interchange	30	17.2	30	24.1	30	10.3	30	48.3

Source: Questionnaire, Fieldwork September 2002

This is suitable with the stages needed to undergone by the firms in producing the new product, showing the complex chains. Moreover, the initiative to develop the product is the risky effort and difficult (Zainal Abidin, 1999; Keinschmidt dan Cooper, 1991; Song dan Montoya-Weiss, 1998 in Muhamad, 2002). Whereas, the success in certain competition and marketing size that will be gained is much depending on (1) firms capability to produce the suitable products that suit the current market, (2) become the first superior that can generate maximum profit and (3) lastly facing the disaster (Ernst, 1997: 26). This shows that the firms need to depend on the input quality and not the output quantity, because by this way, the cost saving can be done.

The IT component needed become more great and complex, it need much more investment and usually the degree of transfer from main office to subsidiary firms become lesser. Meanwhile, to compete in global market, the firms have to make an innovation through the new product and process production, so that it will not be left behind. This is because in the production process, there is three main components that require fast action from the developers, that is related to production technique, production scale and also the production location by which these three elements will be influence by the production and marketing factors (Dicken, 1992).

The most dominant IT component in this stage is the information handling process (37.9%) and data processing (27.6%). Look up closely, the designing and quality assurance services are the utmost important components before the production of the products. This is due to the production of the designing and quality assurance that is not suitable will involve the higher cost (Zainal Abidin, 1999: 15). Hence, to prevent from occurrence of the problems, it needs to be control and validate at the stage before the product being produced. The IT component involved the information handling system (34.5%), data processing (24.1%) and EDI (17.2%). The component service of graphic designing become the component that is considered not important in both production stages by most of the studied firms due to firms expect this component come in the package with the designing process product and not as a different process.

As we can see, the services component that increasing their role in the production process of the product is the uses of the technology that based on advanced production technologies such as CAD/CAM/ CNC² and EDI technology. The increasing uses of the technology that based on advanced production process currently is influenced by the firms needed to become more competitiveness. This is because the CAD service and CAM system can control and integrate the production process although the firms run their operation at another place (Knox and Agnew, 1998: 206). While EDI technology enable the firms to run the transaction process with the customers or services supplier firms such as the buying delivery and sending processes. However, not all the firms used this technology as the main mode of connection. Moreover, frequency and diversity of using EDI is not much differing with other products. This makes the uses of the EDI within the production firms in Malaysia still low. Overall, the uses of the EDI depend on the firm size, experience and also power gained by the supplier. It is noted that, the firms that developed themselves the services component needed in the stage before the product being produced will maintain this effort when the product is being manufactured. And so on, there is the studied firms are referring to these two stages as the same stage. This is related to the type and quantity of the product produce because it will influence the processes involved and also change the production aspect, technology criteria and energy needed.

Generally, majority of the firms in the research areas recognized the capability of the intermediary services component in influencing the development of their production operation, can widespread the marketing geography especially in terms of plaiting the relationships between the supplier – customer. This happen usually because the capability of the global manufacturing company is valued based on the ability to produce the world or global standard products. For that reason, as the industry that considered as the global industry, each electronic products produced by the firms have to fulfil the international standard. The standard is important as a formula or recognition to value the services because it is makes professionally. There are firms studied have reach the ISO9001 standard because have showing the great performance in designing, development, production and providing services for product production activities.

However, most firms only develop certain component services only, while other products are obtained from main office or supplier services' firms from overseas. This shows that, although there are the efforts to develop the IT component services in the firms but its characteristics not enclose enough because only certain component being develop especially the one that easy and simple to be develop. The rest, dependence on the main offices or supplier services' firms from overseas still the dominant although it seem that most of the firms

that operating in Penang's industrial areas can be considered as unwavering in producing the world standard products.

The data gained showing that there is some small foreign multinational firms in both research areas have the proudest performances when the IT component such as development activities and designing products are run by the R&D unit in the firms. This is because usually the R&D activities by most of the foreign multinational firms are done in the main offices while the production and assembly products are done in the subsidiary firms including the firms in Penang. Moreover, another points to be proud of is the IT activity runs by these small numbers is considered as the second best after their main offices in the advanced countries. These firms are responsible to prepare the IT program facilities to other firms that are interested or their subsidiary firms that operate in China and Bangkok. These firms not only focused on activity of production certain components and R&D only, but also involved in the activities such as engineering, marketing and handling the supplier chains to ensure that the competitiveness of the subsidiary firms keep increasing.

Although the total firms involved in this activity not much in term of the quantity and only involved the foreign multinational firms but their performance shown is the one that can be proud of because it is developed by the local technician's workers that obtain the practices in the main offices or during working. These local experts take responsibilities to design the appliance in order to produce new integrated circuits that high in proficiency. They also being exposed to the process of the production the matters at the initial stages that always are considered as the critical parts especially in the firms that focus on the activity of whole component production.

The involvement of many local experts in the stage before the products production showing that the process of the development and new innovation not only conquered by the advanced countries, but also the develop countries. Moreover, the technique of miniature the electronic component to smaller size (micro – electronic) is the new trend in the electronic industry and all the firms are chasing to become the first that successfully producing such products (Marsh, 1981 in Rasiah, 1994). However, how far this process will succeed completely is depends on the capabilities of the local experts to absorb and manipulate the outside technology in the short time. Hence, the increasing of the efficiency and precise productions are mostly depending on the component of the R&D and IT services because it enables the firms to compete with more effective compared to the products from Taiwan, South Korea and Singapore.

As a conclusion, when the production process becomes more complex, it will involve the usage or integration of the components of the intermediary services that is more advanced. Generally because, based on Zainal Abidin (1999: 5), the products produced by the firms must fulfil the desire and admire of the users such as;

- (1) Products must fulfil whole the design needs and specification,
- (2) Can be produced in the most economic ways to minimize the cost,
- (3) Products quality must be control in every single stages of production starting from the designing until the finish products,
- (4) In high competitiveness situation, the production techniques have to be change so that it can fulfil the request that rapidly changing to ensure type of product, production rate and delivery 'jus-in-time' to customers,
- (5) Production activity has to be seen as a big system. All the parts are link to each others. This system can be modelled or simulated to study the effects of certain factors such as request changes, product design, material cost and other costs and production technique towards the quality and costs of the goods,
- (6) Production organization needs to enhance the production efforts such as the way to optimize the resources such as goods, machines, energy, capital, workers and technology.

Policy Implication and Conclusion:

For a developing country like Malaysia, the government must play an increasingly important role in industrial IT, in term of the both policy direction and direct research involvement. This is because the results of IT activities have some attributes of a pure public good. Without government encouragement and financial support, the amount of IT activity in society would become less than optimal, since social benefits would be greater than private benefits over time. Secondly, doing research is an extremely risky enterprise and at this stage Malaysia society has not developed an adequate mechanism to bear part if the inventor's cost and risks. This also means that the government's role becomes crucial. Lastly, technological development requires substantial infrastructural support of various kinds, including education and training, technical extension services, development of public-private sector linkages and a legal framework (i.e. patent laws) to enforce property rights to sustain and enhance such technological innovation. Hence, the supports and helps in term of courages or certain incentives are utmost important in order to realize this dream to become the country with high industrial technology.

Increasing the production of commodities in electronic firms involves combinations of manufacturing and services functions in particular a critical component like IT services. Such combinations of manufacturing can be achieved within a company or by organizing a mix of internal and external expertise. There is an important

shift away from production that dependent upon material resources to production that utilizes knowledge as the key source of competitiveness and innovation. It has also been observed that the restructuring of industrial activity and expansion and related services at the global level and the need for companies to maintain competitiveness. It is in this respect that industrial areas like Penang have repositioned themselves within the global system by restructuring their industrial growth to achieve higher levels of manufacturing and services activities. In order to remain competitive, manufacturing firms have no choice to make their product more efficient, reliable, high value because electronics product life cycle is very short and time-sensitive. The step is taken to ensure that the development and product designing process are able to react swiftly to any change in the global scale. However, industrial upgrading efforts in the manufacturing sector could be achieved through the integration of advanced producer services components in the production process. It is in this respect electronics industrial like the Penang Industrial Areas have repositioned themselves within the global system of regions by restructuring their industrial growth to achieve higher levels of manufacturing.

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