



Human Resource Management

Elixir Hum. Res. Mgmt. 34 (2011) 2520-2529

Elixir
ISSN: 2229-712X

Manufacturing-producer services relationship in electric and electronic firms in Penang's regional production complex, Malaysia

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ARTICLE INFO

Article history:

Received: 16 March 2011;

Received in revised form:

23 April 2011;

Accepted: 28 April 2011;

Keywords

Electric and electronic,

IMP2,

Producer services,

Industrial upgrading,

R&D & IT.

ABSTRACT

Economic globalization has exposed the electric and electronic industrial sector to competition, which is intense and global in character. This situation subsequently influences the capability of firms to plan production based on a new perspective. Affected firms thus implement several strategies to upgrade their competitiveness at the global scale through product upgrading; and this is related to the capacity arising from the producer services sector. Following from the above, this paper aims to examine to what extent industrial upgrading in the manufacturing sector is possible via the integration of the capacity arising from local producer services component, which is in line with the 'Manufacturing Plus Plus' strategy of the IMP2. Using research methods such as face-to-face interviews and questionnaire survey and focussing on R&D and IT, this research on the electric and electronic firms in industrial areas in Penang (30 firms) indicates that industrial upgrading efforts in the manufacturing sector could be achieved through the integration of advanced producer services components in the production process. In this respect, this research contributes to current knowledge and understanding (from the perspective of theory and practice) on producer services—manufacturing sector relationship.

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Introduction

The contribution of the electrical and electronic industries (E&E) as the main force of Penang economic contributor has long been proven. The development of this industrial sector became dominant when the Malaysian Government started emphasising on the exports rather than on the imports in the 1970s. The intention was to promote economic development in the country. Since then, the electrical and electronic industry has become the industry with the most investment proportion rate and contributed 2/3 of the Malaysian total exports. As a pioneer industry in the state, the electronic sector started out as labour intensive operation and at the same time dependences on assembly activities as well as to the product quality test. Nevertheless, Penang and Malaysia emerged as one of the most important exporter of semi conductor products.

Attempts had been made to relate the production process in the electric and electrical industries to the role of producer services particularly R&D and IT to increase the grade of manufacturing industries (IU). The 'Manufacturing Plus Plus' strategy which is in line The Second Industrial Master Plan (IMP2), has tried to provide basis to assist manufacturing industrial sector on a wider scale, resilient and has international level competitiveness, by relating capability from local producer services component. This is because emphasis given towards productivity and international competitiveness intensification needs efforts to prompt production of products which have added value. This mirrors increasing use of capital and technology as well as the use of knowledge and information in innovative production environment. The emerging world

economy, liberalization process and globalization economics activities expose the manufacturing industrial sectors to prevailing global competitiveness, creating so many new opportunities and challenges. The process not only opens wider international market, it also motivates advanced manufacturing technology, makes firms organization to become more complex causing it to be reorganized. This in turn gives implication to the firm's capability in planning production based on a different perspectives or alternatives. Liberation and globalization process and observation towards its effects on the industrial development in Malaysia should be seen from various perspectives. This is because, globalization will cause the future Malaysian industrial policy to be seen in the contexts of the country's efforts to increase its competitiveness in international level particularly through increase of products grade. Specifically, it involves increased products from low value clusters to high value clusters as well as increased function activities along the value clusters in order to compete in the world markets. The question of to what extent the increase in the manufacturing industrial grade can be achieved by relating it to the capability of the producer services, particularly from the components of local R&D and IT will be clarified in this paper work based on the case study of the electrical and electronic industries in the Penang Industrial area.

Productions and Competitions in the new Millennium

Economic development in the preceding millennium was based on high labour input, foreign investment and raw materials resources (see Scott, 1988; Dicken, 1992, 1998; Hayter, 1997; Daniels and Bryson, 2002). Therefore, up until the

end of 1980s, the focus of geographic field was on factors of location and technology particularly in the importance of these factors as a corporate strategy among manufacturing firms to increase their competitiveness (see Scott, 1988; Malecki, 1991; Hayter, 1997). This situation urged for location finding strategy which offer raw materials resources, labours and low payment thus propelled distribution of production units of multinational companies into certain developing countries. Nevertheless, by 1990s onwards, the shift in the development of manufacturing corporate firms strategy specifically in developing countries towards the efforts of restructuring the manufacturing in order to be more conducive and innovative as well as in line with global competitiveness. It also which requires the firms to be more cautious (see Henderson, 1989; Sassen, 1991, 1994; Macpherson, 1994, 1997a, 1997b; Hayter, 1997; Daniels and Bryson, 2002; Ernst, 2002, 2003).

In this new millennium, the conventional approach to development has been debated due to its decreasing return if new technological advancements are not implemented in the firms manufacturing processes (see Henderson, 1989; Britton, 1990; Mathe and Shapiro, 1993; Bryson and Daniels, 1998a; 1998b; Daniels and Bryson, 2002; Ernst, 2002). Consequently, many earlier researches emphasizes on the capability of firms developed technology particularly in industries which are characterized as innovative, the extent to which they will be able to interact with local firms and become the foundation of a region's economic development. The new millennium also sees that development in the manufacturing production sector will be achieved when innovation in the producer service sub-sector is integrated in various level of the products chain. This is caused by the implication that the main characteristics of producer service sub-sector such as skills as well as specific and modern knowledge to the changes in the production process and value added basics on physical products (Hitchens, O'Farrell and Conway, 1994; Bertschek, 1995; Bryson, 1996 in Bryson and Daniels, 1998a). Such situation is fitting with the most dominant criteria in the post industrial era of economic activities which emphasizes on the manufacturing oriented services (see Galenson, 1963; Beyers and Alvine, 1985; Grubel and Walker, 1989; O'Farrell and Hitchen, 1990; Sassen, 1991, 1994; Allen dan Gay, 1994; Bryson and Daniels, 1998a, 1998b; Haksever, Render, Russell and Murdick, 2000; Daniels and Bryson, 2002).

Ever since the 1960s, man power in the economy of developed countries has shown a shift from manufacturing to various service based employment activities. Development in the global scale has also shown rapid growth in service activities especially in producer service sub-sector because of its role and capacity in increasing a country's economy (see Beyers and Alvine, 1985; Daniels, 1985, 1993, 1999; Walker, 1985; Ochel and Wegner, 1987; Elfring, 1989; Grubel and Walker, 1989; Price and Blair, 1989; Sassen, 1991, 1994; Allen and Gay, 1994; Hutton, 1997; Dicken, 1998). Indirectly, the shift has brought about significant implications and challenges towards production techniques, operational structures as well as job environments of the service provider firms, which roles have changed – from local to global scale (Macpherson, 1994, 1997a, 1997b; Beyers and Lindahl, 1996; Bryson and Daniels, 1998a, 1998b; Coe, 2000).

Producer Services — Manufacturing Relationship

Manufacturing sector and service sector have pronounced relationship and rely on each other more than the other economic sectors (see Kotler, 1980; Hirschorn, 1988 in Daniels,

1985; Marshall and Wood, 1995, Dicken, 1998). For instance, a part of the service sector output is used in the production of manufacturing and services through the final consumers (Grubel and Walker, 1989:21). The chain relationship shows development of the producer service urged by demand towards products, which eventually causes the service input to be perceived as a dynamic power to assist in the high end manufacturing product (high end product) such as in the production of wafer fabrication (Grubel and Walker, 1989; Britton, 1990; Coffey and Bailly, 1991, 1992; Mathe and Shapiro, 1993; Macpherson, 1997a, 1997b).

Study conducted by the World Bank in 1988 (see Sassen, 1994) indicates that service content in the end products production and demand for producer services has increased. This is due to the fact that the production of certain products especially JIT (Just-in-time) concept based products and electronic products have brief life span but very high in value and require the firms to act promptly to the changes in the demand trend. This situation forces the manufacturing firms to increase the use of technology especially high technology in order to produce high added value products, reduce risk as well as ensure productive production operation, conducive and more competitive business.

All products presentation and competitiveness the modern manufacturing industries need skills or expertise that can be obtained from producer services (Hitchens et.al, 1994). Urry (1987 in Sjholt, 1994: 116) state that producer services cannot be regarded as a part of the significant components in a production system particularly for different phases in the value added chain. The use of producer services components in the industrial product manufacturing chain can be argued, especially in the context of technical and scientific interaction (Ileris, 1994 in MacPherson, 1997a: 53). According to Tyson (1993 in MacPherson, 1997a: 53), this interaction plays important role in providing innovation to the consumers especially when developing unique new products, which are different from preceding products. The use of new production techniques, which evolved through R&D program will make designing process easier (Calantone et.al., 1988 in MacPherson, 1994: 453), reduce damage rate (Schoenberger, 1989 in MacPherson, 1994: 453) and increase the overall product market performance of the firms (Kotabe, 1990 in MacPherson, 1994: 453). Customers usually measure or evaluate the efficiency of a particularly service based on the end product manufactured by a certain firms in line with intangible service input (Daniels, 1985, 1993; Price and Blair, 1989; Mathe and Shapiro, 1993). Changes in the industrial organization, which has become more complex in the recent time, have increased demand on producer service to expand business in the market (Britton, 1990; Beyers and Lindahl, 1996; Lehtinen, 1999; Coe, 2000; Morshidi, 2000).

As a conclusion, factors initiating the increase in demand for service components among manufacturing firms are the increase in the production of products and the availability of differing service offers especially related to the extent it involves various production processes; increase in the business contexts and firms management either in national or international level, which have become more complex; increase in government involvement; cost factor estimation; flexibility; risk reducing and needs for very specific skills. Factors stimulating the service providing by service provider firms are; advancements in telecommunication, information and computer technology; service firms capability in identifying better opportunities and

alertness towards changes in demands as well as changes in governmental policies and input cost. Achievements shown by producer service provider firms indicate the increase in demands for certain services from other firms inclusive of manufacturing firms because of the rapid development and trade of the sector (Miles, 1993; MacPherson, 1997a; Daniels, 1999; Kellerman, 2002). On the other hand, the unreadiness of producer service (including quality quantifying) is important because it will influence the cost and competitiveness of products.

Even though, the contributions of the producer service sub-sector have been recognized in the manufacturing-production sectors, up until the present time, not many theories or models can be put forward to explain the relationship between the two sectors (refer to Mathe and Shapiro, 1993). Deliberation towards the materials referred by most researchers shows that resources, which discuss on the integration of the manufacturing producer services, are limited. It is acknowledged that many wrote with regards to the producer service but very few relate it to the manufacturing production sectors. This indicates that the suggested theories and models are not establish yet. In theoretical context, it has been discovered that only the book written by Mathe and Shapiro (1993) entitled 'Integrating services in the manufacturing company' discusses about the relationship between producer-manufacturing services. In the earliest chapters, both scholars admitted that until the year 1993 (the year the book was written), not many people write about the relationship between the producer-manufacturing services. According to Mathe and Shapiro (1993), services are important to the manufacturing firms to increase competitiveness especially in determining the overall sales of products. When competitiveness becomes more intense, manufacturing firms cannot avoid from integrating service and manufacturing components especially in the process of producing better physical products to ensure that the market segment remains high. Integrated services by firms in the physical products are predicted to be able to increase benefits to the customers who buy the products directly or indirectly. Further elaboration on the roles of producer services in the manufacturing industrial products chain, which was given emphasized by proceeding theories, is more on the relationship in the context of logistic and importance from the perspective of market size expansion. The model introduced by Quinn and Doorley (1988 in Haksever et.al., 2000) is the only model that try to relate services and manufacturing production sectors. However, this model cannot discriminate the role of services in the production process of the manufacturing sector based on the specific service categories whereby service is supposed to be separated because of its different functions, capability and productivity. This in turn will produce different input and implications.

Area of Study

The profile of the area of study in Penang includes industrial estates, technoplex area and Free Industrial Zone (FIZ). Figures 1 until 4 show the specific profile.

Penang Industrial Area

Penang is situated in the northwest of Peninsular Malaysia, and consists of Penang island and Seberang Prai on the mainland (refer to Figure 1.). Penang industrial area can be divided into industrial estates, technoplex area and Free Industrial Zone (FIZ). More specifically, it is represented by FIZ and technoplex areas in Bayan Lepas as well as in Mak Mandin, Prai, Seberang Jaya, Bukit Minyak and Bukit Tengah. These industrial areas especially the FIZ in Bayan Lepas as well as the technoplex

areas are situated in urban area and near the Bayan Lepas International Airport, which gives these areas the advantages to grow 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 these free industrial zones marked the beginning of exposing Penang 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. Through the industrial manufacturing sector, the Penang State Government encourages firms to shift into automation and increase the use of high technology in their production activities. This encourages the manufacturing sectors to enter a new phase where firm operation push for activities with high added value, capital and technology content as well as high skills. These are the highest and fastest advances in Malaysia. When other states were struggling to make industrial manufacturing as their main economic source, Penang is comfortable with its position and among the earliest to prove that this sector has succeeded in developing domestic economy.

The study areas chosen have the following characteristics:

1) Penang Industrial area is an establish industrial area in terms of electrical and electronic products production in the northern region of Peninsular Malaysia as well as located in urban area (Figures 2, 3 and 4).

2) Operating firms, particularly in Bayan Lepas FIZ and Technoplex areas practice manufacturing based productions compared to the product assembly activities. This is in line with the aim of the study that tries to explore the roles of R&D and 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. The study is also in line with the government's effort through PDC, which has suggested to develop the first Multimedia Super Corridor zone (MSC), the first of it kind in Bayan Lepas industrial area and technoplex. The existence of MSC zone marks the operating firms in both areas has achieved satisfactory level. In short, it can be said that the area of study has unique strength as a manufacturing operational centre compared to assembling product activities.

3) However, there are no specific operating producer service providers in the area of study.



Figure 1. Free Industrial Zones in Penang

The process of decision making related to the types of producer services integrated into the production of electronic products will be done based on the type of industry, the type of products produced and firms ownership. The discussion will focus on electronic firms considering that the R&D and IT components are more critical in the manufacturing based production process compared to assembly practiced more by the electrical firms. The discussion will also focus on the most

dominant service components needed by firms in the phases of before and while a product is being produced as well as examining how it is prepared and the purpose following any decision made(refer to Figure 5 and 6).

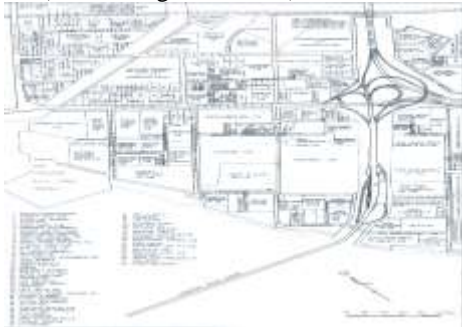


Figure 2. Outflow due to rapid growth of industrialization in Bayan Lepas



Figure 3. Location of Penang Giant Electronic Firms (currently still operating)



Figure 4. Dominating firms on production of high technology and value added product

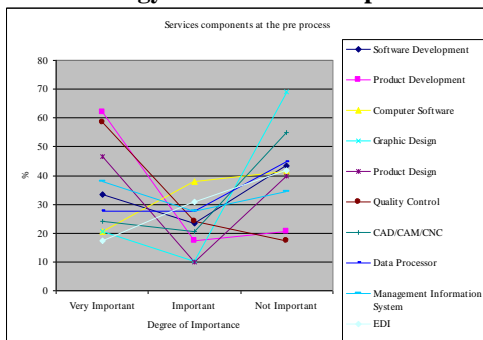
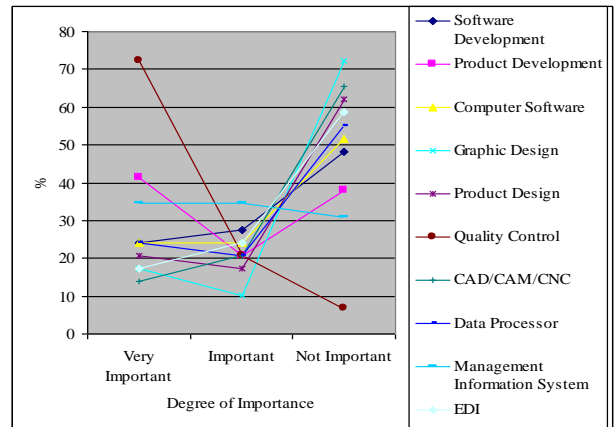


Figure 5. Services Components at the pre process (needed before production) according to degree of importance: Penang Industrial Area (%)

Figure 6. Services Components (post process) needed while production according to degree of importance: Penang Industrial Zone (%)



Source: Author Survey, 2002

The concept of self-developing R&D service component addressed in this study involved two main phases which are (1) developed as a whole by a R&D unit within the particular firms or (2) the firms carry out additional value activities for infrastructures provided by the central head office or customers that are generally characterized as shown in Figure 7. In other words, the second phase shows that these particular firms are involved with the application of developing process instead of product. The firms' involvement, whether in the development of process or product should be recognized as they are two different phases and involves the process of making the most critical decisions. Consequently, firms developing R&D components in both the areas of study involved both situations as clarified in (1) and (2). Nevertheless, most studied firms are more exposed to activities in phase (2). This shows that, the main feature of firms in both areas of study is the tendency to obtain R&D and IT service components compared to products. In addition, the cycle of the manufacturing process shows complex chain, which needs to take into consideration various existing factors and connections.

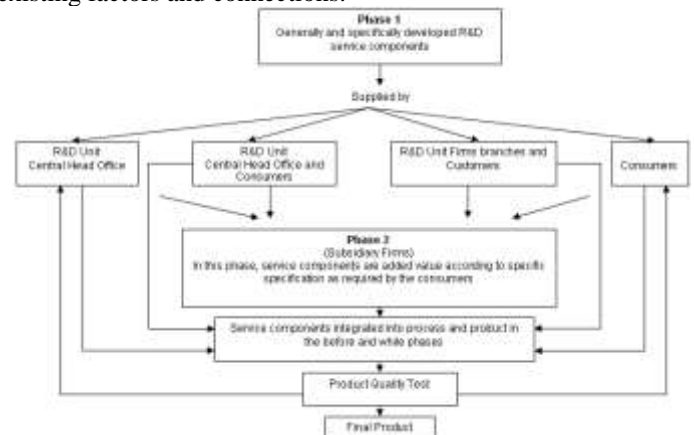


Figure 7. Decision Making Phases in Relation to the R&D and IT Service Components

Source: Interview, Fieldwork September 2002

R&D components integrated by the firms' branch are general or specifically supplied by (1) R&D central head office units, (2) collaboration between the central head offices and the consumers, (3) R&D firm branches unit and consumers or (4) everything is supplied by the consumers. The service components developed in phase (1) will continue to be integrated in the production process without adding value. In

general, in this particular phase, the production process is easier because the infrastructures are provided and firm branches only focus their activities to producing products based on fixed specifications. In the meantime, the (2), (3) and (4) phases show more complex interaction because firms that collaborate with their main consumers have limited control structure as their overall capability is controlled by the consumers' capital. The phases also need value added activities to infrastructures provided so that they will become more specific as required by the consumers based on certain particular ISO specification by using expertise and technical experiences available in the firms.

There are also certain research firms reporting that it will be easier if the needed service components are determined or supplied by the consumers themselves instead of assigning the responsibility to the judgment and capability of the technical experts, who handle R&D units. This matches the complex chain of the phases that need to go through by every firm in producing new products. Moreover, the initiative to develop a product is a high risk effort and hard to carry out (refer to Abibullah et al. 1994; Zainal Abidin, 1999; Keinschmidt and Cooper, 1991; Song and Montoya-Weiss, 1998 in Muhamad, 2002). In contrary, the success in a competition and market size benefited mostly depends on (1) the firms' capability to produce appropriate product in line with the current trend, (2) becoming the first party that is capable to acquire maximum profit and (3) the last to face upheavals (Ernst, 1997: 26). It shows that firms need to depend on the input quality instead of the output quantity because in the course of this method, cost can be reduced.

This situation also describes the process of developing R&D components such as creating ideas and designing product design are not easy tasks because of their major influence and implications to signify the firms capability to their customers as well as their competitors. When the needed R&D component becomes more sophisticated or complex, it needs bigger investment and usually the transfer level from the central head office to subsidiary firms will decrease. On the other hand, to be able to compete in the global market, firms should always be innovative through new products inventions and processes in order to keep up with the latest trends. This is because, in the production process, there are three main component that to be given priority by entrepreneurs which are related to production techniques, production scales as well as production location whereby the combination of the three is influenced by the production and market factors (Dicken, 1992).

The most needed R&D service components by firms in the Penang industrial area in the phase before products are produced are the process of developing product (62.1%), quality control (58.6%) and product designs (46.7%). In the meantime, the most dominant IT components in this phase are the information management system (37.9%) and data processing (27.6%). As seen from both areas of study, the designing services and quality control are perceived to be the two most significant components in the phase before products are produced. This is because, inappropriate design productions and quality control processes involve higher cost (Zainal Abidin, 1999: 15). Therefore, to prevent any arising problem, these processes need to be controlled during the phase before products are produced.

R&D components required for production process in Penang industrial areas according to the degree of importance include quality control (72.4%), product development (41.4%), software development (24.1%) and computer software (24.1%).

The IT components involve information management system (34.5%), data processing (24%) and EDI (17.2%). The component of graphic design service is considered a non-significant component in both production phases in most of the research firms. This is due to the firms' perception that these components come in package with the product designing process instead of in different entities.

If observed, among the service components which are becoming more significant in the process of product production are the use of technology based on the most advanced manufacturing processes such as CAD/CAM/CNC and EDI technology. The increase in the level of the most advanced manufacturing process based technology use is stimulated by the firms' need to become more competitive. It is because CAD service and CAM system are able to control and integrate the production processes even though the firms are operating production in different locations (Knox and Agnew, 1998: 206). In similar vein, the EDI technology enables the firms to carry out transaction processing both with the consumers or service provider firms such as sale order processing and delivery. Nevertheless, it is found that not all the research firms use this method as the main mode of communication. Moreover, the frequency and variety of EDI utilization is not of much between among products. This shows that the EDI usage rate among the manufacturing firms in Malaysia is still low. As a whole, the level of EDI usage depends on the size of firms, experience as well as the power acquired by suppliers. It is also found that, firms with self-develop service components needed in the phases before production will increase the effort until the phases when the products are being produced. Consequently, there are firms, which refer to both phases as the same phase. The truth is that this matter is related to the type and quantity of product produced because it will influence the process involved as well as change all aspects production, technology criteria and needed workforce.

Generally, the majority of firms in the area of study admitted that the capability of the producer service components in influencing the development of production operation (Table 1), are able to expand geographical market (Table 2) especially in the context of establishing close relationship between suppliers-consumers. The capability of a global ranking manufacturing company is typically measured based on its capability of producing global or world standard products. For that reason, being a global industry, all electronic products produced by the firm should cater for international standard. The standard is important as a formula and acknowledgement to measure the rate of services as it was established professionally. There were several studied firms, which had achieved ISO 9001 status for showing satisfying performance in the designing, development, production activities as well as preparing services for the production of products.

On the other hand, most firms only develop certain service components while the others are obtained from the central head office or foreign service supplier firms. Regardless of the efforts to develop R&D and IT service components in firms, its features are not in total, as only certain components are developed particularly the easier ones. The rest are still very much dependent on the central head office or service provider firms even though most of the firms particularly those operating in the Penang industrial area are well established and produce world standard products.

Accumulated data shows that there are a few numbers of

foreign multinational firms in both areas of study that have satisfying performances when the R&D and IT components such as developing and products designing activities are carried out by the R&D unit in the firms. This is because; the R&D activities in most foreign multinational firms are done in the central head office while the process of manufacturing and product assembling are done in subsidiary firms including those in Penang. What is more visible is the fact that R&D activities are carried out by a small number of research firms perceived to be in the second ranking after their central head office in developed countries. These firms are responsible in providing R&D program facilities for other interested firms or their subsidiary firms operating in China and Thailand. These firms not only focusing on the manufacturing activities of certain components and R&D, but are also involved in activities such as engineering, marketing and suppliers chain to ensure steady increase in competitiveness of their subsidiary firms.

Even though there are only a few firms involved in these activities as well as involving only foreign multinational firms, but the achievements shown are significant because they are developed by local technicians, who undergone training in the central head office or while working. These local experts are responsible in designing in the process of producing new high capability integrated circuits. They are also exposed to the materials production processes at the initial stage, which has always been recognized as the most critical phase in the production of products especially for firms who focus solely on the components manufacturing activities.

The involvement of a large number of local experts in the phase before products are produced shows that the re-establishment process and new invention are not entirely dominated by developed countries but are also being dominated by developing countries. Moreover, the technique of reducing the size of electronic components (called micro electric) is the latest trend in the electronic industry and all the firms are competing to become the first party to be able to produce such products (Marsh, 1981 in Rasiah, 1994). On the other hand, the extent to which this process will succeed will depend on the capability of the local experts to absorb and manipulate technology from abroad in a shorter period. In relation to this, the expertise and the level of production depend mostly on the R&D and IT service components because they will enable the firms to compete efficiently with products from Taiwan, South Korea or Singapore. There are also research firms that become the centre of development of the R&D activities on behalf of their central head office. This advancement, is suffice to put thrust in all of the activities, perceived as critical, and done by Japanese firms seen as demanding to carry out R&D activities in subsidiary countries, more so to the central head office.

Wafer production based firms which ordinarily obtain silicon bars from abroad particularly from well-known chemical companies. The imported silicon bars are processed to produce pieces of wafer. The process of cutting the wafer is done according to instruction and specification set by the customers. The machines used should also be suitable and commonly fixed to ensure that the final products follow the customers' specifications. More often than not, the engineers involved in the process of silicon wafer production master the field effectively but are not allowed to change the components into other designs without prior approval from the management. However, these engineers initiated modification to the machines with the purpose of optimizing and maximizing the productions. The

modification of these machines shows that the firms are exposed to the efforts of developing production processes instead of products. Generally, local firms have fewer provisions to carry out R&D activities and are also facing shortages of technical expertise in the process of producing high technology based products including wafer production. The lack of capability is said to be a hindrance in producing new products.

According to MIDA, there are four significant conditions that need to be fulfilled by a firm in handling wafer fabricating level: (1) generally, the unadulterated of materials should exceed 99.9%; (2) specific air-conditioning system is needed to ensure the air cleanliness; (3) constant electricity supply without any disruption and (4) the availability of sufficient professional and technical experts. The question is to what extent the firms in the specify research areas fulfil these specifications. Moreover, the capital needed by a firm in producing wafer-based products is excessive. Consequently, supports and aids in the forms of incentives are important in the realization of the goals of increasing the number of high-tech industries. The process of wafer production also shows a complex relationship. Furthermore, not all stages in the process of producing wafer are carried out by subsidiary firms such as in stage (1) and (2) because in the initial stages, particularly those involving crystal growth and development are still done in the central head offices. It shows that the process of wafer production, which is mostly done in subsidiary firms, only begins in stage (3) onwards. If the R&D activities in the manufacturing industries in this country are developed, the technological skill will indirectly, developed as well.

Conclusion

Foreign multinational firms are depends on their central head office in order to obtain certain expertise particularly related to the latest technology. The step is taken to ensure that the product designing processes 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 that E&E industries like the Penang Industrial Areas have repositioned themselves within the global system of regions by restructuring their industrial growth to achieve higher level of manufacturing. In this respect, this research contributes to current knowledge and understanding on producer services—manufacturing sector relationship.

References

1. Allen, J. and Gay, P.D. (1994) Notes and issues - industry and the rest: the economic identity of services in Bryson, J.R. and Daniels, P.W. Services industries in the global economy (vol.1). Cheltenham, Edward Elgar. Hal: 297-313.
2. Amin, A. and Thrift, N. (1994), Living in the global in Globalisation, institutions and regional development in Europe (ed) Amin, A. and Thrift, N. London, Oxford University Press.
3. Amirahmadi, H. and Wallace, C. (1995), Information technology, the organization of production and regional development. *Environment and Planning A*, 27: 1745-1775.
4. Bagchi-Sen, S. and Sen, J. (1997), The current state of knowledge in international business in producer services, *Environment and Planning A*, 29: 1153-1174.
5. Begg, I. (1996), The services sector in regional development, *Regional Studies*, 27: 817-825.

6. Begg, I.G. and Cameron, G.C. (1988), High technology location and the urban areas of Great Britain, *Urban Studies*, 25: 361-379.
7. Belderbos, R., Capannelli, G. and Fukao, K. (2001), Backward vertical linkages of foreign manufacturing affiliates: evidence from Japanese multinationals. *World Development*, 29: 189-208.
8. Bennett, R.J. and Graham D.J. (1998), Explaining size differentiation of business services centres, *Urban Studies*, 35: 1457-1480.
9. Bertschek, I. (1995), Product and process innovation as a response to increasing imports and foreign direct investment. *The Journal of Industrial Economics*, XLIII: 341-357.
10. Bertuglia, C.S., Fischer, M.M. and Preto, G. (1995), Technological change, economic development and space. Germany, Springer.
11. Beyers, W.B. and Alvine, M.J. (1985), Export services in post-industrial society. *Papers of the Regional Science Association*, 57: 33-45.
12. Beyers, W.B. and Lindahl, D.P. (1996), Explaining the demand for producer services: is cost-driven externalization the major factor? *Journal of Regional Science*, 75: 351-374.
13. Britton, S. (1990), The role of services in production. *Progress in Human Geography*, 14: 529-549.
14. Bryson, J.R. and Daniels, P.W. (ed) (1998a), *Services in the global economy (Vol. I)*. Cheltenham, Edward Elgar.
15. _____ (ed) (1998b), *Services in the global economy (Vol. II)*. Cheltenham, Edward Elgar.
16. Castle, L.V., and Findlay, C., (1988), *Pacific Trade in Services*. Sidney, Allen & Unwin National University.
17. Clarke, A.E. (1994), Spatial linkages and subcontracting relationships among high-technology industries in the Northeast Ohio region. *Environment and Planning A*, 26: 1579-1603.
18. Coe, N.M. (2000), The externalisation of producer services debate: the UK computer services sector. *The Service Industries Journal*, 20: 64-81.
19. Coffey, W.J. and Bailly, A.S., (1991), Producer services and flexible production: an exploratory analysis. *Growth and Change*, 22: 95-117.
20. _____ (1992), Producer services and systems of flexible production, *Urban Studies*, 6: 857-868.
21. Coffey, W.J. and Shearmur, R.G. (1997), The growth and location of high-order services in the Canadian urban system, *Professional Geographer*, 49: 404-418.
22. Cohen, W.M. and Levinthal, D.A. (1989), Innovation and learning: the two faces of R&D, *The Economic Journal*, 99: 569-596.
23. Daniels, P.W. (1985), *Services industries: a geographical appraisal*. London, Methuen.
24. _____ (1993), *Services industries in the world economy*. Oxford, Blackwell Publishers.
25. _____ (1999), Globalization, producer services and the city: is Asia a special case? *World Services Congress*, 1-3, November. Atlanta, Georgia.
26. Daniels, P.W. and Bryson, J.R. (2002), Manufacturing services and servicing manufacturing: knowledge base cities and changing forms of production, *Urban Studies*, 39: 977-991.
27. Dicken, P. (1992), *Global shift: the internationalization of economic activity (2nd Edition)*. London, Paul Chapman Publishing Ltd.
28. _____ (1998), *Global shift: transforming the world economy (3rd Edition)*. London, Sage Publications.
29. Elfring, T. (1989), The main feature and underlying cause of the shift to services, *Services Industrial Journal*, 9: 337-356.
30. Ernst, D. (1997), High-tech competition puzzles: how globalization affects firm behaviour and market structure in the electronics industry, *DRUID Working Papers*, No.97-99, September.
31. _____ (2000a), Catching-up and post-crisis industrial upgrading: searching for new sources of growth in Korea's electronics industry, *East-West Centre Working Papers, Economics Series*, No.2, May.
32. _____ (2000b), Global production networks and the changing geography of innovation systems: implications for developing countries, *East-West Centre Working Papers, Economics Series*, No.9, November.
33. _____ (2002), Global production networks in East Asia's electronics industry and upgrading perspectives in Malaysia, *East-West Centre Working Papers, Economics Series*, No.44, March.
34. _____ (2003), How sustainable are benefits from global production networks? Malaysia's upgrading prospects in the electronics industry, *East-West Centre Working Papers, Economics Series*, No.57, June.
35. Fauziah, Che Leh (2005), *Perkaitan Perkhidmatan Perantaraan-Pembuatan: Kajian Kes Firma Elektrik dan Elektronik di Kawasan Perindustrian Pulau Pinang dan Taman Teknologi Tinggi Kulim*. Tesis Doktor Falsafah (In Malay). Pusat Pengajian Ilmu Kemanusiaan, Universiti Sains Malaysia.
36. Fischer, M.M. (1995), Technological change and innovation behaviour in Bertuglia, C.S, Fischer, M.M and Preto, G. *Technological change, economic development and space*. Germany, Springer. Hal: 145-157.
37. Frenkel, A. (2001), Why high-technology firms choose to locate in or near metropolitan areas. *Urban Studies*, 38: 1083-1101.
38. Galenson, W. (1963), Economic development and the sectoral expansion of employment in Bryson, J.R. and Daniels, P.W. (1998a), *Services industries in the global economy (vol.1)*. Cheltenham, Edward Elgar. Hal: 334-348.
39. Goe, W.R. (1990), 'Producer services, trade and the social division of labour'. *Regional Studies*, 24: 327-342.
40. _____ (1991), The growth of producer services industries: sorting through the externalisation debate. *Growth and Change*, 22: 118-141.
41. Grubel, H.G. and Walker, M.A. (1989), *Services industry: cause and effect*. Vancouver, Fraser Institute.
42. Haksever, C., Render, B., Russell, R.S. and Murdick, R.G. (2000), *Services management and operations (2nd Edition)*. New Jersey, Prentice Hall.
43. Hansen, N. (1990), Do producer services induce regional economic development?, *Journal of Regional Science*, 30: 465-476.
44. Hayter, R. (1997), *The dynamics of industrial location, the factory, the firm and the production system*. New York, John Wiley & Sons.
45. Henderson, J. (1989), *The globalisation of high technology production: society, space and semiconductors in the restructuring of the modern world*. London, Routledge.
46. Hitchens, D.M.W.N., O'Farrell, P.N. and Conway, C. (1994), Business service use by manufacturing firms in Mid Wales. *Environment and Planning A*, 26: 95-106.
47. Hutton, T.A. (1997), Service industries, economic restructuring and the spatial reconfiguration of Asian-Pacific

- city region. A paper prepared for the APEC service industries research project conference, Kamuela, Hawaii, 22-23 February.
48. Juleff-Tranter, L.E. (1996), Advanced producer services: just a service to manufacturing? *The Service Industries Journal*, 16: 389-400.
 49. Kellerman, A. (2002), Conditions for the development of high-tech industry: the case of Israel, *Tijdschrift voor Economische en Sociale Geografie*, 93: 270-286.
 50. Lehtinen, U. (1999), Subcontractors in a partnership environment: a study on changing manufacturing strategy, *International Journal of Production Economics*, 165-170.
 51. Ley, D. and Hutton, T. (1987), Vancouver's corporate complex and producer services sector: linkages and divergence within a provincial staple economy, *Regional Studies*, 21: 413-424.
 52. Lueders, A.H. (1999), Service classification schemes. *World Services Congress*, 1-3 Nov. Atlanta Georgia.
 53. Mackun, P. and MacPherson, A.D. (1997), Externally-assisted product innovation in the manufacturing sector: the role of location, in-house R&D and outside technical support. *Regional Studies*, 31: 659-668.
 54. MacPherson, A.D. (1994), The impact of industrial process innovation among small manufacturing firms: empirical evidence from western New York. *Environment and Planning A*, 26: 453-470.
 55. _____(1997a), The role of producer service outsourcing in the innovation performance of New York state manufacturing firms. *Annals of the Association of American Geographers*, 87: 52-71.
 56. _____(1997b), A comparison of within-firm and external sources of product innovation. *Growth and Change*, 28: 289-308.
 57. Malecki, J.E. (1991), *Technology and economic development: the dynamics of local, regional and national change*. New York, Longman Scientific and Technical.
 58. Marshall, J.N. (1982), Linkages between manufacturing industry and business services, *Environment and Planning A*, 14: 1523-1540
 59. Marshall, J.N. and Wood, P.A. (1995), *Services and space: key aspects of urban and regional development*. Longman Scientific and Technical.
 60. Maskell, P. and Malmberg, A. (1999), The competitiveness of firms and regions 'ubiquitification' and the importance of localized learning. *European Urban and Regional Studies*, 6: 9-25.
 61. Mathe, H. Shapiro, R.D. (1993), *Integrating service strategy in the manufacturing company*. London, Chapman & Hall.
 62. Mclvor, R. (2000), A practical framework for understanding the outsourcing process, *Supply Chain Management: An International Journal*, 5: 22-36.
 63. Mela, A. (1995), *Innovation, communication networks and urban milieus: a sociological approach in Bertuglia*, C.S., Fischer, M.M. and Preto, G. *Technological change, economic development and space*. Germany, Springer. Hal: 75-90.
 64. Morshidi, S. (2002), *Proses globalisasi dan transformasi bandar raya: isu, peluang dan cabaran bagi Kuala Lumpur. Pulau Pinang, USM. Siri Syarahan Pelantikan Profesor*.
 65. Michalak, W.Z. and Fairbairn, K.J. (1993), The producer service complex of Edmonton: the role and organization of producer services firms in a peripheral city. *Environment and Planning A*, 25: 761-777.
 66. Miles, I. (1993), Services in the new industrial economy. *FUTURES*, July/August: 653-672.
 67. Ochel, W. and Wegner, M. (1987), *Service economies in Europe: opportunities for growth*. London, Printer Publisher.
 68. O'Farrell, P. N. and Hitchens, D.M.W.N. (1990), Producer services and regional development: key conceptual issues of taxonomy and quality measurements. *Regional Studies*, 24: 163-171.
 69. O'Farrell, P.N., Moffat, L.A.R. and Hitchens, D.M.W.N. (1993), Manufacturing demand for business services in a core and peripheral region: does flexible production imply vertical disintegration of business service? *Regional Studies*, 27: 385-400.
 70. O'hUallachain, B. and Reid, N. (1991), The location and growth of business and professional services in American metropolitan areas, 1976-1986. *Annals of the Association of American Geographers*, 81: 254-270.
 71. Perry, M. (1992), Flexible production, externalisation and the interpretation of business service growth. *The Service Industries Journal*, 12: 1-16.
 72. Price, D.G. and Blair, A.M. (1989), *The changing geography of the service sector*. London, Belhaven Press.
 73. Romanoff, E. and Levine, S.H. (1993), Information, inter industry dynamics and the service industries. *Environment and Planning A*, 25: 305-316.
 74. Rosander, A.C. (1989), *The quest for quality in services*. Wisconsin, Quality Press.
 75. Sassen, S. (1991), *The global city: New York, London, Tokyo*. Princeton, Princeton University Press.
 76. _____ (1994), *Cities in a world economy*. London, Fine Forge Press.
 77. Scott, A.J. (1989), *New industrial spaces*. London, Pion Limited.
 78. Sjholt, P. (1994), The role of producer services in industrial and regional development: the Nordic case. *Urban and Regional Studies*, 1: 115-129.
 79. Sim, O.F. and Md.Nor, O. (1999), *managing innovation in Malaysia: comparing Japanese and Malaysia companies in Jomo, K.S., Felker, G. and Rasiah, R. Industrial technology development in Malaysia*. London, Routledge. Hal: 38-75.
 80. Simmie, J. (1998), Innovation in the high-tech knowledge economy of a core metropolitan region. *Journal of Urban Technology*, 5: 79-98.
 81. Suarez-Villa, L. and Rama, R. (1996), Outsourcing, R&D and the pattern of intra-metropolitan location: the electronics industries of Madrid. *Urban Studies*, 33: 1155-1197.
 82. Suarez-Villa, L. and Walrod, W. (1997), Operational strategy, R&D and intra-metropolitan clustering in a polycentric structure: the advanced electronics industries of the Los Angeles Basin. *Urban Studies*, 34: 1343-1380.
 83. Walker, R.A. (1985), *Is there a service economy? The changing capitalist division of labor in Bryson, J.R. and Daniels, P.W. (1998a) Services in the global economy (Vol. I)*. Cheltenham, Edward Elgar. Hal: 199-240 .
 84. Wood, P. (1996), An 'expert labour' approach to business service change. *Papers in Regional Science*, 75: 325-349.

Table1. The Influence of Producer Service on the Development of Firms

Response	Penang Industrial Areas	
	Frequency	%
Will change	22	73.3
Will not change	-	-
Unsure	8	26.7
Total	30	100.0

Source: Author Survey, 2002

Table 2. The Influence of Producer Service on the expand of geographical market

Response	Penang Industrial Areas	
	Frequency	%
Will Expand	24	80
Will Not Expand	-	-
Unsure	6	20
Total	30	100.0

Source: Author Survey, 2002