ELECTRONIC MANUFACTURING INDUSTRY IN ASIA

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ABSTRACT

This paper examines the electronic industry manufacturing convergence in Asia, as electronic manufacturing industry is playing an important role as the backbone of countries' development in Asia. Electronic manufacturing industry is important as well in this technological advance era, and to fulfill the consumers' demand. As electronic manufacturing outsourcing becoming a great opportunity for the original manufacturing factory to source for lower cost in manufacturing, thus Asia countries is the great location for them to invest in. This is the reason that this research is important which is to find out the leading electronic manufacturing countries from in Asia.

This research follows closely on Philips and Sul (2007) methodology on testing on convergence and convergence clubs clustering. Eight Asia countries are selected for this research based on their productivity which is value added divided by labour wages.

The research shows that there is convergence between the 8 countries and sub-divided into 4 club clusters. India, Indonesia and Korea are in the leading countries in the industry in the first cluster, secondly is Philippine that diverged into second cluster. Following cluster included Japan, Hong Kong and Malaysia converging and the last diverging country is Singapore.

Electronic manufacturing industry is important for a country to develop into high income group countries and they are focusing in increasing the productivity to improve the competitive advantage of the countries in the market.
CHAPTER 1

INTRODUCTION

1.0 Introduction

Manufacturing is the process of transforming raw materials into finished goods on a large scale, production of goods for use or sale. Manufacturing is to add value on the raw materials and labor, so the products produced can be traded in higher quantities, qualities and to create fine return from the venture (Pinto J, 2005). This process may include the use of labor, machines, tools, chemical, biological processing or formulation. Manufacturing can be range from handicraft to high technology goods, or more commonly refers to industrial production. Before Industrial Revolution, rural areas usually are the place for manufacturing, where the household based manufacturing supported the agriculture sector. As the time pass on, the entrepreneurs structured single enterprise from a number of manufacturing households and move forward to another level of manufacturing industry.

Some economists stated that manufacturing is one of the wealth producing sectors in a country, especially service sector that provide large sum of wealth. For example, America manufacturing firms as the leading industry in exporting which contributed $923 billion in manufacturing goods which is 64% of America goods and services exported in 2006 and generated $1.6 trillion GDP (Scott R, 2008). Today manufacturing underwent a great revolution. Mass production had been replaced by a mission of flexible multiproduct which focuses on quality and speedy response to the market demand, and using the advanced technology and equipment to improve the manufacturing process. Riley Geoff (2012) stated that the world is going into the Third Industrial Revolution which is based on digitalization of manufacturing processes due to competitiveness, productivity and product personalization. He
added that this revolution can bring the manufacturing to a higher quality and moving the lower-wage economies like China and back to economies like America.

Many countries such as America, Japan, Germany, and England used manufacturing industry as their main body to develop and realize industrialization. These countries apply the support transfer and adjustment of labour division of world industrial to build up their manufacturing industry (Hongying S, 2009). As the economic globalization and increasing world trading level, countries getting to realize that manufacturing are playing an important role and cannot be replaced in developing a country. Bureau of Economic Analysis U.S., Industry Economic Accounts 2011 shows that U.S. manufacturing industry contributes $1.8 trillion every year which is U.S. GDP of 12.2 percent. And it is estimated support 17.2 million of jobs in U.S. While for Europe, manufacturing industry remains vitally important to the economy, which contributed 17.1% of GDP and 22 million of occupations in 2007 from EU Industrial Structure 2009 as in the table below.
<table>
<thead>
<tr>
<th>NACE</th>
<th>Sector</th>
<th>Recent overview</th>
<th>Recent evolution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>in %</td>
<td>in %</td>
</tr>
<tr>
<td>A</td>
<td>Agriculture, hunting and forestry</td>
<td>1.8</td>
<td>5.7</td>
</tr>
<tr>
<td>B</td>
<td>Fishing</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>C</td>
<td>Mining and quarrying</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>D</td>
<td>Manufacturing</td>
<td>17.1</td>
<td>16.4</td>
</tr>
<tr>
<td>DA</td>
<td>Food products; beverages and tobacco</td>
<td>2.0</td>
<td>2.3</td>
</tr>
<tr>
<td>DB</td>
<td>Textiles and textile products</td>
<td>0.6</td>
<td>1.3</td>
</tr>
<tr>
<td>DC</td>
<td>Leather and leather products</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>DD</td>
<td>Wood and wood products</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>DE</td>
<td>Pulp, paper and paper products; publishing and printing</td>
<td>1.4</td>
<td>1.2</td>
</tr>
<tr>
<td>DF</td>
<td>Coke, refined petroleum products and nuclear fuel</td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>DG</td>
<td>Chemicals, chemical products and man-made fibres</td>
<td>1.8</td>
<td>0.8</td>
</tr>
<tr>
<td>DH</td>
<td>Rubber and plastic products</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>DI</td>
<td>Other non-metallic mineral products</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>DJ</td>
<td>Basic metals and fabricated metal products</td>
<td>2.5</td>
<td>2.4</td>
</tr>
<tr>
<td>DK</td>
<td>Machinery and equipment n.e.c.</td>
<td>2.0</td>
<td>1.6</td>
</tr>
<tr>
<td>DL</td>
<td>Electrical and optical equipment</td>
<td>2.0</td>
<td>1.7</td>
</tr>
<tr>
<td>DM</td>
<td>Transport equipment</td>
<td>1.8</td>
<td>1.4</td>
</tr>
<tr>
<td>DN</td>
<td>Manufacturing n.e.c.</td>
<td>0.7</td>
<td>1.0</td>
</tr>
<tr>
<td>E</td>
<td>Electricity; gas and water supply</td>
<td>2.2</td>
<td>0.8</td>
</tr>
<tr>
<td>F</td>
<td>Construction</td>
<td>8.5</td>
<td>7.4</td>
</tr>
<tr>
<td>G</td>
<td>Wholesale and retail trade; repair of motor vehicles</td>
<td>11.3</td>
<td>15.0</td>
</tr>
<tr>
<td>H</td>
<td>Hotels and restaurants</td>
<td>2.9</td>
<td>4.5</td>
</tr>
<tr>
<td>I</td>
<td>Transport, storage and communication</td>
<td>7.0</td>
<td>5.8</td>
</tr>
<tr>
<td>J</td>
<td>Financial intermediation</td>
<td>5.5</td>
<td>2.8</td>
</tr>
<tr>
<td>K</td>
<td>Real estate, renting and business activities</td>
<td>22.5</td>
<td>12.3</td>
</tr>
<tr>
<td>L</td>
<td>Public administration and defence</td>
<td>6.1</td>
<td>6.6</td>
</tr>
<tr>
<td>M</td>
<td>Education</td>
<td>5.0</td>
<td>6.8</td>
</tr>
<tr>
<td>N</td>
<td>Health and social work</td>
<td>6.9</td>
<td>9.2</td>
</tr>
<tr>
<td>O</td>
<td>Other community, social, personal service activities</td>
<td>3.9</td>
<td>4.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: EU Industrial Structure 2009

Table 1: Value Added, employment and labour productivity in Europe
As the uncertainty in Europe financial market and hostile external environment for the developing countries, world manufacturing growth is expected low. From the UNIDO statistic, manufacturing industry only grow 3.1 percent in 2012 and it is believed that the effect from the ongoing second world economy recession since 2010 on industrialized and developing countries from Figure 1.
1.1 Manufacturing in Asian

Manufacturing industry had been listed as one of the important industry in a country, especially for Asian countries. According to World Bank statistic, manufacturing industry contributed averagely 46% of their GDP over the last 20 years, while the other countries like Malaysia, Thailand, Korea, and Indonesia also achieving more than 40% of the GDP for the last 20 years. This shows that manufacturing industry considers as the main source of the country income and it is crucial for the economic growth. According to the report of consultant McKinsey, income had been raised and manufacturing provides machinery tools and material to assemble into modern infrastructure and housing. He added that even though India had been focused on global services trade with their advance information technology and business outsourcing industries, but the country still aiming to raise their manufacturing sector to increase living standards, where India aims to gain the economy share of manufacturing from 16% in 2013 to 25% in 2022. Figure 2 below shows the top manufacturing countries by decade and the changes of ranking of the emerging countries. While in Figure 3, the chart shows manufacturing shares of GDP in the top 15 manufacturing nations. It shows that top 4 countries are origin from Asia such as China, South Korea, Japan and Indonesia.
Figure 2: Top Manufacturing Countries by Decade
Source: HIS Global Insight, McKinsey Global Institute analysis

Figure 3: Manufacturing’s share of GDP in the top 15 manufacturing nations
Source: UN Statistic Division, US Bureau of Economic Analysis, McKinsey Global Institute analysis

One thing that help in development of manufacturing in Asia because of the cost conscious on the western countries that causing them to move their manufacturing factory to Asia in order to get low cost and higher quality and services (Freid R, 2004) for cost savings and improve competitive in the market. Table 2 below is the comparison of the wages between countries and shows that Asia, especially China is having the competitive advantage
of low cost labour and attracted overseas company to set up their production plant in Asia and boost up the manufacturing industry. China has as low as $0.77 per hour handwork labour compare to USA which is $13.52 per hour. Dale Weathington of Kolcraft, a man who work for an American firm which contract manufacturers in southern part China claims that China is no longer a location for low cost labour, but still it still provide a relatively low cost production cost.

<table>
<thead>
<tr>
<th>POSITION</th>
<th>USA (Typical)</th>
<th>MEXICO (Guadalajara)</th>
<th>SINGAPORE</th>
<th>MALAYSIA (Penang)</th>
<th>CHINA (Shenzhen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$/hr. Handwork Labor</td>
<td>$13.52</td>
<td>$1.81</td>
<td>$3.45</td>
<td>$1.16</td>
<td>$.77</td>
</tr>
<tr>
<td>Machine Operator</td>
<td>$17.15</td>
<td>$2.96</td>
<td>$4.42</td>
<td>$1.46</td>
<td>$.97</td>
</tr>
<tr>
<td>$/yr. Process Engineer</td>
<td>$53,560</td>
<td>$32,136</td>
<td>$29,458</td>
<td>$21,424</td>
<td>$16,068</td>
</tr>
<tr>
<td>Buyer</td>
<td>$47,214</td>
<td>$28,329</td>
<td>$25,968</td>
<td>$18,886</td>
<td>$14,164</td>
</tr>
<tr>
<td>Operations Manager</td>
<td>$95,983</td>
<td>$57,590</td>
<td>$55,410</td>
<td>$38,393</td>
<td>$28,795</td>
</tr>
</tbody>
</table>

Table 2: Wages Differences in Manufacturing Industry among countries
Source: http://www.cmcseattle.com

Another reason of high development of manufacturing industry and driving the overseas company to Asia is the large market to explore in Asia (Crawford M, 2012). For instance, from the report of Espicorn Business Intelligence in February 2012 reported that Asian markets of medical device consumption is expanding much quicker than more developed, mature medical device markets in Western Europe. Malaysia, South Korea, Cambodia, Vietnam and Thailand are the emerging markets where contribute the manufacturing and potential consumer markets as well. Even though some may claim that China is no longer a location for low cost labour, but still it still provide a relatively close access to many large city and provincial markets with large populations.
China accounts for almost half of the manufacturing industry of developing countries which act as the leader of growth rate in developing countries. From UNIDO statistic, China manufacturing growth is expected to drop to 9.0 percent in 2012 compared to previous year of 10.6 percent. This is due to the loss of demand in the external markets hence causing uncertainty at the global level. According to Wall Street Journal, China is showing better result across other Asian countries, where manufacturing activity is expanding at the end of December 2012. From the report of Deloitte in 2011, China manufacturing industry improved steadily because of the infrastructure quality, continuous and systematic support from government on technology research and vibrant business environment. The chart below derived from one of the Big Four Accounting Firm in the world, Deloitte China shows that China is the second largest after Europe Union output of manufacturing country in the world which is almost 13.5% and it had slowly grown from 1980.

![Chart showing manufacturing exports ratios](http://www.deloitte.com)

Figure 4: Ratios of manufacturing exports of the major countries and regions to the global total
Source: [http://www.deloitte.com](http://www.deloitte.com)
1.2 Industry Specialization

Industry specialization is the domination of a range of industries in a region, this usually due to the high location quotient in a few industries, which the region may focus in few industries to achieve the advantage of functional linkages. Functional linkage can create a chain where they bind the firms together to encounter the severe repercussions and build up the strength to grab the larger market share.

Berry L. and Grebtsova V. (2010) stated that industry specialization can help the country to improve their scientific and technological progress and increase the production scales. Industry specialization encourages the manufacture to concentrate on specialized enterprise and enable the use of specialized and extensively productive machine and equipment compared to those more diversified enterprises. The progress of the industry specialization had involved in different kinds of finished goods production and become more distinct where the individual operation had been carried out to manufacture different parts of a product and singled out to be independent branch of industry. Industry specialization can be divided into product specialization, phase specialization and parts specialization. Industry specialization also helps the industry to grow faster and increase the productivity either in labour or machinery.

Asian has been focused in electronic manufacturing industry to become their industry specialization and boost up their economy growth especially Japan which is the giant in electronic industry in Asian. A lot of big brand in the industry based in Japan, such as Sony, Sharp, Canon, Panasonic, Toshiba and so on. These worldwide brands have brought the great improvement in electronic research and development in Japan. Thus, Asian also looking into industry specialization and in order to obtain the expertise
in the particular field to increase the productivity and improvement in research and development for country development.

Electronics, which concerned on the flow of electrons and other carriers of electric charges especially in semiconductor devices based on the science and technology explanations. While for electronic industry is an industry where the producers venture in creating, designing, manufacturing and trading devices, for instance computers, radio, transistors and integrated electronic (Columbia University Press, 2011). Electronics had blended into our daily lives and as one of the important things for us. Dating back to 1900s, John Ambrose Flemming invented electronics was like there are 2 elements in the electron tube which invented and further developed by Dr. Forest into triode (Lijo, 2010). Moving on to 1950s, radio techniques had been invented which mostly utilized in radio appliances. Then in 1960s, silicon chips and analog device were invented to store information into a small space.

Electronic industry consider one of the fastest growing industries worldwide and it has huge effect on all other industries and throughout the economy by increasing productivity, changing cost structures, enabling development of new enterprises and creating new competitive advantages and challenges (Wellenius B, 1993). This industry is very crucial to develop a competitive modern economy. Policy and strategic is crucial for a country to develop their electronic sector, and their preferred strategy usually in between risks and stakes. Electronic industry requires highly dynamic, which involves large sum of capital in research and development and manufacturing plants where the infrastructure and skilled labour are needed as well.
Electronic manufacturing industry is very strong and acted as the backbone for the development of Asian, especially for Japan, China, and Korea. Electronic industry had been treated as an industry without bottom as it can expand much further than other industry. In Figure 5 above, China, Japan and other Asia Pacific had contributed 57% of the world electronic equipment production in 2008 which is more than half of the world production. From the report of Sturgeon T. and Kawakami M. (2010), East Asia had become increasingly depend on electronic manufacturing industry for country development especially China, Hong Kong and Taiwan as these countries contributed 33.1% of world import of intermediate electronic goods and exported at 29.4% in 2006.

From the Malaysian Investment Development Authority report, the most important sector in Malaysia manufacturing sector is Electrical and Electronics (E&E) industry which supported 26.94% of manufacturing production, 48.7% of exports and 32.5% of occupations. According to Bureau of Economic analysis data, computer and electronic products industry achieved 24.24% productivity growth rates in manufacturing industries from 1997 – 2007 which is the highest in the list. Meanwhile, from the analysis of National Science Foundation in US, semiconductor and electronic
Components has utilized highest intensity of Research and Development in manufacturing industry from 2006 – 2008. This data shows that electronic manufacturing industry is one of the targeted industries by a lot of countries and to expand their control in this industry.

During late 1960s to late 1970s, Japanese electronic manufacturing industry was piloted by Sony and Matsushita which dominated the whole markets with high technologies in consumer electronics from Sony and successful product development from Matsushita. By late 1980s, another two strong brands, Sanyo and Sharp both dominated US and European consumer electronics. By looking at Japan’s achievement in electronic industry, they are able to boost up the impressive performance in high-tech industry with mass-producing and mass-marketing. Semi-conductors ruled in 1980s as well and dominated by US industries while in 1990s, most of the electronic equipments and appliances using semi conductors such as personal computers, mobile phones and so on (Lijo, 2010).

Early in 1960s, Japan was no doubt the big boss of electronics manufacturing industry in Asia. Japan has the well-known components and equipment competency back then to support their advanced electronics and components and products industry (WTEC Hyper, 1997). Then the electronic manufacturing leader followed by Korea, Taiwan, Singapore, China, Hong Kong, Malaysia and Thailand in electronic manufacturing industry. Back in the years, the electronic industry is divided into 4 major business segments in the electronics industry are consumer electronics, computers and peripherals, telecommunications and lastly parts and components.

China itself had to support large populations in work force, which is over 1.2 billion caused the country to reduced reliance on foreign countries and built up their
strong empire in electronic manufacturing with low cost labour. From the statistic of US-China Business Council, U.S. manufacturing industry has misplaced more than 2.4 million occupations to China ever since 2001. India has been followed the step of China as well by providing low cost labour to attract more investors to set their manufacturing in the country. And this is slowly built up their strength to be strong manufacturing countries as well. China had been doing well over the years, they are constantly rising manufacturing skill and achieve momentous cost advantages especially in labour cost (Rhodes J. and Moran, 2007). Meanwhile, they also stated that their products qualities are getting better due to manufacturing expertise and China able to obtain international market share of 25% of washing machines, 50% in cameras, 20% of refrigerators, 30% of air-conditioners and televisions. And the retail monster, Wal-mart purchase $18 billion of goods from China to provide shortest connection to US consumers (Pinton, 2005).

China’s electronic had export a big portion especially to America as a lot of their factory set up in the country. From the chart shows that computer and electronic products scored the higher along the year which make the industry much important to the country export to create surplus. In 2008, China exported electronic products of $108 billion to America and the exports have grown strongly.
Electrical and electronics industry is consider as the most important industry in Malaysia which has RM158.7 billion (US$50.94 billion) gross output, RM235.5 billion (US$75.7 billion) of export and provided job vacant for 325,696 people in 2010. Key export of Malaysia electrical and electronic products are to China, Singapore and U.S. while key import from Taiwan, South Korea and U.S. Malaysia Electrical and Electronic industry can be classified into 4 sub-sectors, such as Electronic components, consumer electronics, industrial electronics and electrical.
1.3 Industry Convergence

Industry has been defined as a group of companies that manufacture products and provide services which having close substitutions and delivering to a general buyers (Weaver B, 2007, pp 7) and it has formed a basic classification for the industry with a scheme such as Standard Industrial Classification. For industry convergence is a phenomenon that blurring the boundaries of the industry classification, or merger of two or several separated industries which initially are clearly defined by firms producing close substitutes (Weaver B, 2007, pp 13). This is because of the emergence of standardization of the products processes in diverse range of products that using the same type of machinery an underlying technology. Industry convergence can be in converging in substitute or complement.

There has been unconditional convergence happened in industrial labor productivity in the world for individual manufacturing sectors since 1990 (Benetrix A, 2012, PP20). Industry convergence also happens in equity market in Asia, and caused the gains from international portfolio diversification to decrease (Apergis N, 2012, PP 2). Electronic industry was going through convergence drastically along the year. For example, Samsung is shaping up as the giant in hardware producing company in television, phones, and components for instance like flat screens and chips (Mandke V, 2007, PP 2). While Microsoft sees Windows to link with abundant of new music, video services, phones and banking with xBox and media computer for houses. From Mandke V, 2007 research, the factors that driving the technology convergence is relentless evolution of technology and the hunger of the industry to grow. Innovation also can be seen the improvement of gearing the broadband access to internet and linking the computers with wireless home networks.
This industry convergence entered homes and businesses with the extensive use of the Internet and spurred the technological innovations growth in Asia Pacific (Jussawalla M, 1999, PP219). IT convergence in Asia Pacific began with the digitization of switching and transmission and the utilization of intelligent network platforms as the cost of equipment fall. For example China has combined Ministry of post and telecommunications, Ministry of Broadcasting and Ministry of Electronics into Ministry of Information Industries as the step of convergence in their telecommunications equipment and services (Jussawalla M, 1999, PP220).

Manufacturing convergence helps the business in their productivity, innovation, globalization and sustainability by combining the technologies, people and processes (Rockwell Automation, 2009). While from the research done by Madsen J & Timol I (2010), manufacturing convergence is driven by research and development, knowledge spillovers, human capital, financial development and the interaction between distances to frontier. From Rockwell (2009) research PP 10, Convergence manufacturing allows the best in combining the professional, physical assets, business processes and data to achieve the new capabilities in manufacturing. Moreover, it can reduced the manufacturing cost and time for new products and processes which enable leaner manufacturing and higher competitive supply chains while adding higher value to their customers.
1.4 Product Sophistication - Electronic Industry Convergence

Chances for consumer electronics firm to provide the digital home will develop by riding the convergence of communications and media industries which will introduce to a digital lifestyle (Nairn G, Whitby P, 2008, PP 2). From the research, other than creating new devices, convergence on service and application level happen as well and lead to new entrants and novel business model and make the outlook of consumer electronics industry estimates good.

For example of Apple, running the business of manufacturing computer also making their own iPhone, created better products and applications that win the competition and emerged as the most influential companies in consumer electronics. Even though Apple not the first mover in manufacturing phone, but the innovative business models and ground-breaking products allow Apple to win the competition.

In order to be innovative in convergence, company has to spend heavily in the research and development and has to be fast in electronics industry to prevent competition for imitating the new products and be the leading company in the industry. Rapid pace of electronic technology innovation had created great consumers' demand on newer and faster products or applications thus encourage the industry to put much effort in innovation. Besides that, from the report of Career Corner Stone (2009), being the first firm that market new products to the market can bring success to both products and firm. For instance, firm that developed new king of computer chips that suitable for many brands of computer can help the firm to earn million of sales until the competitors able to fully imitate or improve the design.
As the fostered advance technology in electronic, to the atomic scale and fast movement in system, cell and molecular biology, there is the convergence of electronic and biology and it believe to has huge impact on nation's economy and well-being, which affect on healthcare, medicine, forensics, homeland security, environment protection and food supply (Walker G et. al., 2009, PP 1). The research found that bioelectronic advancement can improve the method and tool used and reduce the cost at the same time. U.S. currently stands at the position of leader in the field as the outstanding research expertise in both biomedicine and semiconductors. Bioelectronic devices will be integrated a variety of sensor, which include electrical, chemical, optical and so on to achieve desired functionality to improve the industry and to replace the conventional information processing devices which solely depend on electrical signals.