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“Catching Up Process for Knowledge Diffusion in the Automotive Industry: The Importance of Cluster and Institutional Network for Indonesian Case Study“

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1. Introduction

In recent times clusters have grown to be an object of aspiration for many regions. They may be based on different foundations as Pavitt (1987) explains in his argument on clusters. The obscurity of clusters stems from this multidimensionality: clusters are based on different economic dimensions, take different forms, are measured and quantified with relatively different methods and empirical approaches, and are legitimated by a range of theories and hypotheses. Additionally, they have also become a desired object of research: the still vague character of clusters poses problems of theoretically sound definition, of empirical measurement, of policy recommendation and evaluation. However, little is known about the critical success factors that determine economic development of cities and regions and empirical studies that draw lessons for policy are scarce (Tichy 1998, Nijkamp 1999), particularly in cluster studies for developing countries in the Southeast Asian region, specifically Indonesia.

As mentioned by Saxenian (1996) that all economic activity does not cluster within a single regional economy, particularly the automotive industry whereby firms in network systems serve global markets and collaborate with distant customers, suppliers, and competitors. Thus, the automotive industry is highly international. However, the most strategic relationships are often local because of the importance of timeliness and face-to-face communication for rapid product development. Moreover, non-local suppliers succeed in part by integrating into regional economies that specialize in similar lines of business (e.g. original equipment component (OEM), replacement parts manufacturing, replacement parts distribution, and rubber fabricating).

Paradoxically, the creation of regional clusters and the globalization of production go hand in hand, as firms reinforce the dynamism of their own localities by linking them to similar regional automotive clusters elsewhere. Therefore, in the automotive perspective, knowledge diffusion is considered a process that involves systematic interactions (i.e. market and non-market relations) among a wide variety of agents for the generation and exchange of knowledge relevant to innovation and its commercialisation.

In Indonesian automotive industry, Japanese corporation is more internally decentralized and more open to the surrounding economy than their American and European counterparts. Thus Japanese car producers rely on extensive networks of small and medium sized suppliers (i.e. tier 1 and tier 2), to which they are linked through ties of trust and partial ownership. Subsequently, studying the automotive industry, inevitably the technology is characterized by a specific knowledge base. The automotive sector in which innovation is quiet rapid, sectoral boundaries are not static, but change over time. Knowledge and basic technologies constitute major constraints in the full range of complexity in the automotive sector. Links and complementarities among artefacts and activities also play a major role in defining the real boundaries of a sectoral system (Malerba, 2005). Therefore these producers tend to be geographically clustered and depend heavily on informal information exchange as well as more formal forms of co-operation.

This paper is aimed at discussing the policy relevance of a cluster strategy to develop catching up process in the automotive industry in Indonesia. As well as investigating the different interplay among the actors involved in the automotive industry, particularly on how the actors and network within and outside of the automotive clusters could progress the catching up process in Java region.

This paper proceeds as follows: section two is brief literature note for interrelatedness of network and cluster, particularly for the automotive industry. Section three is agglomeration and industry concentration in Java region. Section four is about the automotive cluster-specific characteristic in Java. The cluster based policy in particular for the automotive is discussed in section five. Section six is knowledge diffusion in the automotive cluster in Java from Toyota Indonesia as empirical evidence. As a final point, some general conclusions and directions for future research end the paper.

Keywords: catching up process, FDI, cluster, network, knowledge diffusion-transfer, automotive industry

2. The Interrelatedness of Network and Cluster for the Automotive Industry: A Foreword from Literature

Networks have been recognised as an important ordering principle in the knowledge-economy based. Firms and organizations more actively engage in networks as a means to survive in a volatile international market and to cope with rapid technological change, particularly in the automotive industry whereby heterogeneous agents are connected in various ways through market and non-market relationships.

The types and structures of relationships and networks from the automotive sector is complex, because of the features of the knowledge base, the relevant learning processes, the basic technology, the characteristic of demand, the key links, and the dynamic complementarities.

Previous studies in networks engagement (Jarillo 1993 and Castells 1996) stated the flexibility of the networks: to benefit from chances, a firm has to be able to react fast, and to engage in partnership with complementary strengths and capabilities. Networks are particularly significant with regard to innovation. Strong international competition and fast technological development push for the automotive firm to innovate constantly in terms of producing new products, developing new processes, and accessing new markets. Involvement in a network facilitates the automotive firm to focus on core capabilities, and provides access to resources (e.g. specific know-how, technology, financial means, product, assets, market etc) in another firm and organization. This supports them to improve their competitive position.

Inter-firms and inter-organizational cooperation in network have different spatial dimensions. Networks can extend worldwide, as do global networks of automotive industry. Nevertheless, many network relations between actors can be located in a specific area, region or city. The popular term ‘cluster’ is mostly related to this local or regional dimension of networks. In the literature, clusters are defined and described in many different ways[1]. However most of definition share the notion of clusters as localised networks of specialised organization, whose production processes are

[1] See Porter 1998, Berg, Klink and de Langen 1997, Jacobs 1996, Lazonic 1992

closely linked through the exchange of information, knowledge, ideas is considered an important characteristic such networks. Furthermore, a cluster unites companies from different levels in the industrial chain (i.e. suppliers, customers), with service units (i.e. financial institutions, production-supporting services) and with government bodies, semi-public agencies, universities, research institutes, etc.

With regard to dynamics of cluster, Marshall (1927) described the powerful dynamics in industrial districts, where geographically concentrated groupings of firms, large and small, interact each other via subcontracting, joint ventures or other collaborative means, gaining external economies of scale in doing so (Cooke, 1995), thus deriving international competitiveness from local sources. Porter (1998) also describes how clusters of densely networked firms serve global markets while deriving their strength from a regional basis. As he mentioned in his diamond's strategy, Porter (1998) differentiates four conditions as essential in that development: factor conditions (quality of labour, capital, knowledge); demand conditions (scale and quality of the regional home market); supplier industries (globally competitive suppliers, specialised services); and business strategy (competition between local firms but also willingness to cooperate in research, sales and marketing).

In particular, the interplay of competition and cooperation is fundamental. Excessive competition may be destructive, but the same holds for excessive cooperation when it degenerates into the formation of cartels (Cooke 1995, Harrison 1994). Furthermore, Lazonick (1992) and Boekholt (1994) emphasize on a major role in clusters is played by others than inter-firm linkages: links with government-supported scientific institutes, ties with the scientific community and professional associations are important factors in a cluster's performance.

Nevertheless, the question remains why proximity still seems to matter in networks, where modern communication technology theoretically permits spatial dispersion. Several reasons are put forward in particular for the automotive industry context.

First, face-to-face contacts appear to be very important as sources of technological information and in the exchange of tacit knowledge (Leonard-Barton 1982, Malmberg et.al 1996). Spatial proximity enhances the possibility of such contacts.

Second, cooperation between actors requires mutual trust. This holds particularly when sensitive and valuable information is exchanged, for instance in a joint car product development within the automotive industry whereby there is strong linkages between car maker and its suppliers. During this process, an intensive communication along with engineering visit is crucial part to examine the actual product process, particularly, if it is a new product development, whereby many engineering tests are necessary to have face to face communication rather than virtual contact (i.e. email, phone, and fax).

Third, Piore and Sabel (1994) state that cultural proximity (i.e. the sharing of the norms and values) is an important factor issue concerning the spatial dimension of clusters is how local networks relate to global networks. In the local-global interplay, multinational enterprise (MNE) in the automotive industry by foreign direct investment (FDI) plays a significant role. If MNE is rooted and integrated in the region and engaging in regional networks, it can act as an important disseminator of new knowledge, information and innovation from abroad into the region. This is particularly relevant for research and development activities: knowledge flows are facilitated by personal relationships and mobility of employees (Malmberg *et al*. 1996) or spin-outs from the large firms.

3. Agglomeration and Industry Concentration in Java Region: Extended Overview of Spatial Concentration in Java

Spatial concentration of economic activity occurs mainly because some regions have characteristic that attract more firms to be established there than in other regions. This implies that there are factors that are external to the microeconomic of firm-specific operations that boost productivity in one location compared to another (Venables 2003, Rosenthal and Strange 2003). This leads to important questions: the first is descriptive and concerns the nature of these factors. The second addresses normative issues about the underlying processes that lead to external economies. Of particular interests are determinants of productivity enhancing localized factors that can be influenced by government policies in industry-trade or science-innovation. Specifically in Indonesia, the agglomeration of industry in Java has been accelerated by the manufacturing investment through FDI. Details are discussed in this section.

Manufacturing investment in Indonesia, which is mainly located in Java, is the prime mover for accelerating the growth-cluster. Indonesia's manufacturing sector was formerly the most dynamic sector of the economy, and achieved a persistently high real growth of around 11 % p.a. during the 25 years preceding the Asian economic and financial crisis of 1997 (World Bank 2005). The growth rate of the manufacturing sector, however, was most affected by the economic crisis.

The manufacturing sector contributed about 28 % of Indonesia's total GDP in 2001-2005, which was a slight decrease from the value of 29.7 % in 2000 (ADB 2005) due to monetary crisis in Asia. The number of percentage above confidently shows that manufacturing has consistently been a significant contributor in the GDP. However, the value of manufacturing investment in 2005 slightly dropped to minus 3 % from the value in 2001 due to political instability, the presidential election 2005. Between 2000 and 2005, not only did the sector contract, but expansion was forcibly curtailed. This in turn led to a long-standing neglect of the efficiency and productivity within the manufacturing environment.

Furthermore, the portion of the workforce employed in the manufacturing sector decreased from 13.3 % in 2001 to 12.3 % in 2005 of the total workforce. The decline was apparently attributed to the slight decrease in manufacturing investment during the same period. Therefore, Indonesian government's main strategy for the future development of the manufacturing sector is to boost manufacturing investment in industries, which have competitive and comparative advantages (importantly in automotive industry). In the meantime, government has been continually improving its political, social, and economic conditions in order to create friendly investment climate which will boost investment value in all sectors.

In conjunction with the geographical location, Java has been an important region for the following reasons. First, main industrial areas in Indonesia have been located overwhelmingly in Java. Most of Indonesian modern manufacturing establishments have continued to be predominantly located in Java. In Table 1, it is shown that the growth level of large and medium manufacturing in Java has been growing steadily in each year since 2001. It was 81, 39 % in 2001 followed by decline 80, 95 % in 2002 due to non-stable economic-political condition. Then it has gone up to 81, 71 % in

2003 and 2004. Compared with the growth of large and medium manufacturing outside of Java, which is in average 18 % up to 19 %. This is an imbalance description of manufacturing distribution among the regions in Indonesia.

Table 1 Number of Large and Medium Manufacturing, Java and Outside Java, 2001-2005

Location	2001	2002	2003	2004	2005
Java	17413 (81,39)	17118 (80,95)	16607 (81,71)	16901 (81,71)	16995 (81,99)
Outside Java	3983 (18,62)	4028 (19,05)	3717 (18,29)	3784 (18,29)	3734 (18,01)
Total	21,396 (100,00)	21,146 (100,00)	20324 (100,00)	20685 (100,00)	20729 (100,00)

Source: BPS-Statistics Indonesia

Second, Java with more than half of Indonesians inhabitants offers a huge potential market and is importance by its own rights (i.e. population in Java region is shown in Table 2 in red*). In terms of total population, Indonesia is the fourth biggest country in the world after China, India, and the US and Java region (i.e. Jabotabek) is also in the 9th rank of the world urban agglomeration[2]. As described in the Table 2 below, the growing population in each province in Indonesia.

Table 2 Population of Indonesia by Province 1971, 1980, 1990, 1995 and 2000

Province	Population				
	1971	1980	1990	1995	2000
Nanggroe Aceh Darussalam	2,008,595	2,611,271	3,416,156	3,847,583	3,930,905
Sumatera Utara	6,621,831	8,360,894	10,256,027	11,114,667	11,649,655
Sumatera Barat	2,793,196	3,406,816	4,000,207	4,323,170	4,248,931
R i a u	1,641,545	2,168,535	3,303,976	3,900,534	4,957,627
J a m b i	1,006,084	1,445,994	2,020,568	2,369,959	2,413,846
Sumatera Selatan	3,440,573	4,629,801	6,313,074	7,207,545	6,899,675
B e n g k u l u	519,316	768,064	1,179,122	1,409,117	1,567,432
L a m p u n g	2,777,008	4,624,785	6,017,573	6,657,759	6,741,439

[2] List of countries based on population, http://en.wikipedia.org/wiki/List_of_countries_by_population Largest Urban Agglomeration by data refer to the functional urban area, that is, contiguous areas which are consistently urban in character as indicated by levels of population density, economic functions and facilities, http://en.wikipedia.org/wiki/List_of_urban_agglomerations_by_population#_note-idn

Kep. Bangka Belitung	-	-	-	-	900,197
DKI Jakarta*	4,579,303	6,503,449	8,259,266	9,112,652	8,389,443
Jawa Barat*	21,623,529	,27,453,525	35,384,352	39,206,787	35,729,537
Jawa Tengah*	21,877,136	,25,372,889	28,520,643	29,653,266	31,228,940
DI Yogyakarta*	2,489,360	2,750,813	2,913,054	2,916,779	3,122,268
Jawa Timur*	25,516,999	,29,188,852	32,503,991	33,844,002	34,783,640
Banten	-	-	-	-	8,098,780
B a l i	2,120,322	2,469,930	2,777,811	2,895,649	3,151,162
Nusa Tenggara Barat	2,203,465	2,724,664	3,369,649	3,645,713	4,009,261
Nusa Tenggara Timur	2,295,287	2,737,166	3,268,644	3,577,472	3,952,279
Kalimantan Barat	2,019,936	2,486,068	3,229,153	3,635,730	4,034,198
Kalimantan Tengah	701,936	954,353	1,396,486	1,627,453	1,857,000
Kalimantan Selatan	1,699,105	2,064,649	2,597,572	2,893,477	2,985,240
Kalimantan Timur	733,797	1,218,016	1,876,663	2,314,183	2,455,120
Sulawesi Utara	1,718,543	2,115,384	2,478,119	2,649,093	2,012,098
Sulawesi Tengah	913,662	1,289,635	1,711,327	1,938,071	2,218,435
Sulawesi Tenggara	714,12	942,302	1,349,619	1,586,917	1,821,284
Gorontalo	-	-	-	-	835,044
M a l u k u	1,089,565	1,411,006	1,857,790	2,086,516	1,205,539
Maluku Utara	-	-	-	-	785,059
Papua	923,44	1,173,875	1,648,708	1,942,627	2,220,934
INDONESIA	119,208,229	147,490,298	179,378,946	194,754,808	206,264,595

Source: 1971, 1980, 1990, 2000 Population Census, and 1995 Intercensal Population Census and BPS-Statistics Indonesia

Third, most of investments, either foreign or domestic, have been concentrating in Java. During the period 2000-2005, around 63 per cent of total approved domestic investments were located in Java; while 66 per cent of total foreign direct investment flowed to Java (BPS 2005). More importantly, not only most firms are privately owned, in contrast to government-owned or joint venture firms in outer islands, but also most firms belong to footloose and more modern industries, while most industries in outer islands are recourses-based such as timber and petroleum (Hill 1997). As described in Table 3 below (i.e. the automotive industry and its related industries shown in red mark*).

Table 3 Numbers of Establishments by Subsector in Java, 2001-2005

Subsector		2001	2002	2003	2004	2005
1.	Food products and beverages	4559 (21,31)	4551 (21,52)	4414 (21,72)	4639 (22,43)	4723 (22,78)
2.	Tobacco	810 (3,79)	814 (3,85)	788 (3,88)	810 (3,92)	858 (4,14)
3.	Textiles	1901 (8,88)	1892 (8.95)	1847 (9.09)	1892 (9,15)	1935 (9,33)
4.	Wearing apparel	2123 ((9,92)	2028 ((9,59)	1883 (9,26)	1908 (9,22)	1921 (9,27)
5.	Tanning and dressing of leather	564 (2,64)	533 (2,52)	512 (2,52)	492 (2,38)	491 (2,37)
6.	Wood and products of wood except furniture and plating materails	1668 (7,80)	1629 (7,70)	1450 (7,13)	1411 (6,82)	1325 (6,39)
7.	Paper and paper products	388 (1,81)	340 (1,61)	375 (1,85)	394 (1,90)	414 (2,00)
8.	Publishing, printing and reproduction of recorded media	537 (2,51)	593 (2,80)	545 (2,68)	535 (2,59)	545 (2,63)
9.	Coal, refinedpetrolium products and nuclear fuel	48 (0,22)	40 (0,19)	54 (0,27)	48 (0,23)	52 (0,25)
10.	Chemicals and chemical products	1089 (5,09)	1014 (4,80)	1003 (4,94)	1020 (4,93)	1012 (4,88)
11.	Rubber and plastics products	1416 (6,62)	1466 (6,93)	1422 (7,00)	1487 (7,19)	1475 (7,12)
12.	Other non-metalic mineral products	1657 (7,74)	1612 (7,62)	1518 (7,47)	1507 (7,29)	1522 (7,34)
13.	Basic metals	239 (1,12)	223 (1,05)	209 (1,03)	230 (1,11)	211 (1,02)
14.	Fabricated metal products, except machinery and equipment	906 (4,23)	930 (4,40)	896 (4,41)	880 (4,25)	859 (4,14)
15.	Machinery and equipment *	529 (2,47)	474 (2,24)	390 (1,92)	408 (1,97)	410 (1,98)
16.	Office, accounting, and computing machinery	9 (0,04)	9 (0,04)	8 (0,04)	7 (0,03)	7 (0,03)
17.	Electrical machinery and apparatus	235 (1,10)	244 (1,15)	247 (1,22)	249 (1,20)	252 (1,22)
18.	Radio, television and communication equipment and apparatus	141 (0,66)	167 (0,79)	206 (1,01)	219 (1,06)	191 (0,92)
19.	Medical, precision and optical instruments, waches and clocks	69 (0,32)	52 (0,25)	49 (0,24)	47 (0,23)	47 (0,23)
20.	Motor vehicles, trailers and semi-trailers*	216 (1,01)	270 (1,28)	256 (1,26)	261 (1,26)	262 (1,26)
21.	Other transport equipment*	354	329	334	323	298

		(1,65)	(1,56)	(1,64)	(1,56)	(1,44)
22.	Furniture and manufacturing	1914 (8,95)	1898 (8,98)	1855 (9,13)	1856 (8,97)	1864 (8,99)
23.	Recycling	24 (0,11)	38 (0,18)	63 (0,31)	62 (0,30)	55 (0,27)
Total		21396 (100)	21146 (100)	20324 (100)	20685 (100)	20729 (100)

Source: Modified from BPS-Statistics Indonesia

Furthermore, the description of Indonesian industrial dispersion among the 6 main regions can be depicted in Map 1 below.

Map 1 Indonesian Industrial Dispersion in 2000-2005

Source: Author's Fieldwork

From the Map 1, it can be depicted that Java region (i.e. consisting of DKI Jakarta, Banten, Jabar/West Java, Jateng/Central Java, DI Jogjakarta, and Jatim/East Java) dominates the industrial dispersion with 63 %, followed by Sumatra Island with 12 %. The third place is Bali, Nusa Tenggara Timur, and Nusa Tenggara Barat with total 11, 02 %, while Sulawesi/Celebes Island is 8.14 %, followed by Kalimantan/Borneo with nearly 5 %. The last popular industrial region is eastern Indonesian region with only 1 % (i.e. consisting of Maluku Island, Irian Jaya Barat and Papua).

As a result, Indonesian government has been trying to balance the development of industry across the region, for not only being concentrated massively in Java, since lagging region development has been an important component of the Indonesian industrial policy debate. Historically, Indonesia has had some explicit regional development policies. These have been motivated by economic and social disparities across the archipelago, and concerns about specific region such as eastern Indonesia. Although eastern Indonesia contains several relatively affluent and natural resources endowed provinces, its development lags behind that of western Indonesia region (i.e. Java and Sumatra), mainly due to low population density, the remoteness of some communities, inadequate infrastructure, and high transport costs.

Consequently, Indonesian regional policies have resorted to a range of instruments. The central government in Jakarta has distributed investment grants focused on infrastructure and expanding regional human capital throughout the country (e.g. the pre-decentralization Presidential Instruction scheme). Tax incentives and holidays have been promoted at both national and regional levels. However, their effectiveness for attracting foreign direct investment to eastern Indonesia has been progressing slowly. Therefore, International agencies such as the World Bank are also undertaking transport improvement projects to bridge the development gap in the lagging eastern provinces of Indonesia. For instance, the World Bank 's Indonesia Regions Transport Project (EIRTP) has covered 15 provinces in Indonesia's eastern Islands-consisting of Kalimantan, Sulawesi, Bali, Nusa Tenggara, Maluku, and Irian Barat, in attempt to improve access to employment opportunities, health, education, and other social services and facilities.

Subsequently, significant spatial inequalities in economic activity as well as in welfare are not unique to Indonesia[3]. Such patterns are largely the result of decisions by individual companies to locate in the main selected regions of Indonesia. This creates employment, generates incomes and triggers spillovers into rural, service, and supplying sectors. Understanding what motivates firm location decisions therefore helps explain the causes for spatial economic disparities. As described in Table 4 below, the productivity of worker in sub-sector in Java region (i.e. the automotive sector and its related industries are shown in red remark*)

[3] Studies for large countries include China (Tianlun *et al.*1996; Fujita and Hu, 2001; Wen 2001;Zhang and Kanbur 2001), Brazil (Azzoni, 2001; Azzoni *et al.*2003; Lall *et.al.* 2004), India ((Besley and Burgess, 2002; Lall *et.al.*2004), Mexico (Cikurel 2002; Deichmann, 2004), and the United States (Fan and Casetti, 1994; Rey and Montouri, 1999)

Table 4 Worker Productivity, 2001-2005 (in million rupiahs)

Subsector		2001	2002	2003	2004	2005
1.	Food products and beverages	187,72	213,66	248,61	233,74	320,50
2.	Tobacco	235,62	205,86	204,19	200,01	218,02
3.	Textiles	99,34	117,50	133,75	155,84	164,05
4.	Wearing apparel	55,79	59,51	70,50	67,91	81,44
5.	Tanning and dressing of leather	63,13	90,13	85,33	86,40	109,58
6.	Wood and products of wood except furniture and plating materails	98,89	104,45	132,79	127,18	143,36
7.	Paper and paper products	412,53	623,88	469,70	480,83	570,95
8.	Publishing, printing and reproduction of recorded media	76,36	111,57	142,46	240,39	286,72
9.	Coal, refinedpetrolium products and nuclear fuel	104,88	200,81	341,07	341,31	388,78
10.	Chemicals and chemical products	387,31	454,01	429,33	454,51	527,53
11.	Rubber and plastics products	98,95	117,91	131,94	199,31	291,72
12.	Other non-metalic mineral products	136,06	140,07	154,31	221,29	225,92
13.	Basic metals	737,41	730,70	836,48	1.055,3	1.416,7
14.	Fabricated metal products, except machinery and equipment	100,95	856,38	185,39	216,36	196,13
15.	Machinery and equipment *	300,21	116,98	167,68	182,65	213,48
16.	Office, accounting, and computing machinery	20,03	38,76	29,36	32,45	476,50
17.	Electrical machinery and apparatus	277,86	203,96	226,87	433,08	314,26
18.	Radio, television and communication equipment and apparatus	340,31	377,59	329,95	582,07	201,82
19.	Medical, precision and optical instruments, waches and clocks	91,00	77,80	100,69	116,79	135,96
20.	Motor vehicles, trailers and semi-trailers*	531,89	874,26	434,32	681,26	873,83

21.	Other transport equipment*	436,63	407,34	535,27	521,91	613,34
22.	Furniture and manufacturing	46,99	62,30	59,79	70,37	76,63
23.	Recycling	84,31	93,53	85,06	77,30	93,97
Total		164,12	202,18	196,26	227,97	257,58

Source: Modified from BPS-Statistics Indonesia

From Table 4 above, it can be depicted the increase of the worker productivity in Java region has been risen significantly, starting from 164, 12 in 2001 up to 257, 58 in 2005, yet there was decline in 2003.

In order to understand the firms' location decision in Java, there are two factors that influence their decision.

The first includes those that are external to the firm. Java region has a *natural advantage* that makes them relatively more attractive to different types of firms. This may include induced advantages such as good transport infrastructure that is the result of past public investment. These factors are central to the 'New Economic Geography' models, where firms tend to locate in areas that have high demand for the good, they produce facilitated through good transport infrastructure and thus market access (Krugman 1991a, Krugman 1991b, Fujita and Krugman 1995)

Secondly, there are reasons for locating in a Java region that are more specific to the firm's production process and its interaction with suppliers, customers or competitors. These are *production externalities* where firms locate in proximity to other firms to benefit, for example, from knowledge or information transfers. Over longer period of time, these factors may increase or decrease in importance. Initially, the conditions for the emergence of agglomeration economies might be due to natural endowment that historically encouraged early settlement and economic activity. These 'first nature' geographies (Venables 2003, Burgess and Venables 2004) take account of sheltered harbours, natural resource endowments, access to inputs, proximity to markets and availability of basic infrastructure.

The initial benefits can trigger a self-reinforcing process that leads to the emergence of urban-industrial agglomerations in Java to a point where the initial advantage responsible for the growth of the centre is no longer dominant. A well known case is New York City, which owed its early growth to its location near the mouth of the Erie Canal. Within 15 years of the canal's opening the city has surpassed Boston and Baltimore as the busiest port in America.

In view of that, Java and particularly West Java's *Jabotabek* [4] region has by far the highest concentration of manufacturing activity. Historically, Java's fertile volcanic soils supported high population densities, and by the 16th century the port of Sunda Kelapa in today's Jakarta had established itself as an important trade hub. This in turn attracted the establishment of European trading posts and eventually the capital of the Republic of Indonesia. In the post-colonial period, Indonesia developed what some have called an economic system of 'bureaucratic capitalism' where often created by the state, by members of the government or military and their associates, or by ethnic Chinese businessmen.

There was no prominent class of indigenous entrepreneurs, which might have created a more dispersed pattern of industrial development. These factors accelerated the agglomeration of economic activity near the seat of power in highly centralized political system and resulted in the rapid growth of the manufacturing sector in the Jakarta region in the 1980s and early 1990s. By 1991 the manufacturing share of GDP in Indonesia exceeded that of agriculture and most of that was generated in West Java.

Additional concentration of manufacturing include Surabaya in East Java-originally a Dutch centre of naval industry- and Bandung in West Java at the centre of the highland plantation economy and recently a centre of textile manufacturing. Two smaller manufacturing centres, Medan in Sumatra Island and Makassar in Southern Sulawesi, also be obliged their existence largely to their role as regional trading posts.

These agglomerations are supported by public infrastructure, particularly in the transport sector. Krugman (1991b) shows that manufacturing firms tend to locate in

[4] Jabotabek is the metropolitan area consisting of Jakarta, Bogor, Tangerang, and Bekasi.

regions with larger market demand to realize scale economies and minimize transportation costs. If transport costs are very high, then activity is dispersed. In the extreme case, every location must produce everything locally. If transport costs are unreliable, firms may be randomly distributed as proximity to markets or suppliers will not matter. Therefore, agglomeration occurs at intermediate transport costs particularly when the spatial mobility of labour is low (Fujita and Thisse 1996). Low transport costs allow larger scale production, which in turn creates investment activities in other industries. By increasing demand for each other's products, this process of simultaneous investment raises profitability thus allowing all firms to realize *pecuniary externality* benefit (Murphy *et.al* 1989).

In addition to the pure pecuniary benefits from reducing transport costs, availability of good infrastructure increases the potential for input diversity, a larger labour pool, as well as the probability of technology diffusion through interaction and knowledge spillovers between firms. Thus, improved accessibility has the effect of reducing geographic barriers to interaction, which increases specialized labour supply and facilitates information exchange, technology diffusion and other beneficial spillovers that have a self-reinforcing effect (Handerson *et.al* 2001, Lall *et.al* 2004, McCann 1998).

Other regions specific characteristics that influence industry location decisions include local labour costs and administrative policies that support or obstruct business development such as regulation, taxation and amenity provision. A range of registrations, operating licenses (e.g. zoning permits, environmental impact assessments), minimum wage and employment regulations, and taxation can influence the cost of doing business in a particular location. This also includes the prevalence of informal payments, outright corruption, or 'predatory' taxation. Firms in Indonesia must interact with the bureaucracy at the national (Jakarta) and regional level (i.e. provincial and local governments)[5].

[5] Formally modelling the net cost of dealing with the bureaucracy is challenging, particularly as these may be endogenous to a firm within a given location. For example, individual businesses may pay lower taxes through payments, although rent attraction by individual bureaucrats may also be reflected in the quality of locally provided infrastructure services.

While the central bureaucracy may not formally differentiate in its licensing processes across the regions, transaction costs may increase for firms located further form the central bureaucracy (e.g. owing to delays and uncertainty stemming from absence of face to face contact). At the regional level, certain provincial of local bureaucracies may simply be more prone to corruption and/or predatory taxation. At the same time, accountability mechanisms (e.g. voice or exit option of the part of firms) may not be sufficient to act as a discipline device on local bureaucracies. Since Indonesia's decentralization in 2001, businesses have primarily complained about the nuisance or even predatory taxation on the part of local governments.

Production externalities, in contrast, relate to dynamics that directly affect the firm's microeconomic decision making. Most fundamentally, clusters of firms that are predominantly in the same sector take advantage of localization economies. They include sharing of sector specific inputs, skilled labour and knowledge, intra-industry linkages, and opportunities for efficient subcontracting. Marshall-Arrow-Romer[6] externalities suggest that cost-saving externalities are maximized when a local industry is specialized. These models predict that these externalities predominantly occur within the same industry. Therefore, if an industry is subject to such externalities, firms are likely to locate in a few regions where other producers of that industry are already clustered.

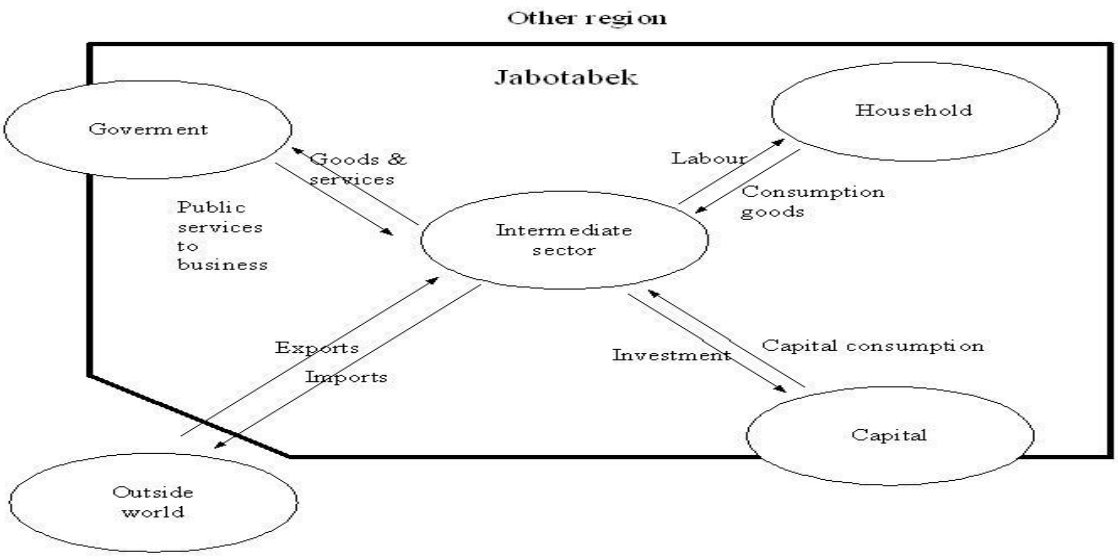
In previous research, Kuncoro (2002) has used I-O model to quantify the economic interdependencies in Java region by using I-O analysis with its main attraction is providing a very detailed picture of all transactions, both purchases and sales, and a basis for the detailed analysis of intersectoral relationship within an economy (West 2002). Regional economist use I-O methods as one of their major analytical tools. The regional I-O is a common tool to analyze three types of spatial linkages for explanation of regional growth: horizontal linkage, vertical linkage, and complementary linkage (Hoover 1971:215-221). Horizontal linkage involves the competition of activities for either markets or inputs. Vertical linkage includes backward linkage (attraction towards input sources) and forward linkage (attraction

[6] Following Marshall (1890), Arrow (1962), and Romer (1986)

towards a market). Complementary linkage is associated with formation of clusters via either marketing of complementary products or use of jointly produced inputs.

Figure 1 explains the mechanics of regional I-O with special reference to Jabotabek. It is assumed that Jakarta and Botabek are likely to be an integrated metropolitan region, which has intersectoral linkages with the rest of Indonesia and the world. The flows shown are goods and services passing from one sector to another, on the other hand money payment for those goods and service move in the opposite direction. More specifically, the figure depicts the linkages between income generation process and region household consumption expenditures, government outlays, investment processes, and trade transactions both with other Indonesian regions and the other countries. The solid line represents regional boundary; The Government and capital sector are partly inside and partly outside the Jabotabek region.

Figure 1 Inter-sector Flow of Goods and Service in a Regional Input-Output Model



Source: Modified from Hoover (1971)

In addition to agglomeration externalities, either supplier or customer driven, are reinforced by the intersectoral linkages mainly between manufacturing industries and the service sector. The easiest way to see this is from the intrasectoral and intersectoral linkages as shown by the coefficients of direct-requirement matrix. In Jabotabek, the most striking pattern by row, which represents a pattern of output linkages, is found in trade and utilities and construction sector. The coefficients of both sectors by row show high intersectoral linkages with other sectors, mainly with manufacturing industries. However, intralinkages among firms in those sectors, especially in trade sector, are not strong as shown by linkages of those sectors.

Table 5 indicates that direct requirement matrix exhibits some different patterns of intrasectoral and intersectoral linkages.

Table 5 Direct Coefficient Matrix in Jabotabek

SECTOR		1	2	3	4	5	6	7	8
1	Agriculture & mining	0.36	0.10	0.00	0.00	0.00	0.00	0.00	0.05
2	Light industries	0.10	0.25	0.01	0.03	0.02	0.01	0.01	0.09
3	Heavy industries	0.13	0.07	0.18	0.14	0.01	0.02	0.01	0.08
4	Utilities & construction	0.02	0.04	0.05	0.09	0.23	0.13	0.33	0.16
5	Trade	0.13	0.11	0.14	0.10	0.02	0.05	0.02	0.06
6	Transport	0.03	0.04	0.05	0.07	0.06	0.17	0.04	0.03
7	Financial services	0.01	0.00	0.02	0.08	0.40	0.04	0.19	0.02
8	Other services	0.01	0.01	0.01	0.03	0.12	0.24	0.28	0.08

High intrasectoral linkages
High intrasectoral linkages

Source: BPS-Statistics Indonesia and Kuncoro (2002)

Moreover, agglomeration generates cost saving through spatial proximity of suppliers in Jabotabek, as shown by each column of the direct-requirement matrix. Column 2 of Table 5, clearly indicates the source of input purchased by light industries sector in Jabotabek come not only from firms in that sector but also from trade, agriculture & mining, heavy industries, utilities & construction, and transport sector.

A final pattern describes the linkages between manufacturing industries and service sector. In Jabotabek, the direct coefficients show the strong linkages are found between manufacturing industries (i.e. light and heavy industries) and service sectors namely utilities & construction, trade, transport, and other service sectors. This finding confirms that both manufacturing and service firms benefit economically from clustering their economic activities in Jabotabek, mainly through well-developed transport and utilities systems, intensive informational, services and material linkages.

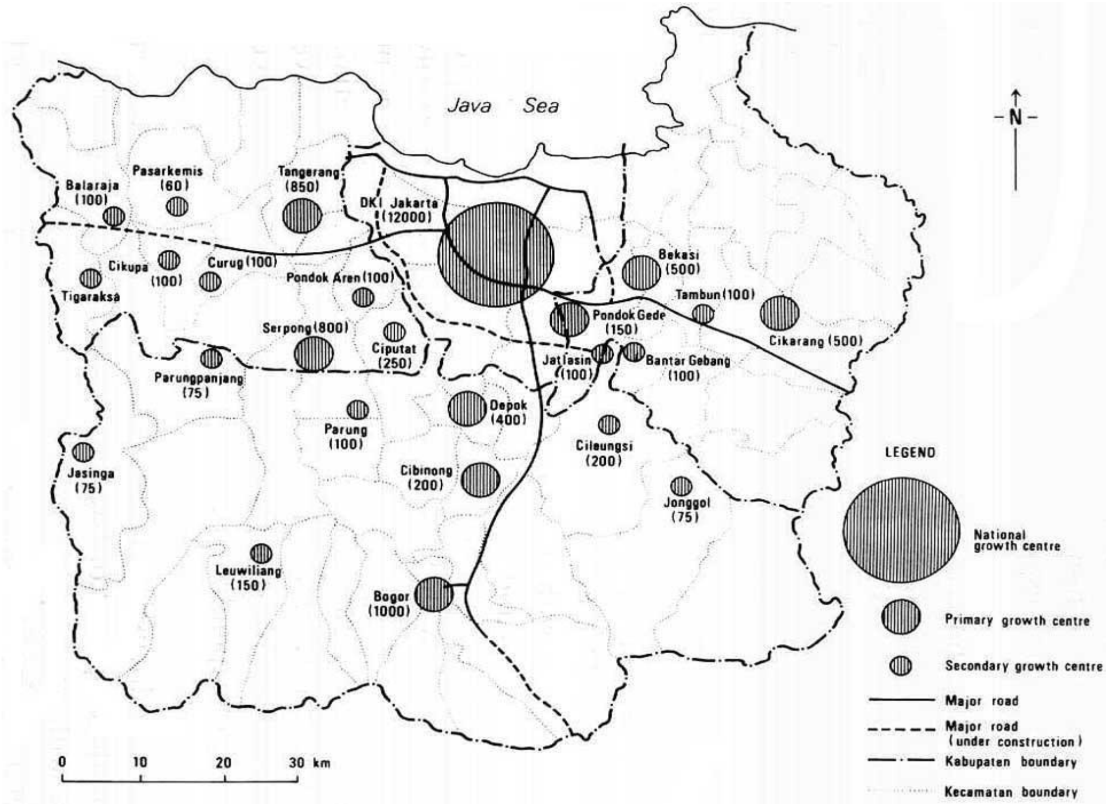
A similar pattern also is found in terms of intrasectoral linkages. As indicated by red highlights, intrasectoral linkages are generally more powerful than intersectoral linkages. This pattern implies that firms are attracted to locate in both metropolitan regions largely because of firms in the same sector are located there.

The findings show that agglomeration externalities, either supplier or customer driven, have been reinforced by the intersectoral linkages mainly between manufacturing industries and service sector. In Jabotabek metropolitan area, firms benefit from both proximity to upstream and downstream industries and large market. Thus is shown by output-weighted and input-weighted effects. The spatial proximity of linked economic activities is facilitated by good infrastructure and transportation within the city of Jakarta and Botabek, provided in Map 2.

As major urban centre, Jakarta has become more integrated with Botabek during the past two decades. A study of Jakarta Mass Transit System revealed the following facts: first, the arterial road network increased over 1979-1989 from 839 to 1106 km leading to annual increase of about 2.8 %; second, Jabotabek was served by 7 rail lines totalling 160 km in length and 55 railway stations; third, the number of trips mainly to work and to school, between Botabek and Jakarta has increased by 50 % during the last five years which mostly done by commuters (JMDPR, 1993).

With regard to interregional linkages, the lack of regional data makes it is difficult to monitor and evaluate a region’s economic performance and linkages with other regions. An interregional I-O analysis (IRIO) is relatively new in Indonesia. The first IRIO 1985 for the five main Islands in Indonesia was compiled in 1989 and the first preliminary report for discussion published in 1990. The IRIO 1985 table consists of 25 sectors and 5 regions, namely Java, Sumatra, Kalimantan, Sulawesi, and Eastern Indonesia. Two studies have utilized this table. Ardani (1992) analyzed the impacts of Inpres and government expenditures on output, income, and linkage on each sector and region. Sonit *et.al* (1997) ha used it to illuminate the feedback loop patterns and the hegemonic role that Java and Sumatra play in the Indonesian economy. Nevertheless, so far there is no intense study that used IRIO to analyse urban area such as Jabotabek.

Map 2 Jabotabek Metropolitan Regions: The Growth Centres and Major Roads



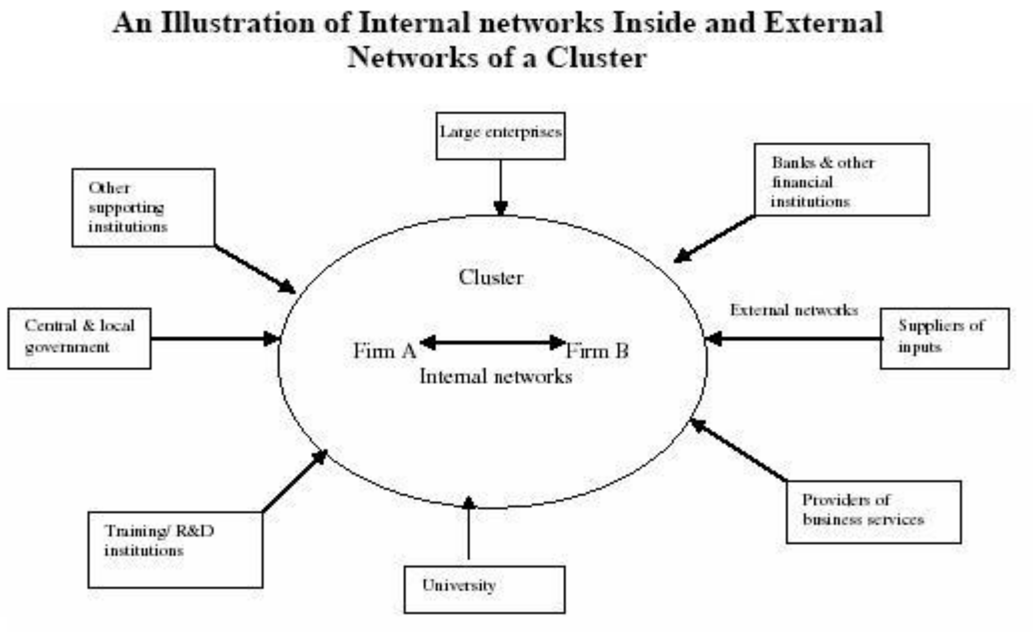
Source: Indonesian-Jabotabek Metropolitan Development Review (2000)

4. The Indonesian Automotive Cluster: Specific Characteristic in Java Region

The important components of a cluster's functioning are its size and its development level. Meaning that whether the cluster possess critical mass and if so how many companies and educational and research institution are active in the cluster.

There several reasons why critical mass is important and thus it will lead to elaboration of the automotive cluster's characteristic in Java. As it can be seen in Figure 2 in this section, the interrelatedness of internal and external network is important element to explain the characteristic of the automotive cluster in Java. The discussion is elaborated in this section as follows.

Figure 2 Illustration of the Automotive Cluster in Java



Source: Author’s fieldwork

Firstly, critical mass ensures a market large enough to support the (specialist) activities in the cluster. In May 2007, Indonesia's vehicle market remained on track for strong recovery from the major slump in 2006. PT Toyota Astra Motor, the leading local vehicle distributor that compiles statistics as well those sales escalated 66 % year-on-year to 38,313 units as against 23,079 in May 2006. The initial five months of 2006 registered cumulative sales to the tune of 158,189 units, a 26.5 % increase over 125,068 units last year. High optimism rules the industry regarding the full-year prospects and expectations for sales are now for 380-390,000 units in 2007, in contrast to 317,000 units last year. Additionally, the Ministry of Industry also forecasted that automotive exports in CBU (Completely Build-Up Unit) and CKD (Completely Knock Down) condition may increase in the next few years. Exports of CBU units in 2007 was 34,627, increasing from 30,307 in 2006, while exports of CKD units was gone up from 105,022 in 2006 to 118,045 in 2007. Moreover, The Ministry of Industry has also projected an increase in investment in the automotive industry from about Rp. 3.9 trillion to Rp. 4.1 trillion in 2007 boosting production capacity utilization in the national automotive industry from 38 % to 43 %.

These projections are proved by the recent announcement from one of the global automotive giant, Toyota, who expressed its plan to designate Indonesia as one of its main production base to supply Multi Purpose Vehicles (MPV) in the global market. With the planned exports of Toyota Fortuner and Avanza to the Middle East, Latin America, Africa and Asia, Toyota Indonesia will overtake Toyota Motor Thailand as the largest supplier of Fortuner cars to the Middle East market. Carmakers are also engaged in expansion of their current production capacity to keep pace with demand and take advantage of the market potential due to the fairly low car ownership ratio in the country with the fourth largest population in the world.

Secondly, the presence of many companies may invite keen competition and thus push the companies to operate in effective and efficient way. In the automotive cluster in Java, the manufacturing activities have spread across different locations in different industrial estates. Although, some concentrations have taken place in some main industrial estates, particularly the one who are closed to the big car or motorcycle firms. Table 6 is providing the detail of major car cluster location in Java.

Table 6 the Major Car Cluster in Indonesia

No	Assemblers/Manufacturers	Location in Java
1.	Volkswagen	DKI Jakarta
2.	Isuzu Motor	DKI Jakarta
3.	BMW Indonesia	DKI Jakarta
4.	Astra Daihatsu Motor	DKI Jakarta
5.	Peugeot	DKI Jakarta
6.	Mazda National Motor	DKI Jakarta
7.	Mitsubishi Krama Yudha	Bekasi
8.	Hyundai Motor Indonesia	Bekasi
9.	General Motor	Bekasi
10.	Indomobil Suzuki International	Bekasi
11.	Toyota Motor Manufacuring Indonesia	Karawang-West Java
12.	Honda Prospect Motor	Karawang-West Java
13.	KIA motor and Timor Motor	Karawang-West Java
14.	Nissan Motor	Karawang-West Java
15.	Hino Mobil	Karawang-West Java
16.	Mercedec Benz	Bogor-West Java

Source: Author’s fieldwork

From Table 6, currently there are 16 major automotive clusters in Indonesia, producing 22 brands of automobile. Total capacity if the assembling manufacturers are more than 800,000 units per year. In Indonesia, more than 170 companies are producing various types of automotive components, covering 36 six-digit HS (Harmonized System) numbers.

Table 7 the Major Motorcycle Cluster in Indonesia

No	Motorcycle Company	Location in Java
1.	Astra Honda Motor	DKI Jakarta and Bekasi
2.	Yamaha Indonesia Motor MFG	DKI Jakarta
3.	Danmotors Vespa Indonesia	DKI Jakarta
4.	Kawasaki Motor Indonesia	DKI Jakarta
5.	Indomobil Suzuki International	Bekasi
6.	Kymco Motor	Bekasi
7.	Yamaha Motor Indonesia	Karawang-West Java
8.	TVS	Karawang-West Java
9.	Sanex Motor International	Tangerang-DKI Jakarta

Source: Author's fieldwork

Based on Table 7 in the motorcycle industry, there are nine major players dominated mostly by the Japanese. Ownership patterns in this industry have been quite stable since the late 1970s continued to 2007.

Thirdly, the chance of fast penetration of all types of innovation is the greater as the cluster is larger. In studying the automotive industry, inevitably the technology is characterized by a specific knowledge base. The automotive sector in which innovation is quiet rapid, sectoral boundaries are not static, but change over time. Knowledge and basic technologies constitute major constraints in the full range of complexity in the automotive sector. Links and complementarities among artefacts and activities also play a major role in defining the real boundaries of a sectoral system.

In Southeast Asia region particularly Indonesia, foreign direct investment (FDI) from Japanese car producers has played crucial role for developing knowledge and technology in the automotive industry (Chen, 1996). Nowhere in the world is the influence of transferred Japanese technology greater than in Southeast Asian region (Chen 1996:7). For Japan, this region has always been crucially important source of raw materials and cheap labour for its dynamic manufacturing industry. Furthermore, Indonesia has become not only springboard for Japanese products to West European and North American markets, but also itself one of the fastest growing markets for Japanese products. Japan's technology transfer through FDI to Indonesia has been designed to strengthen and develop its ties with this country.

Additionally, the Indonesian automotive industry, to some extent has benefited from technology and innovation including process and production technology. Knowledge accumulation has been embedded in this cluster when the MNE decided to develop the production know-how to be more enhanced, by not only being an assembling based but also doing several complicated productions namely stamping plant, casting plant, welding plant, and engine plant. Therefore, the process of knowledge transfer from MNE to its local plants and its supplier has been embedded in the automotive cluster in Java over the last four decades since 1967.

Fourthly, regional cooperativeness is easier to accomplish within a large cluster, as it is easier to find a complementary partner or actor in the region. At last, scale offers prospect for the sharing of resources, the benefits of a shared pool of specialised labour and the scope for a cluster benefit like joint education facilities. In conjunction with the role of actors, the quality of actors will lead to the quality of cluster. Quality refers to the degree of international competitiveness of firms, the technological sophistication of their output, the standing of a university, etc. Therefore, the presence of one or more engines in a region-either large multinational firms or other actors-is supposed to be a determinant of a cluster's functioning, in their role of spider in global and local networks.

In addition, Japanese corporation in Indonesia is more internally decentralized and more open to the surrounding economy than their American and European counterparts. As a result, these producers tend to be geographically clustered and rely on informal information exchange and formal forms of cooperation.

Furthermore, there is large-as-well as small firm variants of network-based systems. Large corporations can integrate into regional networks through a process of internal decentralization. As newly independent business units are forced by competition to achieve the technical and productive standards of outsiders, they often draw on the social and technical infrastructure of the local economy and collaborate with external suppliers and customers.

Specifically, in Toyota's case study, it has developed a vocational engineering school to educate professional in the automotive sector and enhance the practical engineering knowledge for being employee in the Toyota's group in Indonesia. Toyota has also established the learning centre for intensive knowledge-sharing amongst the Toyota's group and it has been appointed as one pilot project to diffuse knowledge for non-Toyota's group across Indonesia. Besides, the employee exchange programme between Indonesia and Japan has also been accelerating the knowledge exchange between parent company and its transplants in Indonesia.

5. The Cluster Based Policy for the Automotive Sector to Complement the Indonesian Automotive Policy

Indonesian government through its industrial policy has planned the initiative called *Indonesia Bangun Industri 2025* or translated as Indonesian Industrial Growth 2025, which is intended to underpin the role of manufacturing industry as prime mover for national economy; thus, this initiative can help to alleviate not only the industrial difficulties but also national difficulties in economy.

Indonesian economy condition, which was badly suffered from financial crisis in 1990s, has been attempted to tackle national difficulties as follows: the high level of poverty and unemployment, slowness in both national economic growth and development through export, and lack of high technology in industry.

In conjunction with automotive industry, Indonesian automotive industry has been experiencing open competition since the issuance of the 1999 automotive policy, which has opened the door for all importers to bring in complete built-up products and cut import duties to a maximum of 80 % from the previous 200 %. Such a change of policy spurred the automotive industry to raise its capability to compete in the local, regional, and even global market.

Indonesia's automotive industry has proven it can survive the changes and move forward. After going through various phases of growth, particularly in the difficult days of the economic crisis, the local industry is now adept at being a supplier of four-wheeled vehicles as well as in motor cycle in the international market. This, in turn, has propelled the component industry to improve its ability to fulfill the rising demand from the assembling industry.

In 2005, the domestic production of four-wheeled vehicles is estimated to reach more than 500,000 units after registering some 420,000 units in 2004 - far higher than the sales booked before the economy crisis in 1998. Responding to the mentioned challenges and opportunities, the government is currently focusing its efforts on promoting the growth of the auto component industry. One of its focuses is on component design and engineering ability in a bid to raise Indonesian automotives independence in the automotive industry within the next five years. The development of specific Indonesian products to meet the needs of certain markets as required by society could become a training ground for Indonesian engineers to build their design and engineering abilities

Together with the cluster strategy, Indonesian government initiated the setting up of industrial district toward industrial estate model in Java region later known as industrial cluster. By providing all necessary infrastructures and facilities in one safe location-at a reasonable cost, a secure base for industry and manufacturing is an important agenda for Indonesian government. Currently, Indonesia has 16 major car clusters and 7 major motor cycle clusters.

In attempt to advance the economic condition through industrial policy; Indonesian Government divide the time setting of the *Indonesia Bangun Industri 2025* or Indonesian Industrial Growth 2025 into two term setting-up plan: middle-term (2004-2009) and long-term (2010-2025).

The middle term industrial objectives have been set up as follows:

1. Improving the level of employment in industrial sector

2. Improving the Indonesian export and empowerment of national market
3. Providing significant contribution for national economy
4. Supporting the development of infrastructure
5. Improving the technology ability
6. Improving the core of industrial structure and product diversification
7. Improving the balance of industrial distribution across the nation

In addition, the long-term industrial objectives are as follows:

1. Strengthening the core manufacturing industry in order to be the world class industry
2. Improving the role of priority industry as prime mover in national economy
3. Improving the SMEs' role as indigenous enterprises to play actively in national economy along with large manufacturing industry

In order to achieve the setting objectives above, the government has initiated Operational Strategy as follows:

1. Developing Supportive and Conducive Business Environment

Meaning that more collaboration with the relevant institution is needed to develop infrastructure in the areas whereby the existing or potential industry takes place. Improving the human resource management specifically in production engineering as well as business management, developing industrial zone whereby there are some industrial district within. Developing Research and Development service, calibration service, quality management based on ISO 9000 and ISO 14000 standards and other relevant manufacturing service to qualify the highest quality in production.

2. Setting up Industrial Development through Implementing Cluster Strategy for Primary Industry

Indonesian government has set up five priorities industrial cluster for prime mover in accelerating current industry situation. The framework used to set up priority industry is based on international competitive advantage and the Indonesian potential factor in developing industrial condition. The working definition of clusters in this research is "*a geographical concentration of related industries and institutions".* In Indonesian, *sentra*, is similar concept, as it is defined as a geographical concentration of manufacturers in the same sector. The five priority clusters are:

1. Agro industry
2. Transportation (Automotive, Ship, Aviation, Train) and Machinery industry (**provided in Map 3 below**)
3. Electronic and Information-Computing industry
4. Basis Manufacturing industry
5. Selected SMEs to be involved with large manufacturing industry, along with other supporting industrial cluster and related industries, mainly in agriculture, food processing, shoes, sea and marine industry, textile, rattan and timber, pulp, palm oil, electric equipment, and chemical industry.

Map 3 the Government's Plant for the Automotive Cluster in Indonesia

Source: Ministry of Industry Republic of Indonesia (2002)

3. Setting up Priority Eco-Regional

This is aimed to balance the industrial distribution across the nation, not only concentrated in Java region. The other reason is external proximity whereby raw material, labour, and variable cost will be cheaper to be used by the industry.

4. Improvement of Innovation Ability, Particularly In Industrial and Production Engineering As Well As Business Management

Specifically, the enhancing of R&D in Industry involves with design, production-engineering, plan construction, equipment fabrication.

In the early stage of economic development in the country, much of the investment came from the government, while the contribution of the private sector was still relatively small. This was because in that period, the government had relatively big savings, especially from oil/gas receipts, which enabled it to put in substantial investment. On the other hand, private enterprises had not developed due to, among other things, lack of capital and infrastructure.

Afterwards, as development funds from the government became more limited, the government concentrated its investment in infrastructure development, which had stimulated and strengthened the private sector. Under the assumption that the private sector played a greater role in economic development; hence, a stronger private capital brought a change in the composition of investment funding.

In connection with government's cluster strategy for manufacturing in Indonesia, in fact the automotive sector has been agglomerated organically long before the cluster strategy was intended. The process itself has been geographically grown along with the firm's decision to locate in particular area in Java region[7]. However, since 1989 when the government issued policy on industrial estate to provide better infrastructure for manufacturing sector, the procedure for the investment has been changed. Now, the government will suggest that the investor's manufacturing investment should be located in the certain industrial estates rather than in outside of the industrial estates. The changed bureaucracy has enhanced cluster-growth in the automotive sector, from being organic growth to be 'artificial' growth, which is easier for the internal and external network within and outside of the cluster to have more collaboration.

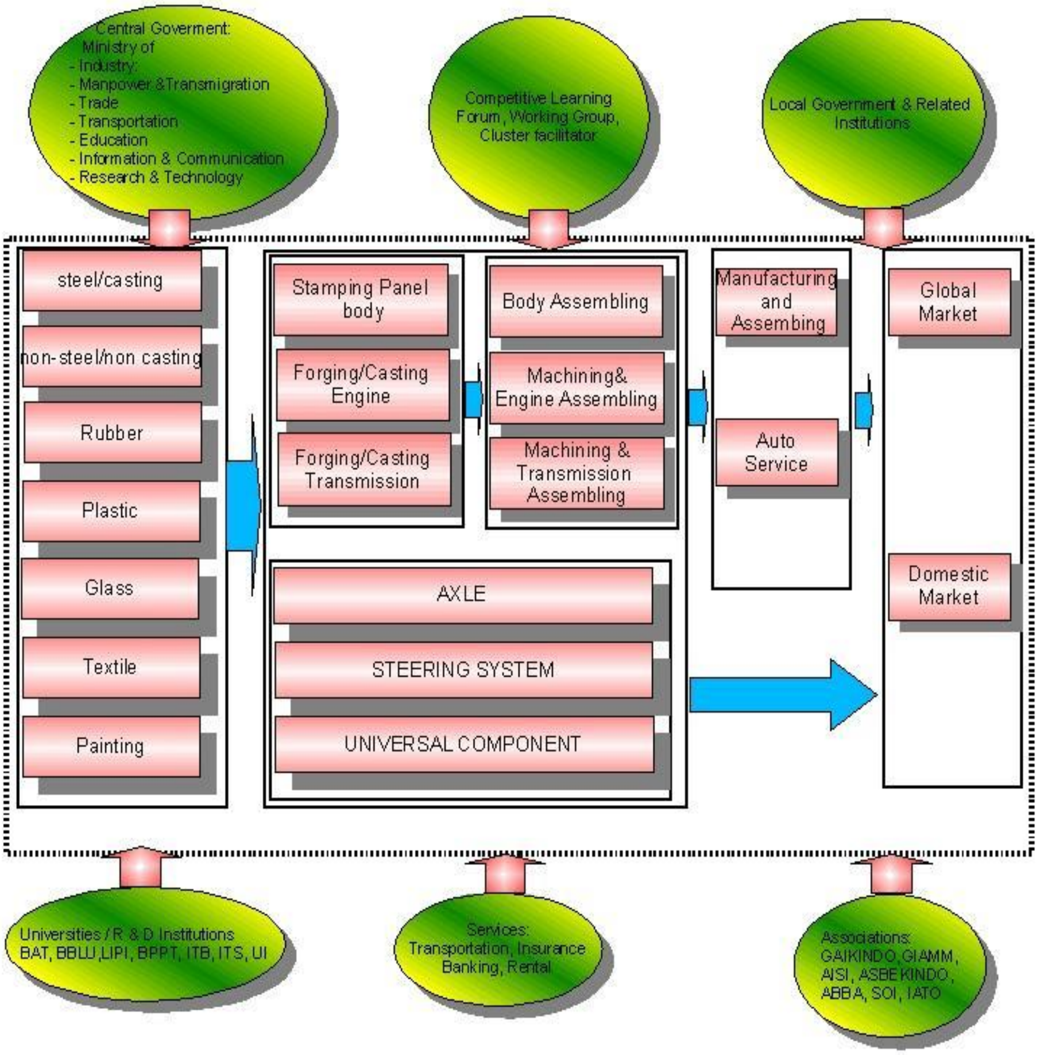
Under this new regulation, since 1989 the automotive industry has located their manufacturing plants in selected industrial estate across the Java. Therefore, most of the automotive industries have deliberately chosen Jabotabek area as their main manufacturing bases. As a result, the cluster-growth for the automotive industry in Java has made the network with different actor involved as shown in the following Figure 3.

[7] See section 3 : Agglomeration and industry concentration in Java region and section 4: The automotive cluster-specific characteristic in Java

Based on the following Figure 3, the actors involved are: the government that has been divided into 7 relevant ministries (i.e. ministry of industry, ministry of manpower & transmigration, ministry of trade, ministry of transportation, ministry of education, ministry of information and telecommunication, and ministry of research and technology), the learning forum together with working group, and cluster facilitator (i.e. industrial estate developer), the local/provincial government with local institution, the universities and R&D institutions, services firm, and the automotive association. The internal network includes competitive learning and working group as they are located within the automotive cluster. The external network includes government both central and local, universities and R&D institutions, service industries, and the automotive associations.

Starting from raw material production to the machining and engine assembling followed by marketing process, each of the actors are playing their roles in each path of the automotive manufacturing process. The central government under the ministries are accommodating the raw material stage by providing tax incentive and policy to support the gathering of raw material from domestic and international suppliers. The universities and R&D institutions are helping the automotive industry in material testing and early engineering stage. Followed by learning forum along with working group whereby engineer can exchange the knowledge in production system. This stage is important stage as the engine and body are produced and assembled in detail. Also important is the role of service industries, for example: banks, transportation/delivery services, and insurances. The last stage is the marketing and distribution whereby local government and the automotive association are involved. Accordingly, this interrelatedness of internal and external network has continuously supported the growth of the automotive cluster in Java.

Figure 3 the Indonesian Automotive Network within and Outside of Cluster



Source: Modified from Indonesian Ministry of Industry (2002)

Additionally, in strengthening cluster-growth for the automotive sector in Java, Indonesian government has set up a strategic plant to manage the on-going process in the automotive cluster. The detail of Figure 4 can be explained as follows.

The Indonesian government has set up automotive as one of the economic prime movers from manufacturing industry. Therefore, the agglomeration of automotive industry in Jabotabek in Java has been determined to be the automotive cluster in Indonesia. The automotive here consist of car and motor cycle production, which triggers the establishment of supportive industries and related service industries. The plant has been divided into short (2004-2009) and long (2010-2025).Each of them has different operational actions. Details are available in Figure 4 (APPENDIX).

The government strategic plan has been planned based on the characteristic of Indonesian automotive industry. The automotive industry in Indonesia has at least six important characteristics and most of them are universally significant. They are explained as follows:

1. It is scale-intensive industry, particularly in some major manufacturing activities for instance casting and engine construction
2. It is generally technology and capital-intensive
3. There is pronounced product differentiation, as illustrated by the importance of brand-name recognition in this industry
4. The industry comprises a diverse collection of interrelated subsectors, of greatly varying technological, capital and scale intensity
5. In consequence particularly of the first three factors, the industry is almost completely dominated by multinational enterprises (MNEs); globally, it is one of the most highly concentrated industries in the world
6. The industry invariable attracts more government intervention than almost any other manufacturing activity, particularly in Indonesian context. It is seen as a vehicle for the introduction and diffusion of new technologies-in particular a means of technology transfer from MNEs-and as an instrument for the development of small-medium sized enterprises (SMEs) through subcontracting arrangements.

As a result, the cluster capacity building and monitoring programme in 2004-2009 for the automotive industry can be described in Table 8a and Table 8b (APPENDIX). In these tables, each actor has their own responsibilities to develop the cluster-growth in Java.

In Table 8a, the operational actions are managed under the central government (i.e. divided into four ministries), local government (i.e. provincial and district), and private sectors (i.e. association and industry). Central government is doing all the operational actions in strengthening cluster-growth, while the local government is supporting mainly for the tax and credit incentive. In the meantime, the role of private sector is dominant with nearly all the actions have been supported.

In Table 8b, the role of university and R&D institutions are not dominant as they just support the manual production process along with the quality improvement. Additionally, the role of forum is quiet interesting as it is divided into three players namely: competitive learning forum, working group, and cluster facilitator. The learning forum here is the automotive association in the automotive industry, which is mainly emphasizing on technology, marketing, and investment. The working group forum is the engineer-learning group within the automotive industry whereby they can share the production system and the technological aspect. Therefore, they are much more attached to developing knowledge and technology. At last, the cluster facilitator (i.e. industrial estate developer) is the intermediary between the automotive industry, government, university, and another business network, to expand the internal and external network within and outside of the cluster.

5. Knowledge Diffusion in the Automotive Cluster in Java: Empirical Evidence from Toyota Indonesia

International technology transfer has been covering the process of the economic relationship between a transferor (i.e. TMC) and a transferee (i.e. TMMIN). Also, it might include the whole series of related issue, such as the relevant national policies and legal framework of the nation. Furthermore, technology transfer has played significant international trade and increased the involvement of different countries in the flow of goods and service across the national boundaries.

In addition to general economic benefits to their respective home societies in terms of export promotion, increased job opportunities and technology advancement, technology transfer transactions also generate economic rents that both the transferor and transferee may share. However, like other forms of international business, technology transfer not only brings particular benefits but also some costs to the participants. Those benefits and costs vary a great deal for transferors and transferees, depending upon the channels selected for the transfer.

In consequence of different nature and developmental reasons, technological advances in different countries have always been uneven. This uneven nature of technological progress throughout the world provides the very basis for technology transfer. Accordingly, in the past few decades, international technology transfer has multiplied by leaps and bounds. Technology trade has not only formed an independent market, but also become a significant part of international economic relations. Export of technology and relevant experience has become a distinct trademark of MNE business world wide.

The successful conclusion of negotiations with the signing of a contract only marks the beginning of a continuing relationship between the transferor and transferee. Transferring technology from one company to another is not often a one-time, single act, but rather an ongoing process. Therefore, technology transfer agreement should be a mutual commitment to work together for the benefit of both sides. Accordingly, a good technology transfer arrangement is a long-term and cooperative venture.

Building the industry in the automotive sector is complex, because the product itself is complex. A car has some five thousand components (excluding child parts), which can be disassembled into over twenty thousand individual pieces. Therefore, this complexity makes cars expensive and thus they do not sell when per-capita income levels are low. On the supply side, production of car requires the simultaneous growth of supporting industrial activities such as the manufacturing and processing of raw materials and the supply of various parts and components.

Technology transfer in the automotive sector by its nature is a very complicated process, which may involve multiple players. Because the technology normally does not have a clear-cut market value and the negotiation process is characterized by a bilateral monopoly. For that reason, the bargaining process can be intricate and difficult, with each participant trying very hard to increase its shares of the economic rents. Consequently, trust and cooperative spirit are indispensable for an agreement to be doable in the long run.

To be clear, technological knowledge in terms of the automotive sector in Japanese characters can be classified into two broad categories: capital-embodied and labour-embodied (Odaka et.al, 1988). Capital-embodied technology is intrinsic to various production processes such as casting, forging, metal-cutting, welding, pressing, etc.

Additionally, the technologies are related to process and quality controls. On the other hand, labour-embodied technology includes (1) skills and know-how in the operation of specific processes, (2) the ability to understand capital-embodied technology, which is the ability to maintain and repair machines and equipment (this is applied for elementary level of employees),and (on more advanced level) the ability to devise alternative processes and equipment in response to various economic and engineering needs, (3) the capacity to design or redesign products, processes and plants, and (4) the ability to innovate and to develop new production techniques.

Indonesia has become not only springboard for Japanese products to West European and North American markets, but also itself one of the fastest growing markets for Japanese products. Japan’s technology transfer (i.e. Toyota) through FDI to Indonesia has been designed to strengthen and develop its ties with this country. As it is mentioned by the Toyota Indonesia representative in the following quotes:

> “Indonesia has great potential to be base for TMC for its base to produce low cost car, regardless of the other rivalry countries such as China, Brazil and India. However, the realisation of doing this investment has not been officially announced yet, as the feasibility study has been underway. Despite the hegemony of TATA which produced Nano along with Hyundai, Toyota wants to start the low cost car project by 2010 or 2011. Accordingly, it is expected that Indonesian government keeps improving its infrastructure including car port “

In the automotive industry, the transfer technology is commonly happening between the parent company (i.e. TMC) and the host company (i.e. TMMIN). The process itself does take time as it is not simply technology per se but also involves human interaction which leads to the absorptive capacity (Cohen & Levinthal 1990), as it is mentioned by the Toyota Indonesia engineers as follows:

"When we started working in the actual plants of Toyota, it is not a trouble-free work place. The learning process would begin since the first time we joined the company and it would be a never ending journey. The training for a new engineer will take about three months and six months for operator under the probation scheme and it will then be examined by the supervisor and line manager to continue for a permanent contract. It is very challenging work place and sometimes it is a stressful situation. However, once we achieved the target, it is rewarding place to be "

The nature of the technology that Japan transfers (i.e. Toyota) to advanced industrialized countries is fundamentally different from that of the technology transferred to Indonesia as a developing country. Technology transferred to the advanced industrialized countries largely consists of patented high-level technology, while transferred to the developing countries is mainly modernization experience and skills closely related to standardized production methods.

The scope of a typical technology transfer contract usually covers production, management, and marketing. The various production activities that Toyota Motor Corporation has transferred to Toyota Indonesia include: material selection, selection and installation of equipment, plant layout, assembly methods, machine operation, training of personnel, maintenance techniques, provision of technical data, quality and cost controls, and inventory management (TMI 2007a, TMI 2007b). The following quote is addressing the nature of technology transfer in Toyota Indonesia, mentioned by the Toyota Indonesian engineers:

"The learning process as stated in Toyota Production System (TPS) has become the fundamental foundation for Toyota Motor Corporation to transfer technology to Toyota Indonesia. However, it is not about the higher level in R&D, but it is part of continuous improvement / *kaizen* in product development as a result of market demand and customer. The final decision in R&D is a managerial level decision between CEO/Production Manager in Indonesia and CEO/Production Manager in Japan"

In general, one notable motive for many Japanese car producers to select direct investment as a transfer vehicle was derived from the nature of the transferred technology. For along time, Japanese car producers almost exclusively transferred general know-how and industrial experience. The transfer of this type of technology entails long-term involvement by the transferor in the production and management activities in the host country. Moreover, technology recipients tend to require foreign investors to be involved in the initial stage of production. Many developing countries do not usually recognize the economic value of industrial expertise and tend to regard as a free service that should accompany the purchase of machinery and equipment. Therefore Japanese car producers found it necessary to obtain sufficient compensation for their technology through capital ownership and direct management of their foreign investment (Ozawa 1981:40).

As most technology transferred by Japanese car producers to Indonesia is related to labour-intensive industries, labour training occupies a prominent position in the Japanese strategy of technology transfer. For this reason, on-the-job training (OJT) has been considered by some as Japan’s ‘inner mechanism of technology transfer’ (TMI 2007a, TMI 2007b). OJT not only provides technical and administrative knowledge to the employees, but also coaches them how to have higher motivation and better discipline so that the process of never-ending quality improvement (i.e. *kaizen*) can be fulfilled. Unlike European and American companies, which utilize written manuals and detailed job description, Japanese car producers support their production management methods and their technical training all the way through OJT.

Additionally, in order to establish common ground for bargaining, Toyota Motor Corporation (TMC) and Toyota Indonesia (TMMIN0 have to close the gaps in their ceiling and floor price offers. This process is further complicated by some specific factors, for instance governmental regulations, political and business risk, levels of competition for technologies, and so on. Therefore, both TMC and TMMIN have to pay attention to the appropriateness of the transfer. Technology appropriateness has both macro and micro dimensions. The macro dimensions comprise such issues as the impact on employment and shifts in the overall balance of power among the nations involved. The micro dimensions deal with the direct impacts upon the participants of technology transfer.

Moreover, Japanese car producers (i.e. Toyota) have different approaches towards technology transfer. Most Europeans and American companies will pull back their technical advisers when the factory runs smoothly; and the local employees will only need to follow manuals carefully. On the contrary, in Japanese automotive affiliated companies, technical advisers tend to stay even after a good operation has been achieved. They will continue to train the employees step-by-step in productivity and quality control, maintenance and repair, utilization of new production methods and new technology, as well as other production-related skills.

There are a number of reasons for the Japanese to adopt such an approach (Hieneman, 1985:63). First and foremost, the technologies transmitted by OJT are basically know-how or experience related to well-proven and standardized production techniques. As technologies in the automotive are the type which cannot easily be transferred both in the form of industrial equipment or through blueprints or operating manuals, instead it can be better transferred through personal communication between employees and managers at all levels. However, for most Japanese expatriates the language barrier poses a particular difficulty in communication, as most of them do not have a sufficient training in local languages and their constant job rotation makes language learning even more difficult. This problem may help explain why Japanese managers tend to like the ‘learning by doing’ approach in transferring technology rather than depending on comprehensive manuals that a large number of employees may have trouble understanding.

Additionally, by adopting OJT, Toyota expects to improve technology at the shop floor level. As technology continually progress to a higher level, it can hardly be written into the manual thoroughly. For Toyota, there should be no end to technology improvement as Toyota wants to be always moving forward to technology. Technological process is considered as a dynamic and incremental process, and must be pursued by all members of the organization rather than only by engineers. Therefore, Toyota employees on the shop floor are also involved in the activity of technological improvement. This conception is clearly manifested in the quality control that symbolizes the unique strength of Japanese production management. The Japanese excel in continuing to improve the quality of their products, the process commonly called *kaizen*. The effect of such incremental innovation is highly visible when the product or technology is standardized.

Nevertheless, despite relatively evident accomplishment in technology transfer by OJT, the transfer of technology from TMC to TMMIN has not been trouble-free. The manner in which most Japanese car producers handle technology transfer has also been criticized by locals as reflecting the Japanese unwillingness to teach more sophisticated technology to the local people. Seeing that Japanese managers have tended to show insufficient confidence in local employees and consider it appropriate to design and develop new products at the headquarters research centres in Japan. Therefore, Japanese car producers tend to transfer technology that is necessary mainly for routine operations. Furthermore, the heavy reliance on OJT or on the Japanese technician's experience sometimes causes serious misunderstandings between employees and managers.

Even in OJT, Toyota has encountered a serious problem, which is mainly the relatively high rate of turnover of the trainees once they return to their respective companies in Indonesia. Lifetime employment is not part of indigenous traditions and the commitment of employees to their companies is much less than that of the Japanese. When skilled employees return home, they are usually in high demand in the job market and find it hard to reject more lucrative offers from other companies.

Responding to this negative side, since the beginning of the 1980s, Toyota has made increasing efforts to deal with the problems accompanying their technology transfer and direct investment to Indonesia. As a result, Toyota has begun to examine the applicability of its management system and the possibility of a higher degree of localization and decentralization. With further diversification of production from purely labour-intensive industries to more complicated manufacturing processes, pressure has built up to expedite higher-level technology transfer. At long last, there is a mutual benefit based on understanding of the actual depiction from the shop floor to managerial decision making. This initiative has been agreed by Indonesian government as part of the FDI agreement and the support to spur innovation into local automotive industry.

Accordingly, in the automotive industry, Japanese car producers, notably Toyota, is currently the main source of mature technology transfer to Indonesia. Industrial expertise and know-how have been the primary transfer while foreign direct investment constitutes the most widely used transfer channel. Traditional Japanese OJT management has commonly been used to assure success of the transfer process.

As a result, the process of transfer is beneficial for Toyota and its host country, since Toyota needs to shed some of its traditional industries in order to promote high-technology and service-based industries. On the other hand, the continued flow of technology and investment from Japan to Indonesia will not only contribute to growth of industrialization but also help generating Indonesian economy in the booming Pacific Rim.

Conclusion

Studying the automotive cluster in Indonesia is an interesting object, as it will involve the catching up process from FDI to the local cluster in Java region. In the case of the automotive industry, mostly Japanese car and motorcycle in Indonesia decided to relocate their manufacturing support as part of their global production network. Along the time, their activities have triggered the industrial agglomeration in Java region as well as in spreading the knowledge and technology, in particular the engineering, design, and production system in the automotive production.

Java region itself has been regarded as the most attractive geographical location for the manufacturing activities in general and specifically for the automotive industry. Java is important for manufacturing development in Indonesia due to the benefit of its infrastructure, proximity, and external economies. Therefore, the most of investment both domestic and foreign have been largely taken place across the Java. However, this brings another critical concern for the Indonesian government, as there are another region in Indonesian those needs to be developed, particularly in Eastern part of Indonesia.

With regard to the cluster development in the automotive industry in Indonesia, the general spatial-economic conditions and cluster specific conditions, these elements still need to be enhanced with regard to the organising capacity. The interrelatedness of the actors and networks involved are promising but lack of government involvement, as the actors have been playing their roles without much support or facilities from the government

In conjunction with that, political and societal support is necessary conditions for a cluster policy as well. Political support helps to being about positive collaboration on the local level. Proper presentation and communication of policies are principal importance to achieve results. Societal support is important for the acceptance of policies aimed at growth clusters.

In the end, university-industry-government partnership on the strategic, tactical and operational levels is very important for a successful cluster policy. Moreover, government can act as network broker, stimulating the formation of inter-an-intra-sectoral networks, by bringing people and firms together. Local or regional government can engage in university-industry-government partnership directed at the stimulation of the growth cluster, for instance by providing facilities or specific education, it has not much been done by the Indonesian government.

Additionally, the automotive industry (i.e. car) is developed to an increasingly high degree, on a global and transnational basis, not only in marketing terms but also in corporate structures and strategies, finance, product design, development, and manufacture. While the growth of vehicle industries in newly-industrializing countries is an important current development, in the major industrialized countries the motor industry is mature. These two broad features of the industry mean that the main dynamics of change in its structure are generated by technical development and competitive forces along with market growth. And both these dynamic forces express themselves transnational rather than within the confines of national boundaries.

At present, the industry faces the risk of volatile changes in the highly competitive car markets in the world. Despite the dominance of American, European, and Japanese car companies, Asian car companies are now exerting an influence on the world industrial system, even though some of them have been part of the Japanese car as parents company.

In focus, the example of Toyota, the leading car manufacturer, has expanded its managerial and manufacturing in Indonesia as regarded as lucrative market and promising production location for Asia-Pacific rim .The globalization of Toyota in the automotive industry has caused restructuring, developing it into a truly world wide. Since then the operation of Toyota Indonesia has been doing progressively growing along with managerial and technological path dependency.

Nevertheless, implementing the Toyota's basic principle and characteristic outside of the Japan is another challenge for Toyota as the transplants have been relocated globally. Therefore, understanding path dependence of managerial and manufacturing technology from Parents Company in Japan to the selected host country is deliberately significant to understand the trajectory in Toyota Production System supported by suppliers and partners.

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APPENDIX

Figure 4 the Indonesian Government Plan to Underpin the Growth-Cluster in the Automotive Industry

Primary Industry	Main Supportive – related Industries	Related Service Industries
Car and Motorcycle	Engine & Parts, Electrical Parts, Axle, Universal Components, Engine, Machining, Steel, Glass, Suspensions, Plastic Parts, Car Body Parts, Carburetors	Maintenance/Workshop, Distribution/Dealer, Transportation

Middle Term Plant (2004 – 2009)	Long Term Plant (2010 – 2025)
1. To achieve capacity production is up to 750.000 unit per year for car manufacturing(90 % to fulfill the domestic demand) 2. To achieve export growth of car production is up to 10 % per year 3. To achieve capacity production is up to 5.000.000 unit per year for motorcycle manufacturing with export growth 10% per year 4. To achieve component supply industry up to 80% for the car industry both assembling manufacturing; And able to do in-house engineering for the component of motorcycle industry	1. Ability to perform the indigenous automotive engineering (i.e. design and enhanced product development through advanced R& D) 2. Ability to achieve national automotive industry and capable of giving contribution in design engineering for global scale

Strategy

Sector: Development of MPVs (Multi Purpose Vehicles) car, Trucks, Buses, Motorcycle; Mastering of production technology of the automotive; and Mastering of component manufacturing industry
Technology: Full Development of Automotive Engineering, design and engineering for motorcycle

Operation Actions of Middle Term Plan (2004 - 2009)	Operation Action for Long Plan (2010 - 2025)
1. Improving investment in component manufacturing industry for 2nd tiers and 3rd tiers 2. Improving the ability of component manufacturing industry to enhance its manufacturing technology and production technology 3. Improving productivity and quality of component manufacturing and assembling industry 4. Improving ability and relation between FDI's ownership with domestic's automotive players	1. Establishing the integrated centre of R&D for the automotive industry 2. Improving the cooperation and linkages among the automitve industry, suppliers, component manufacturing industry and university,R&D institution 3. Enhancing the cooperation and network between Indonesian automotive industry with the global automotive player 4. Enhancing the regional and global automotive market and their network

Supportive Elements:

Technology & knowledge for the Automotive Industry	Human Resource Capacity:
A. For the Motorcycle Manufacturing a. Rapid development level (2010-2015): Full manufacturing design and engineering b. Matured and advanced level (2016-2025): Industry and technology upgrading **B. For the Car Manufacturing** a. Initial basic level (2004-2009): Design and engineering for local component b. Rapid development level (2010-2015): Industry and technology upgrading c. Matured and Advanced level (2016-2025): Design and engineering for full manufacturing capacity Marketing a. Improving export for ASEAN and Global market b. Improving cooperation and network of the component manufacturing industry c. Building up the global market network of the automotive industry d. Developing the local component supplier's network	1. Improving human resource competency in mastering manufacturing technology and product development of the automotive industry 2. Developing human resource ability in the automotive management and engineering skills **Infrastructure:** 1. Harmonization of tariff and tax 2. Providing tax allowance for new investment and expansion 3. Credit/Tax reduction for the automotive industry and its R& D 4. Improving the test and engineering workshop for the automotive certification 5. Providing the international hub/port for export-import of the automotive

Source: Modified from Indonesian Ministry of Industry (2002)

Table 8a the Responsibility of Actors in the Automotive Cluster

Operational Actions (2004-2009)	Central Government under Ministry of				Local Government		Private Sector	
	Industry	Transportation	Trade	Finance	Provincial	District	Association	Industry
1. Improving investment level in component manufacturing and automotive industry	0			0	0	0	0	0
2.. Improving component manufacturing industry to master the advanced technology	0						0	0
3. Establishing sub-contractor partnership	0				0		0	0
4.. Improving productivity and quality of component manufacturing industry	0						0	0
5 . Establishing integrated R&D for the automotive industry	0							0
6. Improving the ability for international certification institution	0	0					0	0
7 . Developing global market for the automotive and component industry	0		0				0	0
8. Strengthening domestic market (tariff, production capacity, import reduction)	0	0	0	0	0	0	0	0
9. Improving the automotive export and component industry	0	0	0	0			0	0
10. Providing tax incentive for growth and expansion	0	0		0	0	0		
11. Providing credit for automotive and component industry	0			0	0	0		

Source: Author's fieldwork

Table 8b the responsibility of Actors in the Automotive Industry

Operational Actions (2004-2009)	University & R & D Institution			Forum		
	University	B4T	KRT/BPPT	Competitive Learning Forum	Working Group	Cluster Facilitator
1.Improving investment level in component manufacturing and automotive industry				0		
2..Improving component manufacturing industry to master the advanced technology	0		0	0		
3.Establishing sub-contractor partnership					0	0
4.. Improving productivity and quality of component manufacturing industry	0		0		0	0
5 .Establishing integrated R&D for the automotive industry	0		0			
6. Improving the ability for international certification institution	0	0	0		0	
7 . Developing global market for the automotive and component industry					0	0
8. Strengthening domestic market (tariff, production capacity, import reduction)				0		
9. Improving the automotive export and component industry				0	0	0
10. Providing tax incentive for growth and expansion						
11. Providing credit for automotive and component industry						

Source: Author's fieldwork