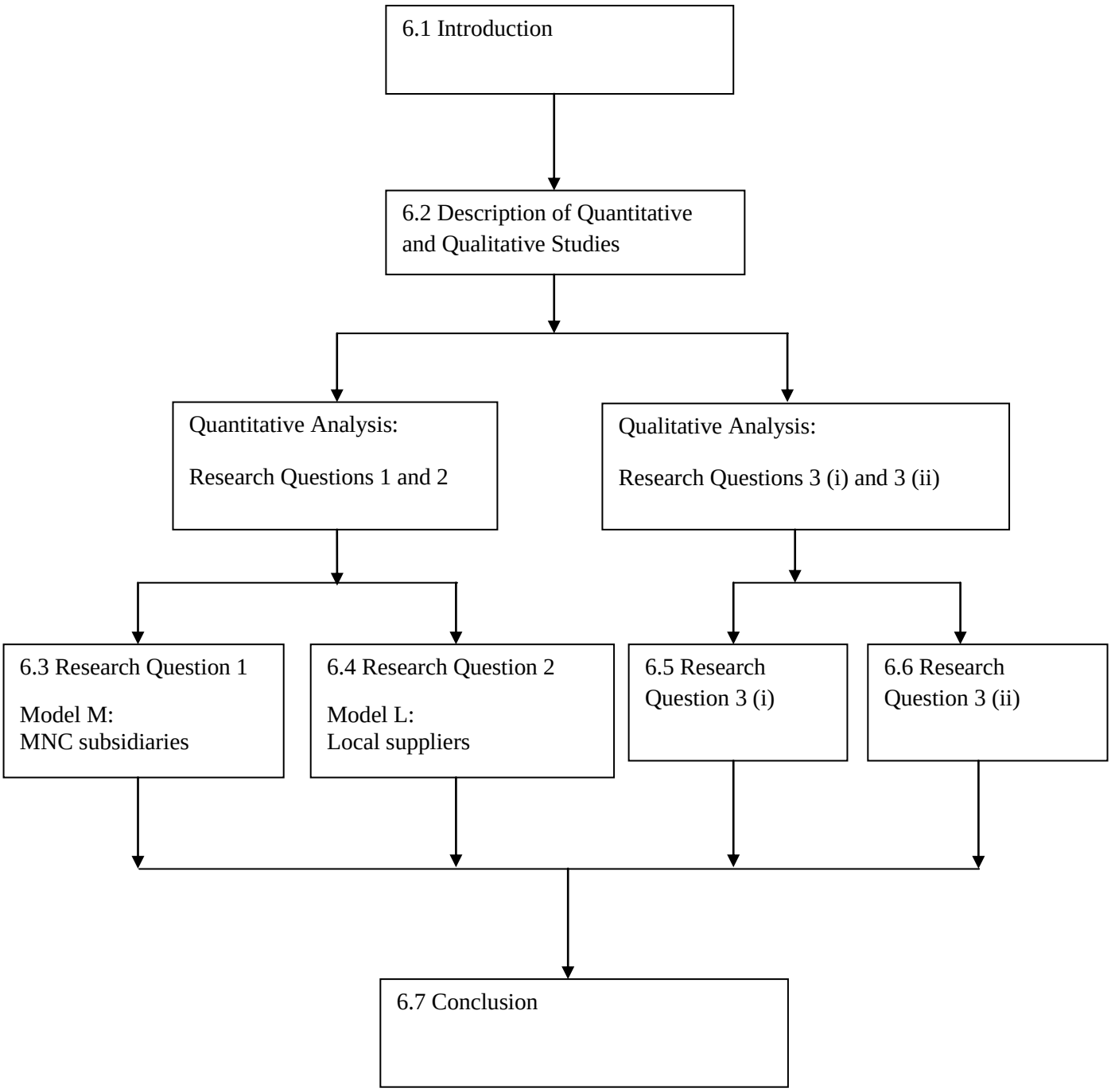
CHAPTER 6 – ANALYSIS OF FACTORS AFFECTING BACKWARD LINKAGES IN MNC SUBSIDIARIES AND LOCAL SUPPLIERS, AND TECHNOLOGICAL UPGRADING

6.1 Introduction

This study examines the relationship between MNC strategies and intended upgrading effects from linkage collaboration between MNC subsidiaries, or producer firms of the petrochemical industry, and local suppliers. More specifically, it measures the extent of the interaction (linkage effects) between MNC subsidiaries and local suppliers and the shared effects of this interaction, using data collected from interview surveys. As explained in Chapter 2, there are two types of linkage effects on local firms: static (quantitative effects) and dynamic (qualitative effects). The study is interested in dynamic effects, because these effects are associated with the upgrading of local firms. In the upgrading of local firms, there are two types of upgrading effects – namely, intended upgrading effects (the extent of collaboration between MNC subsidiaries and local suppliers) and unintended upgrading effects (spillovers). The study deals only with the former.

This chapter attempts to answer the research questions that were presented in Chapter 2. It first discusses the quantitative and qualitative aspects of the study. These approaches are used to analyze the factors that affect backward linkages between MNC subsidiaries and local suppliers. Once the two approaches have been analyzed, a conclusion is drawn. An outline of this chapter is presented in Figure 6.1.

Figure 6.1: Outline of Chapter 6



6.2 Description of Quantitative and Qualitative Studies

This chapter is divided into two sections: quantitative analysis and qualitative analysis of case studies. The quantitative analysis section presents how linkage effects (which in this case are intended upgrading effects) are shaped by MNC strategy. In other words, it examines the relationship between MNC strategy and linkage effects. It looks at two manifestations of MNC strategy: 1) FDI motives (local embeddedness) and 2) intra-MNC coordination (autonomy). As we have seen, MNC strategies that pursue local responsiveness are positively related to strong backward linkages, whereas MNC strategies pursuing global integration are related to weak backward linkages. Another variable is the technological level of local suppliers. Local suppliers with different technological capabilities engage in varying degrees of strength and in varying categories of backward linkages with MNC subsidiaries.

The quantitative analysis section is divided into two analytical frameworks – one for MNC subsidiaries (Model M) and the other for local suppliers (Model L), as shown in Figure 6.2. Model M is the analytical framework used to analyze the determinants that affect the backward linkages provided by the MNC subsidiaries. For Model M there are nine respondents. Since the number of respondents is small, a descriptive statistical analysis is used. As described in Section 5.4, among the determinants that affect the role of subsidiaries are: subsidiary factors (that is, factors specific to MNC subsidiaries), MNC group factors and environmental factors. The subsidiary factors, such as subsidiary typology, length of operation, size of firm, autonomy level and sourcing rate, are introduced as control variables in the model. MNC group factors include the nationality of the subsidiary and its number of expatriates. As the number of respondents is limited, only subsidiary factors are analyzed here.

For Model L, data from eighteen respondents are used to analyze the determinants of the technological level of suppliers. In this model, again with a small sample, non-parametric analysis is used, as the requirements for a normal distribution and large sample size are not necessary. Non-parametric tests are suited to samples with nominal or ordinal data and provide a power efficiency of nearly 95% compared to equivalent parametric tests (Siegel, 1956). For Model L, a whole range of non-parametric tests was used, including: a) Cross-tabulations and test of independence; b) Mann-Whitney tests; and c) Correlations.

Chapter 5 showed that there are two modes of entry for MNCs investing in the Malaysian petrochemical industry: wholly foreign-owned and joint ventures. The strength of the linkages formed between MNC subsidiaries and suppliers from the two modes of entry was compared to those made by wholly local-owned MNCs. In the qualitative analysis, the two case studies of locally owned MNC subsidiaries are of firms whose previous joint-venture partners were bought out. The case studies approach is used to analyze why and how technological upgrading took place among local suppliers as a result of MNC subsidiaries embarking on FDI in Malaysia, and how local producer firms respond to technology transfer. This qualitative data is used to present an in-depth analysis complementing the generalized argument from quantitative data obtained in Chapter 5 and also the earlier quantitative analysis part of Chapter 6.

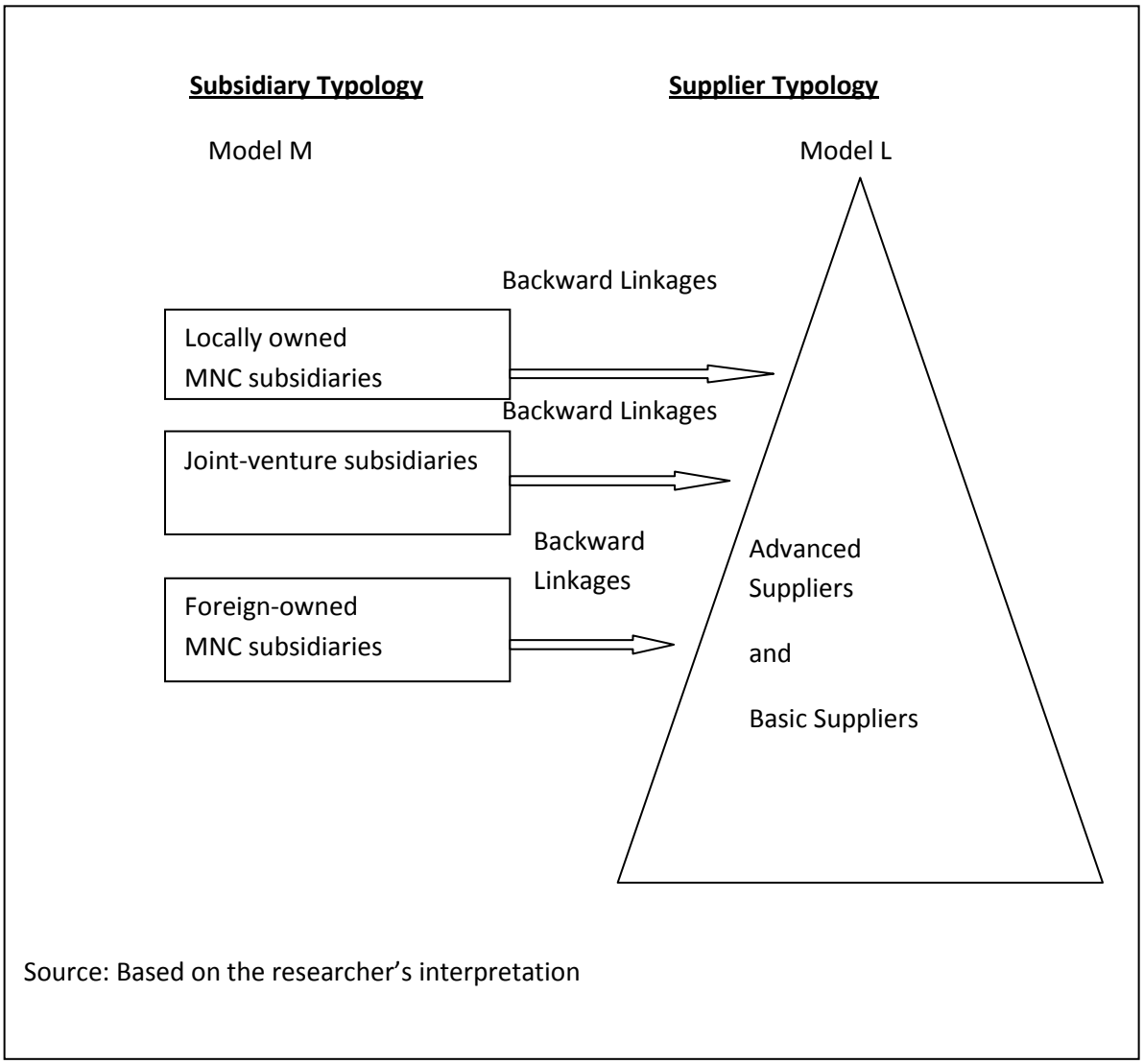
6.3 Model M: Quantitative Analysis of Factors Affecting Backward Linkages provided by Different Subsidiary Typology

Figure 6.3 shows the study's conceptual model for analyzing MNC strategies as discussed in Chapter 2. MNC strategies pursuing local responsiveness and high autonomy are positively related to strong backward linkages (left-hand side), whereas MNC strategies pursuing global integration and low autonomy are related to weak

backward linkages (right-hand side). Chapter 5 has shown the extent of these interactions by the breadth or diversity of backward linkages between subsidiaries and local suppliers. The result in Chapter 5 showed that the MNC's mode of entry or its ownership structure may influence the breadth of backward linkages formed. It showed that locally owned subsidiaries have higher backward linkages than joint-venture firms, which in turn show higher backward linkages than foreign-owned firms.

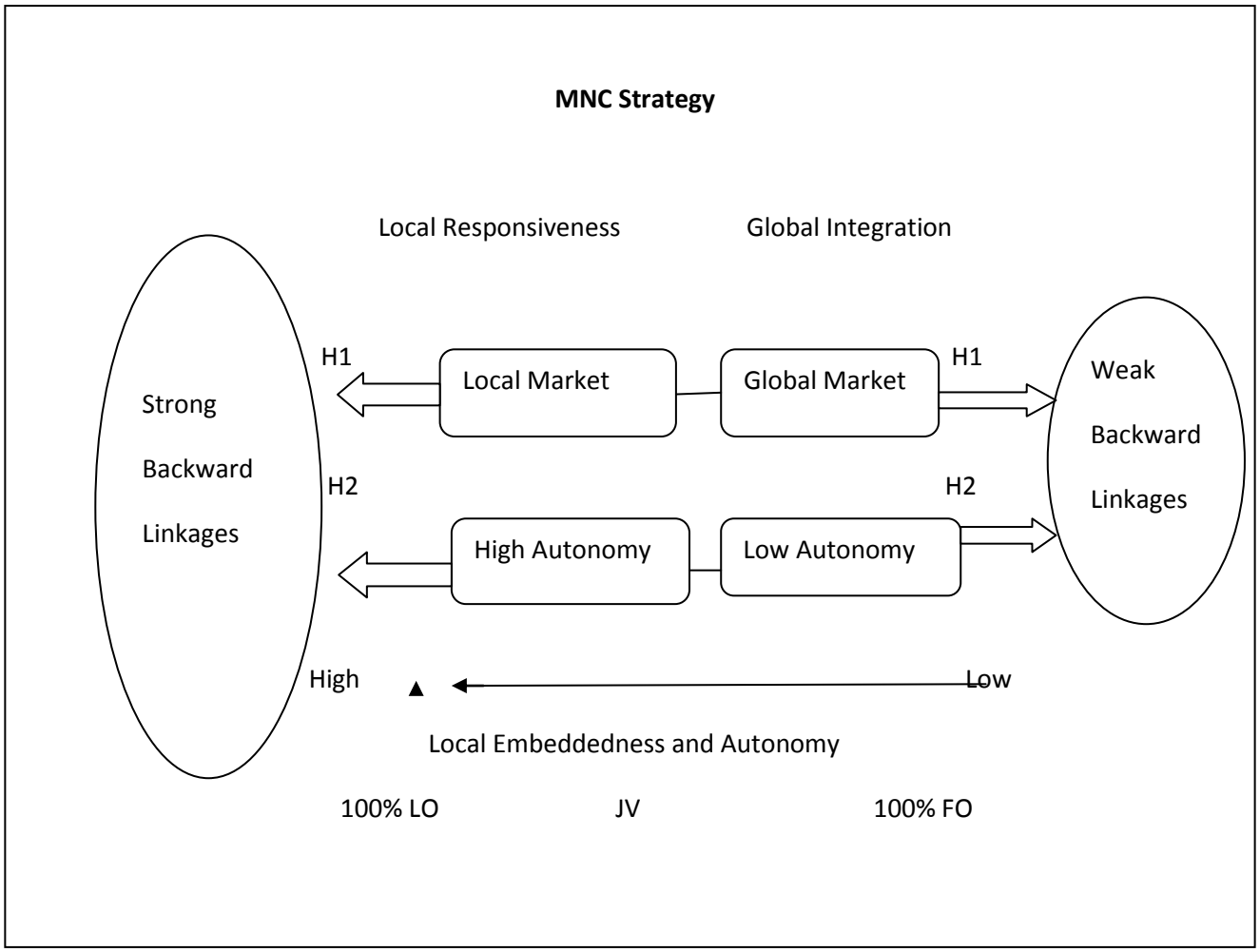
This section uses: 1) the conceptual model in Figure 6.3, to explore MNC strategies and how they influence the strength of backward linkages, and 2) Model M, to explore the determinants of backward linkages provided to local suppliers by MNC subsidiaries.

Figure 6.2: Model M and Model L in the Construction of Possible Linkages Formed between Different MNC Subsidiary Typologies and Supplier Typologies



Source: Based on the researcher's interpretation

Figure 6.3: Conceptual Models for Analyzing MNC Strategy



6.3.1 MNC Strategies and How They Influence the Strength of Backward Linkages

Based on the results of intended upgrading effects of MNC subsidiary typologies in chapters 4 and 5, together with the conceptual model of MNC strategy as shown in Figure 6.3, the set of hypotheses for MNC subsidiaries that was developed in Chapter 2 is answered as follows:

Strategies of MNC subsidiaries

Hypothesis related to FDI motives

Hypothesis 1. In developing countries, local market-seeking MNC subsidiaries have higher interactions of backward linkages with local supplier firms than do export-oriented MNC subsidiaries.

Tables 6.1 and 6.2 show the average BL Index values for different types of MNC subsidiaries engaged in different forms of backward linkages with basic and advanced product suppliers. (Advanced product suppliers show marked interactions, compared to basic product suppliers). The two tables show that local-owned firms engage in the greatest depth of backward linkages, followed by joint-venture and foreign-owned firms. Similar results are found for both advanced product suppliers and basic product suppliers. For local-owned firms with advanced and basic product suppliers, the categories of linkages with strong interactions are Product, Innovation, Others and Management. Among joint ventures and foreign-owned firms, none shows any significant diversified backward linkages. However, joint-venture firms have relatively broader linkages than foreign-owned firms in their interactions with both advanced product suppliers and basic product suppliers.

Table 6.3 shows that in linkages between MNC subsidiaries and basic product suppliers, the average local sourcing rate for local-owned firms is higher (67.5%) than the rate for joint-venture firms (56.6%), which in turn is higher than the rate for foreign-owned firms (26.7%). For linkages with advanced product suppliers, the trend is similar: the average local sourcing rate for local-owned firms is higher (67.5%) than the rate for joint-venture firms (40%), which in turn is higher than the rate for foreign-owned firms (16.7%). The manifestation of FDI motives as argued in Chapter 5 also seems to agree here. In Chapter 5 it was argued that export volume is assumed to be high for the foreign-owned (61%), while for joint ventures the rate (57.5%) is in-between the rates for foreign and local-owned firms (30%). (Refer to Table 6.4). The backward linkages were weakest in 100% foreign-owned companies with a high rate of exports. The rate was stronger in joint ventures and strongest in 100% locally owned firms. Thus we can confirm our hypothesis that local market-seeking MNC subsidiaries have higher interactions of backward linkages with local supplier firms than do export-oriented MNC subsidiaries.

Table 6.1: Average BL Index Values Provided by Subsidiary Typology with Basic Product Suppliers

Typology	Product	Innovation	Process	Training	Others	Management
Local-Owned	0.83	0.60	0.35	0.4	0.7	0.65
Joint Venture	0.5	0.15	0.20	0.25	0.45	0.30
Foreign-Owned	0.33	0.07	0.17	0.4	0.27	0.20

Table 6.2: Average BL Index Values Provided by Subsidiary Typology with Advanced Product Suppliers

Typology	Product	Innovation	Process	Training	Others	Management
Local-Owned	0.83	0.60	0.45	0.40	0.70	0.65
Joint Venture	0.50	0.10	0.20	0.25	0.45	0.28
Foreign-Owned	0.44	0.13	0.17	0.40	0.27	0.23

Table 6.3: Percentage of Local Inputs by MNC Subsidiaries Typology for Basic and Advanced Suppliers

	Level 1 (Basic) input			Level 2 (Advanced) input		
MNC	**Local %**	**Other MNC %**	**Parent**	**Local %**	**Other MNC %**	**Parent**
LOP	65	35		65	35	
LOM	70	30		100		
Average LO	67.5			67.5		
JVGP	NA	NA	NA	NA	NA	NA
JVJG	10	60	30	NA	NA	NA
JVJP	60	40		0		100
JVAM	100			80	20	
Average JV	56.6			40		
FOJ	30	70		0		100
FOB	40	30	30	30	30	40
FOT	10	90		20	80	
Average FO	26.7			16.7		

Hypothesis related to intra-MNC coordination (autonomy)

Hypothesis 2. In developing countries, loosely coordinated MNC subsidiaries create higher interactions of backward linkages with local supplier firms than do tightly coordinated MNC subsidiaries.

Table 6.4 shows that the autonomy level of foreign-owned firms is low (1.67), the local-owned level is high (3.0), and the joint-venture level is in-between the two (2.67). From tables 6.1 and 6.2, with respect to the backward linkages index between MNC subsidiaries and basic product suppliers, and between MNC subsidiaries and advanced product suppliers, we can confirm our hypothesis that loosely coordinated MNC subsidiaries create higher interactions of backward linkages with local supplier firms than do tightly coordinated MNC subsidiaries.

Table 6.4: MNC Subsidiaries Typology and Level of Autonomy

MNC Sign	Firm Nationality	% of Exports	Average % of Export	Level of Autonomy	Average level of Autonomy
LOP	Malaysia- Petronas	MITCO	30	3.00	3.00
LOM	Malaysia	30		3.00	
JVGP	German-Malaysia (Petronas)	80	57.5	3.00	2.67
JVJG	Japan-German	100		2.17	
JVJP	Japan-M'sia. Petronas	20		2.50	
JVAM	US-Malaysia	30		3.00	
FOJ	Japan	83	61	1.50	1.67
FOB	United Kingdom	40		2.50	
FOT	Taiwan	60		1.00	

6.3.2 Determinants of the Breadth of Backward Linkages that MNC Subsidiaries Provide to Local Suppliers

In order to examine the factors that affect the breadth of the backward linkages between MNC subsidiaries and local suppliers, further analysis of the BL Index using statistical

analysis was performed. (The BL Index measures the breadth or diversity of the linked activities, but not their aggregate level). The impact of these linkages will upgrade the technological progression of local suppliers and increase spillover effects. It is expected that the breadth of backward linkages will increase as more long-term relationships are developed between MNC subsidiaries and local suppliers, and as local suppliers provide MNC subsidiaries with more custom-made or specialized products. As Pavitt and Patel (1993) argued, linkages also increase as local suppliers gain more technological capabilities and skills. Thus we assume that the longer the linkages continue, the greater the extent of backward linkages between MNC subsidiaries and their local suppliers will be.

In terms of the embeddedness and global outlook of the wholly foreign-owned firms in the study, FOB has been operating in Malaysia since 1994 and its main customer is domestic, with more than 60% of its output being for the local market. As shown in tables 5.8 and 5.10, FOB is the only wholly foreign-owned MNC to have significant backward linkages with both basic and advanced suppliers.

Below are the explanatory variables that act as determinants of the breadth of backward linkages of MNC subsidiaries.

6.3.3 Determinants of Backward Linkages

Subsidiary Factors:

Subsidiary factors are the internal factors that are assumed to affect backward linkages in MNC subsidiaries. In the subsidiary factors, five control variables are included: 1) the size of the subsidiary (total number of employees); 2) the age of the subsidiary (number of years since inception); 3) its sourcing rate (the local sourcing rate); 4) the

autonomy level index (responses on which subsidiaries are allowed to carry out activities by the parent are converted to an index as explained in Chapter 5); and 5) categorization of subsidiary typology. The autonomy level index and the categorization of subsidiary typology are highly co-related. As the findings above show, a higher autonomy level will result in a stronger BL Index. In order to establish the determinants of backward linkages of MNC subsidiaries, a non-parametric analysis can be conducted using Model M. Table 6.5 shows the control variables used in Model M. The average number of employees for the MNC subsidiaries sample is 312 and the number of years in operation is 16.5. However, due to small numbers in the sample, no non-parametric or parametric tests were conducted for further analysis.

There are other determinants, such as MNC group factors and environmental factors that affect the level of backward linkages formed. However, due to the limited number of responses and time constraints, they are not dealt with here.

Table 6.5: Independent Variables used in Model M

	Control Variable	Variable Type	Description	Mean
Subsidiary Factors	Firm size	Number continuous	Number of employees	312
	Firm age	Number Continuous	Number of years in operation	16.5
	Local sourcing rate	Index Continuous	Local sourcing rate	For basic: 0.58 For advanced: 0.50
	Autonomy level	Index Continuous	Responses in Likert scale on which subsidiaries are allowed to carry out activities	0.80
	Subsidiary typology	Scale	Categorization of subsidiary typology	-

Source: Statistical Results for MNC Subsidiaries

6.4 Model L: Analysis of Factors Affecting Backward Linkages provided by Different Local Suppliers' Typology

Analysis from Chapter 5 shows that in terms of the BL Index there is a marked difference in suppliers' typologies. It is assumed that the main factor that affects the gain in the strength of interaction of the collaboration between suppliers and MNC subsidiaries is the technological capability of the local suppliers. Hence, suppliers with different technological levels engage in different strengths and in different categories of backward linkages. As shown in the descriptive statistics in Chapter 5, none of the basic product suppliers shows any diversified backward linkages. This shows that the technology requirements are simple and so do not require the firms to go beyond their own internal technological capabilities. When basic product suppliers are compared to

advanced product suppliers, however, there is a marked difference. We notice from Table 5.14 in Chapter 5 that there is a high intensity of product linkages (0.77), process linkages (0.55), and training linkages (0.60) with advanced product suppliers. These linkages show that local advanced suppliers are looking up to MNC subsidiaries for knowledge in Product, Process, and Training. Besides these three linkages, Level 2 suppliers or advanced suppliers also show stronger linkages in Innovation (0.31), Others (0.47) and Management (0.45) compared to Level 1 basic product suppliers, which register Innovation (0.11), Others (0.34) and Management (0.12).

There are several reasons why Level 2 or advanced product suppliers have stronger backward linkages. Linkages increase over time as entrepreneurs increase their skill levels and become involved in more custom-made products, components and services that involve technological knowledge (Ivarsson and Alvstam, 2009). MNC subsidiaries begin to use local suppliers' components and services as the suppliers' technological capabilities increase (Bell and Pavitt, 1993).

In order to establish the determinants that influence the technological capability level of local suppliers, a non-parametric analysis of the local supplier samples was conducted using Model L.

6.4.1 Determinants of Technological Capability of Local Suppliers

Model L is used in analyzing the determinants of the technological capability of local suppliers based on the technological capability framework as discussed in Chapter 2. In this model, the measurement of technological capability level is used as dependent variable. This model could use the multinominal logit analysis if the number of sample is large. However, due to certain criteria that one has to have before applying multinominal regression, non-parametric analysis was conducted. The main reason the

study uses non-parametric analysis is the small sample of local supplier respondents, which has 18 observations. Non-parametric tests were applied as these tests did not require a normal distribution and large sample size (Siegel, 1956). A range of non-parametric tests was conducted according to the types of propositions and measurement level of the sample data.

Dependent Variable of Model L

Technological Capability Levels	Scale
Basic product suppliers	1
Advanced product suppliers	2

6.4.2 Determinants of Technological Capability

There are three factors that determine the technological capability level of local suppliers in terms of their linkages with MNC subsidiaries. As discussed in Section 5.6, they are backward linkages factors, suppliers' factors, and environmental factors. The backward linkages factors represent the breadth of backward linkages for each category of linkages/collaboration between local suppliers and MNC subsidiaries. The control variables for backward linkages factors are the Product BL Index, Innovation BL Index, Process BL Index, Training BL Index, Others BL Index and Management BL Index. The suppliers' factors, on the other hand, are internal to the local firms and represent the technological capability that contributes to the suppliers' technological level. Among the control variables for suppliers' factors are: 1) the size of the suppliers (total number of employees); 2) their sales figures (sales for the year); and 3) their age (number of years since inception). As explained earlier, the environmental factor is not

within the scope of this study. Table 6.6 summarizes the description of the control variables for Model L in the measurement of determinants of technological capability of local suppliers.

Table 6.6: Independent Variables used in Model L

	Control Variable	Variable Type	Description	Mean
BL Factors	Product index	Index Continuous	The value of Product BL Index computed	0.67
	Innovation index	Index Continuous	The value of Innovation BL Index computed	0.23
	Process index	Index Continuous	The value of Process BL Index computed	0.43
	Training index	Index Continuous	The value of Training BL Index computed	0.48
	Others index	Index Continuous	The value of Others BL Index computed	0.42
	Management index	Index Continuous	The value of Management BL Index computed	0.33
Suppliers' Factors	Firm size	Numbers Continuous	Number of employees	98.11
	Firm sales	Numbers Continuous	Sales figure in 2008/2009 in RM million	58.01
	Firm age	Numbers Continuous	Number of years in operation	14.72

Source: Statistical Results for Local Suppliers

6.4.3 Statistical Results and Hypothesis Testing for Local Suppliers' Technological Capability Level

Before doing the non-parametric tests, various tests of the local supplier sample were done. For example, tests of independence between variables against nominal data were done by using the Chi-Squared test of independence. The Mann-Whitney test was also done. Table 6.7 presents the correlation coefficient of the parameters of Model L using Spearman's correlation coefficient.

Table 6.7: Model L Spearman's Correlation Coefficient Indicating Factors Affecting Technological Level of the Local Suppliers

	Control Variables	**Technological Capability Coefficient of Local Suppliers (N=18)**
Backward Linkages Factors	Product linkages index	0.389
	Innovation linkages index	0.335
	Process linkages index	**0.503***
	Training linkages index	0.459
	Others linkages index	0.271
	Management linkages index	**0.648****
Suppliers' Factors	Firm size	-0.231
	Firm sales	-0.132
	Firm age	-0.286

*correlation is significant at the 0.05 level (2-tailed).

**correlation is significant at the 0.01 level (2-tailed).

The set of hypotheses for local suppliers that was developed in Chapter 2 (based on the research question regarding the effects of suppliers' factors and the different forms of backward linkages to local suppliers' technological capabilities) is answered in Section 6.4.4, below, from the Spearman's correlation coefficient non-parametric test results.

6.4.4 Local Suppliers' Technological Capability:

1) Backward Linkages Factors; and 2) Suppliers' Factors

Hypothesis related to technological capability: backward linkages factors

Hypothesis 3. In developing countries, the breadth of backward linkages is affected by local suppliers' technological capability level.

FDI is one form of knowledge transfer by which developing countries are able to acquire modern technologies as well as new management and organizational practices from the superior knowledge of MNC subsidiaries. Spillovers occur as a result of these interactions in the form of inter-organizational linkages. As discussed in Chapter 2, studies have shown that horizontal linkages produce few spillover effects for developing countries; hence this study is interested only in vertical inter-organizational linkages. There are two forms of vertical inter-organizational linkage: backward linkages and forward linkages. The study is interested in seeing the strength of backward linkages between MNC subsidiaries and local suppliers, since it is through backward linkages that local firms gain spillover effects from subsidiaries.

Table 6.7 shows backward linkage factors affecting the technological capability level of local suppliers in two of the six categories of backward linkages. The Process linkages index (0.503) and Management linkages index (0.648) are positive and significant at

the levels of 5% and 1% respectively. Another category showing some significance is the Training linkages index, with a correlation coefficient of 0.459.

These results confirm the fact that investment by MNC subsidiaries in developing countries is an important source of knowledge for local suppliers, who learn by interacting with the subsidiaries (Lundvall, 1988). Process, Training and Management as significant linkages are very important in the upgrading of technological capability in the petrochemical industry. Process linkages are very important as the industry involves chemical processes. Management linkages are also crucial as this industry is highly integrated: the output of one firm is an input to another firm. By obtaining more effective management skills from subsidiaries, local firms can enhance their profit margins. Training linkages as usual are important for subsidiaries to provide to local suppliers as they are the foundation of learning. However, in this case the correlation is less significant. This may be due to the fact that firms are able to turn to many sources for training, especially to third parties.

Hypothesis related to technological capability: suppliers' factors

Hypothesis 4. In developing countries, local suppliers' technological capability is affected by the internal factors of local suppliers.

If Hypothesis 3 is confirmed, and backward linkages affect the technological capability level of local suppliers, we also want to know whether the internal factors of local suppliers also affect their technological capability level. Studies have shown that internal factors such as size, sales and age are indicators of the technological capability level of local firms in developing countries (Blomstrom and Kokko, 1997, Giroud, 2000). However, from Table 6.7, the Spearman's correlation coefficient shows there is

no correlation of technological level with the size of firms, their age, or their sales. The results show that for the petrochemical industry in Malaysia, these independent variables have no significance. Thus local suppliers' internal factors do not affect the technological development of local suppliers in Malaysia's petrochemical industry. We can assume that besides backward linkages factors, other factors, such as environmental factors, may affect the technological development of local suppliers. However, due to time constraints, the environmental factors are not included in this study.

6.5 Case Studies of Technological Assistance and Upgrading to Local Suppliers by Subsidiary Typology

To analyze the data derived from the interviews described in Chapter 4, quantitative and qualitative analyses were used. The quantitative analysis method is used to generalize the argument, while the qualitative analysis method is used to provide an in-depth analysis through case studies of firms. This section is presented to answer Research Question 3(i), and Section 6.6 is presented to answer Research Question 3 (ii). Research Question 3 is as follows:

i) *How do backward linkages promote the upgrading of local suppliers' technological capabilities?*
ii) *To what extent and in which ways does an MNC provide its local suppliers with technological assistance as part of a regular and ongoing business relationship?*

This section provides in-depth case studies of MNC subsidiaries and local suppliers based on the results of the previously analyzed quantitative analysis in Section 6.3 and Section 6.4 and the descriptive statistics in Chapter 5. This qualitative analysis is based

on primary data which were collected in 2008-2009 through interviews with heads/personnel of the MNC subsidiaries and local suppliers.

6.5.1 Case Studies of MNC Subsidiaries: The Process of Upgrading in the Petrochemical Industry

Based on the quantitative analysis discussed earlier, five MNC subsidiaries and two local suppliers are used here to provide in-depth analysis of linkages formation between subsidiaries and local suppliers. The five MNC subsidiaries are used to explain how backward linkages promote the upgrading of local suppliers' technological capabilities. The typology of the MNC subsidiaries is local-owned, foreign-owned and joint-venture firms. Representing the local-owned companies are one owned by Petronas and one owned by a private entity. For the foreign-owned, the study uses a 100 percent Japanese company that exports most of its products. Of the joint ventures, two firms that are among the most important players in the Malaysian petrochemical industry are used. The five subsidiaries are: i) a 100 percent local-owned company belonging to Petronas (LOP); ii) a 100 percent local-owned Malaysian company (LOM); iii) a joint venture between a German subsidiary and Petronas (JVGP); iv) a joint venture between an American subsidiary and a Malaysian company (JVAM); and v) a 100 percent foreign-owned Japanese company (FOJ). A structured, open-ended questionnaire was used in the interviews, focusing explicitly on how technological capabilities and linkages are formed in the firms.

This study of linkages looks only at local suppliers that interact with these five MNC subsidiaries. It follows the typology of suppliers by Kaufmann (2000). From this typology, the study recognizes only two types of suppliers: the collaboration specialist, which the study terms 'basic suppliers,' and the technology specialist, termed 'advanced suppliers.' In this analysis, the basic supplier and the advanced supplier are

called SA1 and SB1 respectively. They are chosen as representatives of the two types of local suppliers. They are also chosen because it was possible to obtain an in-depth discussion on technological assistance on linkages from them during interviews.

As seen in Table 4.8, the five MNC subsidiaries produce a range of petrochemical products. The five MNCs are characterized by high level of internationalization, with a high level of sales for export either directly or through MITCO, the marketing arm of Petronas. These exports complement their domestic sales. The five have also been in operation for a long time. The original motives for the foreign parent firms to establish the subsidiaries for production in the host market were: market-seeking investment; to overcome various trade restrictions (for example, tariffs and non-tariff barriers); to reduce the cost of transportation and logistics; and local content requirements. For the local firms, the downstream petrochemical industries were seen as strategic industries by the Malaysian government (IMP2). It intended to develop the petrochemical industry and all the related industries that come with having the producer firms (IMP3).

Most of the five MNCs were established through greenfield investments. In order to meet the standards of the petrochemical plants, they source parts and components from their parent companies, which produce their core 'firm-specific' proprietary technologies. However, the subsidiaries also source raw materials, parts and components from external suppliers through import or sales companies, distributors or manufacturers in Malaysia. Subsidiaries are asked to get approval from the Malaysian Investment Development Authority (MIDA)[i] if parts, components or raw materials are not available in Malaysia.[ii] As a result of this requirement, many international suppliers have local partners in Malaysia.

During the last decade, many MNCs have established closer collaboration with suppliers in developing countries. The incentives for such strategic moves consist of a

mix of the pressure to lower costs and the ambition to improve quality standards. Parallel to these developments, the host market economies have increasingly opened up through a liberalization of imports and inward FDI. Whatever its short-term goals, this liberalization supports the strategic interest of the MNCs in building up a network of suppliers that meets world standards (Mefford and Bruun, 1998).[iii] But such a trend does not necessarily stimulate the upgrading of domestic suppliers in emerging markets (Dunning 2000; Humphrey et al, 2000; UNCTAD 2001).

Growing demand for technological capabilities, reduced production costs and increased delivery precision, together with economies of scale in production and design, mean that MNCs often stick to their established 'follow source' suppliers from the industrialized core countries when setting up manufacturing in newly emerging markets (Ivarsson and Alvstam, 2005). In addition, many domestic suppliers are acquired by large global actors, resulting in a situation where foreign-owned actors dominate the more technology-intensive first-tier segments, while local domestic suppliers are reduced to the second- and third-tier levels (Carillo, 2001; Humphrey, 2001; UNCTAD, 2001).[iv] However, those domestic suppliers who are successful in establishing business contacts with MNCs can generate significant business opportunities and technological advantages (Ivarsson and Alvstam, 2005). This can lead to local suppliers becoming global suppliers.

As this study is looking at interactions between MNCs and local suppliers in Malaysia, it also looks at any differences in interactions between different typologies of MNCs and typologies of local suppliers. The following section presents a deeper analysis of how the five MNCs have been able to upgrade through business relations with local suppliers. The discussion is based on the literature of evolutionary economics, which suggests that buyer-supplier relations in many engineering industries are based on

deliberate exchanges of information and skills, resulting in a collective learning of technology (UNCTAD, 1999, 2001; Ivarsson and Alvstam, 2009). These inter-firm linkages are often local in character, making possible personal interaction that especially facilitates learning of vital tacit elements (Bell and Pavitt, 1993; Lall, 1992; Nelson, 1990). Such local linkages are particularly important in developing countries with restricted technological capacity. Foreign MNCs often need to provide their existing and potential suppliers with extensive technological assistance and a variety of detailed technical specifications.

The main objective of the local plants of the MNCs is to produce petrochemical products either for export or for domestic consumption. Thus, depending on the typology of the subsidiaries, one of their principal tasks is to find local suppliers and establish business relations with them in order to source material inputs for their plants. For some MNCs, their role is to find and develop potential suppliers that can be included in the global value chains of their parent companies (Ivasson and Alvstam, 2009). Equipped with significant accumulated production and engineering experience, these subsidiaries also monitor their local suppliers in order to secure quality products and processes, while providing them with various types of technical assistance (Ivasson and Alvstam, 2009).

There are various forms of technological support extended by MNCs to their suppliers. For example, Ivasson and Alvstam (2009) describe support through regular and standardized quality audits. Studies done by Ivasson and Alvstam (2004, 2009) in auto and truck firms found that such audits cover a broad range of indicators, from management structure, to quality systems and product and process competence. Through these audits, potential and existing suppliers are provided with verbal suggestions and written documentation giving them clear indications of which

improvements are needed in order to fulfill the standards expected by a long-term supplier. These audits are important in improving the general quality levels for those suppliers that have the capacity and commitment to learn from such assessments.

Sections 6.5.2 and 6.5.3 describe cases of upgrading of suppliers or supplier development from the perspective of MNC subsidiaries and local suppliers respectively.

6.5.2 Cases of Supplier Development in the Petrochemical Industry: MNC Subsidiaries

Case 1: 100 Percent Locally-owned Petronas (LOP) Subsidiary

Background of the Firm. LOP was established in 1992. Its plant is located on the East Coast of Peninsular Malaysia and produces petrochemical products mostly for the local market, with about 10 percent of its product sold overseas. Malaysia is still a net importer of the product produced by LOP. It is 100 percent owned by its parent company, Petronas. In 2009, LOP had 604 local employees and three foreign employees. Its sales/turnover in 2007/2008 was RM2.3 billion. Most of its products are sold through its parent's marketing arm, MITCO. LOP produces intermediate materials such as low-density polyethylene (LDPE), high-density polyethylene (HDPE), polypropylene (PP), and other monomers. LOP is required by the Malaysian regulations to purchase local inputs, depending on whether the inputs are available on the local market.

As stipulated under the Petroleum Development Act 1974, LOP participates in the Malaysian government supplier development program known as the Vendor Development Program (VDP). Under the VDP, local suppliers are given preferential treatment in selling their manufactured products to Petronas. Under this provision, Petronas will often give one company, or not more than three companies, the right to sell the specified products to Petronas, depending on the market demand for the specified products. Local suppliers also compete to become sole suppliers to Petronas under the much higher VDP category known as Restricted Category (RC) status. Usually, two or three companies are chosen under RC to become sole suppliers to Petronas of specified manufactured products. All local suppliers that want to supply to

any subsidiaries of Petronas are required to register as a license holder of the parent company. At LOP, matters in regard to local suppliers are handled by a unit called the Supplier Chain Management (SCM) department. This department, which liaises with Petronas headquarters, is considered the middleman between the subsidiary and the local suppliers.

LOP used to have a partner through FDI. It was then a joint-venture company between Petronas and a Japanese firm. There were many problems with the plant during its initial stages of production: it was not running up to full capacity, the market for the product was weak, and the Japanese partner decided to sell its interest. Petronas, which already held a 70 percent stake, was keen to buy. Now the technology licensor for the plant is an independent licensor.

About 65 percent of LOP total inputs come from internal suppliers (from the parent company or from other subsidiaries of the parent company). The other 35 percent come from external suppliers (from companies other than the parent company and its subsidiaries). LOP has been able to ensure that the parts, components, services and resources procured from local suppliers meet its precise requirements. In order to get what it wants, LOP provides the necessary specifications to its suppliers. As a result of its linkages with local firms, LOP does not encounter any specific problems. More often there are improvements in the manufacturing process, quality control, existing products, reduction of costs, delivery conditions and product design or development.

Technological Capabilities. Initially, LOP built its technological capability in petrochemicals through learning by experience. The technology licensor operated the plant for the first few years. Sources of improvement in technological capability came from international licensors. Over the years, LOP got its own employees through its parent company, which produced its own graduates. Over time the plant came to be

run by fewer and fewer expatriates. At the moment there are only two expatriates, down from at least 20 to 30 when it first started. In terms of production capability, LOP is basically a user of technology or an applicator of technology, so the company simply applies the known technology in the plant. Since LOP is a government-owned company, its parent company later introduced the VDP, aimed at building up Malaysia's domestic technological capability. Through the VDP, various inter-firm and intra-firm linkages were initiated. LOP has since developed its owned internal liaison department, the above-mentioned SCM, to coordinate linkages between itself and its suppliers.

As a subsidiary, LOP does not have an R&D unit. Its parent company has its own research facilities, which are used for all of Petronas's subsidiaries. In order to improve its technological capability, LOP also uses benchmarking against producers of petrochemical products as a tool to compare plant performance and to reach a quality standard for its products. The plant is registered under the International Organization for Standardization (ISO) specification.

Linkages. There are various types of suppliers to Petronas's subsidiaries. All suppliers to Petronas are required to have a Petronas license. Within these licensed suppliers, there are several special categories of suppliers. The first is VDP suppliers. For VDP suppliers, the LOP interviewee said, "Petronas require the product and at the same time there is reason to develop local entrepreneurs." The second category is Engineering, Procurement and Construction (EPC) contractors, which are usually large firms. They are selected to give Petronas subsidiaries the overall cost of a project, and they source their supplies from their own supplier lists. However, as part of the contract with the subsidiaries, EPC contractors will also need to use the list of suppliers from Petronas's VDP. The third category of suppliers is the international Original Equipment

Manufacturer (OEM) companies that partner local companies. OEMs are given incentives by Petronas to partner local companies, but not necessarily under the VDP. In this way, Petronas develops service centers for the products of the international OEM companies, and these centers are used in the long run by other regional firms in the petrochemical and oil and gas industry. According to the LOP interviewee, this procedure helps Malaysia develop its local capability and upgrades the supply chain in the industry.

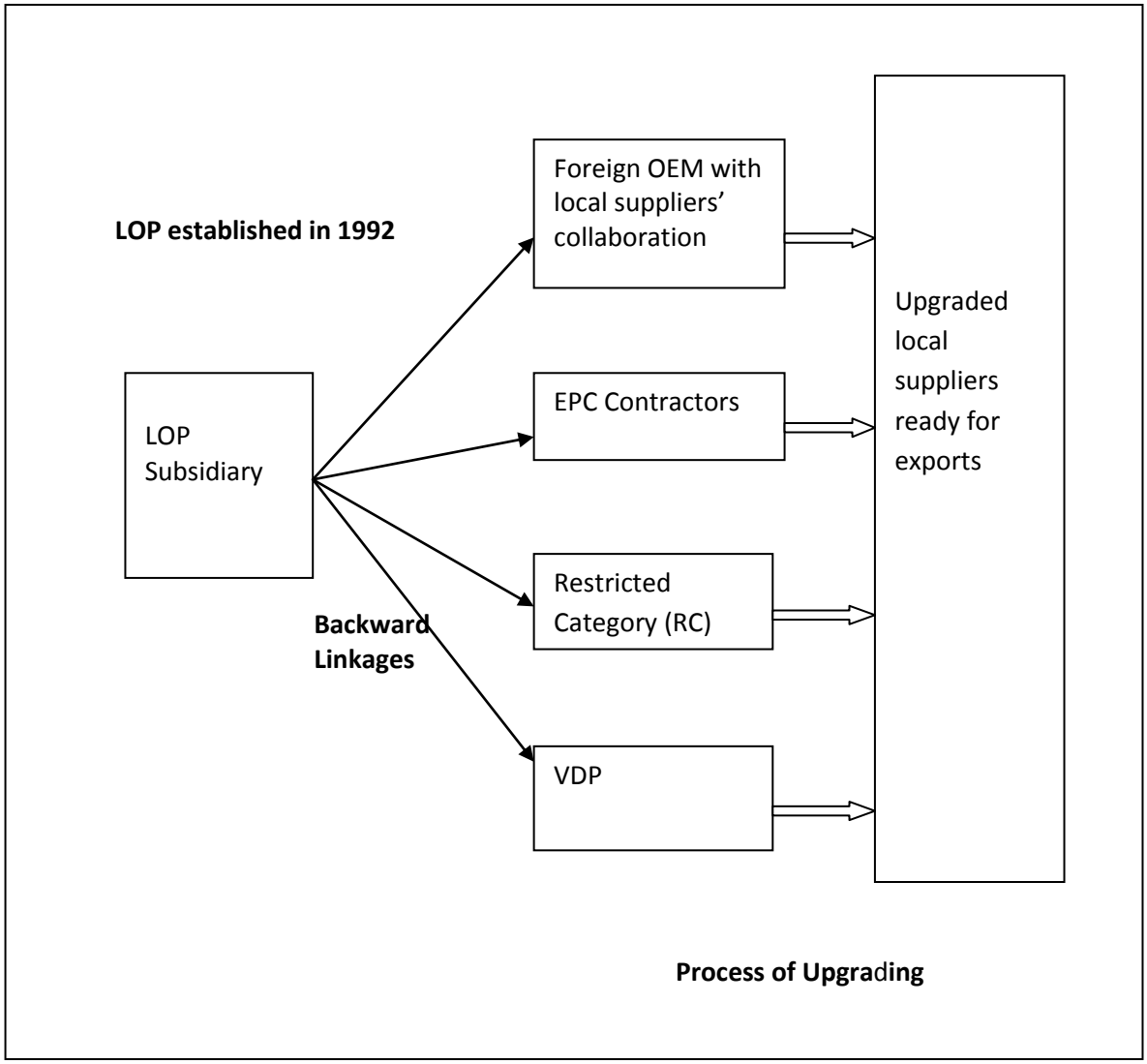
Even though LOP has to support local suppliers, it will only take their supplies on a competitive basis. The interviewee said that the suppliers should have their own capability before his company chooses them, and they will not be selected unless they are competent. The interviewee stated that the company will go for local suppliers, as they are easy to access and faster to deliver. The company will also try to help small suppliers that are working with foreign principal companies. These suppliers have accumulated some technical capabilities. The interviewee said these companies could be nurtured by having firms buy products from them.

In describing how LOP outsources its supplies the interviewee said, "All suppliers have to go to a bidding process. During the bidding process the suppliers have to show the capability that they have. Technically, before the suppliers are accepted, LOP will assess the suppliers' capability and will get the suppliers on a competitive basis. Once the suppliers are accepted, they are given ample technological assistance. The suppliers are able to learn from LOP and vice versa. However, for the VDP status companies, since there are only one or two companies supplying the product, once they are nominated as a vendor for the parent company, then these companies can supply to all subsidiaries of the parent that require the product. These VDP companies are given ample technology assistance." However, the LOP interviewee said that the vendor

companies could not depend on the parent subsidiaries alone for contracts. They also have to find other customers for their products. This was to keep the suppliers from being too dependent on Petronas. With a contract from Petronas, though, these VDP companies will have no problem selling their products, as they will now have Petronas credentials.

When it comes to procurement, LOP receives advice from its parent company about purchase sourcing, but considers itself mostly independent in this area. LOP considers itself as having full autonomy when it comes to launching new products, adopting a new process, deciding which parts to outsource, changing relationships with local suppliers and choosing the suppliers. Suppliers' technological capabilities are among the factors that have encouraged LOP to build stronger linkages with local suppliers. A clear picture of how LOP has helped to upgrade indigenous suppliers is given in Figure 6.4.

Figure 6.4: Case Study of LOP Upgrading Technological Capabilities of Local Suppliers



Case 2: 100 Percent Locally Owned Malaysian (LOM) Company

Background of the Firm. The subsidiary LOM was established in 1969. It started as a subsidiary of a Taiwanese MNC and is located in Johor Bahru, Johor. At present, it is a public-listed company and 100 percent Malaysian owned. The company is among the few that are licensed by the government to produce PVC and PVC compounds. LOM supplies petrochemical products mainly for the local market; the domestic market takes around 70 percent of its production, with 30 percent going to export, mainly compound and resin destined for India and China. The company started very small, with 10,000

tons of PVC and 5,000 tons of compounds. Today it has the capacity to produce 50,000 tons of PVC and 30,000 tons of PVC compound. The shareholders have changed many times. The present owner took over management of the company in 2001 by means of a management buy-out (MBO).

In 2009, LOM had 250 local employees and no foreign employees. Its sales/turnover in 2007/2008 was RM220 million. LOM is required by Malaysian regulations to purchase local inputs, depending on whether the inputs are available on the local market. LOM can purchase supplies from outside Malaysia if it cannot find the supplies locally. According to the interviewee, LOM does not participate in the VDP program, as the company is considered too small.

Most of LOM's total inputs besides raw materials come from external supplies (inputs from companies other than from the parent company or other subsidiaries of the parent firm). LOM has been able to ensure that the parts, components, services and resources procured from local suppliers meet its precise requirements. In order to get what it wants, LOM provides the necessary specifications to its suppliers. LOM does not encounter any specific problems as a result of its linkages with local firms. More often, LOM considers there are improvements after its involvement with local suppliers, especially in the manufacturing process, quality control, existing products, reduction of costs, delivery conditions, and product design or development.

Technological Capabilities. LOM's technical knowledge was introduced by earlier shareholders, including the original Taiwanese shareholder. From there, the management has developed and refined the company's technology. As far as the company is concerned, the technology is considered indigenous. It does not hold any third-party licenses at present, as the company owns its in-built technology. In terms of technological knowledge, the company continues to improve.

To improve its technological capability, LOM enhances its employees' knowledge by sending them to attend conferences and courses and keeping them up-to-date with the available literature on the petrochemical industry. It develops relations with all major producers of chemicals and research on PVC. The LOM interviewee said, "When these big producers or players come up with new things or know-how, they will inform everybody and ask everybody to attend their briefings. There is no formal training in this petrochemical business. It is very informal. LOM develops its skill by interacting with fellow manufacturers, suppliers and customers. The customers will give feedback. To build its technological capability, LOM will use its small R&D lab." The interviewee also pointed out that LOM sometimes appoints consultants to come and look at issues in his plant. These consultants are in the services sector of the petrochemical industry. They have their own small firms whose owners used to work for big oil and gas companies.

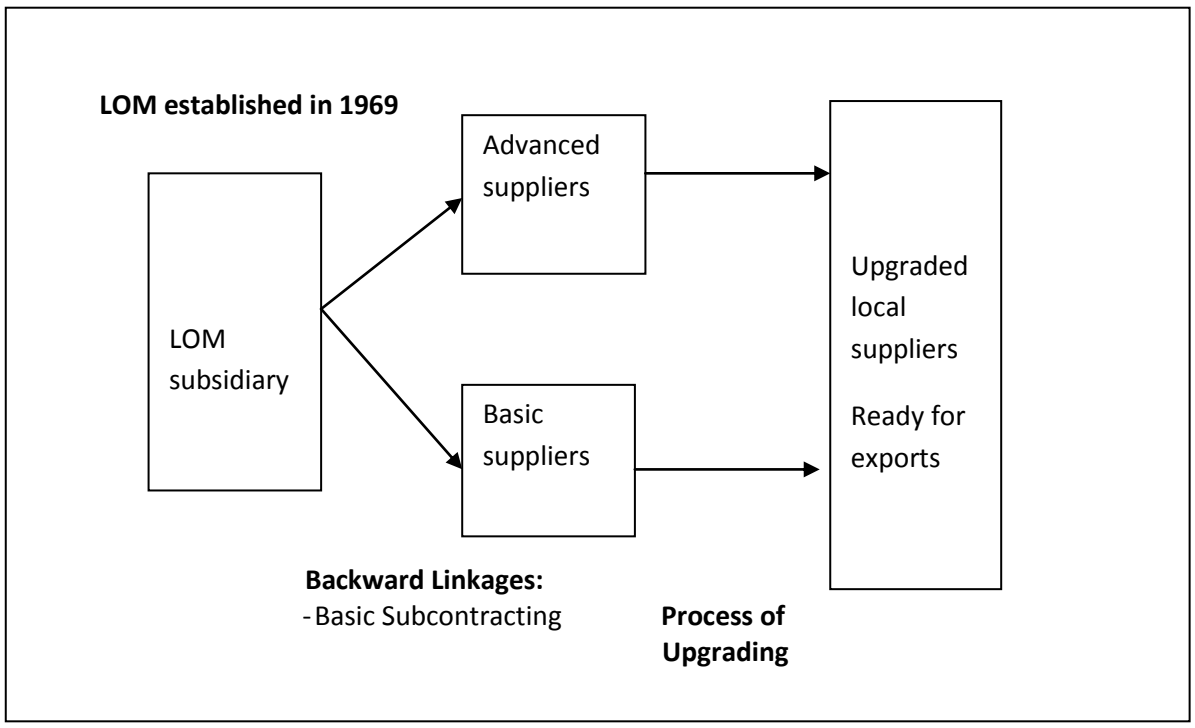
Linkages. To select suppliers, LOM uses a subcontracting mechanism. Most of the suppliers of maintenance and services to LOM are domestic firms. However, the company has its own engineering department for repairs and maintenance on its plants. Its own workers do most of the cleaning of the reactors, but the big reactors are cleaned by outside suppliers or contractors because of the need for specialized equipment.

In showing how LOM outsources its supplies, the interviewee of LOM said, "These subcontracting works are being given through a tender process. As part of the tender document, it specifies the entire work to be done by the contractor. The subcontracting company has its capability and their works at the plant are being verified by an independent third party and inspected by a government agency, the Department of the Environment."

In terms of support, LOM will give feedback to the suppliers if there is problem. The company shares information with its suppliers. For example, LOM sometimes needs to know the characteristics of a customer's end product. The customer may want to change its input materials. When the customer has new requirements, LOM will give this feedback to the suppliers.

When it comes to procurement, LOM receives advice from its board of directors on where to purchase its input resources. It considers itself as totally independent when it comes to purchase sourcing, and also considers itself as having full autonomy when it comes to launching new products, adopting a new process, deciding which parts to outsource, changing relationships with local suppliers and choosing the suppliers. Suppliers' technological capabilities are among the factors that have encouraged LOM to build stronger linkages with local suppliers. A clear picture of how LOM has helped to upgrade indigenous suppliers is given in Figure 6.5 below.

Figure 6.5: Case Study of LOM Upgrading Technological Capability of Local Suppliers



Case 3: Joint Venture German-Petronas (JVGP) Company

Background of the Firm. The subsidiary JVGP was established in 1999 as a joint venture between Petronas and a German company. 40 percent owned by Petronas and 60 percent by its German partner, it had 604 local employees and ten foreign employees in 2008. Its sales/turnover in 2007/2008 was RM3.4 billion. JVGP produces derivatives of propylene, and it operates an integrated site in Gebeng, Pahang, on the East Coast of Peninsular Malaysia. The parent company also operates other such plants in China for the Chinese market. 80 percent of JVGP's production is exported (with 60 percent going to South Asia and 20 percent to China), while the remaining 20 percent is sold on the domestic market.

JVGP is required by Malaysian regulations to purchase 40 percent local inputs, depending on whether the inputs are available on the local market. Since the plant is majority owned by the German partner, it is independently run by the joint-venture company. Petronas has little say in the operation of the plant. The joint-venture company does not participate in local suppliers' programs like the VDP. When it comes to procurement, JVGP uses its own list of suppliers and also the Petronas list of suppliers.

JVGP's procurement is done electronically, with advice from its parent company. Most of its input comes from internal supplies, either from the two parent companies or from other subsidiaries of the parent companies. However, JVGP also procures some inputs from external suppliers (inputs from companies other than from the parent company or other subsidiaries of parent firm). JVGP has been able to ensure that the parts, components, services and resources procured from local suppliers meet its precise requirements. In order to get what it wants, JVGP provides the necessary specifications to its suppliers. JVGP does not encounter any specific problems as a result of its

linkages with local firms. More often there are improvements in the manufacturing process, quality control, existing products, reduction of costs, delivery conditions and product design or development.

According to the JVGP interviewee, its joint venture with Petronas is not because of the size of the host country's domestic market. It is rather due to Malaysia's location in the midst of South East Asia and its excellent workforce. JVGP considers Petronas as a very good partner due to its excellent corporate culture, and Petronas is also its main raw material supplier. JVGP considers as plus factors in attracting FDI the tax incentives given by the government, as well as the good port facilities, regional and international airports, telecommunications and road infrastructure.

The interviewee mentioned that the joint-venture contract stipulates that in the long run the company should be localized. This means that some positions in the company are to be given to locals, although some positions will remain with the foreign partner.

Technological Capabilities. When it first started, JVGP brought the most advanced technology from its home country and used it in its Malaysian plant. Its operation in Malaysia does not have its own R&D. It basically relies on its foreign parent company for new knowledge. The company has a typical optimization program. Like any company, it looks at maintenance, including proactive maintenance, and at its workforce in order to continue to improve.

To train its employees in Malaysia, each year the company has a plan for introducing new and more advanced technology. Together with its parent company, the company organizes an international technology exchange meeting, which is sometimes held in Asia and sometimes in its home country. It sends both expatriates and local people to the event in order to maintain its leading place in the industry. JVGP has full access to

its parent's technology and to that of its sister subsidiaries worldwide. It pushes to make sure there is no difference in technology between the home country and Malaysia.

Linkages. JVGP has a lot of suppliers locally and internationally. Among them are suppliers of IT, scaffolding, maintenance and engineering. The company sources its main raw materials from Petronas as part of the joint-venture contract. JVGP has more than 200 local contractors. The plant's basic engineering is from the home country. It was constructed mostly by European companies, but the manpower came from Malaysian construction companies. When it began operations, most of its suppliers were foreign companies, but over the years more of the work has been done by local companies. In maintenance work, for example, the JVGP interviewee said, "100 percent of the works are being done by local companies. However for special equipment or advanced machineries work, the company would send them for repair by advanced international maintenance companies." The interviewee also noted that if JVGP can source parts locally, it will do so. However, for specialized equipment there is no choice. The company has to source it from abroad.

On the Vendor Development Program, the JVGP interviewee said the suppliers to JVGP have to develop their technology by providing competitive services. He said, "JVGP is not like Petronas. It is 100 percent market oriented. If the suppliers cannot meet its specification, it can always get another supplier to fulfill its contract." Even though JVGP does not develop suppliers under the VDP, the interviewee said, "If there are local vendors that the company can assist and grow them, they will do so." The interviewee said that this was because local vendors will stay with them for the long term. The company's motivations are speed, cost, reliability, and commitment. It is much easier to have local suppliers.

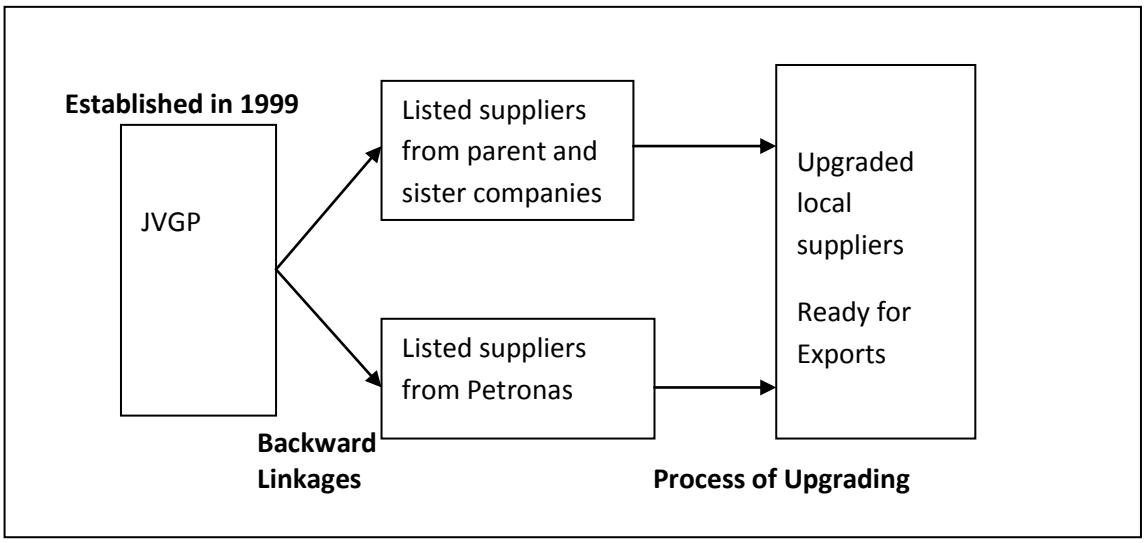
In showing how JVGP outsources its supplies, the interviewee said, "In terms of the bidding process for contracts, the company uses electronic bidding. But the company will invite only short-listed suppliers for bidding. These bidders will then get the specification for the parts. Later the company will send out bidding tenders to the shortlisted companies that meet the qualification and quality standard. JVGP does this in order to get the lowest price possible. It does not open the bidding to all suppliers. This is to make sure only selected suppliers are called for. These suppliers that are in the company system are the ones that have met the company's standard. The JVGP bidding process talks about quality and price. Thus, the company expects quality, price, and timely delivery." Besides using its own available databases for suppliers, JVGP can also gain access to the home country's and host country's supply networks to get the best prices. According to the interviewee, the company can purchase from abroad any parts that are not available through local suppliers. The company has no problem getting approval from MIDA.

JVGP maintains that its material suppliers have to be competitive. The interviewee said, "Once JVGP have the material suppliers, it does not drop them but will try to develop relationships. These suppliers know after a while the way JVGP do business. This will add value to the suppliers. However, if the suppliers later find that they cannot deliver and another supplier offers better conditions, then JVGP has to terminate the suppliers. Otherwise, JVGP will be off the market. If we are not in the market, then it will be worse for the rest of the suppliers."

When it comes to procurement through local suppliers, JVGP considers itself as mostly independent in its purchase sourcing. It considers itself as having full autonomy when it comes to launching new products, adopting a new process, deciding which parts to outsource, changing relationships with local suppliers and choosing the suppliers. In its

relations with local suppliers, it does not see improvement in its manufacturing process or quality control, reduction in cost or any improvement of product design or development. However, it does see some improvement in existing products and in delivery conditions. It sees that by buying locally, the delivery can be much faster. Suppliers' technological capabilities are among the factors that have encouraged JVGP to build stronger linkages with local suppliers. The respondent also mentioned that among the reasons that JVGP develops linkages with local suppliers is that by doing so, the company can get a tax exemption. A clear picture of how JVGP has helped to upgrade indigenous suppliers is given in Figure 6.6.

Figure 6.6: Case Study of JVGP Upgrading Technological Capability of Local Suppliers



Case 4: Joint Venture American-Malaysian (JVAM) company

Background of the Firm. The subsidiary JVAM was established in 1989. The company is a joint venture, 70 percent owned by an American group of companies and 30 percent by a Malaysian equity company, and is located in Johor Bahru, Johor.

JVAM was the first petrochemical company to invest in Malaysia, and the marriage between its partners was aimed at sharing the risk of this large investment. According to the JVAM interviewee, the state-owned Malaysian partner had no experience in petrochemical technology, but had money to invest. The American group had the technology, manpower and experience. In the 1990s, JVAM was among the first companies in Malaysia to build a petrochemical plant using naphtha as its raw materials. The company built its first cracker to make polypropylene in 1994, and in 2000 it started its second cracker to make olefins, such as ethylene and propylene. In 2008 the company started producing butadiene for export. Its production is 40 percent for the domestic market and 60 percent for export, mainly to China.

In 2009 JVAM had 1,163 local and 75 foreign employees. It sales/turnover in 2007/2008 was RM1.5 billion. The company is not required to purchase local inputs; however, when local inputs are available on the local market, JVAM will buy them. According to the interviewee, JVAM will buy its supplies from anywhere that is available to it, but most of its basic supplies can be found in Malaysia. Advanced supplies are usually procured from OEMs and also from licensors. JVAM does not participate in the VDP.

JVAM has been able to ensure that the parts, components, services and resources procured from local suppliers meet its precise requirements. It has a Process Control Center where its customers and suppliers can do testing and product specification. In order to get what it wants, JVAM provides the necessary specifications to its suppliers. It encounters no specific problems as a result of its linkages with local firms, but it has found that linkages with local suppliers result in improvements in the manufacturing process, quality control, existing products, cost reduction, delivery conditions and product design or development.

Technological Capabilities. When the American group came to Malaysia to set up the plant, it was in package form. The interviewee said, "Malaysia does not have technology at all. For the cracker technology in petrochemical, it is international technology. So the technology can be transferred from one country to another. The JVAM cracker technology is basically from US crackers. Initially in the construction of the plant, the company used the Japanese EPC contractor, JGC. JGC brought in the technology and purchased all the equipment to construct the plant here. The majority of equipment, materials were imported from overseas. JVAM also brought in Malaysian companies as subcontractors to build the plant during the initial stage of plant construction."

The American group started its first petrochemical plants in Taiwan and the US, so it had accumulated a great deal of experience before entering the Malaysian market. This experience naturally carried over to JVAM. In building a local technological capability, JVAM recruited local engineers and hired many expatriates. Expatriates and local engineers jointly made up the company's technical manpower. It was a mixed combination of employees working at the plant, as Malaysia's graduate engineers had no experience or know-how to run the petrochemical company. As Malaysia was new in the industry, there was no commercial company that could provide training for specific knowledge or dispense petrochemical industry know-how. Knowledge in this field was picked up through on-the-job training.

Linkages. Initially, when JVAM built the plant, the company bought technology from foreign companies. JVAM still buys technology from these suppliers, but over the years JVAM has had many local technology suppliers in the areas of process, equipment technology, control technology, optimization and instrumentation. These technology suppliers are not based in Malaysia, however. Some may have offices in

Malaysia, but most often they are overseas. The interviewee explained, "Malaysia has quite a small market for these products. They are only called in as and when required. There are not many Malaysian companies who are technology suppliers. However, in the services sector of the industry, local construction and installation contractors are quite common. But for technology and engineering suppliers, the local [supply] is quite poor. There are not many, and the company does not use them very much."

In terms of knowledge transfer, the interviewee said, "In Malaysia, construction work must be done by a local company. For services work in the industry, the manpower must be local. However, when it comes to technology, as technology needs knowledge, manpower may not be local. As the petrochemical industry needs special knowledge, this industry needs support from other countries' manpower. Thus the company has to source knowledge from anywhere in the world. In this regard the company does not differentiate between local or overseas suppliers. Any company that has the capability that can provide the best technology or services and know-how, the company will take them."

In showing how JVAM outsources its supplies, the interviewee said, "Suppliers are taken by the company through a bidding process which is based on their capability and price. For major projects, the company needs to outsource its work through the EPC contractors. Once the EPC contractors have the engineering design, then when it needs all the relevant materials such as the piping, equipment and others, they will purchase them themselves from anywhere in the world. If some local company has some capability, the EPC company will use their service. These EPC companies may have some partners from overseas countries to help them in the engineering. They will purchase this equipment, construct it and build and install the project. The local [companies] have limited EPC capability. For big construction projects JVAM would

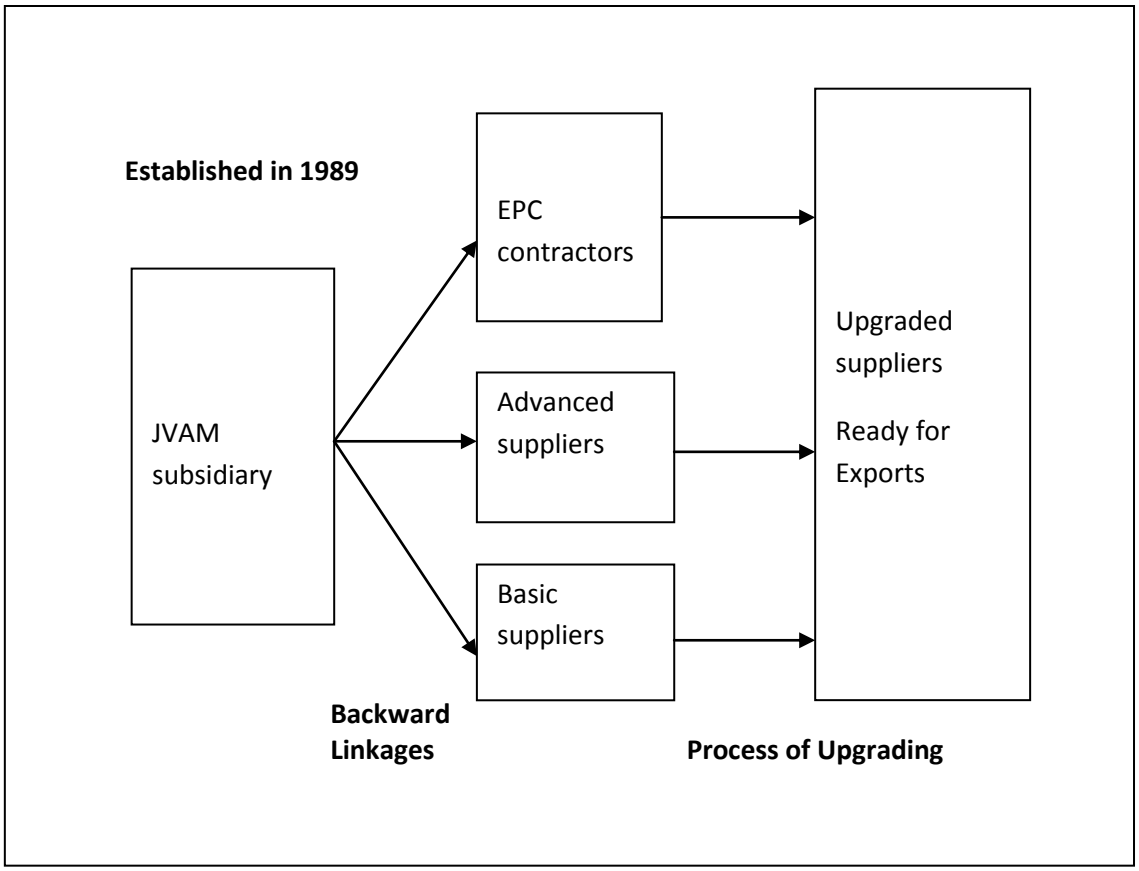
deal with an EPC contractor. But for services works, they mostly deal directly with local contractors. Most of the time in the engineering services, JVAM will get support from overseas as well as a local company. The local company also liaises with overseas companies for their works."

For work done by local suppliers, JVAM supervises the work through its supervisors. The interviewee said, "These suppliers must have the capability to do it, or else they do not get the contract. Usually all services and day-to-day maintenance are all done by local companies. They have certain capability to carry the job. To attain this capability the suppliers have certain standards that they have to follow, such as having licenses and following international standards in their work."

On why JVAM chooses local suppliers, the interviewee said, "The local suppliers are convenient and price competitive." However, according to the interviewee, the company has to go to foreign suppliers if there is no local supplier to do the job. On giving technological assistance the interviewee said, "The company has also given cooperation to its many suppliers. It has given information and has formed linkages with other technology providers and gives knowledge on safety requirements and the company's requirements and feedback so that local suppliers can keep on improving."

When it comes to procurement, JVAM does not receive advice from its parent company about purchase sourcing. It considers itself as totally independent in this area, and also considers itself as having full autonomy when it comes to launching new products, adopting new processes, deciding which parts to outsource, changing relationships with local suppliers and choosing the suppliers. Suppliers' technological capabilities are among the factors that have encouraged JVAM to build stronger linkages with local suppliers. A clear picture of how JVAM has helped to upgrade indigenous suppliers is given in Figure 6.7 below.

Figure 6.7: Case Study of JVAM Upgrading Technological Capability of Local Suppliers



Case 5: 100 Percent Foreign-owned Japanese (FOJ) Company

The subsidiary FOJ was established in 1997. The plant is located on the East Coast of Peninsular Malaysia. It is a 100 percent foreign-owned subsidiary. In 2008 it had 247 local employees and two foreign employees, and its sales/turnover in 2007/2008 was RM160 million. FOJ supplies petrochemical products mainly for the export market, with 83 percent of its exports going to Japan, South Korea and Taiwan. The company produces intermediate materials such as polyoxymethylene, polybutylene terephthalate, liquid crystal polymer, and cyclic olefin copolymer. FOJ is required by Malaysian regulations to purchase 40 percent local inputs, depending on whether the inputs are

available on the local market. It can purchase supplies from outside Malaysia if cannot find the supplies locally.

Almost 30 percent of FOJ's total inputs come from internal supplies (inputs received from from the parent company or other subsidiaries of the parent firm) and 70 percent of inputs are from external supplies (inputs received from companies other than the parent firm or its subsidiaries). However, the interviewee said that most of these external suppliers are from overseas, explaining: "There is not much that the company can buy locally. Most often its parent company decides where to buy." With the small amount that it bought from local suppliers, FOJ has been able to ensure that the parts, components, services and resources procured from local suppliers meet its precise requirements. In order to get what it wants, FOJ provides the necessary specifications to its suppliers. FOJ does not encounter any specific problems as a result of its linkages with local firms; more often it considers there are improvements after its involvement with local suppliers, especially in the manufacturing process, quality control, and delivery conditions. However, FOJ sees no improvement in existing products, cost reduction, or product design or development.

When it comes to procurement, FOJ considers itself as mostly dependent in its purchase sourcing. FOJ considers itself as having no authority when it comes to launching new products, adopting new processes, or spending on local suppliers' staff training. It has limited authority when it comes to deciding which parts to outsource, changing relationships with local suppliers and choosing suppliers. Among factors that have encouraged FOJ to have stronger linkages with local suppliers are the suppliers' technological capabilities, the suppliers' willingness to adopt new technologies, and incentives from the Malaysian government.

These findings contrast with those on FOB, whose parent company is British. The survey interview showed that even though FOB is 100 percent foreign-owned, it is mostly independent when it comes to outsourcing. Hence its BL Index distribution with basic product suppliers, as shown in Table 5.7, is as follows: Product (0.83); Innovation (0.00); Process (0.40); Training (1.00); Others (0.60) and Management (0.57). Its BL Index distribution with advanced product suppliers, as shown in Table 5.9, is as follows: Product (0.83); Innovation (0.20); Process (0.40); Training (1.00); Others (0.60) and Management (0.71). These two sets of values show that FOB gives assistance more to advanced product suppliers compared to basic product suppliers, especially in innovation and management. This is markedly different from the case of FOJ, which had no significant linkages with either basic or advanced suppliers (refer to tables 5.7 and 5.9).

6.5.3 Cases of Supplier Development in the Petrochemical Industry: Local Suppliers

Case 1: Basic Supplier - SA1

Background of the Firm. The basic local supplier SA1 was established in 1996. It is 100 percent locally owned and is located in Petaling Jaya, Selangor. In 2009, SA1 had 20 employees with sales/turnover of RM 24 million. It sells parts and components to petrochemical and oil and gas companies. It also produces its own products from parts and components sourced from its principals in the United States and Australia. SA1 supplies basic items/parts and components that use standardized technologies and meet customer specifications, and it delivers services to petrochemical plants and many other industries that use its parts/components and services. SA1 is not under Petronas's VDP program but does hold a license from Petronas. Among the parts and components

it sells are filtration equipments, separators, scrubbers and corrosion inhibitors. SA1 sells its products and components only on the domestic market.

Technological Capabilities. The interviewee said that he had worked with Petronas and was a chemical engineer by profession. He was involved with process simulation and project optimization. The company's strategy was first to partner with companies from advanced countries, and it has since partnered with American, British, and Australian firms that wanted to enter the Malaysian market. Along the way, when the company had acquired more knowledge, it began to perform most of the work itself.

The interviewee said many foreign companies want to enter into Malaysian market. But it takes a long time if they enter by themselves, so SA1 goes into partnership with these principal companies. One of Petronas's requirements is that the foreign companies that want to supply to Petronas need to go through a local company. Accordingly, foreign companies usually form a joint-venture company with a local company in order to get a Petronas license. SA1 tries to develop local technical capability first and only then form a strategic technical alliance, which means that it only uses its partner services when required, and vice versa.

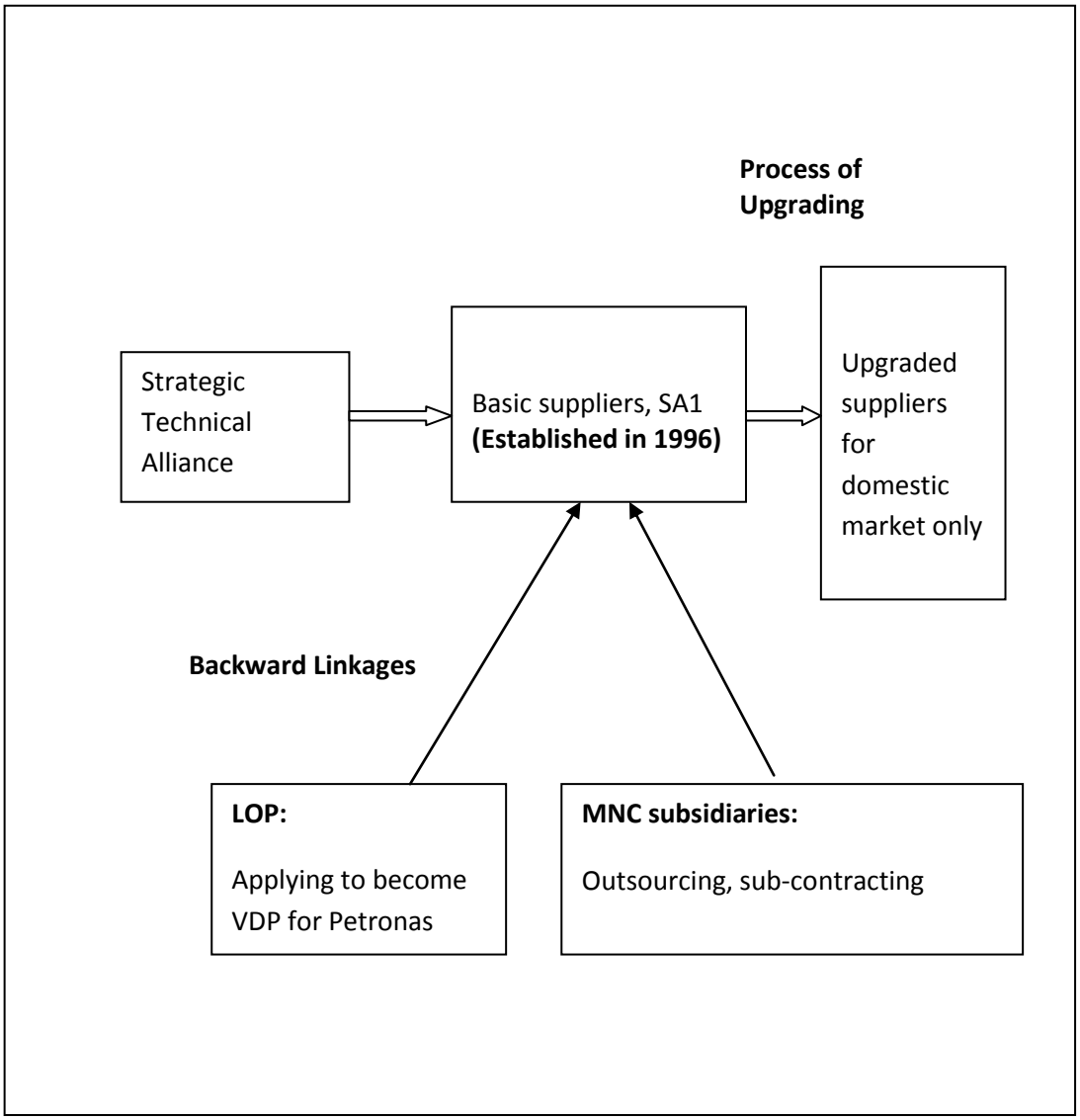
In regard to technological capabilities, the company puts an emphasis on knowledge, which is one of the biggest challenges in oil and gas. The company is trying to sell its proprietary products to Petronas and is in the process of obtaining VDP status. In order to get the Petronas license, the company has to have a proven track record. The company is also supplying to other MNC companies besides Petronas. As with supplying to Petronas, local suppliers also need to have a license to supply to Shell and Esso.

Linkages. According to the company interviewee, SA1 is waiting for Petronas to give one of its products VDP status. Even with VDP status, though, it can only supply to

Petronas for a given time and is subject to audit by Petronas. Thus VDP companies still have to upgrade their technological capability and compete with rivals. But some VDP companies can supply Petronas for up to ten years, and VDP status gives the company greater credentials, which it can use to supply many more companies in the industry. For a VDP company, normally there are only one to three companies bidding for the contract. As a result of this, the company has no great competition and can supply Petronas throughout the duration of contract. However, after the contract expires, the company is considered mature enough to stand on its own. In regard to its customers, the interviewee said that there is some kind of understanding on the product specification and so on. SA1 develops the specifications together with the client.

SA1 found that its linkages with customers have not brought any improvement in its manufacturing process or in reducing costs. However, the linkages have improved quality control and improvement of existing product, delivery conditions, and product design or development. When asked about what SA1 would like to learn from customers, the SA1 interviewee said the most beneficial factor in having foreign customers was technology transfer. According to SA1, there are differences in how MNCs of different nationalities make technology transfer available. A clear picture of how SA1 was upgraded is given in Figure 6.8 below.

Figure 6.8: Case Study of Upgrading of Basic Product Suppliers, SA1



Case 2: Advanced Supplier - SB1

Background of the Firm. The advanced supplier SB1 was established in 2003. Its plant is located on the East Coast of Peninsular Malaysia. Besides Malaysia, it has an overseas operation in Sudan, Africa. It is 100 percent locally owned, and its sales/turnover in 2008 was RM90 million. In 2009 its operation in Malaysia had 32 local employees and no foreign employees. The company has integrated chemical capabilities and engineering capabilities. SB1 produces chemical products for corrosion inhibitors and emulsifiers, and it offers various services such as high-pressure water jet cleaning, cooling-tower refurbishment, industrial wastewater treatment, water purification, and various technical services. It is on Petronas's VDP list of companies. It produces for the domestic market as well as for export. In 2008, it exported 10 percent of its production.

SB1 is a chemical provider for wastewater treatment and the chemicals needed to enhance petrochemical production in a plant. Besides supplying chemicals, the company also provides engineering services. Its customers can buy the chemicals on their own, but SB1 offers a complete package, providing chemical services (injecting the chemicals for the process) and engineering services (monitoring the performance of the chemicals and production). The SB1 interviewee said customers were very particular about price. If its pricing is cheaper, and its performance and technical services are good, the customer will choose SB1.

Technological Capabilities. The interviewee had worked with Petronas for more than ten years. Before that, he ran a number of companies – such as PCI, LNG, MITCO or the Petronas Trading Corporation, Petco – that were subsidiaries of Petronas. He also had experience in running three petrochemical companies: MTBE, Petronas Ammonia,

and Aromatics. He acknowledged that quite a number of Petronas employees have left the company and formed their own companies in the oil and gas sector.

According to the interviewee, SB1 formulates chemicals to be used in the petrochemical industry, which means that the company needs expertise. SB1 expertise comes from the company's owner himself. The owner acquired a great deal of knowledge in the petrochemical field after working extensively in the oil and gas and services industry and later set up his own company.

SB1 obtained VDP status in 2005. The company has the capability to supply Petronas. It has its own plant and its own laboratory and has done some kinds of R&D. The company has done chemical formulation by looking at customers' requirements. SB1 is the VDP for water treatment chemical suppliers. The company is one of two that gets VDP facilities from Petronas.

Linkages. The SB1 interviewee said that the company gets assistance from customers – for example, the customers may give information on how to penetrate a market. In giving the company a contract for a job, the customers also give it knowledge about the processes of the project that they are working on. SB1 needs to understand these plant processes before it can provide a solution to the problem. As a result, there are interactions. SB1 agreed that customers give the company much-needed assistance and that in the process the company learns from such interactions.

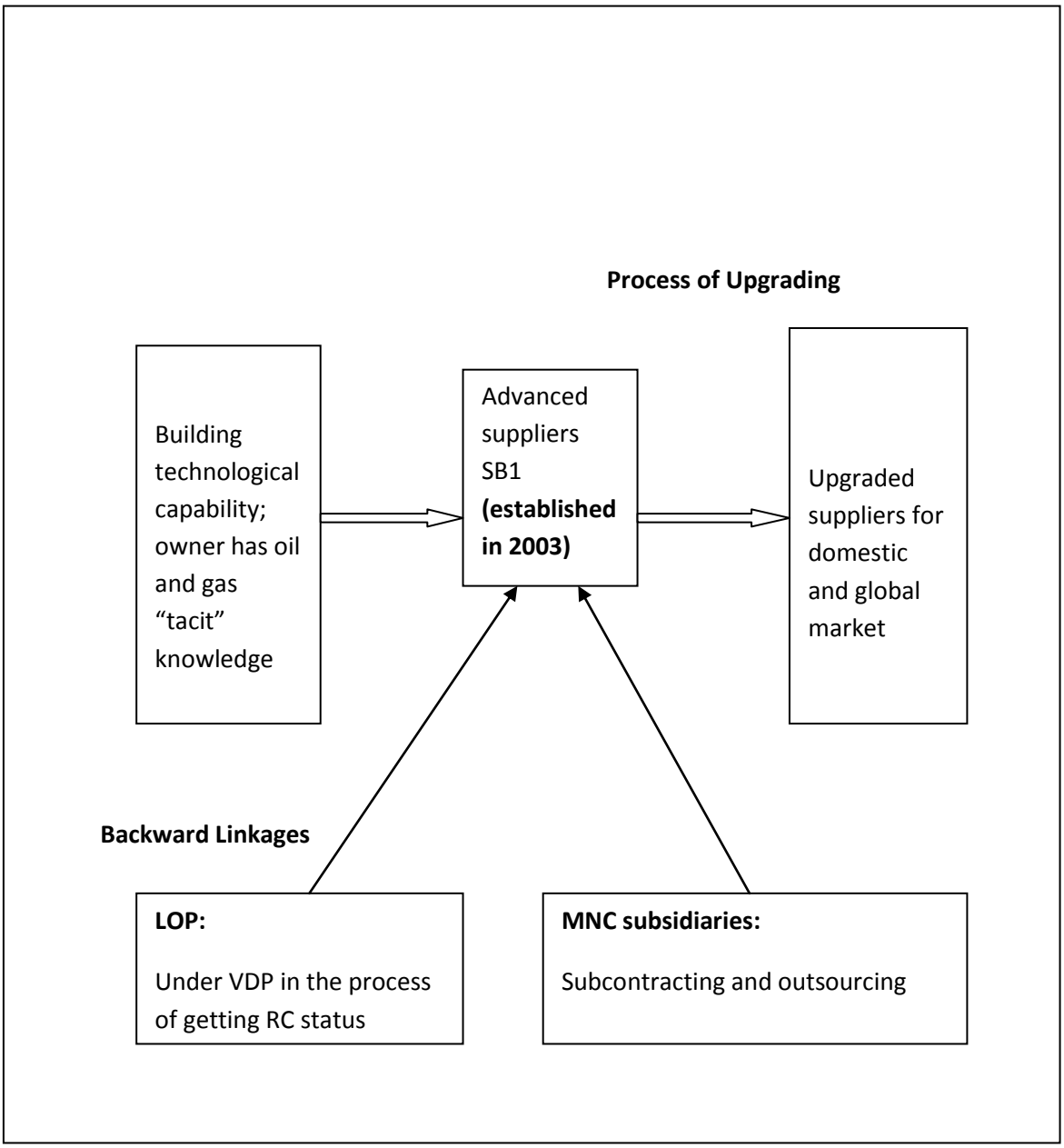
In giving local companies VDP status, Petronas also gives them the opportunity to participate in the supply chain and build up their capabilities. Without these contracts, VDP companies would not be able to improve their technological capability. After being selected under VDP they face less competition, and once they get a Petronas contract they receive assistance from Petronas to improve their capabilities.

The interviewee said that even if the company gets a contract from Petronas, the company still finds other customers for its products. If, for example, the company has a delivery defect, the customer will help the supplier by consulting the contractor to make the service better. The interviewee said, "Other customers may terminate the suppliers. But under VDP, Petronas will consult the contractor. This is to get the contractor to become better."

The interviewee also said that customers give suppliers feedback, telling them where and how to improve. Shell, Petronas and other clients also provide the company with support by giving feedback right after a project with them begins. However, the company still has to compete to get the project from the client in the first place.

In showing how suppliers have to go through the bidding process for contracts from customers, the interviewee said, "During the bidding process, there is no contact between the company and the clients. During the bidding process, SB1 has to propose its bid. All communication is done through mail and fax and there is no oral communication between clients and suppliers. However, after the work has started, then there are lots of interactions. During the bidding stage, there were many bidders. The culture is the same whether at Shell, Exxon Mobil or Petronas. Once the contract job is done, the customers have their own assessments. They would tell the scoring that the supplier got for the job. The scoring is like 1 to 5, where 3 are considered average."

Figure 6.9: Case Study of Upgrading of Advanced Product Suppliers, SB1



SB1's customers give a lot of support to bring the company up to the necessary standard, even though the customers do not know the suppliers before the contract is awarded. The interviewee said that once SB1 got the technological capability and worked on maintaining its customer relationships, some of the work became repeat business.

Under the VDP, SB1 found that linkages with customers have improved its manufacturing process, quality control, existing products, delivery conditions, product design and development, and have helped to reduce its costs. When asked about what SB1 would want to learn from MNC subsidiaries, the reply was that it wants to learn how to penetrate the overseas market. As to the differences between nationalities in terms of giving technological assistance, SB1 sees no difference in this regard. According to SB1, MNCs are eager to impart knowledge, since they know that if the suppliers can produce quality products, it will give them a big advantage in terms of cost and speedy delivery. A clear picture of how SB1 was upgraded is given in Figure 6.9, above.

6.5.4 Summary of Case Studies of Technological Upgrading

Presented above are case studies of five subsidiaries and two local suppliers. These case studies are to provide illustrations to support the descriptive statistics in Chapter 5 and the statistical results as discussed earlier in the present chapter. As explained in Chapter 2, subsidiaries' strategies on backward linkages are affected by their motives, or embeddedness, and by their relationship with their parent companies, or autonomy. Thus, depending on the subsidiaries' ownership type, this case study tries to discern the extent of technological support given by different types of MNC subsidiary to different types of local suppliers. The supplier case study shows how different levels of

technological capability on the part of suppliers affect backward linkages. These two sets of case studies help to explain how backward linkages promote the upgrading of local suppliers.

MNC Subsidiaries' Case Study

The supplier development literature distinguishes between supplier development by MNC subsidiaries that (1) is simply a process to select appropriate new suppliers to meet a firm's requirements, and (2) involves active intervention to upgrade existing suppliers' capabilities (Hahn, et al., 1990; Watts and Hahn, 1993). From the analysis, it can be considered that LOP and JVGP are companies that give active intervention to upgrade existing suppliers' capabilities, while LOM, JVAM and FOJ basically only use suppliers that already meet their requirements.

Studies have also shown that firms that have higher autonomy are locally embedded, whereas firms that have low autonomy are less embedded in the local structure. In this study, LOP and LOM are respectively a locally owned MNC subsidiary and a Malaysian-owned large company. LOP, being a subsidiary of Petronas, has higher autonomy in terms of outsourcing, even though it follows the guidelines prescribed by the parent company.

Petronas, as a government-linked company, has a responsibility to develop local capabilities in the petrochemical industry. Petronas is the anchor company for the Malaysian government VDP program, under which MNC subsidiaries have to develop linkages with local supplier firms. The extent of linkages varies according to different categories of suppliers to Petronas. From Table 6.8, it is clear that LOP has developed various linkage promotion programs. Among others, there are the VDP, the RC, and

development of EPC contractors – which, when getting a contract from Petronas, is aimed at involving local companies in the work contracts, and at getting foreign OEM companies to form collaborations with local supplier firms. In this respect, Petronas has played a more important part than the rest of the MNC subsidiary typology in enabling local suppliers to upgrade their technological capabilities.

The status of VDP is sought after. This is because when a company is awarded it, the company is given preferential treatment to supply the product to all Petronas subsidiaries. Petronas gives preferential technological assistance to suppliers once they have VDP status. However, to become a VDP supplier, local companies must show that they have the capability to make products that Petronas considers useful to its operations. In the case of LOM, it considers that it has high autonomy when it comes to outsourcing. As a local company that is licensed to produce petrochemical products for the local market, LOM outsources its supplies to local suppliers. LOM has been in operation since 1969, and through this long experience has formed linkages with many local suppliers. But LOM also has an in-house maintenance crew that it uses when servicing its plant. This means that the company can save in terms of labor costs, but also that it provides less work to the local suppliers and hence diffuses less knowledge to them.

In the case of the joint ventures JVGP and JVAM, both companies consider themselves to be highly autonomous. Both companies are MNC subsidiaries, and in each case the foreign partner has the majority stake in the equity structure, with the local partners having no direct control over the company operations. However, JVGP does have a partial supplier development program, albeit not as elaborate as Petronas's VDP. JVGP is keen to help develop local suppliers, and for its outsourcing activities it lists all its suppliers in databases obtained either from its parent company or from its own

resources in Malaysia. It will also use its partner's list of local suppliers when it comes to outsourcing. By contrast, JVAM does not have a supplier development program, although all local suppliers have the opportunity to supply the company.

In contrast to the other case-study companies, FOJ has low autonomy; it is totally dependent on its parent company when it comes to outsourcing. One might presume that its length of operation in Malaysia is too short for the company to have built knowledge linkages or bases (Benito and Gripsrud, 1992). However, it is actually centralization of knowledge by the parent company that has prevented FOJ from doing this (Tsai, 2002; Gupta and Govindarajan, 2000). With FOJ exporting most of its products, it is believed that the Malaysian government may have given the company a special provision to use Malaysia as a processing base for exports.

The observations from all five case studies of MNC companies support the observation by several scholars that the headquarters-subsidiary relationship has an important influence on building linkages capabilities. The parents of LOP, LOM, JVGP and JVAM permitted their subsidiaries to develop their own linkages either with local firms or with foreign firms, depending on the price, quality and delivery capability of the suppliers. This gave rise to these companies forming linkages resembling an integrated complex of networks making up local as well as global supply chains (Nobel and Birkinshaw, 1998). FOJ, however, is totally dependent on its parent company. As a result, it has formed fewer backward linkages with local suppliers. But when we look at FOB in tables 5.7 and 5.9, there are linkages with basic product suppliers and advanced product suppliers in Product, Training, Others and Management. This shows that autonomy vis-à-vis the parent company is a very important factor in whether a subsidiary will develop strong backward linkages.

Table 6.8: Summary of MNC Subsidiaries' Case Study

	LOP	**LOM**	**JVGP**	**JVAM**	**FOJ**
Motives	Seeking strategic asset	Seeking strategic asset	Seeking market	Seeking market	Seeking natural resources
Mode of entry	Acquisition	Acquisition	Greenfield	Greenfield	Greenfield
Autonomy	Mostly independent	Totally independent	Mostly independent	Totally independent	Mostly dependent
Linkages promotion	- VDP - RC - EPC contractors scheme - OEM company collaboration	Subcontracting mechanism. Most work done by in-house employees	Supplier development take into consideration of listed suppliers from both parent companies	Developed local EPC contractors in services and maintenance	Mostly done by foreign contractors
Analysis: (Hahn, et. al, 1990; Watts and Hahn, 1993)	Active intervention to upgrade existing suppliers' capabilities	Undergoing process to select appropriate suppliers to meet a firm's requirements	Active intervention to upgrade existing suppliers' capabilities	Undergoing process to select appropriate suppliers to meet a firm's requirements	Undergoing process to select appropriate suppliers to meet a firm's requirements

Source: Own compilation

Local Suppliers' Case Study

Studies have shown that different technological capabilities of firms affect the forms of backward linkages they establish with MNCs (Iguchi, 2008). Nonetheless, all local suppliers recognize that they need interactions with MNC subsidiaries in order to learn new technologies or to get assistance, or to increase their technological capabilities on their own simply through learning. In the present study the basic supplier, SA1, and the advanced supplier, SB1, have both experienced technological learning. But this process can take time. In the case of SA1, the company understands that it could increase its own value to Petronas if it could come up with a new technological product that added value to the petrochemical industry. Such a product could be sold to Petronas, and by developing it the local suppliers could become a sole supplier to Petronas. All local suppliers aspire to VDP status, since it entitles them to technological assistance from Petronas. SB1, on the other hand, is already in the category of advanced suppliers. Its aim is now to reach the Restricted Category of suppliers. By winning a place in this category, the company could not only get technological assistance from Petronas, but could also become one of its more select suppliers.

Like suppliers in the electronics and electrical industry, firms are classified according to their technological capabilities (Iguchi, 2008). This study classifies basic suppliers and advanced suppliers as two different categories of suppliers in the petrochemical industry. These suppliers need to upgrade their technologies, and the government gives them many kinds of support. The VDP itself is a Malaysian government program that has been entrusted to Petronas, a government-linked company, to run. There is also Petronas's Restricted Category program. Local suppliers as a whole also have linkages with other MNC subsidiaries. With VDP or RC status, it is easy for them to supply

their products, as this status gives them the credentials for their knowledge. Thus, depending on the type of ownership structure the subsidiaries have, the extent of backward linkages that the subsidiaries have with local suppliers can have an impact on the development of local suppliers in the host country. What is important is that the subsidiaries give these local suppliers the opportunity to supply their products to them.

Subsidiaries form linkages with local suppliers if these suppliers have technological capabilities and their products are competitive in terms of price and quality (Sako, 1994). When given the opportunity, these local suppliers will upgrade their technological capabilities in order to fulfill the contract with the customers. Upon getting the contract, the backward linkages that are formed between the MNC subsidiaries and the local suppliers will further upgrade the capabilities of the suppliers. And with more contracts received, local suppliers will gain more experience, which in turn could lead to the local firm becoming a globally competitive firm. A summary of the local suppliers' case study is shown in Table 6.9.

Table 6.9: Summary of Local Suppliers' Case Study

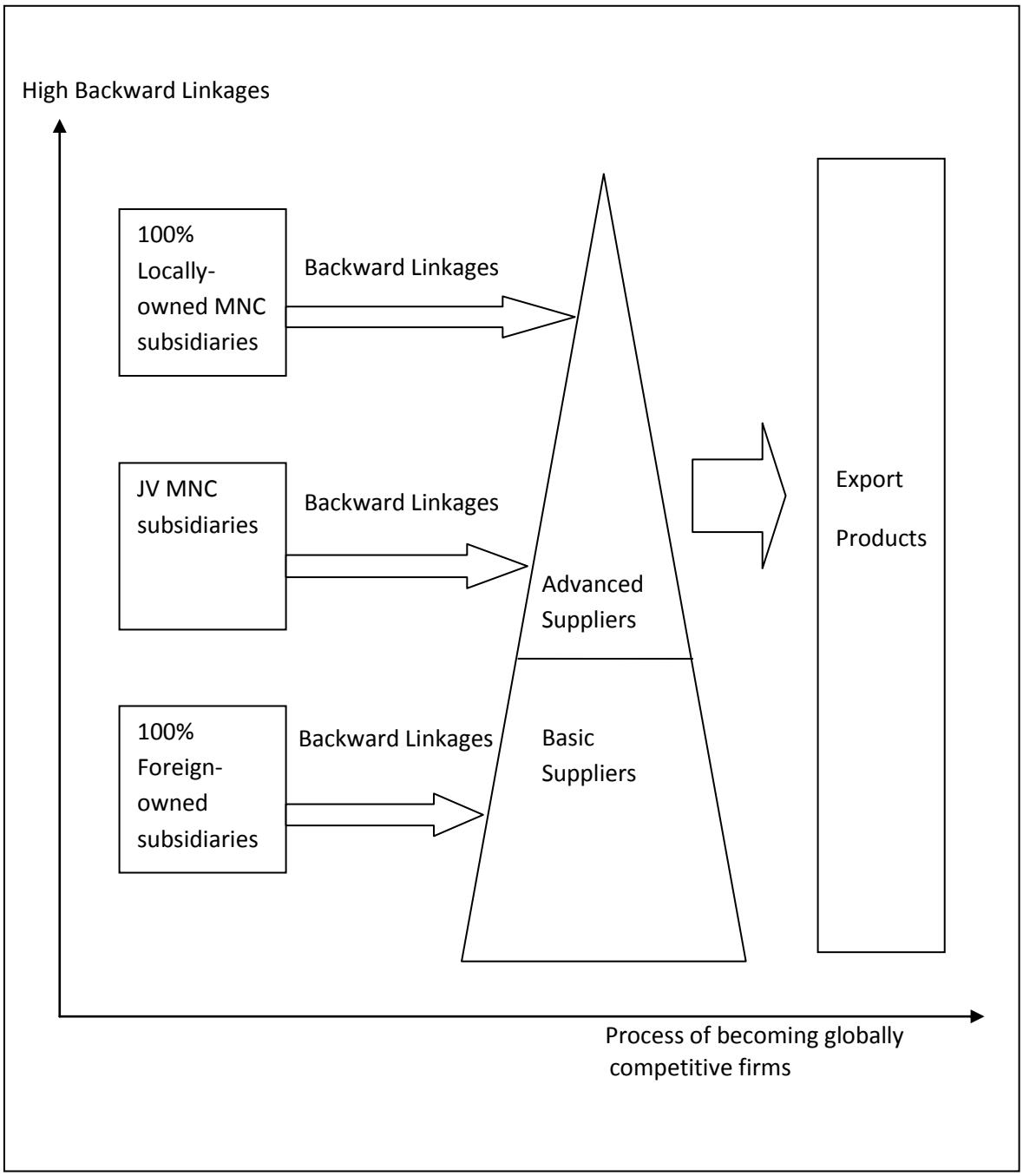
	Basic Supplier, SA1	**Advanced Supplier, SB1**
Technological level	1	2
Supplier Development Program (SDP) by Petronas under VDP	No.	Yes.
Competitive in price for products	MNC subsidiaries only go for quality and competitive price for products.	MNC subsidiaries only go for quality and competitive price for products.
Want learning contracting work from producers	Wanting to get the basic supplier development program, the VDP status from Petronas, to increase its technological capabilities.	Wanting the next step of supplier development program, the Restricted Category from Petronas .
Methods used to increase technological capabilities	Using Strategic Technical Alliance.	Owner has vast knowledge in oil and gas and petrochemical industry. Active in bidding process for contracts. Getting more experience as a result of interaction with producers after getting the contracts. More knowledge gained.
Analysis: MNC subsidiaries under pressure to cut cost. Looking for price-competitive product. Sako (1994)	Increase internal as well as external knowledge as products are bought by producers. Most jobs are standardized. Fewer interactions.	Increase internal as well as external knowledge as products are bought by producers. More producers are willing to exchange knowledge. More interactions due to engineering nature of works.

Source: Own compilation.

From this analysis, MNC subsidiaries are either using active intervention in upgrading existing local suppliers' capabilities or are just selecting appropriate local suppliers as long as they meet the subsidiaries' requirements. This is in line with studies by Hahn, et al. (1990) and Watts and Hahn (1993). Thus, based on the analysis of the case studies of MNC subsidiaries and local suppliers, the trajectory of local firms'

development to become global players as described in Chapter 3 could be explained as in the model shown in Figure 6.10.

Figure 6.10: Process of Becoming Globally Competitive Firms through the Process of Backward Linkages based on Ownership Structure of MNC Subsidiaries



6.6 Analysis of Types of Technological Assistance Given by MNC Subsidiaries to their Suppliers

In order to examine how technological assistance by different types of MNC is given to local suppliers, or how upgrading of local suppliers is carried out, the researcher used quantitative as well as qualitative analysis to answer Research Question 3(ii). The research used a survey adapted from classifications by UNCTAD (2001) that identified different types of technological support given to local suppliers by MNC subsidiaries. As the present study is more interested in the upgrading of local suppliers, it only looks at upgrading in product technology and process technology (Schmitz, 2004). Table 6.10 shows how suppliers have been provided with each type of technological assistance or upgrading, according to MNC typology. Table 6.11 shows the extent of local suppliers' linkages with MNC subsidiaries among the basic and advanced suppliers.

Based on the qualitative analysis in answering Research Question 3(i) earlier, the same five MNC subsidiaries are used here to provide an in-depth analysis of linkages between subsidiaries and local suppliers. The typology used is made up of three separate types: local-owned, foreign-owned and joint-venture. The local-owned are the Petronas-owned LOP and LOM, a company owned by a private entity. For the foreign-owned we use a Japanese subsidiary, FOJ. For the joint-venture typology, two firms are used: JVGP and JVAM. These two are among the two most important players in the Malaysian petrochemical industry. A structured survey questionnaire was used in the interview, focusing explicitly on different types of technical support and possible supplier improvement as a result of this support. The background of the five MNC subsidiaries is described in detail in Section 6.5.2, above. Section 6.6.1, below, presents an overview of the technological assistance given by each type of subsidiary to

local suppliers. Section 6.6.2 elaborates on the technological assistance received by the local suppliers.

6.6.1 Technological Assistance Given by Each Type of Subsidiary to Suppliers

Table 6.10 shows how MNC subsidiaries have provided each type of technological assistance to suppliers. Below, the different types of technological assistance given to suppliers are explained according to MNC typology.

Table 6.10: MNCs Providing Product and Process Technology Linkages to Local Suppliers

Type of technology linkage	100%LOP	100%LOM	JVPG	VAM	100%FOJ
Product Technology:					
1a Provide proprietary knowledge to local suppliers (Pd1)	Yes	No	No	Yes	No
1b Provide product component/services/feedstock/raw materials designs or technical specifications for local suppliers (Pd2)	Yes	Yes	No	Yes	No
1c Provide advance technical information about changes in products/raw materials to suppliers (Pd3)	Yes	Yes	No	No	No
1d Provide technical consultations/advice to local suppliers (Pd4)	No	Yes	No	No	No
1e Provide feedback on local suppliers' performance (Pd5 or Pd6)	Yes	Yes	Yes	Yes	No
Total of "Yes" for Product Technology Linkages	4	4	1	3	0

Process Technology:					
2a Provision, advice or financial assistance to suppliers to obtain machinery or equipment (Pc1)	No	No	No	Yes	No
2b Provide technical support to improve local suppliers' manufacturing process (Pc2)	Yes	No	No	Yes	No
2c Provide technical support to improve quality control methods (Pc3)	Yes	No	No	Yes	No
2d Provide technical support to improve inspection and testing methods (Pc4)	Yes	No	No	Yes	No
2e Provide technical support on selection or use of process equipment or technologies (Pc5)	Yes	No	No	Yes	No
2f Provide consultations on suppliers' facilities and advice on production layout/factory layout (Pc6 there are 2 questions)	Yes	Yes	Yes	No	Yes
2g Provide advice on installing machinery (Pc7)	No	Yes	No	No	No
2h Provide advice on production planning (Pc8)	No	No	No	No	No
2i Provide assistance on production problems and quality control (Pc9)	No	No	Yes	No	No

2j Attach company's engineers to local suppliers (Pc10)	No	No	No	No	No
Total of "Yes" for Process Technology Linkages	5	2	2	5	1

Table 6.11: Local Suppliers Receiving Product and Process Technology Linkages from MNCs

Type of technology linkage from MNCs	Basic Suppliers	Basic Suppliers	Advanced Suppliers (under VDP)	Advanced Suppliers (under VDP)	Advanced Suppliers (no VDP)	Advanced Suppliers (no VDP)
	For Domestic Market-mid enterprise (SA1)	Domestic & Global Market-large entpse. (SA3)	For Domestic Market-small entpse. (SB8)	Domestic & Global Market-large entpse. (SB1)	For Domestic Market-small entpse. (SB10)	Domestic & Global Market-medium entpse. (SB4)
Product Technology:						
1a Receive proprietary knowledge from MNCs (Pd1)	Yes	Yes	Yes	Yes	Yes	Yes
1b Receive product component/ services/ feedstock/ raw materials designs or technical specifications from MNCs (Pd2)	Yes	No	No	Yes	Yes	Yes
1c Receive advance technical information about changes in products/raw materials from MNCs (Pd3)	Yes	Yes	No	Yes	No	Yes
1d Receive technical consultations/advice from MNCs (Pd4)	Yes	No	Yes	Yes	Yes	Yes
|1e Receive feedback on local suppliers'	Yes	No	Yes	Yes	Yes	Yes

performance from MNCs (Pd5 or Pd6)						
Total "Yes" for Product Technology Linkages	5	2	3	5	4	5
Process Technology:						
2a Receive advice or financial assistance to obtain machinery or equipment from MNCs (Pc1)	Yes	No	No	Yes	No	No
2b Receive technical support to improve manufacturing process from MNCs (Pc2)	No	No	Yes	Yes	Yes	No
2c Receive technical support to improve quality control methods from MNCs (Pc3)	Yes	No	Yes	Yes	Yes	Yes
2d Receive technical support to improve inspection and testing methods from MNCs (Pc4)	Yes	No	Yes	Yes	Yes	No

2e Receive technical support on selection or use of process equipment or technologies from MNCs (Pc5)	Yes	No	Yes	Yes	Yes	No
2f Receive consultations on facilities and advice on production layout/factory layout from MNCs (Pc6 there are 2 questions)	Yes	Yes	Yes	Yes	Yes	Yes
2g Receive advice on installing machinery (Pc7)	Yes	Yes	No	Yes	Yes	No
2h Receive advice on production planning (Pc8)	No	Yes	Yes	Yes	Yes	No
2i Receive assistance on production problems and quality control (Pc9)	Yes	Yes	No	Yes	Yes	No
2j Receive MNCs' engineers for attachment (Pc10)	No	No	No	No	No	No
Total "Yes" for Process Technology Linkages	7	4	6	9	8	2

Product Technology Assistance

When it comes to assistance related to product technology, in almost all cases except FOJ suppliers were given 'product designs and technical specifications' (1b), demonstrating that the products delivered are almost exclusively non-standardized and customized to meet the requirements of the MNC subsidiaries. The provision of detailed and updated drawings and product specifications particularly helps the suppliers to achieve more rapid and cost-efficient development of tools and initial samples. Also, two MNCs, LOP and LOM, gave 'advance technical information about changes in products/raw materials to suppliers' (1c). This provision can help suppliers to manufacture customized products. Many critical raw materials, components and subcontracting services used by the suppliers also have to be approved by their MNC customers. In the case of LOM, the management directs their suppliers to produce the specified product required by LOM's customer. LOP also assisted its suppliers to partner a foreign OEM in extending its own sourcing base.

All subsidiaries except FOJ provide 'feedbacks on local supplier performance' (1e). This category includes various types of product quality measurement, as well as regular personal meetings between managers and engineers, during which suppliers frequently visit their customers to monitor product quality and assist with services that the suppliers have undertaken.

Another category of technological assistance is related to situations when MNC customers intend to 'provide technical consultation/advice to local suppliers' (1d). This is to improve the technological features of existing products, or to introduce new product technologies. In such situations, only LOM is provided with such assistance. This type of consultation is also often based on personal interaction. The meetings between suppliers and their

customers are, obviously, particularly frequent in the early development phase. Depending on the complexity of the new products and the level of experience of the supplier, these face-to-face contacts can be on a daily, weekly or monthly basis, lasting over several months, and sometimes over a year.

Only LOP and JVAM were involved in providing 'proprietary knowledge to local suppliers' (1a). Such a low level of participation can be explained by the fact that for product development and design, not all firms would want to share their proprietary knowledge resulting from their R&D.

Process Technology Assistance

When it comes to assistance related to production (process) technology, only one MNC – JVAM – gives 'Provision, advice or financial assistance to obtain machinery and equipment' (2a). Such assistance may consist of the gradual replacement of existing machinery, equipment and tools with more modern versions, or investment in radically different types of process equipment. MNC subisidiaries may make suggestions on new production technology, either on an ad hoc basis or more systematically through regular quality audits. There are cases where an MNC has used its global organization to invite suppliers to learn about new process technologies directly from plants in the home country or from suppliers in other parts of the world. In the case of JVAM, customers and suppliers can use its Process Control Center to do testing and work out product specifications.

In addition to the relatively small number who were provided with active assistance, many suppliers had independently become aware of the need to invest in new process technology in order to respond to the quality and design requirements of MNC customers. Only LOP

and JVAM provide ‘technical support to improve local supplier manufacturing process’ (2b), ‘technical support to improve quality control methods’ (2c), ‘technical support to improve inspection and testing methods’ (2d) and ‘technical support on selection or use of process equipment or technologies’ (2e). The indirect provision of essential technological information from the MNCs exposed them to world standards, helping them to reduce uncertainty and searching costs when acquiring the needed process technology.

The introduction of new process technologies might also involve a radical change in the suppliers’ factory layout in order to rationalize the process flow. All MNCs except JVAM have provided suppliers with ‘advice on production layout/factory layout’ (2f). Only LOM gives ‘advice on installing machinery’ (2g). No MNC provides ‘advice on production planning’ (2h) or ‘attach[es the] company’s engineers to local suppliers’ (2j). Lastly, only JVGP gives ‘assistance on production problems and quality control’ (2i).

6.6.2 Technological Assistance by Subsidiaries to Basic and Advanced Suppliers

The above results show the assistance given by MNC subsidiaries to local suppliers. Next, we investigate the extent to which technological linkages between the MNCs and their suppliers are affected by the different types in the typology. Past studies have shown that technology linkages differ according to whether local suppliers deliver only to local plants or also export intermediate products to MNCs' global operations (Ivarsson and Alvstam, 2009). Accordingly, in this section we will distinguish between basic suppliers that serve only the domestic market, and basic suppliers that serve both the domestic and the global markets. The same distinction will be made with advanced suppliers. The study also distinguishes between advanced suppliers that are under Petronas's VDP program and those that are not. Through these analyses, we can tell whether the supplier development program has influenced MNCs to give any extra assistance either to firms supplying the domestic market or to those supplying both the domestic and global markets. We will therefore be able to tell whether there is any upgrade of local suppliers through their business relations with their customers.

The following suppliers are examined in the study: the basic suppliers SA1 and SA3; the advanced suppliers SB8 and SB1, which are under the VDP; and the advanced suppliers SB10 and SB4, which are not under the VDP.

Case 1-1: Basic Supplier for the Domestic Market – SA1

The basic local supplier SA1 was established in 1996 and is located in Petaling Jaya, Selangor. It sells parts and components to petrochemical, oil and gas companies. It also produces its own products from the parts and components, which are sourced from its

principals in the United States and Australia. Its sales/turnover in 2009 was RM24 million. Based on the definition of SMEs in Malaysia as shown in Table 3.9, this local supplier is considered a medium enterprise. SA1 supplies basic items/parts and components that use standardized technologies and meet customer specifications, and it delivers services to petrochemical plants and many other industries that use its parts/components and services. SA1 is not under Petronas's VDP. Among the parts and components sold are filtration equipment, separators, scrubbers and corrosion inhibitors. SA1 sells its products and components only on the domestic market.

SA1 found that linkages with its customers have not improved its manufacturing process or reduced its costs. However, these linkages have improved quality control and improvement of existing product, delivery conditions and improvement in product design or development. When asked about what SA1 would like to learn from a customer, its representative said the most beneficial factor in having a foreign customer was technology transfer. According to SA1, there are differences in how MNCs of different nationalities make technology transfer available.

Case 1-2: Basic Supplier for the Domestic and Global Markets – SA3

The basic supplier SA3 was established in 1989 and its production plant is located on the East Coast of Peninsular Malaysia. It supplies its parts and components to petrochemical plants. It is 100 percent locally owned. In 2009 it had 500 local employees and 100 foreign employees, and its sales/turnover was RM195 million. According to the SME definition (Table 3.9), this local supplier is considered a large firm. SA3 supplies basic items/parts that use standardized technologies and meet customer specifications and delivery

requirements. In addition to its sales to petrochemical industries, the company also sells its parts and components to the oil and gas industries, power plants, and oleo-chemical and refinery plants. When SA3 started operations in the 1980s, it sold 100 percent of its products on the local market. In 2008, 90 percent of its production was for the export market.

SA3 found that its linkages with subsidiaries had brought no significant improvement in terms of manufacturing process, quality control, existing product delivery conditions, product design and development, or reduction in costs. When asked what SA3 would want to learn from MNC subsidiaries, it pointed to the need to learn how to be professional in every undertaking. It added that working with MNC customers is very challenging. SA3 did not find that differences in MNC nationality affected the technological assistance the companies offered.

Case 2-1: Advanced Supplier for the Domestic Market (under VDP) – SB8

The advanced supplier SB8 was established in 1995 and is located on the East Coast of Peninsular Malaysia. It is a 100 percent locally owned company. In 2009 it had 17 local employees and no foreign employees. In 2008, it sales/turnover was RM7.5 million. According to the SME definition (Table 3.9), SB8 is a small enterprise. Its products and services are for the domestic market only. SB8 is on Petronas's VDP list. Besides being a vendor to Petronas, SB8 supplies a wide range of catalysts and absorbent products for the refining and petrochemical industries. It also sells instrumentation products manufactured by its principals in France and Switzerland, and it provides services related to its core

business, such as catalyst handling, spent catalyst disposal, and maintenance, installation and servicing of instrumentation products.

Under the VDP, SB8 found that linkages with customers improved the manufacturing process, quality control, delivery condition, product design and development, and reduced its costs. However, SB8 has seen no improvement of existing product. SB8 said that under the VDP, the program has helped tremendously in giving the company the chance to produce for Petronas, which is a ready market.

Case 2-2: Advanced Supplier for the Domestic and Foreign Market (under VDP) – SB1

The advanced supplier SB1 was established in 2003 and is located on the East Coast of Peninsular Malaysia. Besides Malaysia, it has an overseas operation in Sudan, Africa. It is 100 percent locally owned and its sales/turnover in 2008 was RM90 million. According to the SME definition (Table 3.9), SB1 is a large enterprise. In 2009 its operation in Malaysia had 32 local employees and no foreign employees. The company has integrated chemical capabilities and engineering capabilities. SB1 produces chemical products for corrosion inhibitors and emulsifiers, and it offers various services such as high-pressure water jet cleaning, cooling-tower refurbishment, industrial wastewater treatment, water purification, and various technical services. It is on Petronas's VDP list of companies. It produces for the domestic market as well as for export. In 2008, it exported 10 percent of its production.

Under the VDP, SB1 found that linkages with customers have improved its manufacturing process, quality control, existing products, delivery conditions, and product design and development, and have helped to reduce its costs. When asked about what SB1 would want to learn from MNC subsidiaries, the reply was that it wants to learn how to penetrate the

overseas market. As to the differences between nationalities in terms of giving technological assistance, SB1 sees no difference in this regard. According to SB1, MNCs are eager to impart knowledge since they know that if the suppliers can produce quality products it will give them a big advantage.

Case 3-1: Advanced Supplier for the Domestic Market (no VDP) – SB10

The advanced supplier SB10 was established in 1995 and is located on the East Coast of Peninsular Malaysia. It is a 100 percent locally owned company. In 2009 it had 30 local employees and no foreign employees. In 2008/2009, its sales/turnover was RM2 million. According to the SME definition (Table 3.9), it is a small enterprise. Its products and services are for the domestic market only. SB10 is not on Petronas' VDP list. The company supplies a wide range of products and services, such as pipes, storage tanks, chemical injection pumps, cooling towers, valves, and gas turbines. It also provides services such as blasting, painting and fabrication of steel structures.

SB10 found that linkages with MNC customers have improved its manufacturing process, quality control, delivery condition, product design and development. They have reduced its costs and improved its existing product. SB10 said that under these linkages, the MNCs have transferred technology to the company. It says that it wants to learn new technology from its customers.

Case 3-2: Advanced Supplier for the Domestic and Foreign Market (no VDP) – SB4

The advanced supplier SB4 was established in 1999 and is located on the East Coast of Peninsular Malaysia. It has a branch office in Bintulu, Sarawak, in East Malaysia, and is a 100 percent locally owned company. In 2009 its operation on the East Coast had 33 local employees and no foreign employees. Its sales/turnover in 2008/2009 was RM20 million. According to the SME definition (Table 3.9), SB4 is a medium enterprise. In 2009, it exported five percent of its products to China. The company has integrated chemical capabilities along with engineering capabilities. SB4's main line of work is in production chemicals and services, remedial chemicals and services, pipeline treatment chemicals and completion chemicals and services. SB4 is not on Petronas's VDP list.

SB4 found that linkages with MNC customers have improved its quality control and existing products. It did not see any improvement of its manufacturing process, costs, delivery conditions or product design and development. When asked about what SB4 would want to learn from MNC subsidiaries, the reply was that it wanted to learn new technology and know-how. Being an SME, SB4 appreciates prompt payment from its customers.

6.6.3 The Impact of MNC Subsidiaries' Assistance on the Upgrading of Suppliers

Table 6.11 shows how technology linkages differ according to whether the supplier is of the basic or the advanced type, as identified in the quantitative analysis section of this study. In terms of product technology upgrading, when we distinguish between the two types of basic suppliers (basic suppliers for the domestic market and basic suppliers for the domestic and global markets), Table 6.11 shows there are a total of five attributes or linkages associated

with basic suppliers for the domestic market, while there are two for basic suppliers for the domestic and global markets. For process technology upgrading, there are seven linkages associated with basic suppliers for the domestic market and four linkages for basic suppliers for the domestic and global markets. In each case, the figures for basic suppliers to the domestic market are larger, possibly because MNC subsidiaries are more inclined to give assistance to small-to-medium basic suppliers operating on the domestic market. By contrast, SA3 is categorized as a large firm with its own internal capability and the ability to produce without assistance from the customers, as its products are standardized. Hence firms that already have a technological capability and export their products can manufacture them without resorting to robust interactions with their customers.

In the case of advanced suppliers, a larger share of those firms which also operate as global suppliers seems to be provided with various forms of technological support. From Table 6.11, five attributes each are associated with the advanced suppliers under VDP (SB1) and with no VDP (SB4). These two firms sell their products on both the domestic and the global markets. By contrast, there are three and four attributes respectively for the advanced suppliers under VDP (SB8) and with no VDP (SB10). They both operate entirely on the domestic market.

From this observation, when we distinguish between advanced suppliers under VDP and advanced suppliers with no VDP, we find that they are given the same share of technological assistance related to product technology (1a-1e) if they operate on both the domestic and the global markets. On the other hand, with advanced suppliers operating only on the domestic market (regardless of whether they are under VDP), the product technology assistance given is less than for those targeting both the domestic and the global markets. This reflects the general tendency for close technological linkages between

customers and suppliers of non-standardized, customized intermediate inputs in engineering industries, where the MNCs' customers will provide a high degree of technological assistance if the product is for the global market.

In process technology, however, if one compares the technological support for advanced suppliers under VDP operating only on the domestic market with the support for firms operating on both the domestic and global markets, the total attributes are six and nine respectively, as shown in Table 6.11. For advanced suppliers not under VDP and operating only on the domestic market, compared with suppliers operating on both the domestic and the global markets, the total attributes are respectively eight and two. This observation shows that in process technology assistance, advanced suppliers that are under VDP and target the global market are given more assistance than advanced suppliers who target the global market but are not under VDP, as shown by the attributes nine and two respectively. This shows that Petronas gives more assistance to local suppliers if they are involved in the global market. More often firms that are not under VDP do not need assistance if they go for the global market, as they are considered big enough to do so; the term used in the literature is "Third World MNCs." If the firms are under VDP, the MNC subsidiaries give them more assistance so long as they are targeting the global market. This is reflected in the number of attributes given in the advanced-supplier-under-VDP-for-domestic-market category, compared with under-VDP-for-domestic-market-as-well-as-the-global-market, which register total attributes of six and nine respectively. This shows that Petronas will give more assistance if the firm is targeting the global market.

Inspired by the technological capability perspective, a possible reason behind the priority given to further improvement of advanced suppliers is that they already have the capability to become a reliable local supplier (Iguchi, 2008; Ivasson and Alvstam, 2009). Thus by

giving them technological assistance, MNCs can procure supplies locally. This will give competition to global supply chains of intermediate products, as products produced locally will be cheaper and will have a better delivery time for the producers. At the same time, global suppliers are motivated to make the necessary investments in order to avoid the risk of losing business relations with their customers in an environment of extremely tough global competition.

Generally, a larger share of those who also operate as advanced suppliers seems to be provided with various forms of technological support. This observation holds especially true in the case of 'consultations of product characteristics to master new product technology' (1d) and in all five categories of assistance related to improvement of process technology (2a-2e). Thus, those advanced suppliers which have a broader scope than the domestic market and are integrated into MNCs' global value chains seem to be associated with substantially more technological assistance and support compared with basic suppliers. This holds true in the study of Ivasson and Alvstam (2009).

6.6.4 Case Summary of Product and Process Technological Assistance

This section is about the impact of MNC technological assistance on the technological competence of suppliers. The findings suggest that suppliers in general are provided with significant amounts of technological support from the MNC subsidiaries. Thus, depending on the suppliers' technological capabilities, these suppliers will get access to the knowledge of the MNCs. However, we cannot assume that technological improvements among these suppliers necessarily result from the technological linkages and assistance that their MNC customers provide. This is because technological upgrading is largely dependent on the

absorptive capacity of the suppliers, which reflects the suppliers' existing internal resources and competence, and also their commitment to learning (Cohen and Levinthal, 1990). However, it can be deduced that suppliers with high technological capability can get more technological support from MNC subsidiaries, as it is in the strategic interest of the MNCs to decrease the cost of production. By reducing the cost of inputs that they get from the host countries, the MNC subsidiaries make their products more competitive. And MNC subsidiaries are still more interested in giving technological support to suppliers who are seeking a global market. With the upgrading of local suppliers, more local suppliers will be formed, as more products produced by spin-offs of new firms are formulated in the engineering industry. As knowledge is localized, it generates greater economic activity. This in turn should result in the economic growth of the host country.

Two important findings are generated by the analysis of this section. Firstly, there seems to be significant potential for local suppliers to upgrade their technological competence in this engineering-dominated industry. There is a general tendency for the MNCs and local suppliers to interact regularly, especially in product and process technology, in order to manufacture non-standardized and customized intermediate products in the petrochemical industry. Thus technological assistance from MNCs is an integral part of the business relationship between the two entities. Secondly, it seems that local suppliers aiming at export are provided with more technological assistance from MNC subsidiaries than those aiming solely at the domestic market. Being part of the global value chain therefore has a positive impact on supplier upgrading. This is consistent with the studies done by Ivarsson and Alvstam (2009), which show that Swedish engineering MNCs will help in the upgrading of local suppliers in emerging markets.

6.7 Conclusion

From the quantitative analysis, we support our hypothesis H1 that MNC subsidiaries motivated by local market-seeking have higher interactions of backward linkages with local supplier firms than do export-oriented MNC subsidiaries. The analysis also supports H2: that subsidiaries with higher autonomy levels engage in a higher diversity of backward linkages than do tightly coordinated MNC subsidiaries. This suggests that locally owned firms have the strongest influence on the diversity of backward linkages, followed by joint ventures, and then by foreign-owned firms. Thus H1 and H2 – MNCs' motivation for sourcing and the autonomy of their subsidiaries – can be demonstrated from the positive effect of the sourcing ratio on the breadth of backward linkages. Locally owned subsidiaries tend to increase their local sourcing and linkages, and this is one way to further develop local suppliers' capabilities.

From the quantitative analysis we can deduce that the ownership structure or the types of subsidiaries in Malaysia can directly determine the strength or the breadth of backward linkages. This in turn can indirectly determine whether local suppliers will be given technological assistance. In regard to local suppliers, we support hypothesis H3 in that the breadth of backward linkages is affected by local suppliers' technological capabilities. In other words, backward linkages factors do affect the technological capability level of local suppliers. Among the six forms of backward linkages, it is an increase in process linkages and management linkages and to a lesser extent the training linkages that has the most persistent influence on the upgrading of the local suppliers' technological capabilities. However, the quantitative analysis does not support H4, in that local suppliers' technological capabilities are not affected by the internal factors of local suppliers. The results show that for the petrochemical industry in Malaysia, local suppliers' internal

factors do not affect their technological development. This shows that other factors, such as environmental factors or the type of knowledge in the engineering industry, can influence technological development for local suppliers.

From the qualitative analysis through the case studies, Petronas has played a big role as the anchor company in the Malaysian government's effort through VDP to enable local suppliers to upgrade their technological capabilities. Through the various mechanisms such as the VDP, RC, EPC contractors and OEM-local suppliers' collaboration, the national oil company has dispensed a range of contract work that has given these local suppliers their tacit knowledge of the petrochemical industry. With this knowledge, local suppliers can develop their credentials to sell their products to other producer firms. As a result of Petronas's supplier development program, another subsidiary, JVGP, is emulating the supplier development program, albeit on small scale. However, as MNC subsidiaries are looking at ways to increase their profits, supplier development programs are going to be an important factor in MNC strategy.

As for the local suppliers, MNC subsidiaries' supplier development programs are an important means of increasing the firms' technological capabilities. If the supplier firms have the absorptive capacity and technological capabilities, they will be the preferred choice for these MNC subsidiaries. MNC subsidiaries will give technological assistance if the local suppliers are into the global market, as compared to concentrating only on the local market. For as we have seen, MNC subsidiaries are keen to give technological assistance to firms that already have technological capabilities and a high absorptive capacity, and advanced local suppliers are given more technological assistance as compared to basic product suppliers. This finding corresponds to Chandler's (1977) hierarchical

structural economic theory which argues that productive organizations and institutional arrangement would create conducive environment for innovation.

[i] MIDA is the Malaysian government department that oversees the oil, gas and petrochemical industry.
[ii] Interview with LOP.
[iii] Mefford and Bruun 1998
[iv] Carillo, 2001; Humphrey, 2001; UNCTAD, 2001