Chapter 4

Knowledge-Based Linkages and Local Firms' Capability Formation in the Vietnamese Motorcycle Industry

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CHAPTER 4

Knowledge-Based Linkages and Local Firms' Capability Formation in the Vietnamese Motorcycle Industry

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Despite being one of the late comers among the Asian countries launching on the development of automotive industry, Vietnam experienced rapid growth of the motorcycle industry and gradual accumulation of domestic component supply base since the late 1990s. Based on the analyses of major learning milestones experienced by local component suppliers, this paper found that the sectoral system of production and innovation in the Vietnamese motorcycle industry is increasingly driven by firms, while non-firm agents including universities play relatively minor roles. Acknowledging the challenges that Vietnam faces in deepening basic production capabilities and moving towards accumulation of innovation capabilities in this sector, this paper presents sets of policy recommendations aimed at realigning the national-level policy agenda and the structure of incentives so as to meet the increasing need for greater roles to be played by non-firm agents in promoting accumulation of innovative capabilities.

Keywords: capabilities, knowledge sources, suppliers, motorcycle industry

1. Introduction

As one of the latest comers among the batch of Asian countries, Vietnam has made certain initial steps in developing the automotive industry. While the country's automobile production still lags far behind other countries in the region, the recent growth of the motorcycle industry has been truly remarkable. Within just 15 years of launching on industrialisation under transition to the market economy, the country has emerged as the world's fourth largest producer and market of motorcycles, only after China, India and Indonesia. More importantly, the dynamic development of the industry has been accompanied by steady progress in the build-up of local component supply base, consisting mainly of Japanese, Taiwanese and local Vietnamese component suppliers (Vietnam Development Forum 2007; Fujita, forthcoming). Indeed, a key challenge for Vietnam is whether or not the country can succeed in further deepening the basic production capabilities and moving towards accumulation of innovation capabilities in this sector. The formation of production and innovation capabilities in the design and manufacturing of automotive components would have major influence over the country's potential for developing a wide variety of complex assembly industries (Vietnam Development Forum 2007).

In exploring Vietnam's prospects for deepening production and innovation capabilities in the local component supply base, an important question is whether or not the sectoral system of production and innovation in this industry is structured in such a way that encourages knowledge flows between firm and non-firm agents and provides incentives with firms to engage in innovative activities. A sectoral system of innovation and production consists of a set of new and established products for specific uses and the set of agents carrying out market and non-market interactions for the creation, production, and sale of those products. The constellation of firms and non-firm innovation-supporting agents—including universities and research institutes—shapes the nature of knowledge flows between agents, thereby affecting the trajectories of the buildup of production and innovation capabilities within agents.

Comparing the sectoral innovation systems of the Thai and Vietnamese motorcycle industries, Intarakumnerd and Fujita (2008, 2009) argued that firms—especially motorcycle manufacturers or "lead firms"—play decisive roles in the sectoral system of innovation and production in the Vietnamese motorcycle industry, while non-firm agents like universities and research institutes have developed limited dynamic linkages with firms. This is broadly consistent with findings of other existing works on the Vietnamese motorcycle industry (Nguyen Duc Tiep 2006, 2007; Pham Truong Hoang 2007). The discussion thus far has focused on whether the linkages between firm and non-firm agents have emerged. However, the questions remain as to the *nature* of the linkages, which none of the existing studies cited above empirically looked into. How do the agents interact in practice? Do the linkages promote knowledge flows between the agents? Where do the firms source the knowledge from as they engage in production and innovative activities? Only by empirically exploring these questions, it can be shown how the sectoral innovation systems in the Vietnamese motorcycle industry function in practice.

This is what this paper aims to achieve. By engaging in systematic empirical analyses on the relative roles played by varieties of firm and non-firm agents in promoting supplier learning, this paper seeks to present a comprehensive picture of the nature knowledge flows within the sectoral innovation system. The empirical analyses will be conducted in two complementary steps: the first step, which focuses on the suppliers' side, and the second step, which looks at the non-firm agents—specifically, local universities. On the basis of this discussion, this paper will also make suggestions as to how the sectoral innovation system might be better aligned in order to provide an environment more conducive to supplier learning.

The remainder of the paper is structured as follows. Section 2 provides an overview on the Vietnamese motorcycle industry, including the three-stage development and the two types of value chains. Section 3 develops the analytical framework. Section 4 discusses the methodology. Sections 5 and 6 comprise the core of the paper. Section 5 presents findings of the empirical analyses on knowledge sources mobilised by suppliers in acquiring important capabilities. Acknowledging that universities play relatively minor roles in supplier capability formation, Section 6 then turns the focus to the nature of university-industry linkages, presenting case studies of two major universities with programmes that are directly relevant to the automotive industry. This section will also discuss recommendations for strengthening knowledge-based university-industry linkage. Section 7 presents policy recommendations derived from the empirical analyses. Section 8 concludes the paper by summarising the findings.

2. An Overview on the Vietnamese Motorcycle Industry

The decade-long development of the Vietnamese motorcycle industry documented by Fujita (2007, 2008, forthcoming) shows that the industry's development has been driven mainly by the competition between two distinct groups of lead firms. On the one hand, Japanese lead firms, i.e., Honda Vietnam, Yamaha Vietnam, and Vietnam Suzuki, are powerful global industry leaders producing high-priced, high-quality proprietary models. In the terminology of the global value chain approach (Humphrey and Schmitz 2001, 2004; Gereffi, *et al.* 2005), 'Japanese chains' coordinated by these Japanese lead firms are a typical example of captive chains in which small suppliers are under strict control and monitoring of powerful lead firms (Gereffi, *et* al. 2005). On the other hand, Vietnamese lead firms include numerous Vietnamese local assemblers, which started assembly of imported Chinese components in the early 2000s and later expanded local sourcing and in-house manufacturing of components, often in cooperation with Chinese companies. They mainly produce low-priced, low-quality imitations of Japanese models. Assembler-supplier relationships in these 'Vietnamese-Chinese chains' are market-based chains characterised by arm's-length transactions (Gereffi, *et al*. 2005).

The development of this industry can be explained primarily in terms of the emergence and transformation of these two types of value chains, as shown in the three-stage classification of the development process in Table 1. Stage I (the late 1990s) was the start-up phase. At this stage, only Japanese chains existed. Japanese motorcycle manufacturers set up their production behind the tariff wall and non-tariff barriers erected by the Vietnamese government. The Japanese manufacturers enjoying oligopolistic positions produced high-priced, high-quality product beyond the reach of most Vietnamese, and consequently the market stagnated during this period.

Table 1. Three-Stage Development of the Vietnamese Motorcycle Industry

Stage		Years	Market Size (Units sold per year)	Policies	Main Developments among Foreign Motorcycle Manufacturers	Main Developments among Vietnamese Assemblers
I	Start-up	late 1990s	300,000-500,000	Import substitution	Japanese companies dominated the market.	-
II	China Shock and its Repercussions	2000-2001	over 2 million	Weak enforcement of local content rules & import controls	Lost market shares.	Emergence of 51 local firms assembling Chinese components dominated the market.
		2002-2004	Approxi-mately 1.5 million	Strengthened enforcement of local content rules. Restrictive rules to limit the overall market growth and production of foreign manufacturers.	Diverse attempts at recovering the market shares. Honda Vietnam: launching of a low-priced model in Jan. 2002.	Decreased in number and market share.
III	FDI-led Growth	2005-2008	over 2.5 million	Deregulation on production and registration; protection on CBU imports remain.	Rapid expansion of production and recovery of market shares.	Further consolidation into a small number of large assemblers. Market shares reduced to 30-40%.

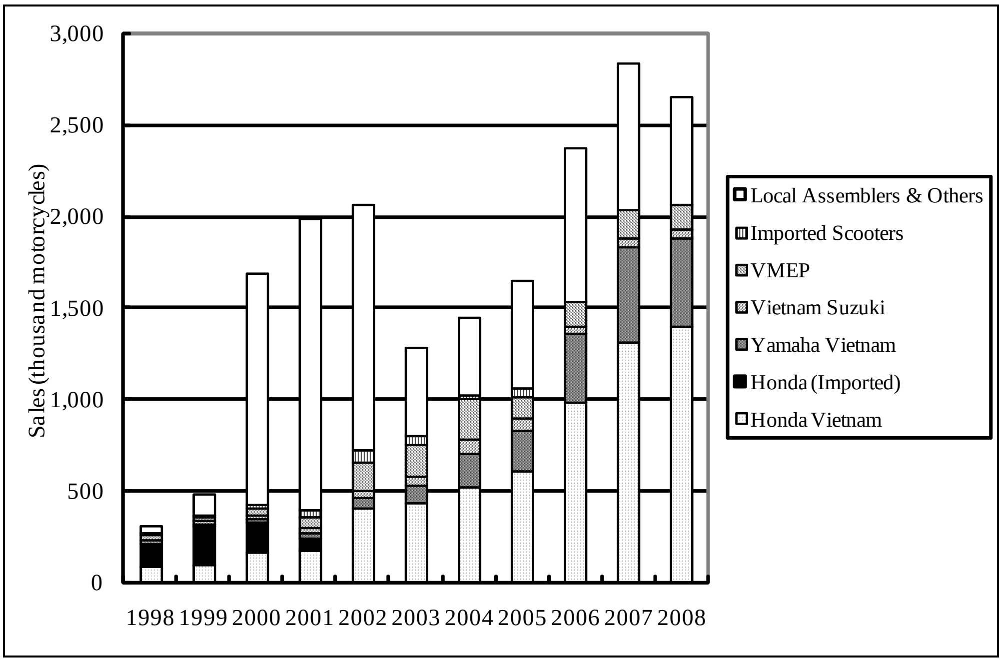
Source: Prepared by the author.

Stage II (2000-2004) is the period of market and policy turmoil triggered by an external shock. In 2000-2001, massive numbers of low-priced motorcycles were virtually smuggled into Vietnam from China, a time referred to as the 'China shock.' Since Vietnam had prohibited the import of assembled vehicles since 1998, Chinese imports arrived in the form of 'knockdown' component kits. More than 50 local assemblers entered into assembly of Chinese motorcycle component kits. With prices substantially lower than Japanese-brand models, these motorcycles quickly penetrated medium- and low-income consumer markets in urban and rural areas which had remained unexploited by Japanese firms. As a result, the annual sales of motorcycles expanded from 500,000 million units to more than 2 million units per year, and the local assemblers accounted for the bulk of this enlarged market (Figure 1).

The shock provoked a series of reactions, most notably, Honda Vietnam's (HVN) launching of a low-priced model in 2002 as an attempt to recover the market shares that had been lost. In the policy arena, the Vietnamese government reacted by enacting key policy changes to restore order and to promote sound development of the industry, e.g., stepping up the enforcement of local content rules and import tariffs, which had been circumvented by local assemblers, and introducing product quality and environmental standards. In desperate attempts to prevent uncontrolled proliferation of motorcycles, the government also resorted to more direct and arbitrary interventions to limit the production and sales of motorcycles. Foreign motorcycle manufacturers, particularly HVN, were seriously affected since these policies artificially prevented them from expanding production.

Stage III (2005-2008) was the period of FDI-led growth. By this stage, the Japanese motorcycle manufacturers fully recovered their market shares, while local assemblers were driven to the corner. During these years, Vietnam's moves towards deregulation, including the abolition of restrictive rules, and economic boom significantly boosted domestic motorcycle sales which climbed to 2.8 million units in 2007. As Figure 1, shows, this far exceeded the figures during the "China shock". The boom stimulated a new wave of FDI in the production of motorcycles and components, moving the industry even further toward an FDI-led development path. Even though the radical price reductions by the Japanese motorcycle manufacturers and changes in the policy environment drove local assemblers into a corner, they still held roughly one third of the market as of 2007-2008.

Figure 1. Sales of Motorcycles by Manufacturers



Source: For the years 1998 to 2005: Bo cong nghiep "Quy hoach phat trien nganh cong nghiep xe may Viet Nam giai do an 2006-2015, co xet den nam 2020", Vien nghien cuu chinh sach, chien lu oc cong nghiep, 2007.
Figures for the years 2006 to 2008 are estimated by the author base on interviews of Japanese and Tawanese motorcycle manufacturers and component suppliers in March 2009.

This research asks whether the remarkable industrial dynamism discussed above has been accompanied with the emergence of a sectoral system of innovation and production that is conducive of accumulation of technological and production capabilities of local component suppliers. The subsequent section will present the framework to be used for empirical analysis.

3. Analytical Framework

According to the evolutionary view of economic change, technical changes are not generated simply by adopting machinery or equipment that embodies new technology but require specialised resources accumulated through deliberate investment and efforts (Lall, 1992; Bell and Pavitt, 1995; Bell and Albu, 1999). Such specialised resources needed to generate and manage technological change such as knowledge, skills, experience, and institutional structure and linkages are called capabilities (Bell and Pavitt, 1995; Figueiredo, 2008).

Manufacturing firms in developing countries generally start production by importing technologies developed elsewhere. The key issue is how successfully they manage to move from acquiring and assimilating the imported technology to adapting it to the local needs, improving it, and finally creating new technology on their own. The key challenge for developing country firms is whether they could move from acquiring the capability to use the existing technology, i.e., to produce goods at given levels of efficiency and given input requirements technology-changing capability, towards accumulating the capabilities to change the existing technology, i.e., to create, change or improve products, processes, production organisation, or equipment (Bell and Pavitt, 1995; Ariffin, 2000; Figueiredo, 2008). The former is usually referred to as "production capabilities," while the latter is often called "innovation capabilities" (Schmitz 2007)[1]. The latter is much more difficult to acquire and therefore forms an important foundation for firms' competitiveness.

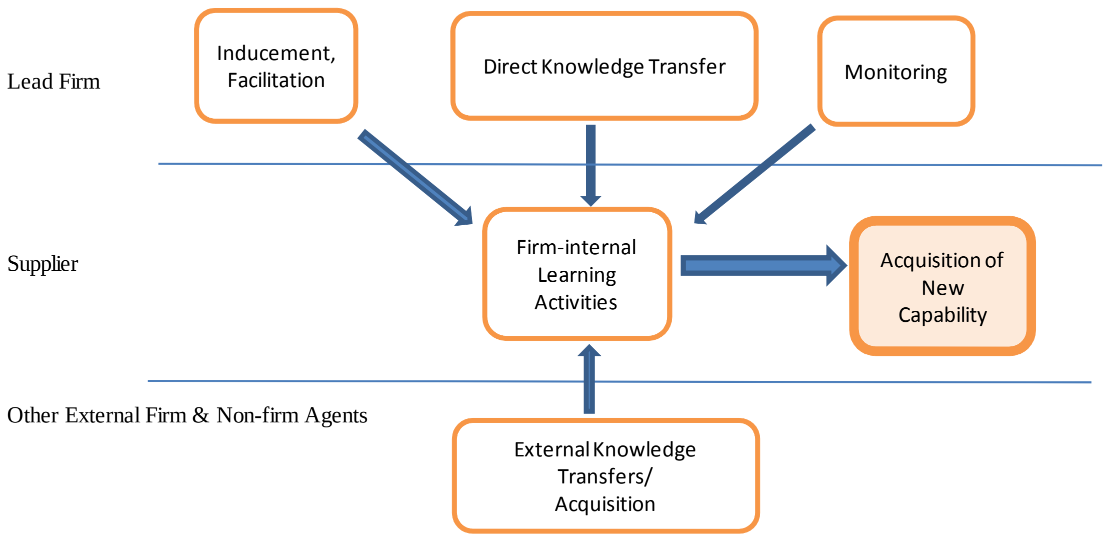
The present research is concerned with the sources of production and innovation capabilities in component suppliers in complex assembly industries. In this regard, various streams of literature have emphasised different groups of actors: (1) the suppliers themselves, the focus of the TC approach (Bell 1984; Bell and Pavitt 1995, 1997), (2) lead firms or buyers, emphasised in the GVC approach (Humphrey and Schmitz 2001, 2004; Schmitz 2006) and (3) other firm and non-firm agents including universities, research institutes, and business associations, highlighted by the innovation systems approach (Lundvall 1993; Malerba 2004). Since capability formation in essence involves accumulation of knowledge, we need to devise a framework that captures the modes of actor involvement and knowledge flows between the actors (Bell and Albu 1999; Ernst and Kim 2002). Figure 2 presents a model of supplier learning incorporating the roles played by the lead firms, suppliers and other external firm and non-firm agents—including both direct modes of involvement in the suppliers' sourcing or generation of knowledge and indirect modes in inducing and facilitating the suppliers' sourcing or generation of knowledge.

Suppliers: In the present context, suppliers are the very agents of learning. The TC approach has focused on the endogenous process through which local firms diffuse, adapt and create knowledge. In the case of component suppliers in motorcycle value

[1] Different authors use different terminologies to refer to technology-using capability and technology-changing capability. Bell and Pavitt (1995) use "production capacity" and "technological capability", while Ariffin (2000) and Figueiredo (2008) use "routine production capability" and "innovative technological capability".

chains, the main channels through which suppliers generate new knowledge include investment in physical resources like machinery and equipment, investment in human resources via recruiting and training, and in-house R&D and deliberate improvements in their activities (Bell and Pavitt 1995, 1997; Caloghirou, *et al.*2004).

Figure 2. Model of Supplier Learning Roles of Key Actors



Source: Prepared by the author

Lead Firms: Supplier learning also is heavily influenced by lead firms who place orders. The lead firms' roles in shaping supplier learning have been conceptualised by the literature on global value chains (Humphrey and Schmitz 2001; Schmitz and Knorringa 2001, Schmitz 2006) and technology transfer (Wong 1991, 1992; Capannelli 1999; Ivarsson and Alvstam 2004, 2005). On the basis of the existing literature, the lead firm's involvement in supplier learning is classified into the following categories. *Inducement* refers to the lead firm's roles in equipping suppliers with often challenging requirements and targets to be reached, thereby motivating them to learn and enabling them to come up with specific learning targets. Specifically, the lead firms provide supplier with product design specifications and performance requirements, which may include indirect forms of knowledge transfer, advance indications of future production plans and quality, performance, or feature requirements and targets (Ivarsson and Alvastam 2004, 2005; Wong 1991; Mitsuhashi 2005). *Direct knowledge transfer* includes advice or assistance on technical or non-technical aspects of production, on-site audit of plant operation, troubleshooting of specific problems, and training of supplier staff through formal programmes or informal consultations or visits (Wong 1991; Lall 1980; UNCTAD 2001; Ernst and Kim 2002; Ivarsson and Alvstam 2004, 2005; Mitsuhashi 2005; Schmitz 2006). *Monitoring* refers to testing and diagnostic feedbacks on quality and other dimensions of performance of suppliers or their products against the initially prescribed targets or requirements (Schmitz 2006; Wong 1991).

External Agents Other than Lead Firms: Apart from the lead firms and suppliers, other firm and non-firm agents also contribute to supplier learning as sources of explicit and tacit knowledge. Public and private innovation-supporting organisations such as business associations, government agencies, consultants, international and aid organisations, or research institutes and universities may act as providers of advice, training, knowledge, or consultancy services (Malerba 2004; Malerba and Mani 2009). Intra-cluster sources may also important source of knowledge for small suppliers, such as the mobility of skilled labour among firms and diffusion of know-how (Bell and Albu 1999).

4. Methodology

This paper will analyse the nature of linkages and knowledge flows in the Vietnamese motorcycle industry in two complementary steps. The first step will focus on the local suppliers. Based on case studies of 21 strategically selected local suppliers, the empirical analysis will look into the sources of knowledge that the suppliers mobilised in acquiring important capabilities. The second step, in turn, will focus on the non-firm agents. In-depth case studies of two major technological and industrial universities will provide the insights on the extent and the nature of the linkages that the universities have developed with firms operating in the automotive industry. I n both steps, data were collected via extended interviews with the respective firm and non-firm agents.

4.1 First Step: Analysis of Suppliers' Knowledge Mobilisation

In analysing the sources of local suppliers' capability formation, this paper adopts an event-based approach (Van de Ven and Poole 1995, Lema 2010). Based on the assumption that capability formation processes entail major leaps, incremental progress, halted progress, or even retrogression from previous levels, instead of progressing steadily along a linear, pre-determined path (Bell 2006), this approach focuses on important milestones in the capability formation process, which we refer to as "learning events." These are the incidents of major leaps in supplier capabilities in one or more of the key functional domains of motorcycle component suppliers' operation: new product introduction (including product design and development activities), equipment-related activities (operating, maintaining, and improving production equipment and machinery), and production management.[2]

An event has a start date, when the supplier launched a new initiative or target for new product introduction or improvement in equipment-related activities or production management. Events may last just for few months, or they might extend over several years. The goals or plans initially set at the start date may eventually have to be adjusted or altered. Events are perceived to have terminated when the supplier has achieved observable learning outcome ('end date'). Given that suppliers' activities are fundamentally constrained by the nature of the orders they receive from lead firms, it is basically assumed that an event takes place in the supplier's activities in one or more value chains.[3]

Since this research assumes learning paths and sources to differ widely by the nature of lead firm involvement, supplier learning activities and involvement of other agents, the research adopted multiple case study design. The strategy was to include five to six suppliers with different levels of learning performance for each of the three broad groups classified by the types of value chains and their positions in the value chains (i.e., first-tier suppliers in Japanese chain, second-tier suppliers in Japanese chain, and suppliers in the Vietnamese-Chinese chain[4]), and to identify, for each supplier, up to three most important milestones in the capability formation process after the supplier's participation in motorcycle value chains.

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2 For details of this classification, see Sato and Fujita (2009).

3 It is also possible for learning to take place for exploring completely new markets, in which case an event may not be associated with specific value chains. However, this was rarely observed among local motorcycle component suppliers in Vietnam. Unstable market and policy conditions made it high risky for suppliers to engage in medium- to long-term R&D without any market assurance.

4 This classification is based on the author's previous research (Fujita 2007).

Table 2 shows 21 suppliers selected for case study. Given the diverse patterns of value chain participation and their changes over time, suppliers are broadly classified into three groups according to the types of motorcycle value chains they participate: *Group A*, which includes eleven suppliers that have participated in Japanese chain but not in Vietnamese-Chinese chain; *Group B*, which includes five suppliers that initially participated in Vietnamese-Chinese chains but eventually entered into Japanese chain; and Group C, which includes five suppliers that have participated in Vietnamese-Chinese chains but not in Japanese chain. None of the suppliers in Group A shifted from Japanese chains to Vietnamese-Chinese chains. Suppliers in both groups also participated in value chains other than Japanese or Vietnamese-Chinese chains at different points in time.

Data were collected via interviews conducted by the author in between September 2008 and March 2009. All of the firms except for A5, A10, A11, C1, C4 and C5 were interviewed more than once. The first interview was usually with the top management of the companies, and aimed to identify up to three major learning events experienced by the suppliers since the mid-1990s. The second interview was usually with the manager(s) who directly took charge of new product introduction or production activities, and focused on collecting detailed data learning events consisting of thick description of the process of events as well as the roles of various actors involved in the events—including the suppliers themselves, lead firms, and other firm or non-firm agents.

Table 2. List of Case Suppliers

Supplier	Owner-ship	Type of components	Number of Employees	Start of operation	Previous Products/ Experience	Value Chain Participation							
						Stage I		Stage II			Stage III		
						J	Other	J	V-C	Other	J	V-C	Other
A1	State	Metal (overall)	1,350	1974	Bicycle components	✓	✓	✓			✓		
A2	State	Metal (overall)	1,000	1974	Household Products	✓	✓	✓		✓	✓		
A3	State	Plastic	550	1972	Household Products	✓	✓	✓		✓	✓		✓
A4	State	Metal (overall)	1,000	1968	Agriculural machinery and components		✓	✓		✓	✓		✓
A5	Private	Assembly type	500	1994	Automobile components for export to Japan		✓	✓		✓	✓		✓
A6	Private	Plastic	1,000	1988	Plastic packages for foreign buyers		✓	✓		✓	✓		✓
A7	Private	Specialised (Dies & Molds)	81	2004	General director and key engineers gained experience at a Japanese mold company						✓		
A8	State	Metal (overall)	1,100	1980	Diesele engines for the domestic market		✓	✓✓		✓	✓✓		✓
A9	Private	Specialised (Plating)	150	1988	Replacement components		✓	✓✓			✓✓		✓
A10	Private	Plastic	182	1994	Household products and packages.		✓	✓✓			✓✓		✓
A11	Private	Specialised (Precision Machining)	170	1999	Components of dies and molds.					✓	✓✓		✓
B1	State	Metal (overall)	600	1974	Bearings for the domestic market.		✓		✓		✓		
B2	State	Metal (overall)	157	1970	Components for agricultural machinery.			✓		✓	(✓)		
B3	Private	Metal (diecasting)	200	1986	Replacement components		✓	✓✓	✓		✓✓		✓
B4	Private	Metal (overall)	400	1981	Bicycle components		✓	✓✓	✓		✓✓	✓	
B5	Private	Metal (diecasting)	150	2001	Trading				✓		✓✓		
C1	Private	Metal (overall)	150	1959	Bicycle components		✓		✓				✓
C2	Private	Metal (overall)	450	1987	Bicycle components		✓		✓				✓
C3	Private	Metal (overall)	170	1996	Replacement components		✓		✓			✓	✓
C4	Private	Assembly type	115	1988	Trading		✓		✓			✓	
C5	Private	Assembly type	100	1999	Trading				✓				✓

Notes: Types of value chains are abbreviated as follows: J (Japanese chain), V-C (Vietnamese- Chinese chain), and Other (other types of chains).
Source: The author's interviews.

4.2. Second Step: Analysis of Universities' Knowledge-based Linkages with Firms

In order to complement the first step of analysis, the second step turned the focus to local universities as one of the key non-firm agents in the sectoral system of innovation and production in the automotive industry. The analysis attempted to examine the extent and nature of the knowledge-based linkages that the universities developed with firms in the automotive industry. At the same time, attempts were made to look for possible factors that inhibited the development of linkages and/or knowledge flows between local universities and firms in the automotive industry.

Two major universities of particular relevance to the automotive industry were selected for case study: Hanoi University of Technology (HUT) and Hanoi University of Industry (HaUI). These are renowned universities with different areas of specialisation, both of which are closely related to the needs of the automotive industry. While HUT is strongly oriented towards academic research and development, HaUI focuses on training industrial human resources with practical skills. Although there are numerous universities located in different parts of the country, universities in Hanoi were selected because the automotive industry is overwhelmingly concentrated in northern Vietnam.[5] In fact, most of the 21 suppliers selected for the first step of analysis were located in Hanoi or surrounding provinces, and the two universities were explicitly named by two of the 21 case suppliers as complementary knowledge sources for their important learning milestones. Data were collected via interviews with the respective universities in November 2010.

[5] This is because the two largest foreign motorcycle manufacturers (HVN and Yamaha Vietnam), as well as many of the major local assemblers, are located in the North.

5. Local Suppliers' Capability Formation and the Knowledge Sources

This section presents the findings of the first step of empirical analysis on the sources of in local suppliers' learning. It will start by presenting an overview of the "learning events" and then proceed to discuss the roles of different actors involved in supplier learning.

5.1. Overview of Learning Events

Through in-depth interviews of 21 local Vietnamese suppliers of motorcycle components conducted between September 2008 and March 2009, the author was able to identify a total of 44 learning events that took place in the suppliers' activities in designing and manufacturing motorcycle components. An overview of the learning events is provided in Table 3.

Table 3. Number of Learning Events by Types of Chains, Functional Types of Capabilities Acquired, and Timings

Functional Category of Capabilities Acquired		New Product Introduction	Equipment-related	Production Management	Total Number of Events
Events in Japanese Chain (1st tier) (9 suppliers)	Stage I	0	3	3	3
	Stage II	0	5	6	6
	Stage III	0	7	9	11
	Total	0	15	18	20
Events in Japanese Chain (2nd tier) (7 suppliers)	Stage I	-	-	-	-
	Stage II	0	3	3	4
	Stage III	0	8	9	9
	Total	0	11	12	13
Events in Vietnamese-Chinese Chain (5 suppliers)	Stage I	1	1	1	1
	Stage II	5	5	4	7
	Stage III	3	1	1	3
	Total	9	7	6	11

Source: The author's interviews.

As regards the types of supply networks, 33 events took place in the suppliers' activities in Japanese chains (20 events at the first-tier and the remaining 13 events at the second-tier), while 11 events took place in the suppliers' activities in Vietnamese-Chinese chains. Though not the explicit focus of this paper, the functional categories and the levels of the capabilities acquired by the suppliers varied by the types of value chains in which the events took place.[6] Learning in Japanese chains focused almost exclusively on production-related capabilities, which included equipment-related and production management capability. Most suppliers experienced a series of learning events in the course of a decade, and the levels of attainment improved over time. By contrast, suppliers in Vietnamese-Chinese chains engaged in wider functional categories of activities including component design, though the levels of learning attainment remained limited.

The timings of learning events also deserve attention. Events in Japanese chains are concentrated in Stage III. In fact, more than half of all the learning events in Japanese chains took place in Stage III. This can partly be accounted for by the fact that more and more suppliers, many of which had previously participated in Vietnamese-Chinese chains, entered into Japanese chains—both at first- and second-tier in Stages II and III. However, remarkable increases in the *levels* of capability observed for given suppliers—particularly in Stage III—do indicate that Stage III was in fact the period of most intensive learning for suppliers in Japanese chain, which is due to increasingly challenging requirements imposed by lead firms on suppliers at this stage (Fujita, forthcoming). By contrast, learning events in Vietnamese-Chinese chain are overwhelmingly concentrated in Stage II. This is because many suppliers had exited

[6] Further details of the findings can be found in Fujita (forthcoming).

from Vietnamese-Chinese chain by Stage III and, even among those that stayed, few managed to substantially improve their capability levels in Stage III.

5.2. Contrasting Actor Constellations

The present focus is on identifying the sources of knowledge that suppliers mobilised in acquiring new capabilities. Table 4 shows key actors involved in the 44 earning events in the order of importance as identified by the interviewees. First, as regards the types of actors involved, the table clearly points to the importance of two types of actors: suppliers themselves and lead firms. Other firm and non-firm agents including consultants, aid organisations, related companies, training institutes, machinery or software suppliers, and universities were generally ranked at lower levels of importance, suggesting that they played relatively minor roles complementing those of the suppliers themselves and/or the lead firms. As far as universities are concerned, there were only two events in which local Vietnamese universities played any role: the second learning event in supplier A4 and the third learning event in supplier B1. Both of the two events took place in the suppliers' activities in Japanese chain.

Table 4. The Key Actors in Learning Events

Main Type of Value Chain	Stage	Firm	Event #	Key Actors		
				Most Important	Second Most Important	Other Actors Involved
J (first-tier)	I	A1	1	Suppliers themselves	Customers or customer-designated unit (HVN)	
		A2	1	Suppliers themselves	Customers or customer-designated unit (HVN)	
		A3	1	Suppliers themselves	Customers or customer-designated unit (HVN)	Codified information obtained from foreign journals
	II	A1	2	Suppliers themselves	Customers or customer-designated unit (HVN)	Vietnamese consulting company (consultancy)
		A2	2	Suppliers themselves	Customers or customer-designated unit (HVN)	Vietnamese Chamber of Commerce & Industry (training programme)
		A4	1	Suppliers themselves	Customers or customer-designated unit (HVN)	Japanese aid organisation,
		A5	2	Suppliers themselves	Customers or customer-designated unit (HVN)	Japanese companies in Vietnam (learning by observing)
		A6	1	Suppliers themselves	Customers or customer-designated unit (HVN)	Related company (training); Training centre funded and assisted by Japan (training)
		B1	2	Suppliers themselves	Customers or customer-designated unit (HVN)	Japanese companies in Vietnam (learning by observing); related company (mobility of human resources)
	III	A1	3	Suppliers themselves	Customers or customer-designated unit (HVN)	Training centre funded and assisted by Japan (training)
		A2	3	Suppliers themselves	Customers or customer-designated unit (HVN)	Vietnam Chamber of Commerce & Industry (training programme)
		A3	2	Suppliers themselves	Customers or customer-designated unit (HVN)	
		A3	3	Suppliers themselves	Othe external actors (supplier of machinery/equipment)	
		A5	3	Suppliers themselves	Other external actors (related company)	
		A6	2	Suppliers themselves	Other external actors (recruiting engineers)	Customers or customer-designated unit (HVN)
		A7	2	Suppliers themselves	Customers or customer-designated units	
		A8	3	Suppliers themselves	Customers or customer designated unit (Japanese company with technology transfer agreement)	
		B1	3	Suppliers themselves	Customers or customer-designated unit (HVN)	Japanese aid organisation (training programme); Hanoi University of Technology (training programme jointly offered with Toyota Vietnam); Japanese companies in Vietnam (learning by observing)

Main Type of Value Chain	Stage	Firm	Event #	Key Actors		
				Most Important	Second Most Important	Other Actors Involved
J (first-tier)	III	B2	2	Suppliers themselves	Customers or customer-designated unit (HVN)	
J (2nd-tier)	II	A10	1	Suppliers themselves	Customers or customer designated unit (Japanese motorcycle manufacturers & first-tier suppliers)	Software supplier (Europe) (knowledge transfer)
		A8	1	Suppliers themselves	Other external actors (Japanese aid organisation)	Japanese aid organisation (training programme)
		A9	1	Suppliers themselves	Customers or customer designated unit (Japanese first-tier suppliers)	Companies in Japan (learning by observing)
		B3	2	Suppliers themselves	Customers or customer designated unit (Japanese first-tier supplier)	
	III	A10	3	Suppliers themselves	Customers or customer designated unit (Japanese motorcycle manufacturers & first-tier suppliers)	Japanese aid organisation; Training centre funded and assisted by Japan (training programme)
		A11	1	Suppliers themselves	Customers or customer designated unit (Japanese first-tier suppliers)	
		A11	2	Suppliers themselves	Customers or customer designated unit (Japanese first-tier suppliers)	
		A4	2	Suppliers themselves	Customers or customer-designated unit (HVN & a Japanese first-tier supplier)	Hanoi University of Industry (training programme)
		A7	1	Suppliers themselves	Customers or customer-designated unit (Japanese first-tier supplier)	Recruiting engineers
		A9	2	Suppliers themselves	Customers or customer designated unit (Japanese first-tier suppliers)	Companies in Japan (learning by observing)
		B3	3	Suppliers themselves	Customers or customer designated unit (Japanese first-tier supplier)	
		B4	2	Suppliers themselves	Other external actors (Japanese companies other than customers)	
		B4	3	Suppliers themselves	Other external actors (supplier of machinery/equipment)	
		B5	2	Suppliers themselves	Other external actors (Thai consultant who had worked for a joint venture supplier in Vietnam)	Customers or customer-designated unit (Japanese first-tier supplier), Japanese aid organisation (training programme)
V-C	I	C1	1	Suppliers themselves		
	II	B1	1	Suppliers themselves		
		B2	1	Suppliers themselves		
		B3	1	Suppliers themselves	Other external actors (observing factories in China)	
		B5	1	Suppliers themselves	Other external actors (a partner in China)	Companies in China (learning by observing)
		C2	1	Suppliers themselves	Other external actors (observing factories in Taiwan)	

Main Type of Value Chain	Stage	Firm	Event #	Key Actors		
				Most Important	Second Most Important	Other Actors Involved
		C3	1	Suppliers themselves		
		C5	1	Suppliers themselves	Other external actors (a partner in Russia)	
	III	B4	1	Suppliers themselves	Customers or customer designated units (local assemblers)	
		C3	2	Suppliers themselves	Customers or customer designated units (local assemblers)	
		C4	1	Suppliers themselves	Customers or customer designated units (local assemblers)	

Source: The author's interviews.

Second, as regards the roles of suppliers and lead firms as the key actors in supplier learning, all of the suppliers ranked their learning activities as the most important source of learning for all of the events they experienced, regardless of the types of value chains in which the events took place. While the suppliers' self-evaluation of their own roles needs to be interpreted with caution, taking into account that entrepreneurs tend to insist on the value of their own achievements, this is consistent with the insights of the TC literature that firm-level capability formation is ultimately determined by deliberate investments in specialised, change-generating activities by the firms as the very agents of learning (Bell and Pavitt 1995: 100).

Third, the key differences between the Japanese and Vietnamese-Chinese chains were observed in the role of lead firms. Lead firms turned out to be extremely important in learning events in Japanese chains especially in the early years. They were identified as the second most important actor for the majority of learning events that took place mainly in Japanese chain. In Vietnamese-Chinese chains, lead firms played minimal roles in learning events. In more than half of these events, suppliers turned out to be the only actors involved.

These very different actor constellations in Japanese and Vietnamese-Chinese chains point to two contrasting patterns of supplier capability formation. In Japanese chain, capability formation involves active roles of *both* suppliers and the lead firms. By contrast, in Vietnamese-Chinese pattern, supplier capability formation is achieved mostly by the suppliers' own initiatives with limited roles played by lead firms. The following sub-sections will examine the specific modes of actor involvement in greater depth, focusing on the intensity and nature of knowledge flows between the actors.

5.3. Knowledge Sources for Suppliers in Japanese Chain

While the main actors involved in the majority of learning events in Japanese chains were lead firms and suppliers, the relative importance and specific roles played by the respective actors, as well as the extent to which other actors were involved, changed over time. Table 5 shows the details of the roles played by suppliers, lead firms, and other external firm and non-firm agents.

As regards the learning events that took places in Stage I, suppliers and lead firms virtually turned out to be the only actors involved. The lead firm's roles were extensive, covering all three domains of lead firm involvement in supplier learning outlined in the conceptual framework: inducement, direct knowledge transfer and monitoring. Given the limited number of suppliers available in Vietnam, low initial level of suppliers' capabilities, and the limited experience they had had in serving foreign customers, a great deal of intervention on the part of HVN was required to bring the suppliers' capabilities up to the required standards.

Table 5. Sources of Learning in Case Suppliers (44 learning events experienced by 21 local suppliers in Japanese & Vietnamese-Chinese chains)

			J-Chain (1st tier)				J-Chain (2nd tier)			V-Chain			
Timing (Stages at which learning events took place)			Total	I	II	III	Total	II	III	Total	I	II	III
Total number of Learning Events			19	3	6	10	14	4	10	11	1	7	3
Lead Firm (or units designated by lead firms)	Inducement	Product specifications and QCD requirements	19	3	6	10	13	3	10	3			3
		Providing dies and molds	5	3	1	1	4	1	3				
	Facilitation	Financial support											
		Guarantee orders											
	Assistance	Technical Advices & Training	10	3	5	3	6	2	4				
		Troubleshooting	14	3	5	6	4	1	3				
		Transfer codified knowledge											
	Spillover	Learning by observing	4		2	2	2	1	1				
	Monitoring	Testing & feedback											
		a) OK/NG on final products					2	1	1	2			2
		b) Feedback on reasons for NG					6	1	5				
		c) Follow-up on the measures taken to overcome	18	3	6	9	5	2	3				
		Factory audit	19	3	6	10	9	4	5				
Supplier		Physical investment	13	2	4	7	10	3	7	6	1	3	2
		In-house improvements/R&D in product design								2			2
		In-house improvements/R&D in production	9	3	2	6	4	2	2	5		3	2
		Organisational changes	14	1	5	8	5	2	3	1			1
Other external actors		Technical Advice & Training (foreign organisations)	5		1	4	5	2	3	2		2	
		Technical Advice & Training (domestic organisations)	2			2							
		Consultancy											
		Recruiting individuals/Mobility of Human Resources	5	1	2	2	1		1				
		Learning by observing (foreign companies or companies abroad)	2		1	1	4	1	3	3		3	

Notes: Dark-shaded cells: The respective role of the key actor was observed in two-thirds or more of the learning events.
Light-shaded cells: The respective role of the key actor was observed in one-third or more of the learning events.
Source: The author's interviews.

In Stages II and III, lead firms continued to be the main actors involved, yet their relative importance diminished for the majority of suppliers. As Table 6 shows, while the lead firm's roles in inducement and monitoring continued to be important, the role of direct knowledge transfer diminished in comparison to the previous period. This is because, with the new wave of FDI in component production and increased competence of incumbent suppliers, HVN no longer had to spare much time and resources for nurturing suppliers. In the meantime, intense competition with Chinese motorcycles meant HVN was compelled to reduce component costs while maintaining quality levels. Rapid increase in production in Stage III also meant much tighter delivery requirements on suppliers. Under the renewed circumstances, HVN made extensive use of *inducement* in the forms of tight quality, costs and delivery (QCD) requirements and regular and systematic *monitoring* of supplier performance to exert greater pressure on suppliers, while hands-on assistance was provided only selectively.

Another change that took place in Stages II and III is increased instances of involvement by external firm and non-firm agents other than lead firms. Table 5 shows increased incidence in Stages II and III of learning events that involve various firm and non-firm agents such as aid organisations, training institutes, consultancies, related companies, and/or local universities. Nevertheless, most of the linkages with these firm- and non-firm agents in fact developed largely out of the suppliers' relationships with the lead firms. This is evident from the fact that most of these external agents involved—whether private companies or public organisations—turned out to be Japanese. Most often suppliers gained access to these organisations or companies directly or indirectly through their relationships with HVN.

As regards the roles played by these external agents, these external sources largely turned out to be complementary rather than critical sources in their own. This is evident from the fact that these external actors are ranked generally low in the order of importance identified by the suppliers (Table 5). In order to reach the performance targets imposed by lead firms, suppliers essentially used the methods, schemes, or know-how sourced from these external agents to supplement their own learning activities. As Table 6 shows, the specific roles played by these external agents in the course of learning events include provision of technical advice and training is the most typical form of involvement, followed by provision of human resources and opportunities for suppliers to learn by observing sophisticated operations conducted at other companies.

An important point to note in the context of this study is the very low incidence of learning events in which local universities were involved. There were only two learning events for which the interviewed suppliers explicitly acknowledged the linkages with local universities as an important source of knowledge: the second learning event in supplier A4 and the third learning event in supplier B1. In both of these incidents, the respective suppliers took advantage of training programmes offered by local universities as one of the knowledge sources to supplement their in-house learning activities and technical assistance offered by HVN.

- While supplier A4started its relationship with HVN in 2001 by supplying sprockets, which required relatively simple processing technology, it started receiving orders for increasingly complex components around the year 2005 onwards. For processing these components, the supplier invested in a large number of CNC machining centres and sent its engineers to a training programme on operation of

CNC machines offered jointly by Hanoi University of Industry and a Japanese university.

- After supplying components to local assemblers for a few years in the early 2000s, supplier B1 started to make preparation for becoming a first-tier supplier of HVN. As the supplier was faced with the need to obtain ISO9001 certification, it started initiatives to improve production and quality management. Sending all the department and factory managers to training programmes organised jointly by Hanoi University of Technology and Toyota Vietnam helped the company to disseminate the basic principle of 5S within the company at this stage, which facilitated the subsequent processes of working directly with HVN to meet their specific requirements.

5.4. Knowledge Sources for Suppliers in Vietnamese-Chinese Chain

As discussed in Section 5.2, learning in Vietnamese-Chinese chain is broadly categorised as suppliers' independent learning with limited roles played by the lead firms.

During Stages I and II, there was no incidence of lead firms playing key roles—in any of the three domains of lead firm involvement. Learning inducement was extremely limited because specifications and requirements were only vaguely defined and thus failed to give incentives or targets for supplier learning. Given the lack of standards or requirements for the lead firms to check the products or processes against, monitoring was also largely absent. The low quality and precision requirements meant that direct technical assistance was not needed. Supplier learning during this period was instead largely a result of the suppliers' mobilisation of internal knowledge sources on the suppliers' own initiative. At the very minimum, in-house improvements in a wide range of activities including product design, equipment-related activities, or organisation turned out to be the main source of learning for most of the learning events in Vietnamese-Chinese chains.

While the essential features of the learning model remained unchanged, slight adjustments took place in the role of the key actors by Stage III. In three learning events took place in Stage III, the lead firm was identified as the second most important actor besides the suppliers themselves. However, the roles played by the lead firms in Vietnamese-Chinese chains were still limited to providing product specifications and monitoring of the supplier performance (Table 6). Interviews with suppliers also revealed that, while increased quality and precision requirements did exert pressure on suppliers, the ways lead firm implemented learning inducement and monitoring were still arbitrary, far from the detailed and systematic methods of providing specifications and performance monitoring implemented in the Japanese chain.

Suppliers in Vietnamese-Chinese chains occasionally mobilised external sources of knowledge other than lead firms. Particularly where the suppliers only had limited internal resources to leverage on, they turned to other actors to complement internal sources of learning. Table 5 indicates that most of these sources were firms, meaning that the linkages are largely business-based. There was no incidence of learning events where non-firm agents were involved. Two suppliers received direct technology transfer from abroad. In launching component production, supplier B5 went into a technology transfer agreement with a Chinese partner, which provided everything in a package: design drawings, dies, machinery and equipment, engineers, sub-components, and materials. The Chinese engineers stayed at the factory for throughout the period of contract, which extended for seven years, to assist operation of the machinery (the first learning event in supplier B5). Supplier C5 went into a technology transfer contract with a Russian partner to obtain technology to produce motorcycle chains, though in this case the Russian engineers stayed at the supplier's factory for several years only (the first learning event in supplier C5). Some suppliers exploited knowledge gained from visiting and observing factories abroad (the first learning event in supplier B3; the first learning event in supplier C2).

6. The Role of Innovation-Supporting Organisations: The Nature of University- Industry Linkages

The analysis in the previous section revealed that universities played extremely limited roles in the acquisition of important capabilities by the 21 local motorcycle component suppliers. In an attempt to explore the reasons for the lack of dynamic university- industry linkages, as well as the possible approaches for encouraging the emergence of such linkages, this section turns the focus to the universities. It will conduct in-depth examination of two universities of direct relevance to the automotive industry yet with contrasting features: Hanoi University of Technology (HUT) and Hanoi University of Industry (HaUI). Unfortunately, neither of the universities compiled detailed data on the modes of engagement with firms in the automotive industry. The discussion will therefore be largely descriptive, with little details on the magnitude or frequency of the programmes.

6.1. Overview of the Two Universities

Since its establishment in 1956 as the first university of technology in Vietnam, HUT has consistently been regarded as the top natural sciences university in Vietnam. The university has churned out numerous engineers and scientists trained at the bachelor, master and doctoral levels. While it has numerous departments of direct relevance to the automotive industry, the university is particularly renowned for strong tradition in mechanical engineering. Every year, approximately 4,000 students graduate with the university with the degree of bachelor of science or engineering. Many of these graduates are employed as engineers in the automotive industry, including the major Japanese automakers, motorcycle manufacturers and core component suppliers.

HaUI, by contrast, started as a vocational school as early as 1898. After serving many years in vocational training in the fields of mechanical and electrical engineering, the school was upgraded to an industrial college in 1999 and further to a university in 2005. The university now has educational programmes at three different levels: university, college, and vocational high school. Apart from the Department of Automobile Industry, which is established exclusively to serve the requirements of the automotive industry, the university has departments that are directly relevance to the automotive industry including mechanical engineering and electrical and electronics. Every year, approximately a total of 10,000 to 15,000 students complete the university, college or vocational high school programmes. In contrast to the HUT strongly oriented towards scientific research and development, HaUI has focused on providing practical training for technical labour force.

6.2. University-Industry Linkages—Current Situation and Outstanding Issues

The author's interviews revealed that the roles that the two universities have played in capability accumulation of local firms in the automotive industry can be classified into the following three categories: (1) education via degree programs, (2) training courses for engineers and staffs working in the automotive industry, and (3) other forms of collaboration such as production to order and R&D projects. All of the three types of engagement were found in both of the universities, though their content or the relative importance differed between the universities.

Education via Degree Programs

At the most basic level, the universities have contributed to the industry by providing qualified human resources. HUT has focused on educating engineers and technicians. The author's research found that HUT's graduates worked at major Japanese motorcycle manufacturers as well as Japanese, Taiwanese and Vietnamese suppliers as engineers and managers in production engineering, equipment engineering, and product and process design. Many of the graduates of this university also became leading entrepreneurs. In fact, some of the local suppliers analysed in the previous section were established by the graduates of this university (e.g., A7 and B5), and many more managed by the graduates of this university. By contrast, HaUI has focused on practical vocational training for leaders and managers in the areas of production, production control, quality control, and/or production engineering.

However, there have been criticisms that education offered by the Vietnamese universities, industrial colleges and vocational schools has not responded sufficiently to the requirements of the industry. On the basis of the business surveys conducted by the Vietnam Business Forum and JETRO, Mori, *et al*. (2009) pointed out that many foreign businesses in Vietnam expressed difficulties in recruiting skilled labour—particularly middle managers and engineers. For this reason, Japanese motorcycle manufacturers and suppliers interviewed by the author have had to invest in substantial in-house training for new recruits (Intarakumnerd and Fujita 2008). The shortage of qualified teaching staffs and outdated facilities are among the reasons why the content and quality of the programmes failed to respond to the practical needs of the industry (Mori, *et al*. 2009).

One of the measures that have been taken to address the above gaps is the internship programme. According to the author's interviews, internship programmes had been implemented by both of the two universities to provide opportunities for students to gain first-hand working experience in the industry before graduation. HUT even required all undergraduate students to participate in internship programmes in their third, fourth and fifth years.[7] Both universities pointed out that foreign firms, in particular, made strategic use of internship programmes by linking them with their recruitment process. They sought to use the internship programmes as the chances to look at prospective employees in their own work environment and to select promising candidates. The period of internships generally extended from one to two months. The sorts of experience that the internship programmes offered to students varied by firms. While some foreign firms organised lecture-based training sessions for interns, much of the time was normally spent on practical on-the-job training in factories.

[7] However, students could choose to participate in internship programmes organised at workshops in the university rather than programmes organised by firms.

Considering the extreme cases where interns were simply “used” by the receiving companies as unpaid workers, or where sufficient safety standards were not adhered to in the workplace, some sorts of guidelines may be needed to ensure that the internship programmes would be beneficial for students, universities and firms.

Training

The two universities provide short-term training courses for engineers, managers, leaders and/or supervisors who are being employed in the industry. The main subjects covered included mechanical engineering (e.g., the operation of CNC machining centres) and production management (e.g., lean production, quality management, 5S, and kaizen). The requirements for university-run training courses were particularly large in suppliers that are short of internal resources for running in-house training programmes.

Some of the training courses directly assisted and funded by foreign companies have served as important bases for training qualified human resources. The training centre on mold/die manufacturing established as early as 1993 deserves particular attention. This centre was established by Shiroki Corporation, a Japanese auto component manufacturer, at HUT. The Japanese company provided machinery and equipment, textbooks, and instructors to train Vietnamese engineers in designing and manufacturing molds and dies to work at the joint venture mold manufacturer it established. Although the joint venture closed down in the early 2000s, its former engineers and staffs of are known to have played key roles in numerous die/mold manufacturers in the Vietnamese automotive industry—including suppliers A6 and A7 among the 21 suppliers examined in the previous section.

Another important initiative is the training course on manufacturing (*monozukuri*), which Toyota Motor Vietnam established at HUT in 2005. This initiative started with the three-month training organised by Toyota Motor Vietnam to teach the essence of Toyota's production system to two of the HUT's a faculty staffs, who became the core organisers of the course. Every year HUT runs three series of five different courses that cover various areas in production management like lean production and quality management. Participants so far came mainly from Japanese, Taiwanese and Vietnamese suppliers of automotive components. As discussed in the previous section, this training programme was mentioned as one of the complementary knowledge sources mobilised by supplier B1 in the course of one of its important learning incidents.

Project-Based Collaboration

Although precise numbers were not available, the author's interviews suggested that such project-based collaborations between universities and firms were largely limited in both number and content. There were no cases of collaborative R&D or R&D-based consultancies. While HUT was occasionally engaged in small projects subcontracted from foreign firms in Vietnam, the bulk of these projects mainly involved short-term, problem-solving activities using the existing technology such as development of electroplating lines incorporating environmental treatment facilities. HaUI often received orders for production of jigs, screws and casks, which, if ordered to independent suppliers, could be very costly as they are not usually demanded in large quantities.

Despite the limited cases of formal university-enterprise collaboration, the interviews pointed to the possibility of many more instances of informal forms of collaboration that are bypassing the universities. As various complex assembly industries emerged in Vietnam, an increasing number of university professors have set up private businesses producing components, dies or molds or providing relevant services. For firms, it is often faster and more flexible to work directly with these businesses. Although the precise numbers could not be obtained, it was suggested there were many instances where faculty members used their personal connections with foreign firms to direct their orders to their private businesses.

7. Policy Recommendations

The findings presented in Sections 5 and 6 suggest the role of universities in Vietnam still focuses largely on the conventional area, i.e., education. For suppliers, recruiting educated human resources is critical in laying the basic foundation for undertaking various innovative activities, yet it is rarely a direct trigger to specific innovation events. In the meantime, other forms of university-industry linkages, particularly joint R&D projects with firms, remained largely limited in both quantity and content. These results are roughly consistent with the findings of the previous section on the sources of knowledge mobilisation by local suppliers.

In the early years of Vietnam's market-oriented reforms and open door policy, universities acted an important knowledge centre in engineering technology. This is evident from the fact that HUT was selected by a Japanese mold/die company as the base for developing human resources for designing and manufacturing dies/molds in the early 1990s. However, over the last two decades, while universities have failed to keep up with the practical needs of the industry, increased access to diverse knowledge sources—both within Vietnam and abroad—opened up for firms in the automotive industry. As a result, firms have increasingly sought to develop direct linkages with foreign firms and/or non-firm agents, largely "bypassing" local universities.

On the basis of the analysis in this paper, the following sets of policies are recommended in order for universities to play stronger roles in promoting production and innovative activities of firms in the automotive industry,

The first set of recommendations concerns the national-level policy agenda.

- The issue of developing university-industry linkages should be addressed in Vietnam's science and technology policy agenda. While this has never been done in the past, the growing need for accumulation of innovative capabilities calls for greater roles played by non-firm innovation-supporting agents—in addition to firm agents that already play dominant role in the sectoral innovation system in the Vietnamese automotive industry.
- Although universities have been made more independent over the previous years, they still lack autonomy in their operations. They are still subject to many regulations imposed by the Ministry of Education and Training. Public universities, in particular, are subject to salary ceilings and personnel management and financial regulations, which significantly limit the scope of the activities that could be implemented by the universities. In order for universities to develop stronger linkages with the industry, more autonomy needs to be granted to national universities concerning the scope of their activities and programmes. In addition,

as a precondition for providing incentives to universities and university professors (see the second group of recommendations below), it is essential to grant greater flexibility in universities' personnel and financial management.

The second set of recommendations concerns the incentive structure. While the cases of training programmes and internship programmes proposed by firms (see Section 6.2) illustrates that there exists persistent interest from the firms' side in collaborating more closely with local universities, there was apparent lack of interest on the universities' side. Because of the current system that places emphasis on the teaching programmes, university staffs face heavy teaching and administrative workload and therefore have neither the time nor the incentive to interact with firms. The lack of financial incentive also explains why project-based collaborations seem to be increasingly "bypassing" universities.

- In line with the emphasis on university-industry linkages in the national science and technology agenda, universities' performance needs to be evaluated on the basis of a broad range of contributions they make to the industry in addition to the existing set of criteria.
- The current system that rewards university professors on the basis of their teaching should be adjusted to reflect contributions and impact that the professors make to the industry.

The third set of recommendations concerns the ways of improving substantive activities and programmes implemented by the universities.

- As a broader attempt to accommodate the industry's needs into the programmes and activities, universities should engage in closer dialogue with the industry.

- Considering that universities are mandated to educate and train students, priority of action should be on improving educational and training programmes. Specifically, universities should reflect on the industry's practical needs into the contents of their teaching curriculum. HaUI's initiatives at reflecting on suggestions from enterprises in improving the university's teaching curriculum[8] can be seen as an important initial step in this direction.

The fourth set of recommendations relates to the measures to improve the universities' capacities. In order for universities to continue to serve as technological hubs for the Vietnamese industry—as they used to be in the early 1990s, their resources need to be upgraded substantially.

- Universities consistently suffer from limited number and low qualification of teaching staffs, which have resulted in excessive workload on the incumbent staffs, and outdated facilities. The human and physical resource constraints need to be addressed urgently, as they directly influence the prospects for improving the quality of the teaching and training programmes discussed above.

8. Conclusions

This paper sought to explore whether the sectoral system of innovation and production in the Vietnamese automotive industry functioned in such a way that encourages accumulation of innovation and production capabilities on the component

[8] Every three years, HaUI reviews its teaching curriculum on the basis of comments and suggestions from firms (the author's interview in November 2010).

supply base. To this end, analysis on the nature of knowledge flows between firm and non-firm agents was conducted in two complementary steps. The first step focused on the firms' side. Attempts were made to identify where the local component suppliers mobilised knowledge for acquisition of new production and innovation capabilities. The second step turned the focus to the non-firm agents. It looked specifically into the nature of linkages that two major technological/industrial universities developed with firms in the automotive industry.

In the initial step, systematic, empirical analysis on the sources knowledge in suppliers' acquisition of new production and innovation capabilities found that knowledge sources for suppliers were in fact limited primarily to firm-internal sources and, in some instances, external firm agents—often foreign companies in Vietnam or companies abroad. Particularly in suppliers in Japanese value chains, lead firms played powerful roles in guiding and assisting the suppliers' capability formation processes. In the meantime, the roles played by non-firm agents were found to be extremely limited. Universities were found to be playing complementary roles in only two of the 44 learning events analysed in this paper.

The second step turned the focus to the non-firm agents. The case studies of two major technological/industrial universities revealed that the two universities so far have contributed to capability formation in the automotive industry primarily in the form of providing qualified human resources, while other more direct forms of university-industry linkages have remained limited in both intensity and content.

On the whole, the sectoral system of innovation in the Vietnamese motorcycle industry has indeed come to be driven increasingly by firms over the past few decades. Vietnamese firms, in particular, are increasingly relying on linkages with foreign firms and non-firm agents, based in Vietnam or abroad, as sources of knowledge. On the basis of the empirical findings, this research presented policy recommendations at different levels: national-level policy agenda, incentive structure, specific programmes and activities, and the capacity on the part of the universities. Given the persistent interest shown by automotive firms in engaging with local universities, it is imperative to realign the national-level policy agenda and the structure of incentives so as to meet the increasing need for greater roles to be played by non-firm agents in promoting accumulation of innovative capabilities in this strategic industry.

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Appendix. List of Learning Events

Supplier	Event #	Event title	Stage of Industrial Development	Main Value Chain	Capabilities Acquired		
					New Product Introduction	Equipment-related	Production Management
A1	1	Improving processing and production management capabilities for obtaining a contract to supply chain cases to HVN	1	HVN-1		X	X
A1	2	Improved processing and process design capabilities for higher product variety with higher precision levels for HVN	2	HVN-1		X	X
A1	3	Instituting organisational arrangement for making constant improvements in process design to meet HVN's tighter QCD requirements	3	HVN-1		X	X
A2	1	Improving processing and production management capabilities for obtaining a contract to supply toolboxes to HVN	1	HVN-1		X	X
A2	2	Improved processing and process design capabilities for higher product variety with higher precision levels for HVN	2	HVN-1		X	X
A2	3	Improved production management and establishing high-precision procesing lines at a new factory to meet tigheter QCD requirements	3	HVN-1		X	X
A3	1	Improving processing and production management capabilities for obtaining a contract to simple plastic components to HVN and VMEP	1	HVN-1		X	X
A3	2	Developing and instituting a company-wide management system for improved QCD performance; obtaining ISO 9001 certification without the assistance of external consultants.	3	HVN-1			X
A3	3	Upgrading the capacity to design and manufacturing plastic molds of higher precision; obtaining HVN's recognition as a supplier of plastic molds.	3	HVN-1		X	
A4	1	Improving processing and production management capabilities for obtaining a contract to supply sprockets to HVN	2	HVN-1		X	X
A4	2	Establishing and operating a new high-precision forging process to supply core engine components for Japanese first-tier supplier of HVN	3	HVN-2		X	X

Supplier	Event #	Event title	Stage of Industrial Development	Main Value Chain	Capabilities Acquired		
					New Product Introduction	Equipment-related	Production Management
A5	2	Setting up oprerations to source sub-components and assemble wire harnesses to be supplied to HVN.	2	HVN-1			X
A5	3	Improved production management to meet HVN's tighter cost reduction targets and environmental standards (obtaining knowledge and skills for mold maintenance for improved supplier management)	3	HVN-1		X	X
A6	1	Improving processing and production management capabilities for obtaining a contract to supply simple plastic components to HVN	2	HVN-1		X	X
A6	2	Setting up mold design and manufacturing operations; started to in-house production of molds to be used for manufacturing components for HVN.	3	HVN-1		X	X
A7	1	Setting up operations to design and manufacture dies and molds to be supplied to HVN and its suppliers.	3	HVN-2		X	X
A7	2	Improved production management to meet large orders with HVN's tighter lead time/delivery requirements.	3	HVN-1			X
A8	1	Improved production management practices in the course of supplying sub-components to a local first-tier supplier of HVN.	2	HVN-2			X
A8	3	Setting up high-precision forging lines for supplying core engine components to HVN.	3	HVN-1		X	X
A9	1	Developing a new plating line with improved production management practices for subcontracting plating process for Japanese and Taiwanese supplieres of HVN and YVN.	2	HVN-2		X	X
A9	2	Acquring the new plating technology (trivalent chromium plating) to meet the tighter environmental standard imposed by HVN.	3	HVN-2		X	X
A10	1	Improved mold design/manufacturing capability to supply plastic molds to Taiwanese & Japanese 1st tier suppliers of Japanese motorcycle manufacturers.	2	HVN-2		X	
A10	3	Improved production management to meet QCD requirements under a larger scale of orders; obtaining ISO 9001 certification.	3	HVN-2			X

Supplier	Event #	Event title	Stage of Industrial Development	Main Value Chain	Capabilities Acquired		
					New Product Introduction	Equipment-related	Production Management
A11	1	Improved processing and production management practices for supplying sub-components to first-tier Japanese suppliers of HVN and YVN.	3	HVN-2		X	X
A11	2	Improved processing and production management to realise higher precision level and shorter lead time required by customers.	3	HVN-2		X	X
B1	1	Reverse engineering and manufacturing metal stamped components to the order of local assemblers.	2	V-C	X		
B1	2	Improved processing and production management practices to obtain a contract to supply components to HVN.	2	HVN-1		X	X
B1	3	Improved production management to meet HVN's tighter QCD requirements, awarded as one of HVN's best suppliers in 2007.	3	HVN-1		X	X
B2	1	Improved processing capability to produce engine components for local assemblers.	2	V-C		X	
B2	2	Improved production management in preparing to obtain a contract to supply components to HVN.	3	HVN-1			X
B3	1	Reverse engineering and manufacturing aluminium diecast components to the order of local assemblers.	2	V-C	X	X	X
B3	2	Improved processing and production management practices to obtain a contract to supply components to a first-tier Japanese supplier of HVN.	2	HVN-2		X	X
B3	3	Improved production management and mold maintenance capacities for a new product to be supplied to the Japanese first-tier supplier of HVN.	3	HVN-2		X	X
B4	1	Improved design capability for regularly launching new designs of silencers incorporating cosmetic and functional improvements potentially demanded by local assemblers.	3	V-C	X		
B4	2	Improved production management to meet tighter QCD requirements for the first-tier Japanese supplier and to explore new customers of motorcycle components.	3	HVN-2			X
B4	3	Setting up mold design and manufacturing operations to explore new customers of motorcycle components.	3	HVN-2		X	

Supplier	Event #	Event title	Stage of Industrial Development	Main Value Chain	Capabilities Acquired		
					New Product Introduction	Equipment-related	Production Management
B5	1	Launching production of clutches to be supplied to local assemblers	2	V-C		X	X
B5	2	Meeting the precision and production management requirements of Japanese first-tier suppliers	3	HVN-2		X	X
C1	1	Reverse engineering and manufacturing metal stamped components to the order of local assemblers.	1	V-C	X	X	X
C2	1	Reverse engineering and manufacturing an increasing variety of engine components to the order of local assemblers.	2	V-C	X	X	X
C3	1	Acquisition of reverse engineering capability for producting silencers to the order of local assemblers.	2	V-C	X	X	
C3	2	Improved reverse enigneering and processing capability to meet design and quality requirements of local assemblers	3	V-C	X	X	
C4	1	Setting up assembly operations of shock absorbers to local assemblers	3	V-C	X		X
C5	1	Setting up production lines to manufacture motorcycle chains to be supplied to local assemblers	2	V-C	X		X

Note: Types of value chains and suppliers' positions are abbreviated as follows.

HVN-1: first-tier supplier of HVN

HVN-2: second-tier supplier of HVN

V-C: supplier in the Vietnamese-Chinese chain

Source: The author's interviews.