Production Networks and Technology Transfer: —Empirical Analysis Based on Survey Data for Companies in Southeast Asia—[*1]

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Abstract

Southeast Asian countries are active in infrastructure development and the introduction of preferential tax measures for trade and investment. Such policy measures have been implemented in anticipation of the development of new industries and industrial sophistication as well as the growth of local companies through the introduction of foreign technologies. Consequently, Southeast Asian countries have achieved high economic growth, even though the development of local companies has not necessarily been sufficient. There is a gap between the macroeconomic and microeconomic situations in terms of policy achievement, presumably because technologies transferred through trade and investment go mainly to multinational companies' subsidiaries, rather than to local companies, in Southeast Asia. If local companies cannot be expected to improve their capabilities for lack of learning ability, multinational companies will not make efforts to transfer technologies to them. In consideration of this problem, this paper first analyzes the correlation between inter-company technology transfer and innovation. As a result, it is confirmed that technical assistance brings beneficial effects mainly to process innovation, while developing cooperative inter-company relationships is essential for promoting product innovation. Next, the paper analyzes the correlation between continuous improvement (i.e., Kaizen) activities and technology transfer and makes clear the effectiveness of continuous improvement activities in the development of companies' basic learning ability and cooperation ability. These findings suggest the importance of international cooperation for local companies in introducing continuous improvement activities and developing inter-company cooperation capacity to promote innovations.

Keywords: technology transfer, continuous improvement activity, Kaizen, innovation, ASEAN

JEL Classification: M11, O15, O33, O53

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I. Introduction

Production fragmentation, or the second unbundling of production processes due to the development of information and communication technologies (ICTs), regional cooperation for trade, investment facilitation, and infrastructure development, is expected to increase the opportunity for companies to participate in international production networks and promote industrial development at the national and regional levels (ERIA 2015). One of the merits for companies to participate in international production networks is that companies will be able to have more opportunities to obtain new knowledge on the market, products and manufacturing and technologies from other companies participating in the production networks. Companies can learn from their customer and supplier companies and improve their own performance by establishing closer cooperative relationships rather than transactional relationships for buying and selling goods.

Industrialization in developing countries, particularly in East Asia, has been realized by supporting trade and investment promotion policies to attract multinational companies (MNCs). MNCs are expected to be involved in the development of new industries and export industries, as well as playing key roles in the development of supporting industries and local companies and facilitating technology transfer to local people and companies. In other words, policies to attract MNCs can make it easier for developing countries not only to secure access to overseas markets but also to obtain information on overseas situations and market needs. MNCs are also large buyers in business-to-business (B2B) transactions; therefore production expansion by MNCs can attract foreign direct investments (FDIs) by multinational suppliers in related industries. The concentration of multinational buyers and suppliers is likely to enable more local companies and people to obtain knowledge from these multinational companies.

Some local companies have grown into large international companies by leveraging technologies and knowledge transmitted to developing countries through international production networks. However, for local companies in developing countries, especially small and medium-sized enterprises (SMEs), it is not always easy to participate in international production networks and to establish inter-company linkages that involve technology transfer and knowledge creation. Therefore, many countries in East Asia have not achieved satisfactory results from local SME policies, and SME development has been an important policy issue.

This difficult situation for SME development in developing counties may be caused by the lack of skills and experiences of local SMEs. In order to establish a B2B transactional relationship, the seller must meet requirements from buyers in terms of quality, cost (price) and delivery, which are referred to as QCD. Many local SMEs cannot build transactional relationships with multinational buyers and therefore have not had opportunities to receive technology transfer because local companies, especially SMEs, cannot meet the QCD requirements due to lack of human power, capital and other resources. In developing countries where MNCs set up operations for low-cost production, both the manufacturing industry

and local companies are underdeveloped. Such developing countries in the early stages of industrialization have neither managers or skilled workers with experience in manufacturing nor local companies that can meet the high QCD requirements, especially quality standards, required by MNCs.

To overcome these problems for industrial development, many developing countries implement industrial workforce training and SME development policies in cooperation with foreign governments and MNCs and in parallel to foreign trade and investment promotion policies. The Japanese government, its relevant organizations and Japanese companies also cooperate with developing countries to disseminate continuous improvement (in quality and productivity) or Kaizen activities that comprise the basis of manufacturing, in which Japan used to demonstrate an advantage.

Kaizen activities consist of various methods. Among them, 5S (sort, set, shine, standardize, sustain) activities in the workplace, including factories and small group activities for quality control (QC) improvement (i.e. QC circle), are considered fundamental for continuous improvement in company-wide quality management. For example, a Japanese auto parts company in Thailand, which the author interviewed, develops a training program and teaching materials at its own training center. Its Thai instructors teach Thai employees Japanese-style production philosophy and methods and instill an awareness of the importance of 5S and QCD.

An advantage of promoting Kaizen activities is that local companies without financial resources can adopt them by starting basic quality control activities such as 5S and QC circles that do not necessarily involve large-scale capital investment. Kaizen activities have been widely recognized as methods that contribute to cost reduction even in cost-efficient organizations. However, critics against 5S activities raise doubts that cleaning of the factory may not lead to innovations. In order to consider the appropriateness of these views, it is necessary to understand the mechanism of innovation creation and the direct and indirect contributions and limitations of Kaizen activities to innovations.

This article focuses on companies in Southeast Asia, including local and foreign-affiliated companies, in order to investigate (1) the impact of inter-company technology transfer (mainly from customer to supplier companies) through production networks on supplier innovation and (2) the influence of the adoption of Kaizen activities on the establishment of inter-company relationship that can lead to technology transfer. By combining and interpreting the results of these analyses, this study will consider the effects and limitations of Kaizen activity promotion as a policy tool for facilitating the participation in international production networks and introduction of new technologies through customer-supplier relationships by companies in Southeast Asia.

The structure of this article is as follows. Following Section I, which describes backgrounds and purpose of this study, Section II reviews prior research related to innovation, quality control, and inter-company linkage to derive hypotheses. Section III presents the methods to examine the hypotheses. Section IV shows regression results. Section V discusses policy implications derived from the empirical results and other related cases of Japanese

firms operating in Southeast Asia.

II. Literature review and hypotheses

II-1. Definition of innovation

Innovation, which is one of the main research focuses of this article, has recently attracted more interest from researchers and practitioners as a necessary condition to secure sustainability of company competitiveness and national economic development. Among various definitions of innovation, the third revision of Oslo Manual (OECD 2005) has provided a widely used definition of innovation. Many countries in the world have referred to the Oslo Manual as a source of guidelines for developing official statistics and data analysis on innovation in industry, even though the manual was updated in 2018.

The Oslo Manual (OECD 2005) categorizes innovation into four types: product innovations, process innovations, organizational innovations and marketing innovations. Among these types of innovations, product and process innovations used to be classified as technological innovation. Innovations are also categorized into radical and incremental, according to the degree of novelty.

Innovations defined by the Oslo Manual must be changes involving a significant degree of novelty for the company. However, innovation for the Manual covers a wide-ranging degree of novelty from innovations new to the company to those new to the world.

According to this definition, introduction and learning from other companies about products, processes, organizations, and management methods is considered innovation for the company even if they have been already introduced by other companies. Therefore, the adoption of the Kaizen activities can be interpreted as innovation. The Oslo Manual supposes that the learning process in adopting an innovation can lead to subsequent improvement in innovation and to the development of new products, processes and other innovations (OECD 2005; 18), irrespective of the degree of novelty of the innovation.

This study investigates associations among Kaizen and other innovation activities, based on the definition of innovation by the Oslo Manual. It should be noted that technologies introduced to developing countries through intra-firm networks may not be considered innovation at the company level. However, this study considers intra-firm technology transfer as innovation if the transferred knowledge is new to the recipient affiliate in developing country. A MNC transfers technologies not only new to individual employees of its overseas subsidiaries but also new to the host countries in which the subsidiaries operate. Even if the technologies are known at the company level, it may be necessary for the company to adjust local environments when introducing them to developing countries. Taking such situations in developing countries into consideration, this paper investigates factors promoting innovation, including intra-company technology transfer.

II-2. Factors promoting innovation

Although the innovation process is complex, a fundamental input into innovative activities is knowledge. Klette and Kortum (2004) proposed a company's innovation production function that has two arguments: investment in research and development (R&D) and knowledge capital, which represent skills, techniques, and know-how accumulated within the company. As this function assumes, many companies, especially large companies, have developed new products and production processes, utilizing existing technologies available in the company and new technologies developed by their R&D department.

According to this innovation production model, the government can support innovation by promoting corporate R&D spending and accumulating knowledge capital within the company. However, since Schumpeter described innovation as new combinations, new technology development through in-house corporate R&D activities is not considered essential for innovation. In recent years, such closed innovation that relies solely on resources available within an organization tend to be viewed as disadvantages in developing and commercializing new technologies and products that meet market needs in a short period of time. On the other hand, recent innovation approaches emphasize benefits for an organization from open innovation, which promotes acceleration and commercialization of innovation by collaborating with external organizations, combining technologies available inside and outside the organization, and disclosing own technologies outside the organization (Chesbrough 2006; JOIC & NEDO 2018).

Open innovation realizes innovation by combining externally and internally available technologies and knowledge. Open innovation involves the process of searching, acquiring and utilizing external technologies. Therefore, in order to adopt the open innovation process, companies need to acquire organizational capabilities necessary for introducing and utilizing external technologies. The concept of absorptive capacity proposed by Cohen and Levinthal (1990) is useful for understanding such organizational capability.

II-2-1. Company's absorptive capacity

According to Cohen and Levinthal (1990), absorptive capacity is the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends. It can be conceptualized at the individual and organizational levels.

Although the development of absorption capacity requires external knowledge, brief exposure of personnel to external knowledge does not necessarily improve their individual absorption capacity. An individual's absorption capacity depends on prior knowledge and efforts for absorbing it, as well as a diversity of knowledge accumulated in the past. Prior knowledge promotes the learning of relevant new knowledge, and learning experiences enhance learning capability. Prior knowledge includes those related to problem solving methods, which also enables improvement in problem solving capability. The improvement of learning capability involves the enhancement of the capacity to assimilate existing knowl-

edge, whereas the improvement of problem-solving skills leads to the improvement of a capacity to create new knowledge. An intensity of effort is also required to develop an absorption capacity.

Organizational absorptive capacity depends on individual absorptive capacity of the organizational members and organizational efforts for the development of individual absorptive capacities. Organizational absorptive capacity is not equal to a simple sum of individual absorptive capacities, and includes not only the ability to acquire external information but also abilities to assimilate and exploit it. The development of an organization's absorptive capacity necessitates knowledge transfer within and between sub-organizations within the organization, in addition to contacts and communications with external knowledge sources.

Therefore, personnel who can play a key role in the development of organizational absorptive capability are those who have accumulated the prior knowledge, learning capability and communication skills necessary for recognizing new knowledge and sharing learning outcomes of that knowledge within the organization. In order to develop organizational absorptive capacity, organizations need to foster experts, deploy them in the right place, and develop an internal mechanism to promote communications within the organization. As such a mechanism, companies dedicating to R&D activities introduce a cross-functional team composed of R&D, marketing, production, and other department or a cross-departmental job rotation for R&D personnel.

It can be supposed that a company creating new knowledge from R&D investment has succeeded in facilitating communications among R&D and other departments within the company and utilizing internally available knowledge effectively to develop absorptive capacity. These aforementioned discussions by Cohen and Levinthal (1990) indicate that absorptive capacity can be a byproduct of R&D activities.

II-2-2. External knowledge usage

According to Cohen and Levinthal (1990), companies can develop absorptive capacity through R&D activities to recognize values of external new knowledge and make use of it effectively. However, it is not difficult to find companies without R&D investment who introduce knowledge from external organizations. Although a limited number of companies invest in R&D in developing countries, companies can introduce knowledge new to the companies and their home countries mainly from foreign sources to make the existing business more competitive or to enter new businesses. In many situations, companies in developing countries cooperate with foreign organizations to introduce new knowledge. This fact suggests that a company's ability to recognize external knowledge can be differentiated from an ability to introduce it through cooperation with an external organization.

(1) Inter-organizational cooperation capacity

It is realistic to think that a company needs to cooperate with external organizations who own valuable knowledge new to the company when introducing it. Considering that a purpose for a company to build a strategic alliance with other companies is to acquire knowl-

edge, Konno (2007) emphasized the importance of alliance capability, which is a firm's ability to acquire knowledge through strategic alliance and to make effective use of such knowledge within the firm in order to generate innovations. According to Konno (2007), the alliance capability is based on absorptive capacity conceptualized by Cohen and Levinthal (1990), although absorptive capacity does not necessarily assume an inter-company partnership to access external knowledge.

Lane and Lubatkin (1998) extended absorptive capacity of Cohen and Levinthal (1990) to the relative capacity of a company compared with another company to conceptualize relative absorptive capacity. Lane and Lubatkin (1998) argued that a company's ability to learn from another company (i.e., relative absorptive capacity) depends on the similarity of both companies' (1) knowledge bases (i.e., basic and specialized knowledge), (2) knowledge processing systems (i.e. organizational structures and compensation policies), and (3) dominant logics (i.e., organizational problem set). This argument suggests that even if a company has a business relationship with another company, knowledge transfer between them will not always be realized. By having a partner company with a common knowledge base, organizational structures, and management issues, a company can acquire knowledge possessed by the partner, make effective use of it, and develop the ability required to create innovations.

(2) Intent and willingness to learn

Effective realization of inter-company knowledge transfer requires certain level of capabilities for both knowledge transferor (i.e., teacher) and transferee (i.e., student) companies. A company willing to introduce knowledge from its partner company can acquire learning opportunities with the partner by constructing the knowledge base and organizational structure necessary for knowledge introduction.

However, the acquisition of learning opportunities and learning ability do not always lead to real learning. If a student company does not have a willingness to learn from a teacher company, the teacher's effort cannot result in a learning of the student company. Unlike school education, inter-company cooperation and knowledge transfer cannot be established without benefits to both the teacher company and the student company. If the teacher company cannot expect educational effects on its student company, the teacher will find no merit to teach the student company and does not transfer knowledge.

Previous studies point out that intent and willingness to learn affect effective use of external knowledge (Hamel 1991; Senge 1990). According to Hamel (1991), learning by a student company through collaboration with its teacher company depends on intent of learning and competence acquisition, as well as factors such as transparency and receptivity that affect collaboration with the teacher company. In addition, independence from the teacher company of the student company depends on the understanding of related knowledge by the student company and investment in learning, as well as establishment of the disciplines of continuous improvement. Senge (1990) also points out that the learning organization has five disciplines (i.e. personal mastery, mental models, shared vision, team learning, systems thinking).

II-3. Kaizen activities and inter-company knowledge transfer

What kind of management practices do companies need to adopt in order to promote inter-company collaboration and learning? What kinds of management practices do companies who achieve innovations through inter-company learning tend to adopt? The aforementioned theoretical considerations suggest that in order to utilize external knowledge and create innovation through inter-company collaborations companies need to promote the development of (relative) absorption capacity and organizational learning. It seems that promotion of organization learning can be realized by inculcating the disciplines necessary for learning into an organization or an individual who constitutes the organization.

The need for continuous improvement and learning organization and the importance of disciplines for these developments tend to be associated with quality management in practical situations. Quality control (QC) has been emphasized as activities that form the basis of continuous improvement and learning by the previous related research that has presented relationships between total quality control (TQM) and learning (Terziovski, Howel, Sohal, & Morrison 2000; Hung, Lien, Yang, Wu, & Kuo 2011; Lam, Lee, Ooi, & Lin 2011).

TQM aims at improving not only quality but also efficiency of entire operations in a company at the individual and organizational levels; it also aims to enhance company-wide productivity and performance. TQM of an organization is a set of customer-oriented activities used to realize continuous improvement with the full participation of personnel working for the company. This managerial approach implements various scientific methods, including statistical quality control and staff training at a company-wide level to achieve goals shared among all personnel.

TQM is a company-wide activity and has evolved from QC activities that have been carried out mainly in manufacturing settings. At manufacturing sites in Japan, 5S and QC circle activities are widely adopted as the basis of QC activities. 5S has substantial effects for reducing wastes and improving work safety at manufacturing sites. QC circle activities are expected to have effects on continuous quality improvement at the production line and departmental level, customer satisfaction improvement, and the development of multi-skilled workers that allows more flexibility in production systems.

Although TQM contains scientific approaches to quality management, Japanese manufacturers tend to think that continuous improvement can be realized by instilling disciplines into employees through continuous activities for QCD improvement and fostering an organizational culture oriented to quality and customer satisfaction. Therefore, Japanese manufacturing companies emphasize as effects of 5S and small-group QC activities the enhancement of each employee's awareness, compliance with rules, work motivation and sense of responsibility, as well as trust building and improvement in communication and teamwork among employees.

It seems that such methods and views regarding QC activities are Japanese-style. However, the factors that are emphasized in QC activities in Japan are also considered to be effec-

tive in developing disciplines of continuous improvement by non-Japanese research. For example, Jamali, Khoury, and Sahyoun (2006) showed empowerment, commitment, communication, teamwork, trust, and flexibility are elements for learning organizations to develop the disciplines presented by Senge (1990). Although different countries may have different ways to instill disciplines into an organization and people, it is assumed that disciplines will affect the use of external knowledge and organizational learning, irrespective of country.

II-4. Hypotheses

The purpose of this study is to investigate the aforementioned theoretical backgrounds in the context of manufacturing companies in Southeast Asia. The focus of this study is placed on quality improvement activities and their relationships with inter-company cooperation and technological innovation (i.e., introduction of new products and new processes). Based on the discussions on related literature, this study develops the following three hypotheses regarding factors promoting technology transfer/collaboration between companies and innovations.

Hypothesis 1: Inter-company cooperation increases the possibility of creating innovation

A company participating in inter-company cooperation can have an opportunity to introduce new knowledge from its partner company. It is supposed that if the company has sufficient absorbing capacity, the company is more likely to achieve innovations by utilizing the transferred external knowledge and internal knowledge than companies without access to external knowledge.

This study categorizes inter-company cooperation into technology transfer and collaboration. Technology transfer is, literally, a transfer of knowledge from a teacher company to its student company, which is realized through assistance and advice to the student company by the teacher company. Thus, technology transfer assumes a one-way knowledge flow from a teacher company to a student company. Another characteristic of knowledge transfer is that the transferred knowledge is new to the student company but already known to the teacher company. On the other hand, collaboration emphasizes interactive knowledge exchange between companies to create new knowledge to both parties. The created knowledge through collaboration can be highly novel for both participating companies.

It should be noted that this study uses cross-sectional data for empirical analysis. Therefore it is not possible to investigate detailed dynamic process of absorptive capacity development. It can be assumed that a student company receiving technology transfer will improve its absorptive capacity by accumulating the knowledge acquired from its teacher company. As a result, the relative difference in capacity between the teacher company and the student company is reduced, the knowledge flow between them becomes more interactive, and the relationship between the two companies can be more collaborative.

However, the level of absorption capacity of individual participant companies in such cooperation may not necessarily affect the establishment of the collaboration, but can affect the content of the collaboration. This is because knowledge new to companies with lower absorptive capacity may be less novel and available without establishing close relationships with other companies.

Therefore, this study assumes that companies collaborating with other companies tend to have higher absorption capacity than companies that cannot establish inter-company collaboration. It is also assumed that inter-company collaborations will promote exchange and creation of more technically advanced knowledge and likely to contribute to achieving more technologically complex innovations than knowledge transfer will do.

Hypothesis 2: Implementation and deeper understanding of Kaizen activities increases the feasibility of inter-company cooperation

This paper hypothesizes that the adoption and consequent deeper understanding of Japanese-style continuous improvement activities help companies to develop absorptive capacity and a common knowledge base for QCD management, organizational structure and dominant logics, which promote inter-company technology transfer and collaboration. Therefore, it is also assumed that the diffusion of Kaizen activities will improve conditions for establishing inter-company cooperation.

The Japanese-style continuous improvement activities are based on 5S and QC circle activities. 5S is considered to be the most basic activity of QC activities, as it is said that "quality control starts and ends with 5S" in Japanese manufacturing sites. The 5S consist of such activities as sort, set, and shine and do not require the participants to have specialized skills and techniques. On the other hand, small group activities such as QC circles are developed to improve employee skills and techniques and solve problems. Therefore, companies can gradually increase the level of difficulty in skill development and tasks of QC circle activities.

Both 5S and QC circles improve communication and teamwork and promote knowledge sharing among employees. However, in the case of a QC circle, since the small group activity is carried out in an organizational unit or a group within the unit, experiences and knowledge acquired through problem solving activities may be shared only within the circle or the organizational unit. In order to reduce such problems, companies hold QC circle competitions to make QC circles more active and promote sharing of knowledge and success experiences across QC circles (i.e., horizontal deployment or Yokotenkai). Such mechanisms for knowledge sharing within a company can be extended to promote knowledge sharing across companies.

Therefore, this study assumes that both 5S and QC circle activities promote inter-company technology transfer and collaboration. Furthermore, it is also hypothesized that a company who attempts to diffuse their experience and knowledge obtained in a QC circle to a larger organizational unit can develop higher company-wide absorptive capacity and realize inter-company collaborations that involve the transfer, exchange, and creation of more com-

plex knowledge than companies that do not.

Hypothesis 3: Knowledge is not ubiquitous but difficult to transfer

The aforementioned observations based on the previous research on knowledge transfer and the prior two hypotheses assume that knowledge necessary for a company is possessed by its partner company. However, specific knowledge is not always ubiquitous. Rather, knowledge directly linked to corporate competitiveness is scarce. Such knowledge is more likely to be unevenly distributed among specific companies, people, and areas where they are located. In addition, knowledge is highly sticky, so that transferring and sharing it are not always easy. Therefore, direct and face-to-face communications are considered to be efficient and effective for transmitting undocumented and non-digitalized information and sharing ideas derived from experiences and intuitions.

Almost all developing countries need to introduce advanced technologies from external knowledge sources, mainly developed countries and MNCs. The distance between knowledge transferor and transferee used to be a matter for developing countries to introduce new technologies as face-to-face communications are effective for knowledge transfer (Kimura, Machikita, & Ueki 2016). On the other hand, the geographical areas of MNCs' business activities are also globalized. Consequently, knowledge sources accessible for developing countries are not limited to foreign countries. Rather, MNCs expanding overseas operations are becoming important knowledge transferors to developing countries. Local companies in developing countries who have introduced advanced knowledge from outside can share the knowledge with other local companies.

Therefore, this study does not develop hypotheses by a priori limiting knowledge sources to developed countries and MNCs. The entities or places where a particular technology is stored may depend on the type and application of the technology, which are to be identified by empirical analyses. On such assumption, this study takes an exploratory approach to identifying the knowledge sources and the transferred technologies.

III. Methods

III-1. Data

The empirical analysis of this study is based on the data obtained from a questionnaire survey conducted for companies operating in six industrial districts in the following five Southeast Asian countries: Indonesia (the Jakarta area), Lao PDR (around Vientiane and other major cities), the Philippines (the CALABARZON area), Thailand (the Bangkok area), and Vietnam (the Hanoi and Ho Chi Minh areas).

As part of an international joint research project on inter-company cooperation and technology transfer, the questionnaire survey was implemented by the Institute of Developing Economies (IDE) and the Economic Research Institute for ASEAN and East Asia (ERIA), in cooperation with universities and research institutes in the target countries, from January

to March 2015. As project implementation agencies, the IDE and ERIA developed a questionnaire in English with reference to the Oslo Manual. The research teams in each country translated the questionnaire into the local language, and they distributed and collected the questionnaire in the ways suitable for their own research environments. In countries where it is difficult to obtain a sufficient number of responses for statistical analysis by mail or e-mail alone, the survey teams collected the questionnaires by not only sending mail and e-mail but also making follow-up telephone calls or visiting companies, in order to obtain as many valid responses as possible.

As a result, the survey project obtained responses from a total of 1061 companies, which includes 181 responses from Indonesia, 207 from Lao PDR, 200 from the Philippines, 160 from Thailand, 313 from Vietnam (152 from Hanoi and 161 from Ho Chi Minh City). After excluding the respondents who did not answer questions used for the analyses in this paper, the number of observations available for the analysis in this paper is 894 (177 for Indonesia, 183 for Lao PDR, 175 for the Philippines, 65 for Thailand, and 294 for Vietnam).

III-2. Variables

The questionnaire survey included a variety of questions asking the respondent companies about attributes of the respondent companies (industry, size, etc.), innovation-related activities, quality control activities, technological information sources for innovation, and relationships with customers and suppliers. In Southeast Asia, response rates of questionnaire surveys are lower than in Japan, and companies tend to avoid providing figures that are the basis of taxation, such as sales and profits. In order to encourage companies to fill the questionnaire, respondents could complete the survey by answering two-alternative or Yes/No questions or selecting from a list of given choices. As a result of developing multiple-choice questions to obtain as many valid answers as possible, the types of variables used for this study are mostly dummy and categorical variables.

(1) Innovation

Since innovation can occur in any business activity, innovations can be defined according to research focuses. Considering the policy interests of developing countries in introduction of technologies, this study analyzed innovations involving the introduction of technologies related to production processes and products. Using the relevant questions in the survey, this study develops the two variables for process and product innovations, which are labeled as Process and Product respectively, as follows.

Process: The questionnaire survey asked the respondent companies to make a subjective assessment with a four-point Likert scale ranging from 0 to 3 regarding the extent to which they have improved during 2013-2014 in 11 production processes (i.e. defective product production, defective product shipment, raw material usage, labor input, lead time to new product introduction, unscheduled production line stop, work safety, delivery delay, cost, product quality variation, and produc-

tion changeover). The total value of the 11 variables was taken to develop the variable for Process. Therefore, the variable for Process can take values ranging from 0 to 33.

Product: The variable for product innovation is defined as a dummy variable regarding whether the respondent companies introduced a new product using a new technology during 2013-2014; this variable is coded as 1 if introduced and 0 otherwise. New technologies are defined as technologies new to the respondent companies. It should be noted that the novelty of the technology depends on the respondent companies.

(2) Inter-company cooperation (knowledge transfer and collaboration)

Companies can work on innovations in cooperation with various economic entities such as competitors, universities and research institutes. In the current situation in developing countries, few companies have a sufficient technology level, human resources and funds for developing innovative technologies by themselves. Companies who can take a teaching role are limited.

As the Cohen and Levinthal (1990) definition of absorptive capacity suggests, the main purpose of innovation for companies is to create benefits from the commercial use of new knowledge. Major challenges in corporate innovation activities are how to understand needs of markets and customers and provide products and services that can satisfy them. Companies can achieve innovation more certainly by establishing close relationships with customers and suppliers and acquiring information related to products and services that customers need. Innovation involves new technologies and the know-how necessary for realizing them.

In practice, MNCs have transferred technologies to local suppliers over a long period of time to increase local procurement from Southeast Asia. Nowadays, some local companies who have received technical assistance from foreign companies use other local companies as their subcontractors and play leading roles in providing local suppliers with technical assistance.

Based on the current situation in Southeast Asia, this study focuses on knowledge transfer from corporate customers. In the questionnaire survey, the respondent companies were asked to answer several questions regarding whether they have or do not have cooperative relationships with their main corporate customers. This study uses these questions to create dummy variables regarding (1) knowledge transfer from the main corporate customers to the respondent company, which is labeled as Assistance, and (2) collaborative relationships between these companies, which is named as Collaboration. These variables are defined as follows.

Assistance: A respondent company received technical assistance from its major customer (coded as 1 if received and 0 otherwise)

Collaboration: A respondent company collaborated with its major customer to design a new product (coded as 1 if collaborated and 0 otherwise)

In order to identify who transferred what technologies to a respondent company, the customer company is classified (1) by location (domestic/foreign) and (2) by capital (100% locally owned/foreign-owned), for each of which a dummy variable is defined. In this classification, "domestic" corresponds to a corporate customer located or operating in the country where the questionnaire survey was conducted (e.g., if the main customer of a respondent company in Indonesia is located in Indonesia, the customer is categorized as domestic, otherwise as overseas). Similarly, "locally owned" means a corporate customer 100% owned by the capital from the country where the questionnaire was conducted (e.g., if the main customer of a respondent company in Indonesia is owned by Indonesian capital, the customer is categorized as locally owned, otherwise as foreign-owned).

By combining these "domestic" and "locally owned" variables, a corporate customer is categorized into (3-1) domestic locally-owned (i.e., 100% locally owned customer operating domestically), (3-2) domestic foreign-owned (i.e., foreign-owned customer operating domestically), and (3-3) foreign (i.e., foreign-owned customer operating overseas). For each of these categories, this study defines a dummy variable.

To summarize the above, taking the variable for Assistance as an example, the following four variables, including the aforementioned dummy variable, are defined as follows.

Assistance: A respondent company received technical assistance from its major customer (coded as 1 if received and 0 otherwise)

Assistance (by location): A respondent company without technical assistance received from its major customer (coded as 0), a respondent company received technical assistance from its major customer operating in the same country (coded as 1), and a respondent company received technical assistance from its major customer operating in a foreign country (coded as 2). This categorical variable can be converted into dummy variables, for which the baseline case is a respondent company without technical assistance received from its major customer.

Assistance (by capital): A respondent company without technical assistance received from its major customer (coded as 0), a respondent company received technical assistance from its major customer owned by 100% local capital (i.e., the capital of the country in which the respondent company is located) (coded as 1), and a respondent company received technical assistance from its major customer owned by foreign capital (coded as 2).

Assistance (by location and capital): A respondent company without technical assistance received from its major customer (coded as 0), a respondent company received technical assistance from its major customer owned by 100% local capital operating in the same country (coded as 1), a respondent company received technical assistance from its major customer owned by foreign capital operating in the same country (coded as 2), and a respondent company received technical assistance from its major customer operating in a foreign country (coded as 3).

In the same way as the variable for Assistance, this study defines a dummy variable for

Collaboration and categorical variables for Collaboration (by location), Collaboration (by capital), and Collaboration (by location and capital).

(3) Kaizen activities

The questionnaire survey asked about the implementation of QC activities. In this study, the questions about whether a respondent company has or has not adopted 5S and QC circle activities that form the basis of the Japanese-style QC method were converted into dummy variables to use for regression analyses.

QC circle activities are based on small group activities. However, as mentioned above, a company can make use of experiences obtained through QC activities to improve its absorptive capacity efficiently, achieve innovations and enhance company performance efficiently and effectively by sharing successful or failing experiences of a small group among larger organizational units within the company (i.e., horizontal deployment or Yokotenkai). The questionnaire includes questions regarding not only whether a company has or has not adopted QC circles but also whether the company has or has not shared experiences of a QC circle across the company. This study uses these questions to define two dummy variables for the respondent companies who have adopted QC circle activities but have not shared their experiences across the company (labeled as QCC) and for those who have adopted QC circle activities and shared their experiences across the company (labeled as Horizontal deployment). For both dummy variables, the baseline case is companies who have not adopted QC circle activities.

In summary, the following three variables are considered as variables related to improvement activities in the analysis of this paper.

5S: A respondent company has adopted 5S (coded as 1 if adopted and 0 otherwise).

QCC: A respondent company has implemented QC circle activities without horizontal deployment (coded as 1 if implemented and 0 otherwise).

Horizontal deployment: A respondent company has shared QC circle experiences across the company (coded as 1 if shared and 0 otherwise).

(4) Control variables

The empirical study in this article performs regression analyses to verify the aforementioned associations between innovation, inter-company cooperation, and Kaizen activities. The regression analyses introduce the following control variables as factors that may promote innovations and the development of inter-company cooperation.

R&D expenditure: An ordinal variable for R&D expenditure made by a respondent company as a percentage of sales measured with a 4-point Likert scale (coded as 0 if no expenditure, 1 if less than 0.5%, 2 if 0.5 to 1%, and 3 if 1% or more).

ISO 9000: A dummy variable for the adoption of ISO 9000 by a respondent company (coded as 1 if acquired and 0 if not acquired).

Local company: A dummy variable for a respondent company owned by 100% local capital (coded as 1 if 100% locally owned and 0 if a joint venture or 100% for-

eign-owned).

Year of establishment: Year of establishment of a respondent company.

Capital size: A variable for capital size of a respondent company measured with a 10-point ordinal scale (coded as 1 if less than 10,000 USD, 2 if from 10,000 to 25,000 USD, 3 if from 25,000 to 50,000 USD, 4 if from 50,000 to 75,000 USD, 5 if from 75,000 to 100,000 USD, 6 if from 100,000 to 500,000 USD, 7 if from 500,000 to 1 million USD, 8 if from 1 million to 5 million USD, 9 if from 5 million to 10 million USD, and 10 if from 10 million USD or more).

Industry: A dummy variable for the main business of a respondent company classified into 20 industries.

III-3. Models and estimation methods

In order to examine the hypotheses developed in the previous section, this study develops regression models. It should be noted that the regression analyses do not verify causalities.

III-3-1. Relationship between innovation and inter-company cooperation

To examine Hypothesis 1, this study estimates the following regression of the variable for innovation on the variable for inter-company cooperation, which is labeled as Cooperation. The model includes a set of control variables, which are labeled as Others, as other factors than inter-company cooperation that may be associated with innovation.

$$\text{Innovation}_i = \alpha + \beta_1 * \text{Cooperation}_i + \beta_2 * \text{Others}_i + u_i \quad (1)$$

Two variables for innovation (i.e. Process and Product) were defined in the previous sub-section. The ordinary least squares (OLS) method is applied to the estimation of a regression model having Process as the dependent variable, whereas the probit estimation is applied to a model having Product as the dependent variable.

Inter-company cooperation has two variables broadly (i.e. Assistance and Collaboration) as defined in the previous sub-section. This study introduces one of these variables individually in the regression model. If a variable for the inter-company cooperation variable is significantly correlated with Process innovation, it is assumed that knowledge related to process innovations is transferred to a respondent company from its main cooperating customer.

To examine Hypothesis 3, this study uses the variables for inter-company cooperation, which were defined according to location, capital, and combinations of location and capital of a respondent firm‘s main cooperate customer, as independent variables. For example, when the variable for Assistance (by location) is used as the independent variable, the regression model has two main independent variables: (1) a dummy variable for technical assistance to a respondent company by its main corporate customer operating in the same country as the respondent company and (2) a dummy variable for technical guidance to a respondent company by its main corporate customer operating in foreign countries. Each of these dummy variables is coded as 1 if the respondent received assistance from its main

customer operating domestically/overseas and 0 otherwise (i.e., for both dummy variables, the baseline case is no technology transfer from the main customer). It can be interpreted that the respondent company introduced knowledge necessary for a type of innovation from the domestic/foreign customer when the dummy variable is significantly correlated with the innovation type.

III-3-2. Relationship between inter-company cooperation and Kaizen activities

In order to examine Hypothesis 2, this study develops a regression model with inter-company collaboration as the dependent variable and Kaizen activities as the main independent variable. The model includes the same control variables as the first model.

$$\text{Cooperation}_i = \alpha + \beta_1 * \text{Kaizen}_i + \beta_2 * \text{Others}_i + u_i \quad (2)$$

Among the variables relating to inter-company cooperation, the dependent variables are the categorical variables for a respondent's cooperation with its main customer classified by location, capital, and combinations of location and capital. Since these are categorical variables that take two or more values, a multinomial logit estimation is used as the estimation method. The baseline category for the multinomial logit models is the case where a respondent company has no cooperation with its main customer or no knowledge transfer through inter-company cooperation.

IV. Results

IV-1. Descriptive statistics

Table 1 shows descriptive statistics for the variables used for the first regression model to examine the association between innovation and inter-company cooperation. The mean values indicate that 18% of the respondent companies have introduced new products using new technology. About 33% of the respondent companies received technical assistance from their main customer companies (by location and capital, 12% received assistance from domestic locally owned customers, 9% from domestic foreign-owned customers, and 12% from foreign customers). Some 44% of the respondents collaborated with their main customers (by location and capital, 16% collaborated with domestic locally owned customers, 11% with domestic foreign-owned customers, and 17% with overseas customers) to design new products.

IV-2. Regression results

IV-2-1. Relationship between innovation and inter-company cooperation

Table 2 summarizes the OLS estimation results of the relationship between process innovation and technical assistance to respondent companies from their main customers. As shown in column (1), the estimated coefficient on technical assistance is significant at the 1% level, which indicates that respondent companies receiving technical assistance from

Table 1. Summary Statistics

	Mean	Std. dev.	Min.	Max.
Process improvement	12.625	7.570	0	33
New product introduction	0.181	0.385	0	1
Assistance from main customer	0.330	0.470	0	1
Locally owned customer	0.150	0.357	0	1
Foreign-owned customer	0.180	0.384	0	1
Domestic customer	0.213	0.409	0	1
Domestic locally owned customer	0.119	0.323	0	1
Domestic foreign-owned customer	0.094	0.292	0	1
Foreign customer	0.117	0.322	0	1
Collaboration with main customer	0.437	0.496	0	1
Locally owned customer	0.213	0.409	0	1
Foreign-owned customer	0.225	0.418	0	1
Domestic customer	0.264	0.441	0	1
Domestic locally owned customer	0.158	0.365	0	1
Domestic foreign-owned customer	0.106	0.308	0	1
Foreign customer	0.173	0.379	0	1
R&D	0.855	1.012	0	3
ISO9000	0.431	0.495	0	1
Local company	0.661	0.474	0	1
Year of establishment	1996.197	12.227	1894	2014
Capital size	7.274	2.256	1	10

Note: The number of observations is 894.

Table 2. Relationship between technical assistance from customers and process innovation (OLS)

	(1)	(2)	(3)	(4)
Customer	1.952***			
	(0.514)			
Locally owned customer		1.566**		
		(0.685)		
Foreign-owned customer		2.296***		
		(0.653)		
Domestic customer			2.492***	
			(0.620)	
Domestic locally owned customer				1.615**
				(0.770)
Domestic foreign-owned customer				3.617***
				(0.853)
Foreign customer			1.090	1.125
			(0.757)	(0.756)
R&D expenditure	0.542**	0.549**	0.523**	0.527**
	(0.240)	(0.240)	(0.240)	(0.240)
ISO9000	1.512***	1.463***	1.530***	1.436***
	(0.552)	(0.555)	(0.552)	(0.553)
Local company	-1.900***	-1.796***	-2.068***	-1.963***
	(0.557)	(0.570)	(0.567)	(0.568)
No. of observations	894	894	894	894
Adjusted R2	0.208	0.208	0.210	0.212

Notes: Other control variables are year of establishment, capital size and industry dummies. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

their customers tend to achieve process innovation. Column (2) is the estimation result when customer companies are classified by capital. The coefficients on technical assistance from 100% locally owned and foreign-owned customers are significant at the 5% and 1% levels, respectively. In column (3) where customers are classified according to location, the coefficient on technical assistance from domestic customers is significant at the 1% level, while technical assistance from overseas customers is insignificant. The estimation in column (4) categorizes customers by capital and location. The result shows that technology transfer from domestic locally owned and domestic foreign-owned customers is significant, but technical assistance from overseas customers is not significant. These estimation results indicate that domestic customers have given the respondent companies technical assistance to transfer knowledge necessary for process improvement.

Table 3 presents results of the analysis with the OLS on the association between process innovation and collaboration with customer companies for new product design. Column (1) shows that respondent companies who collaborated with their main customers in new product design achieve process innovations. The results in columns (2) to (4) suggest that the respondents tend to acquire and create new knowledge necessary for process improvement through collaborations for new product design with domestic foreign-affiliated customers and overseas customer companies.

Table 3. Relationship between collaboration with customers for new product design and process innovations (OLS)

	(1)	(2)	(3)	(4)
Customer	1.551***			
	(0.478)			
Locally owned customer		0.883		
		(0.599)		
Foreign-owned customer		2.236***		
		(0.605)		
Domestic customer			1.795***	
			(0.578)	
Domestic locally owned customer				1.070
				(0.688)
Domestic foreign-owned customer				2.886***
				(0.807)
Foreign customer			1.197*	1.224*
			(0.673)	(0.672)
R&D expenditure	0.501**	0.483**	0.500**	0.483**
	(0.242)	(0.242)	(0.242)	(0.242)
ISO9000	1.644***	1.609***	1.653***	1.611***
	(0.551)	(0.551)	(0.551)	(0.551)
Local company	-1.887***	-1.627***	-1.962***	-1.831***
	(0.558)	(0.575)	(0.567)	(0.570)
No. of observations	894	894	894	894
Adjusted R2	0.205	0.207	0.204	0.207

Notes: Other control variables are year of establishment, capital size and industry dummies. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The probit estimations in Table 4 examined the relationship between product innovation and technical assistance provided by customer companies. Column (1) indicates that respondent companies who received technical assistance from their main customers are more likely to achieve product innovation. Considering the results in columns (2) to (4) as well, it can be said that the respondent companies can acquire necessary knowledge for introducing new products through technical assistance mainly with their overseas customers.

Table 5 shows the relationship between product innovation and collaboration with customer companies for new product design. All the estimates in columns (1) to (4) present statistically significant associations between collaboration for new product design with customer companies and product innovation. Therefore, irrespective of location and capital of customers, the respondent companies could acquire and create new knowledge necessary to introduce a new product through collaboration for new product design with their customers.

IV-2-2. Relationship between inter-company cooperation and Kaizen activities

Table 6 summarizes estimation results of the second model with multinomial logit regression, which examined the relationship between technical assistance received by the respondent companies from their main corporate customers and Kaizen activities adopted by the respondents. The independent variable for the estimation (1) is Assistance (by capital) (i.e.,

Table 4. Relationship between technical assistance from customers and product innovation (probit, marginal effect)

	(1)	(2)	(3)	(4)
Customer	0.072**			
	(0.029)			
Locally owned customer		0.086**		
		(0.043)		
Foreign-owned customer		0.067*		
		(0.040)		
Domestic customer			0.020	
			(0.035)	
Domestic locally owned customer				0.013
				(0.043)
Domestic foreign-owned customer				0.030
				(0.050)
Foreign customer			0.162***	0.162***
			(0.053)	(0.053)
R&D expenditure	0.061***	0.061***	0.062***	0.062***
	(0.012)	(0.012)	(0.012)	(0.012)
ISO9000	0.067**	0.068**	0.067**	0.066**
	(0.030)	(0.030)	(0.030)	(0.030)
Local company	-0.028	-0.031	-0.012	-0.011
	(0.030)	(0.031)	(0.030)	(0.030)
No. of observations	894	894	894	894
Pseudo R2	0.171	0.171	0.178	0.178

Notes: Other control variables are year of establishment, capital size and industry dummies. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. Relationship between collaboration with customers for new product design and product innovation (probit, marginal effect)

	(1)	(2)	(3)	(4)
Customer	0.114***			
	(0.026)			
Locally owned customer		0.111***		
		(0.039)		
Foreign-owned customer		0.144***		
		(0.040)		
Domestic customer			0.117***	
			(0.038)	
Domestic locally owned customer				0.099**
				(0.048)
Domestic foreign-owned customer				0.160***
				(0.060)
Foreign customer			0.140***	0.141***
			(0.044)	(0.044)
R&D expenditure	0.053***	0.053***	0.053***	0.053***
	(0.012)	(0.012)	(0.012)	(0.012)
ISO9000	0.066**	0.067**	0.066**	0.067**
	(0.029)	(0.029)	(0.029)	(0.029)
Local company	-0.028	-0.021	-0.026	-0.022
	(0.029)	(0.031)	(0.030)	(0.030)
No. of observations	894	894	894	894
Pseudo R2	0.187	0.187	0.187	0.188

Notes: Other control variables are year of establishment, capital size and industry dummies. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Relationship between technical assistance from customers and Kaizen activities (multinomial logit)

	(1)		(2)		(3)		
	Assistance (by capital)		Assistance (by location)		Assistance (by location and capital)		
	Locally owned	Foreign-owned	Domestic	Foreign	Domestic, locally owned	Domestic, foreign-owned	Foreign
5S	-0.356	0.726***	0.054	0.612**	-0.401	0.605*	0.620**
	(0.250)	(0.243)	(0.219)	(0.288)	(0.282)	(0.317)	(0.288)
QCC	-0.039	0.417	0.076	0.343	-0.066	0.210	0.351
	(0.378)	(0.324)	(0.321)	(0.394)	(0.446)	(0.411)	(0.394)
Horizontal deployment	0.767***	0.165	0.357	0.478	0.688**	-0.060	0.471
	(0.264)	(0.258)	(0.238)	(0.305)	(0.305)	(0.329)	(0.306)
R&D expenditure	0.227**	0.138	0.258**	0.038	0.293**	0.271*	0.038
	(0.108)	(0.107)	(0.105)	(0.122)	(0.131)	(0.143)	(0.122)
Local company	1.210***	-1.051***	0.645***	-1.190***	1.423***	-0.000	-1.196***
	(0.302)	(0.243)	(0.245)	(0.283)	(0.366)	(0.318)	(0.283)
Year of establishment	-0.020**	-0.009	-0.009	-0.021*	-0.018**	0.006	-0.020*
	(0.009)	(0.009)	(0.008)	(0.011)	(0.009)	(0.012)	(0.011)
Capital size	0.140**	0.148**	0.107**	0.151**	0.144**	0.082	0.148**
	(0.056)	(0.058)	(0.053)	(0.065)	(0.067)	(0.077)	(0.065)
No. of observations	894		894		894		
Pseudo R2	0.182		0.211		0.235		

Notes: The baseline category is the respondent companies without technical assistance from their customers. Other control variables are year of establishment, capital size and industry dummies. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

technical assistance provided by the customers classified by capital). The estimation result shows (1) the positively significant coefficient on horizontal deployment for the respondents receiving assistance from 100% locally owned customers, indicating the respondent companies who promote horizontal deployment of experiences of a QC circle are more likely to receive technical guidance from local customers than those without horizontal deployment, and (2) the positively significant coefficient on 5S for the respondents receiving assistance from foreign-owned customers, which suggests that respondents who have adopted 5S tend to receive technical assistance from foreign-owned customers, compared to the respondents that have not implemented 5S. The independent variable for the estimation (2) in Table 6 is the variable labeled as Assistance (by location), which categorized technical assistance to the respondents from their customers by location of the customers. In the same way to interpret the estimation result, the regression model suggests that respondents who received technical assistance from overseas customers tend to adopt 5S. Estimate (3) used the variable for technical assistance from customers classified according to their location and capital as independent variable. Consistent with the previous two estimation results, domestic, 100% locally owned customers provide technical assistance to the respondents promoting horizontal deployment of QC circle experiences, whereas domestic, foreign-owned and overseas customers provide the respondents conducting 5S receive technical assistance.

Table 7 shows the results of multinomial regression analyses on the association of collaboration in new product design between the respondents and their customers and Kaizen activities conducted by the respondents. The results of estimations (1) to (3) suggest that com-

Table 7. Relationship between collaboration with customers for new product design and Kaizen activities (multinomial logit)

	(1)		(2)		(3)		
	Collaboration (by capital)		Collaboration (by location)		Collaboration (by location and capital)		
	Locally owned	Foreign-owned	Domestic	Foreign	Domestic, locally owned	Domestic, foreign-owned	Foreign
5S	0.044	0.443**	0.188	0.316	0.025	0.456	0.323
	(0.213)	(0.218)	(0.203)	(0.253)	(0.240)	(0.293)	(0.253)
QCC	-0.005	-0.029	0.109	-0.353	0.072	0.170	-0.351
	(0.289)	(0.318)	(0.292)	(0.353)	(0.344)	(0.419)	(0.353)
Horizontal deployment	0.317	0.520**	0.419*	0.247	0.330	0.591*	0.253
	(0.224)	(0.239)	(0.225)	(0.260)	(0.264)	(0.323)	(0.260)
R&D expenditure	0.196**	0.336***	0.285***	0.256**	0.231*	0.366***	0.257**
	(0.096)	(0.097)	(0.098)	(0.105)	(0.119)	(0.133)	(0.105)
Local company	1.022***	-1.027***	0.582***	-1.025***	1.219***	-0.072	-1.025***
	(0.255)	(0.223)	(0.225)	(0.248)	(0.309)	(0.298)	(0.248)
Year of establishment	-0.001	0.012	0.012	-0.003	0.007	0.020*	-0.003
	(0.008)	(0.009)	(0.008)	(0.010)	(0.009)	(0.012)	(0.010)
Capital size	0.065	0.032	0.056	0.033	0.084	0.010	0.031
	(0.048)	(0.050)	(0.049)	(0.054)	(0.059)	(0.070)	(0.054)
No. of observations	894		894		894		
Pseudo R2	0.129		0.205		0.210		

Notes: The baseline category is the respondent companies without collaboration with their customers. Other control variables are year of establishment, capital size and industry dummies. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

panies conducting horizontal deployment of QC circle experiences tend to collaborate in product design with their foreign-owned customers, especially domestic foreign-owned customers. However, it should be noted that the coefficients on the variable for horizontal deployment estimated by the models (2) and (3) are only significant at the 10% level. Estimation (1) presents the association between collaboration in product design with foreign customers and the adoption of 5S at the 5% significance level, although estimation (2) and (3) show no significant relationship between these variables.

V. Conclusions and policy implications

This study performed the regression analyses to investigate (1) the relationship between technology transfer to respondent companies through inter-company cooperation with their customers and innovations achieved by the respondents. By classifying customers according to their location (i.e. domestic or foreign) and capital (i.e. locally owned or foreign-owned), this study attempted to identify in the exploratory ways what knowledge are transferred to companies in Southeast Asia from whom. Furthermore, this study conducted exploratory analyses on (2) the relationship between the inter-company cooperation and the adoption of Kaizen activities to identify Kaizen methods that may promote the development of the inter-company cooperation. The results of the regression analyses can be summarized as follow.

The analysis on the association between technical assistance and process innovation showed that companies in Southeast Asia introduce knowledge through technical assistance from domestic customers to realize process innovation. This finding indicates accumulation of process-related knowledge in Southeast Asia as a result of the progress of industrialization. The estimated relationship between technical assistance and product innovation indicated that international technology transfer leads to the introduction of new products. This result suggests that companies in Southeast Asia still need to introduce product-related technologies from abroad.

The analysis on collaboration in product design and product innovation found that companies conducting collaborations with their customers can acquire product-related technologies from their partners, regardless of location or capital of the customers. However, from the analysis on the association between collaboration in product design and process innovation, it was also confirmed that companies in Southeast Asia depend on transfer of technologies and know-how related to manufacturing of new products from foreign customers within and outside the country where the respondent companies operate.

The findings from the analyses on the relationship between inter-company cooperation and innovations described above can be summarized as follows. Companies in Southeast Asia can acquire process and product- related technologies, which are not new and have already been widely recognized, through cooperation with domestic companies, including locally owned companies. However, if novel technologies and knowledge are required for innovation, companies need to introduce such technologies from domestic foreign-owned

companies or from abroad (i.e., MNCs). Irrespective of the novelty level of technologies necessary for innovations, companies in Southeast Asia can increase the possibility of achieving innovations by promoting cooperation with their customers.

The results of the analysis on the association between inter-company cooperation and Kaizen activities showed that companies in a country who have adopted 5S tend to receive technical assistance from foreign companies operating in and outside the country. However, the correlation between the 5S adoption and collaboration in product design with foreign companies is not necessarily robust. Nevertheless, adoption of 5S will strengthen cooperation with foreign-owned companies.

The results also suggested that horizontal deployment of QC circle experiences may promote technical assistance by domestic local companies and collaboration in product development with domestic foreign-owned companies. However, it should be noted that statistical relationships between these variables include those supported at the 10% significance level. The more obvious result was that innovations were not correlated with QC circle without horizontal deployment. As suggested by previous related research, quality improvement activities will be able to result in innovations only when deployed on a company-wide basis.

Activities like 5S, which are not directly related to the transfer of production technology, contribute to the development and improvement of the capacity to cooperate between companies and lead to inter-company cooperation involving transfer of technologies related to production processes and products. It seems that basic quality control methods, including 5S, are easy for local SMEs to adopt, especially when they embark on innovations, as companies do not have to bear a large capital investment burden in the adoption of such methods. In addition, since the concept of the methods is widely known, companies can support other companies without having much concern about the leakage of technologies and know-how. Such characteristics of quality control management promote the diffusion of Kaizen activities along customer-supplier linkages.

With respect to policy, these findings suggest that Japan can contribute to upgrading industrial activities in developing countries by promoting the Japanese-style quality control methods. The effects of Kaizen activities on building the basic capacity to cooperate between companies and improving the capacity, which is necessary to introduce external knowledge for innovative activities, may not have been sufficiently taken into consideration in Japan's technical cooperation planning. Japan's basic approach to technical cooperation used to transfer Japan's experiences to and dissemination through the local counterparts in developing countries. It is widely recognized that the support for industrial human resource training are useful for increase in QCD skill level of local employees and companies, productivity improvement of local companies, and the establishment of business relationships between local and Japanese companies. However, the improvement in inter-company cooperation capacity and the use of external knowledge contribute to self-sustaining and sustainable business improvement and industrial development. It is necessary to promote a new approach to international cooperation that takes its long-term effects on diverse capacity of companies into consideration.

The estimation results also indicate that technologies necessary for innovations are not necessarily ubiquitous in each Southeast Asian country and that face-to-face communications between companies are conducted to facilitate knowledge transfer. International technology transfers among developing countries through the movement of people were also reported in case studies of technology transfer from China to Southeast Asia and from Thailand to its neighboring countries, which are called "China Plus One" or "Thailand One" respectively (Machikita & Ueki 2013; Norasingh, Machikita, & Ueki 2015). Therefore, even if a company agreed to establish an inter-company cooperation, technologies would not be efficiently transferred between the companies without freer movement of people, including trainers, trainees and engineers. From the viewpoint of technology transfer facilitation, it is necessary to recognize physical and institutional infrastructure development as the issue of international cooperation for promoting innovations.

Although the aforementioned interpretation of the regression results did not pay attention to control variables in the models, the variable for R&D spending shows a positive correlation with innovation and inter-company cooperation in most of the estimations. These results indicate that R&D investment will become necessary for realizing innovations and the establishment of inter-company cooperation that involve transfer of relatively advanced technologies such as the introduction of new products using new technologies and collaboration in new product design. Companies can start with Kaizen activities to acquire the necessary capacity for innovations. However, they will need to expand such activities for innovations to R&D activities in accordance with the improvement in their absorptive capacity. Governments also need to refine their programs to support private efforts for innovations according to the companies' capacity level.

Finally, the limitations of this study should be pointed out. First, the regression analyses in this study only show correlations between the variables and do not verify causalities. Although rigorous examinations of causal relationships require panel data, it is quite difficult to construct panel data from questionnaire surveys by researchers and research institutes in Southeast Asia. The second important limitation is a possible sampling bias, which is associated with a constraint in the questionnaire survey. Even if companies are randomly extracted to distribute a questionnaire, companies with higher absorptive capacity may be more likely to respond to the questionnaire than those with lower capacity. As a result, the obtained data may not reflect the overall situation. Future development and publication of official innovation statistics will allow us to overcome these data problems and conduct more rigorous panel analyses.

References

Chesbrough, H.W. (2006). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business Press.

Cohen, W.M. & Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), pp. 128-152.

ERIA (2015). *The Comprehensive Asian Development Plan 2.0 (CADP 2.0): Infrastructure for Connectivity and Innovation*, ERIA Project Report 2014 No.4, Jakarta: ERIA.

Hamel, G. (1991). Competition for competence and inter-partner learning within international strategic alliances. *Strategic Management Journal*, 12(S1), pp. 83-103.

Hung, R.Y.Y., Lien, B.Y.H., Yang, B., Wu, C.M., & Kuo, Y.M. (2011). Impact of TQM and organizational learning on innovation performance in the high-tech industry. *International Business Review*, 20(2), pp. 213-225.

Jamali, D., Khoury, G., & Sahyoun, H. (2006). From bureaucratic organizations to learning organizations: An evolutionary roadmap. *The Learning Organization*, 13(4), pp. 337-352.

Japan Open Innovation Council (JOIC) & New Energy and Industrial Technology Development Organization (NEDO)(2018). *The Second Edition of the White Paper on Open Innovation*. Tokyo: Research Institute of Economy, Trade and Industry. (in Japanese)

Kimura, F., Machikita, T., & Ueki, Y. (2016). Technology transfer in ASEAN countries: Some evidence from buyer-provided training network data. *Economic Change and Restructuring*, 49(2-3), pp. 195-219.

Klette, T.J. & Kortum, S. (2004). Innovating firms and aggregate innovation. *Journal of Political Economy*, 112(5), pp. 986-1018.

Konno, Y. (2007). Innovation creation and building of alliance capability: From a relation with strategic alliance ad knowledge-based approach. *Mita Business Review*, Vol. 50 No.3 (2007.8), pp. 365-383. (in Japanese)

Lam, S.Y., Lee, V.H., Ooi, K.B., & Lin, B. (2011). The relationship between TQM, learning orientation and market performance in service organisations: An empirical analysis. *Total Quality Management & Business Excellence*, 22(12), pp. 1277-1297.

Lane, P.J. & Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal*, 19(5), pp. 461-477.

Machikita, T. & Ueki, Y. (2013). Knowledge transfer channels to Vietnam for process improvement. *Management Decision*, 51(5), pp. 954-972.

Norasingh, X., Machikita, T., & Ueki, Y. (2015). South-South technology transfer to Laos through face-to-face contacts. *Journal of Business Research*, 68(7), pp. 1420-1425.

OECD (2005). *Oslo Manual Third Edition: Guidelines for Collecting and Interpreting Innovation Data*. Paris: OECD.

Senge, P. (1990). *The Fifth Discipline. The Art & Practice of Learning Organization*. Doupleday, New York.

Terziovski, M., Howel, A., Sohal, A., & Morrison, M. (2000). Establishing mutual dependence between TQM and the learning organization: a multiple case study analysis. *The Learning Organization*, 7(1), pp. 23-32.