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RESEARCH

How Capital Goods Firms Upgrade Innovation Capacity: A Case Study

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Abstract

Objective of the research is to reveal how networks upgrade innovation capacity and to derive policy suggestions necessary for enhancing capabilities for process improvements and innovations, including interactions between users and producers in capital goods industry. The case study results showed that: i) the main driver of technological learning in the capital goods companies is the vision of top management; ii) product innovation as the improvement of existing product can be the results of informal learning without doing formal R&D activity; iii) the limited co-operative arrangements among producer, supplier and consultant are sufficient for stimulating lower level of innovations, which is 'new to the firm' innovations — rather than 'new to the market'; and iv) the producers-users interaction in the forms of exchange in goods and information as well as cooperation will contribute to stimulate innovation in companies. Knowledge sharing through innovation network has a central role in upgrading innovation capacity. It implies that the necessary policies to intensify the wiring innovation network in capital goods industry are: i) the establishment of bridging institution or network broker for training, facilitating and mobilizing of network formation; ii) government financial assistance for hiring external experts/consultant to upgrade the innovation capacity of industry; iii) incentives (i.e.financial compensation, recognition and career advancement) for university and research institute professors working to upgrade the innovation capacity of industry; and iv) government consultancy services and/or subsidized consultancy services from universities/research institutions to upgrade innovation capacity of industry.

Keywords: innovation network, interactive learning, producer-user interaction; innovation capacity, policy

1. Introduction

1.1. Background and objective

Developing countries including Indonesia have attracted Foreign Direct Investment (FDIs) with cheap and ample labour forces for labour intensive assembling processes. Such FDIs together with imported intermediate and capital goods have helped Indonesia to realize industrialization. However, the industrial development in Indonesia has been dependent mostly on product and productive technologies brought in by Multi National Companies (MNCs). Most industries have had difficulties in understanding and absorbing such technologies and acquiring capabilities to develop unique technologies on their own.

On the other hand, Indonesia is facing a challenge at a crucial stage of transition from simple labour-intensive assembly base to more sophisticated production base. This is a matter of industrial upgrading. Capital goods are one of the elements necessary for upgrading of industries. The previous ERIA studies on production networks suggested the importance of purchasing new machineries to introduce new products and refining second-hand ones to improve production processes. In addition, at the national level, fostering capital goods industry is crucial for enabling their user sectors to develop unique products and production technologies (Interkumnerd, 2011). This year's study is going to shed light on sources of machines and related technologies necessary for product or process innovation and to identify where innovations related to machineries are occurring.

There may be several sources of improvement/ innovation in productive machineries. For example, i) Co-development of new capital goods between capital goods users firm and capital goods producers, universities or research institutions, etc; ii) Collaboration between user capital goods firms and capital goods producers, etc. to modify (upgrade) or customize standard machines; iii) In-house design of new processing machines, tools or jig by an user firm; iv) In-house modification of ready-made or second-hand machines, tools or jig by a user firm; v) Development of manufacturing sectors related to capital goods (machines and tools); and vi) R&D, collaborations, and innovation by capital goods producers.

There are four ways of analyzing the sources of improvement/innovation. First is "user-producer interaction (Lundvall) or user-led innovation (Von Hippel)." This corresponds to items (i)-(iv) listed above. Second is "production networks of capital goods industries in region, including collaborations between capital goods producers and universities/ R&D institutions which are closely related to (v) and (vi). Third are building users capabilities necessary for tuning/maintaining machines on their own. There would be firms who can produce exceptional-quality products using commercially available machines. Fourth is the process of users' learning or knowledge transfer from producers. Simple turnkey projects installing ready-made machines are not of this research interest. But how users adopt new production technologies is a relevant topic. This includes aspects of services provided by producers.

Objective of the research is to derive policy suggestions necessary for enhancing capabilities for process improvements and innovations, including the development of machinery industries and interactions between users and produces of such capital goods. Capital goods or productive machineries/tools consist of lots of sub-categories including general machinery, machine tool, specific machinery, and etc. Output of the research is to provide evidence based policy making on: i) how to develop machinery industries viewed from producer or user side; and ii) how to develop firm's capability necessary for managing internal and external resources to achieve process improvements.

1.2. Upgrading innovation capacity: an analytical framework

Innovation network

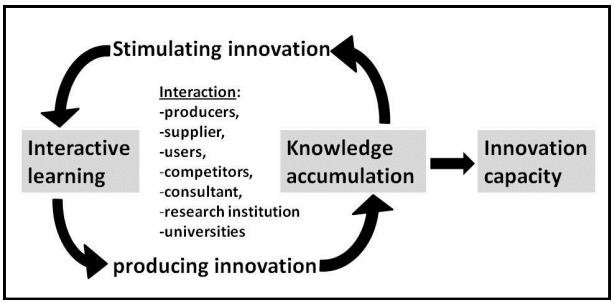
Innovation can be derived from interaction between producers and external agents (supplier, consumer, etc.). It is essentially seeing innovation from the network perspective. Innovation network basically argue that the innovation more as a collective efforts of firms rather than individual effort of a firm. The collective efforts among firms engage in cooperative arrangements involving producers, supplier, users, competitors, consultant, research institution and/or universities. Empirical evidence showed that the extent of co-operative arrangements for innovation appears to depend on the type of firms being considered and on what is meant by innovation. Firms that engage in R&D and that is attempting to introduce higher level innovations, i.e. 'new to the market' rather than 'new to the firm' innovations—are much more likely to engage in co-operative arrangements for innovation (Thether, 2002).

Innovation network can be seen as a medium to enhance the capability of learning in developing, assimilating and utilizing the knowledge, those include codified and tacit knowledge in the forms of expertise, skill and experiences. In the case of learning without R&D facility, innovation network is an alternative way to increase the absorptive capacity toward continuously developing knowledge. Furthermore, innovation network can be seen as a system for creating innovation, knowledge diffusion, opening market access, and technology sources as well reducing risk. Then, innovation network can be seen as a determinant factor in the firm life cycle. The individual cooperation inside the firm generally work at initial stage of development, furthermore social network plays important role at exploitation or growth phase, then interactions between producers and external agents (supplier and consumer) become the determinant factor of firm success in maturity phase. In short, innovation network becomes the factor of firm life cycle (Hernandez, 2011).

Network formation and innovative performance

The process of network formation is a long-term development of mutual and trusted relationship among actors. The pattern of relationship in a network is far beyond market relation, it also concerns about social and cultural relationship. While the types of relationships vary that depends on production, organization, internal and external activities of the firms. Vertical relationship in production chain can be in forms of joint venture and licensing. Furthermore horizontal relationship between organizations can be in forms of partnership and alliance. Then, internal relationship is for product development, design and engineering, while external relationship between firms based on trust (Fischer, 2006).

Network formation is basically a self organizing process to which the network develops naturally. It is therefore, the formation and development of network by social engineering will produced a network with uncertainty (Biggiero, 2001). There are two influential factors of innovative performance for the firm operating in network namely network formation and network configuration. The firm by network formation through bottom-up process and large network configuration will be more innovative in comparison with the top-down process of network formation and small configuration of network



Source: adapted from Lund (2004)

Graph 1. Interactive learning loop for upgrading innovation capacity.

(Thorgen, 2009). Interaction inside the network base on trust and interdependency will enhance the efficiency of firm operating in network (Ahlstrom-Soderling, 2003).

Building innovation capacity through interactive learning

All types of innovation including incremental innovation, product improvement and continues upgrading are stimulated by learning process, which are coming from close, intensive and regular interaction among producer, supplier and consumer. The sources of innovation vary from producer, supplier and user as innovators (vonHippel, 1988). Collaborative tie in vertical as well as horizontal linkage among firms will spur interaction and exchange of expertise in network, which is important to enhance the firm innovative capability (Lundvall, 1995). A strong tie in vertical relationship between cooperative firms has the significant role in enhancing firm's innovative performance (Tomlinson, 2010).

The main objective of product innovation is to meet the variety of consumer needs in global market. The success of firms in global market is for the firm which is successful to meet the consumer needs. In this regard, product innovation reflects the firm's successful in combining technological opportunity with consumer needs. The interaction between producer and consumer occurs in the forms of exchange of goods and information as well as cooperation. The results of learning from the interaction are the increase of producer and consumer communication capability, information mastery, analytical capability, skill and problem solving (Lundvall, 2004). While, shifting the burden of product design from producer to user is by providing the user with toolkit for conducting user innovation (vonHippel, 2005).

It is common that learning come from innovation and innovation derived from knowledge. Consequently, the more knowledge accumulation creates the better innovation and processes the faster learning. The interactive learning is the process of stimulating innovation by knowledge and accumulating knowledge through innovation. Innovation capacity reflects knowledge accumulation. The knowledge accumulation is determined by interactive learning between actors within internal and from external of organization. The interactions between actors those are producer and user, producer and supplier, producer and consultant, functional team and individual, and producer and research institution (Lund, 2004). Based on this concept of interactive learning loop, we drew an analytical framework on putting the network to upgrade innovation capacity. See Graph 1. The framework is used to discuss the results of case study in part IV.

1.3. Methodology

Data and information. The research has utilized the general information on the capital goods industry available from government and other sources including output, export and import, the number of local and foreign firms, employments, major players, and public policies to support process improvements or promote capital goods industry, etc. Furthermore, the research has conducted a case study on two companies in capital goods industry. The data and information were collected through interviews with relevant parties to the two firms including capital goods user/producer firms, universities and public research institutions.

Analysis and reporting. Analysis of information collected through case study was done by making comparison between the two firms to obtain deeper understanding on the differences in ways of upgrading innovation capacity. Furthermore, the analysis has also identified the patterns of managing internal and external resources for process improvement and derived policy suggestions. The report of study is organized as follows: i). Introduction; ii. Overview of capital goods industrial development; iii) the ways of upgrading innovation capacity: the case study of two capital goods companies; iv) managing innovation resources: lessons learned from the case study, and v) conclusion and policy recommendation.

2. Capital Goods Industrial Development

2.1. Investment

The contribution of capital goods investment to the total investment has not been significant in Indonesia since 2000s. From 2000 to 2011, the share of capital goods investment to the total investment has been less than 10%, both for the number of investment and value of realization. While the share of capital goods investment to the manufacturing investment was less than 17% (Table 1).

The number of investment projects in capital goods industry has fluctuated since 2000s. The highest amount of investment reached 188 projects in 2010, while the lowest number was only 40

Table 1. Investment in Capital Goods Industry

No.	Category	Year											
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011*
1	Number of investment project	57	59	52	40	42	67	60	66	85	78	188	171
2	Number of Foreign Direct Investment (FDI) project	50	49	50	36	35	65	54	63	75	71	172	158
3	Number of Domestic investment project	7	10	2	4	7	2	6	3	10	7	16	13
4	Value investment realization (in million US$)	509.34	597.57	569.37	502.20	362.46	468.99	783.74	552.10	1094.5	792.23	551.30	1827.33
5	Value of FDI Realization (in million US$)	258.87	216.39	283.51	339.85	195.56	422.95	734.46	517.43	416.50	737.81	361.95	777.38
6	Value of Domestic investment realization (in million US$)	250.47	381.18	285.86	162.35	166.90	46.04	49.27	356.69	34.68	375.73	189.35	1049.95
7	Share of Investment project number to total number of investment (in percentage)	6.06	9.58	9.32	5.67	6.07	5.93	5.73	5.76	6.15	5.29	4.77	4.19
8	Share of investment project number to total number of investment in industrial sector (in percentage)	9.84	16.34	16.61	10.72	11.86	13.79	12.90	13.41	12.39	12.32	12.51	10.37
9	Share of investment value realization to total value of investment realization (in percentage)	1.59	4.46	3.65	2.83	1.81	1.18	2.94	1.19	3.11	1.63	0.72	2.76
10	Share of investment value realization to total value of investment realization in industrial sector (in percentage)	2.37	7.50	4.94	5.95	2.69	1.92	4.71	1.78	5.37	3.40	1.99	5.74
11	Share of FDI project number to total number of investment project (in percentage)	5.32	7.95	8.96	5.11	5.06	5.75	5.15	5.50	5.43	4.82	4.36	3.87
12	Share of FDI project number to total number of investment project in industrial sector (in percentage)	8.64	13.57	15.97	9.65	9.89	13.37	11.61	12.80	10.93	11.22	11.44	9.58
13	Share of FDI realization value to total investment value (in percentage)	0.81	1.61	1.82	1.92	0.98	1.07	2.75	1.11	2.09	0.86	0.47	1.17
14	Share of FDI realization value to total value of industrial sector (in percentage)	1.21	2.72	2.46	4.03	1.45	1.73	4.42	1.67	3.62	1.79	1.30	2.44
15	Share of Domestic Investment project number to total number of investment project (in percentage)	0.74	1.62	0.36	0.57	1.01	0.18	0.57	0.26	0.72	0.47	0.41	0.32
16	Share of Domestic Investment project number of project to number of project in industrial sector (in percentage)	1.21	2.77	0.64	1.07	1.98	0.41	1.29	0.61	1.46	1.11	1.06	0.79
17	Share of Domestic Investment value realization to total value investment (in percentage)	0.78	2.84	1.83	0.92	0.83	0.12	0.18	0.07	1.01	0.77	0.25	1.58
18	Share of Domestic Investment value realization to total value of investment realization in industrial sector (in percentage)	1.17	4.79	2.48	1.92	1.24	0.19	0.30	0.11	1.75	1.61	0.68	3.30

*data until September
source : Indonesian Investment Coordinating Board (BKPM)

investment projects in 2003. However, based on the value of investment, the highest investment realization amounted to US$ 1827.33 million that was achieved in 2011, while the lowest value was US$ 362.46 million occurred in 2004.

Based on types of investment, the number of FDI projects is far more than the number of domestic investment projects. Even in 2004, the number of FDI projects reached 65 projects while domestic investments were only 2 projects. However, from year to year, the value of FDI and domestic investment does not differ significantly.

2.2. Output

As shown in Table 2, the output value of capital goods with the exclusion of transportation equipment tended to increase from year to year, especially from 2006 to 2010, despite it tended to fluctuate sharply in early 2000s. This value was much higher than the two other categories (passenger cars and transportation equipment). From the year 2000 to 2010, the output value of passenger cars was always higher than the one in transportation equipment for industry.

Added value generated by capital goods with the exclusion of transportation equipment rose rapidly in 2005-2010, despite it tended to slightly increase in early 2000s. Its value was five times that of passenger cars and about 53 times that of transportation equipment for the industry. While, the added value of passenger car was always higher than transportation equipment for the industry.

2.3. Import

From 1994 to 2010, the Indonesia's largest imports came from raw material and supporting goods. During that period, the import value of this category had an increasing trend and always higher than other two categories i.e. consumer goods and capital goods. The highest import value raw material and supporting goods reaching US$ 99 billion was in 2008.

The import value of capital goods was higher than that of consumer goods. Both showed the similar trends, while the imports value of capital goods fluctuated with upward trend in the early 1990s. During the economic crises 1997 the value declined and reached the bottom in 1999. In the early 2000s the value was relatively stable, and then it increased rapidly in the mid 2000s toward moderately increased since 2008 up to 2010. The highest import value of capital goods was amount to US$ 24 billion in 2010. This value was still lower than the import value of raw materials and supporting goods that reached US$ 89 billion.

The highest import value of capital goods came

Table 2. Indicators of Capital Goods Industry

No.	Category	Year																
		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	Output value of capital goods Industry (in trillion US$)***																	
	- Capital goods except transportation equipment	NA	NA	NA	NA	NA	NA	53.88	131.74	215.51	74.78	230.08	102.72	242.55	252.85	299.75	346.11	349.58[a]
	- Passenger car	NA	NA	NA	NA	NA	NA	8.33	17.63	39.29	15.92	47.26	38.15	38.26	27.56	64.33	26.73	71.45[a]
	- Transportation equipment for industry	NA	NA	NA	NA	NA	NA	1.35	2.30	4.34	4.00	3.65	5.81	8.67	9.83	9.92	7.63	10.03[a]
2	Added value for capital goods industry in constant price 2000 (in trillion rupiahs)***																	
	- Capital goods except transportation equipment	NA	NA	NA	NA	NA	NA	53.88	42.24	52.89	64.80	64.38	58.10	91.77	111.81	140.12	156.81	146.00[a]
	- Passenger car	NA	NA	NA	NA	NA	NA	8.33	9.54	10.82	3.26	21.92	25.79	19.05	15.59	27.05	13.80	31.25[a]
	- Transportation equipment for industry	NA	NA	NA	NA	NA	NA	1.35	1.39	1.84	1.76	0.79	3.32	4.12	3.74	2.69	4.74	2.74[a]
3	Indonesia's import value (in billion US$)*																	
	-Import value of consumption goods	1.43	2.35	2.81	2.17	1.92	2.47	2.72	2.25	2.65	2.86	3.79	4.62	4.74	6.54	8.30[b]	6.75[b]	9.00[c]
	-Import value of raw material and supporting goods	23.13	29.59	30.47	30.23	19.61	18.48	26.02	23.88	24.23	25.50	36.20	44.79	47.17	56.48	99.49[b]	69.64[b]	89.10[c]
	-Import value of capital goods	7.42	8.69	9.65	9.28	5.81	3.06	4.78	4.83	4.41	4.19	6.53	8.29	9.16	11.45	21.40[b]	20.44[b]	24.42[c]
4	Import value of capital goods (in billion US$)*																	
	-Import value of capital goods except transportation equipment	6.58	7.89	8.91	8.62	5.43	2.74	4.28	4.12	3.77	3.53	5.41	6.47	6.22	8.41	16.25[b]	13.31[b]	NA
	-Import value of passenger car	0.04	0.08	0.11	0.13	0.03	0.01	0.10	0.09	0.05	0.14	0.29	0.29	0.23	0.39	0.57[b]	0.45[b]	NA
	-Import value of transportation equipment for industry	0.80	0.73	0.63	0.54	0.35	0.31	0.41	61.81	0.59	0.52	0.83	1.53	2.71	2.64	4.58[b]	6.68[b]	NA
5	Export of machinery and transportation equipments (in billion US$)**	NA	NA	NA	NA	NA	5.29	10.77	9.10	9.79	9.77	11.52	13.60	14.12	15.23	17.34	NA	NA
6	Contribution of transportation equipment. machinery and equipment industry to GDP (in billion rupiahs)*	NA	NA	NA	NA	NA	NA	NA	NA	NA	103.41	121.68	136.74	147.06	161.38	177.18[d]	171.96[e]	NA
7	Contribution of machinery and transportation equipments export to total export (in percentage)**	NA	NA	NA	NA	NA	10.88	17.33	16.17	17.13	16.01	16.10	15.88	14.01	13.35	12.66	NA	NA
8	Contribution of transportation equipment. machinery and equipment industry to GDP (in percentage)*	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.56	7.35	7.81	7.96	8.22	8.51[d]	7.90[e]	NA

[a] Estimation [b] include bonded zone [c] data until November 2010 [d] temporary value [e] very temporary value

* Source: processed from Statistics of Indonesia (BPS. 2010)

**Source: processed from Export Statistics (BPS. 2002; 2004. 2006; 2008)

*** Source: processed from requested data from Indonesia's Statistical Bureau

from several capital goods with the exclusion of transportation equipment. Furthermore, the import value of transportation equipment was higher than the import value of passenger cars. It is important to note that in 2001 the import value of transportation equipment suddenly increased that surpassed both two other categories.

2.4. Export

Furthermore, the export value of machinery and transportation equipment appeared to fluctuate with an upward trend over the year. After the economic crisis, the export value increased sharply from around US$ 5 billion in 1999 to around US$ 10 billion in 2000. The value was relatively stable around US$ 10 billion in early 2000s. Since 2004, the export value has shown the increasing trend with the highest value more than US$ 17 billion in 2008.

Viewed from the percentage export of machinery and transportation equipment to Indonesia's total exports, the trend showed the contrasting pattern. The share of machinery and transport equipment export has shown the decreasing trend since 2000. The share of machinery and transport equipment export showed slightly declining in early 2000s then the share became sharply falling from 15% in 2005 to 12% in 2008.

2.5. Contribution to GDP

As shown in Table 2.2, the contribution of transportation and machinery equipment industry to the value GDP has a tendency to increase over year, despite it showed a slightly decreasing in 2009. Furthermore, viewed from its share in total GDP, it appears that the share transportation and machinery equipment industry was stable around 7-8% from 1999 to 2008.

2.6. Industrial Policy

Indonesia has a vision to become the emerging economy through industrialization by 2025. It was stipulated in Presidential Regulation No. 28/2008 on the national industrial policy that put national planning to develop 35 prioritized industrial clusters. The clusters are selected based on national capabilities to compete in domestic and international markets. The prioritized industries are selected based on the potency to compete and to grow internationally. Among the prioritized clusters include capital goods industry those are industrial and transportation equipment industries and machinery industry.

There are some policy measures to facilitate the development of capital goods industry. These facilities can be fiscal incentives, non-fiscal incentives, and other facilities in accordance with laws and regulations. In order to develop the automotive components industry, particularly those with local content at least 40%, government provides the facility of import duty paid by the government – BMDTP, for components and raw materials that do not produced in Indonesia. It is intended to reduce production costs to be incurred by the industry. For example industry producing industrial generator sets is getting the facility of import duty for the components of generators, transformers, turbines and boilers.

Other fiscal facilities for the capital goods industry are the exemption or reduction of corporate income tax. This policy can be utilized by the pioneer industry, which has extensive linkages, providing high added value and externalities, introducing new technologies, and having a strategic value for the national economy. They include the pioneer in introducing a new industrial machinery technology. Furthermore, under government regulation No. 62 / 2008 as an amendment to the regulation no. 1/2007 on income tax facility for investment in certain sectors and/or in specific areas also has implication for the capital goods industry. In this policy, the industry will enjoy tax holiday during the time period prescribed by the regulations, when its investment is more than Rp 1 trillion. Income tax reduction is also available when its minimum investment is Rp 1 billion.

In order to boost innovation in developing machine tools and medical devices industries, the Ministry of Industry cooperates with Engineering Centre at the Bandung Institute of Technology (ITB) for designing national products. The cooperation is directed to create a prototype to be manufactured for mass production. The program has been planned to be implemented for 5 years since 2011. In addition, the assembling of engine components has been delivered to the Vocational School. Some of them has successfully built and manufactured the passenger cars. In order to substitute the old machines in industry, Ministry of Trade issued a policy related to the import of old machines. This policy is expected to fulfil the industrial needs for capital goods with relatively inexpensive capital investment to support the development of real sector.

For the development of heavy equipment, the Indonesia's Association of Heavy Equipment - HINABI (consisting of large enterprises) has important role. Under the association, the heavy equipment industry will be developed into supporting industries for the mining, farming, forestry and infrastructure industries. For the power plant with huge turbines, Nusantara Turbine Propeller (NTP) Company cooperated with Siemens to create a turbine with capacity higher than 100 MW. Besides, NTP also conducted re-engineering activities in cooperation with Barata Company (SOEs) to increase the utilisation and production. In order to standardize the product quality, government developed and applied Indonesian National Standard (SNI). Besides, the industries also use Japanese and Korean standards. The standard set also includes aspect of plant verification and quality management.

3. The Ways of Upgrading Innovation Capacity: A Case Study

Case 1. Company - A

Way to innovate

Company A is a major player and the pioneer of coal-fired boilers producer in Indonesia. The company was established by its founder Mr A in 1981. The first product produced by the company was Kiln Drying System. The product was proven to be better than imported products and it succeeded to lead the market that reached almost 60% of market share. The success of product was influenced by long experience and educational background of its founder in the field of timber industry, especially in providing effective solutions for the problems of timber drying system. That was proven by the customers of company, which mostly were large and reputable buyers such as Yamaha Music and Samick. The competitive advantage of Kiln and drying system was the tacit knowledge of owner. The knowledge about the different types and properties of timber were for the different procedures of drying system. By using this knowledge the company was able to create various products of Kiln and Drying System that worked effectively and efficiently according to the types and properties of timber to be used by its customers

After the success of Kiln Drying System, company A sought to enlarge its market share in local and overseas. Furthermore company has expanded its business in boiler products, pollution control systems, heaters, timber impregnation plant and centrifugal fan. The next product of company is Air Pollution Control. This product began with the idea of company's founder related to the pollution issue. Although at that time, pollution and environmental issues had not yet appeared on the surface as it is today. Main part of Kiln and Drying system machine is boiler that has the function as the source of heat. At that time, the fuel of boiler used the timber waste and it was a fuel that generated pollution. Starting from that idea company eventually formed a partnership with Keller, which is a large company from Germany in producing Air Pollution Control. By such cooperation, company acquired many lessons to modify the product of Keller. Furthermore, company has produced several models of fan that resembles the products of Keller. Besides, company concentrates to supply boiler for Kiln and drying system, company offers various types of Air Pollution Control products for the timber and other industries.

Company developed many types of boilers. One of them is the latest coal combustion technology boiler namely FBC (Fluidized Bed Combustion). The technique produces a very high combustion efficiency ranging between 95-99%. With some choices of new solid fuel beyond the coal are available, such as biomass or high volatile/lower carbon-containing fuels and Tire Derived Fuel or TDF with high moisture content. The Bubbling Fluidized Bed technique becomes a very reliable technique, which is a development of the Fluidized Bed Combustion technique. Fluidized Bed Combustion System itself is public domain. The technology has existed since 1960's, but the application varies. The result of innovative application of this technology is the use of Nozzle (Nozzle Air Distributor) in the products of company. It can be said to be the best result from several innovations conducted by company. The Nozzle developed by company that is the key to the success of company combustion products in market. The nozzle can increase the effectiveness of fuel utilization. Unfortunately, the company's patented industrial design was copied by a multinational company. Until now, the intellectual properties case has not been settled yet.

Currently, company also holds the licenses to manufacture recyclone system in Indonesia, which was developed by a professor from Portugal. At present, one of the users of this product is a large multinational company producing health beverage. In this project company build an open display unit in Cikarang industrial zone. This kind of display unit is something new in Indonesia, despite being common in European countries.

Innovation management

In the process of product development and mastery of technology, company gets more learning process by purchasing a license. Company started the cooperation by licensing of foreign technology. Company learns and begins to de-velop its own products. Initially company created a similar product with its licensed products. Then, company also develops their own products according to the needs of its customers.

Through licensing mechanism, the company did not only sell products but also manufactured it in accordance with the licensed design, installing up the machines and providing after sales service. From the learning process, company gained knowledge and then develops the knowledge to make improvements. Company develops new products those are modified from the licensed product under the engineering team of company.

Company also performs learning from many other external sources. Such catalogues of products are sold in the market. Production and engineering teams integrates them to create improvements in production processes and better product demanded by market.

Sources of innovative ideas

Since its establishment, the founder of company plays a very important role in the process of business expansion, including through innovation. The founder has visionary and excellent insights in

seeing the opportunities that will occur in the future. This becomes a key to conduct innovation activities in the company. The ideas emerge from the owner then it was followed up by the engineering team. The functional team works together to create innovative products that will be produced by company. In addition, extensive relationships and good corporate image have been becoming an advantage for company. Innovations also emerged from relationship with its customer that has cooperation with company. The cooperation is mainly to develop the company's production process, such as creating a machine with higher efficiency. Generally customers come to cooperate due to the founder has had relationships with the customer and they have known exactly about company's capabilities.

Other important source of innovation is the supplier. The technology owned by the supplier must have originated from well-known source. Therefore company tried to absorb as much knowledge as possible from its interaction with suppliers. The process of knowledge transfer between suppliers and company can work well due to the initiative of company. It begins with learning by seeing supplier's product catalogue, then hearing the supplier's presentation and also browsing information on the internet.

Knowledge transfer does not stop at company. The company also transfers the knowedge to its user. This will help company to solve the problem related to the use of product by users. The users also play a major role in company's product innovation. Complaints and suggestions from customers often sparked the useful source of information for product development. The engineering and production teams do their best to listen and accommodate the user's demand. Majority of improvements in company's products originated from complaints and positive feedback from its customers.

Regarding the inputs of innovative ideas from its customer, company has the evaluator team to assess the feasibility of the improvement which the ideas come from the customer. The team which consists of production and engineering department must find scientific reason from those ideas. Besides relying on its team, company also hire the external party, for example in developing combustion system, the company use foreign expert from India. The company actively partipate in exhibitions to develop customer network as the source of innovative ideas.

Role of consumer

Quality is the most important factor for the company to maintain its customers' trust. The company always put the quality at the first place in producing its product. Although at present many China's products penetrate to local market with cheaper price, company feel securely because of its quality higher than those foreign products. Besides, company provides after sales service maximally. These were proven by some notes of customer that compared the quality of company's product with China's product.

Beside selling the licensed product and producing by its own, company also provide service in product installation and after sales service. If there is a trouble in the machine then company's team will give full service to fix the machine. Such interaction with customer opens information flow about machine development, especially in relation to facilitate machine operation for its customer.

In order to get feedback, company also inform its customer about the characteristics of raw material, whether coal has an influence to machine efficiency. Company respond the customer's feedbacks by asking an evaluator assessment on the feasibility of ideas. This is because the ideas are often not scientific one. The teams of production and engineering departments must find scientific reason from the ideas.

The case of machinery innovation created by company based on consumer feedback is the supplying control panel in the monitor device. Other machinery innovation based on customers' needs, which was modified and developed from technology owned by company, it can be seen in the modification of Fluidized Bed Combustion technique. Generally, the technique is used for heating the fuel. But, company has succeeded to create a machine that utilizes the technique of heating up the main material of product. The technique has been implemented in several food industries in Indonesia, for example in salt or cracker industry.

Sources of competitiveness

In the local and global market, company has obtained a good image. This has been shown by the continuous flow of demand from many companies either domestic or foreign users. Company's product also has been used by foreign customers, for example sardine company from Philippines, textile companies in Guatemala, while Malaysia's company uses the product for rice drying using the waste (rice husk) as a fuel. Company's innovative creation has become the source of its competitive advantage. Company always try to produce its own product better than competitors. Starting with incremental innovation that is an imitation with little improvement, the company engages in making substantial innovation by creating machine with much higher efficiency, and even can be used in different industries. Quality is the key factor of company's product competitiveness. The accommodation of consumer needs becomes the company's value, as indicated by some machine orders with particular design for the specific needs of users. Although demand from abroad also continuously comes, however company opened sole

agency only for specific industry not for general industry – like in Bangladesh company have an agent for textile industry and agent for agriculture, in Philippine its agent is specialized in food industry, etc. this strategy will expand company's market widely.

Company always tries to fulfil the customer needs in two ways namely producing by its own and outsourcing from others sources. The company's strategy of blending between technology and market was proven by the facts that company continuously receive customer's order. Company continuously learn from various sources to upgrade innovative capability. Company is also regularly analyze the market needs and carefully pick the technology to be aligned with the market needs. By applying the strategy, company expects to continue to evolve in the future competition.

Case 2. Company - B

Way to innovate

Company B has conducted various innovations especially in product development and production engineering. There were some innovative products such as power plants, passenger boarding bridges and medical device namely ultrasoundgraph (USG). In 2005, company started to make power plant of 0.25 MW. In subsequent period of 6 months, the company succeeded to make another power plant with much higher capacity of 195 MW. Although, company had not enough knowledge to develop such product, however, company succeeded to break through all the constraints into the innovative solution.

The company applied the process of learning by interacting and doing simultaneously to bypass the constraints. Company has the principle of the needed knowledge were actually have been available and it was just not yet collected. In the beginning, company continued to actively conduct searching and acquiring the important (including tacit) knowledge through various activities, including by inviting experts who were paid in high price. The experts were asked to share his knowledge to the group of engineering inside company. The learning process occurred through such interaction between expert and employees. Furthermore, company conducted knowledge comparison by searching and learning to other countries such as China. India and Bulgaria. Based on comparative analysis, the knowledge gained was codified in the form of drawing the design. In order to make improvements, the drawing then was reviewed by inviting Chinese consultants to determine the possible errors in the drawing, After the drawing was fixed, company hired another consultant to re-check it. Therefore, company has been able to create new products through actively conducted searching and learning activities.

Company's innovativeness can also be seen in other product that is passenger boarding bridge. This product was proven to have the ability to penetrate the global markets such as Singapore even Japan. This happened because the price was cheaper than others for similar products but still with well-maintained quality. Company is now developing its new product - a monorail. This product has not been made by company in previous period. Therefore, it becomes new for the company. In this case, company also has its own strategy by subcontracting all of its production activities. Company play a role in making the engineering design.

Another company's innovation by applying the company principle that the needed knowledge were actually have been available and it was just not yet collected, it can be seen in the manufacture of medical devices namely USG. Initially, company tried to identify the consumer needs by observing around a hospital and seeing the opportunity of technology needed by hospital. The results of observations showed that the technology required was USG. The next step was to know the state of the art in USG technology through exhibitions of medical equipment in Germany. From the exhibition, company bought USG which was considered innovative and could be developed further. Company product development was done by involving external experts. However, the initial product that was successfully developed has not perfectly worked because there were problems of noise in the device. In order to resolve the problem, through information from the hired expert, it was known that in United States there was a small company that has expertise in solving the noise. In order to solve this problem, company only pay for US$ 2000. The USG product has been produced for 100 units. However it cannot be commercialized because there was some barrier of regulation from the Ministry of Health.

Innovation management

Company acquires the needed knowledge and technology for its business development by actively searching to find experts, specialists or consultants in the specific fields. The external expertises are required to solve the particular problems of product and process technology or to gain knowledge that is not owned by the com-pany. In selecting an expert or specialist for problem solving, their level of education was considred importance by company, but it was'nt absolute requirements. Expert was more viewed by his experiences. This can be seen at the time of expert selection to assist USG product innovation. He was working at Siemens and had experience in electronics, although his background was only bachelor of mathematics.

Company's relations with external parties are purely business relationship, without any linkage has been nurtured before. The specialists, experts and

consultants are hired in a professional deal without personal contact or intense interaction before. Even though, their role is only to resolve minor problems, but solving the problems have significant influence for the success of company's product and process innovations. Company also don't hesitate to spend huge money to pay for experts, specialists and other things to support product development and production processes those are underway, as long as there is strong belief that the costs disbursed will have tangible results that affects its business performance.

The knowledge of experts or specialist is then transferred to company's employees, in such a rapid learning process. That is possible because company's human resources have the capacity to absorb new knowledge by accurately imple-menting it in the work place. Company recruits high quality of university graduates, where the level of education is necessary but it is not sufficient, because although the education level is high, it will be useless due to lack of experience or knowledge that can be applied to the business world competition. The most important thing is the resilience of employees to struggle through hard work.

Company manages employee activities for effective and efficient learning. Company put the process of learning by doing in work place as a method of gaining true knowledge empirically. The process of learning by interacting is done directly at the workshop; therefore they put the conversation into practice by banning formal and theoretical discussion on the table. Employees are also not allowed to attend scientific seminars and conference (except to find experts) because it is generally considered far from the real world of industry. In addition, company applied flexible working hours to maintain the creativity at work by allowing the employees to do mobile work outside the factory as long as they could show their creative performance. For example, an employee worked in his open air garage to freely exploit his creativity after morning wake up. The company strategy in HRD focuses on pushing engineer's performance to produce creativity and innovation.

Sources of innovative ideas

The source of innovative ideas for company's innovation comes from competitors, customers and consultants. Company is active to conduct 'knowledge surveillance' to close watching and learning by seeing similar innovation that has been done by other companies or competitors. This activity was even conducted in several countries Asia, America and Europe. Company has a belief that making something does not need to be done from basic or by following a particular track, but it could done creatively through breakthrough path to have it done more quickly. Furthermore, customers are become the com-pany's source of innovative ideas, as seen in USG product development. Then, consultants are also the important source of innovative ideas for the company, especially the idea of solving the company problem in product development.

Company attends workshops mainly abroad for the reasons that it can provide inspiration about the picture of latest technological advancement and new opportunities. Other important sources of innovative ideas for company is abandoned documents that often seen as 'useless', but in fact can be useful as the potential source of knowledge. This can be seen when company were making high towers. The company made it from the useless documents of state electricity company. Then, the producers of similar products also become the important source of information for company innovative idea. The company's success in producing turbines was the evidence of company ability to imitate creatively. The knowledge gained after meeting with the producer of turbine in Prague, Germany. Then, it was used by com-pany to produce it own turbine.

Then, exhibition of innovative product abroad also become the important source of infromation for company's innovation. Technology products display at the exhibition has become source of inspiration to be developed further by looking at the weaknesses or opportunities to improve its effectiveness or efficiency. In modifying the product, company do trial and error, it is considered to be an important activity to generate innovation. The way of learning by doing activities that has much generated new knowledge to be imple-mented into new product by company.

Role of consumer

The consumers have an important role for innovation. Based on company's assessment, USG medical device was the most products needed by the hospital. In order to produce the product, company started the process of innovation by observing the similar product that was considered to be most innovative; it was displayed overseas at international medical equipment workshops. By looking at existing technology, the company tried to capture the basic ideas of its product development. Then, company tried to make by its own design despite paying expensively for hiring external experts and specialists. Furthermore, company built a power plant with a capacity of 195 MW which was much higher than before which was only 0.25 MW. Company attempted to produce a plant with a greater power capacity by using local resources in its design, capital and contractors. Basically, the power plant was not having higher level of technology, but it was different value by having the highest content of local technology sources. Besides, the power plant has never produced by other parties in Indonesia, including state owned electricity company as the consumer of company. The evidence indicated the company ability to create product that generates higher satisfaction than that is expected by its

consumers.

Sources of competitiveness

To be able to compete in local and global markets, company has both comparative as well as competitive advantages. The comparative advantage of relative cheap labour cost becomes an advantage in term of product price. The success of passenger boarding bridge in international markets is an example of company's product competitiveness. The product was able to penetrate foreign markets such as Singapore and even Japan not because of its product better than other product but it was cheaper. In addition, the company's innovative creations also become a factor of its competitive advantage. For the company, the original product means the difference and the better products. Company always try to produce better than those are produced by its competitors. Company creates better product through incremental innovations or as the results of creative imitation on competitors' products.

In order to maintain its competitiveness, company continue to close watch it competitor. Innovation is done by observing the condition of competitors, so that company can identify opportunities to be better than its competitor. Company make use of all innovation resources to create the innovative product. Besides the utilization of knowledge owned by its employees, company utilize the knowledge in company catalogue that was obtained from trial and error. Company also utilize cutting-edge knowledge and technology acquired from external sources of knowledge such as expert, specialist, consultants, or competitors either domestic or foreign companies, workshops, even the source that was considered as a waste, i.e. the old documents. Knowledge from external sources was learned by company's employees with rapid process to be improved and implemented into the creation of new products. All become the determinant factors of company competitiveness.

4. Managing Innovation Resources: Lessons Learned from the Case Study

By using the analytical framework of interactive learning loop for upgrading innovation capacity, the discussion identified four patterns of managing internal and external resources for process improvement in capital goods companies.

The vision of top management

The two cases study indicated that the main driver of technological learning in the capital goods companies were the vision of top management. The technological learning was initiated and incited by the creative idea of top management. The idea of top management has to be implemented and operated by the management staff and employee in company. For the company A, the creative idea of top management is to make something new for meeting the future needs of people. Top management has the capability to predict the future needs of people based on the impact assessment on current situation. It is clearly denoted by the creation of air function control, where the product idea came from the founder vision related to the pollution issue. Although at that time the pollution and environmental issues had not yet appeared on the surface as it is today, however the vision of the founder saw it. While for the company B, the creative idea of top management is to make something different for creating new user demand. The compony create higher value of product with competitive price for the user that means to create a new demand for the compny's product. That was proven by company success to build a power plant with a capacity of 195 MW which was much higher than before that was only 0.25 MW. Company produced a plant with a greater power capacity and competitive price by using local resources in its design capital and contractors.

Producing innovation through informal learning

The two capital goods companies studied also showed that product innovation as the improvement of existing product can be the results of informal learning without doing formal R&D activity. Informal learning occurs through the process of learning by DUI (doing, using, and interacting) in work place and workshop inside company. The needs to formal R&D activity for specific problem solving are done by external sources of innovation, such university, R&D institute and foreign experts. For the company A, the process of product development and mastery of technology were done by using the licensed foreign technology. Starting from learning the foreign technology, furthermore company created a similar product with a minor improvement from the licensed products, then company begun to develop its own products. For the company B, the process of product development and mastery of technology was done through learning by interacting and doing simultaneously. Company acquired knowledge and technology needed for its business development by actively searching to find experts, specialists or consultants in the specific fields. The gained knowledge then was applied to solve the particular problems of product and process technology through learning by doing.

Stimulating innovation through limited networks

Stimulating innovation through network occurred in both of companies studied. The networks as cooperative arrangements involve producers, supplier, users, competitors, consultant, research institution and/or universities. The case study results showed that the stimulating innovation without formal R&D activity attempts to introduce lower level of innovations that is 'new to the firm' innovations — rather than 'new to the market'. In

that sense, the limited co-operative arrangements i.e. producer, supplier and consultant are sufficient for stimulating innovation. For the company A, the collective efforts involve the interaction between producers and foreign supplier, supported by hiring foreign expert and sometimes by assigning the local experts from university. The enhancement of absorptive capacity occurs through learning by interacting with technical experts of foreign suppliers. Such interaction stimulated further innovation through learning by doing to develop its owned product by modifying the existing products. For the company B, the collective efforts for innovation involved the interaction between producer and foreign experts or consultant hired in accordance with the specific problem to be solved by company. The enhancement of absorptive capacity occurs through learning by interacting with technical experts as well as learning by doing in work place.

Stimulating innovation through producer-user interaction

Viewed from producer-user interaction, the two companies studied showed that interaction occured in the forms of exchange of goods and information as well as cooperation. The producers-users interaction will contribute to stimulate innovation in companies, as showed by problem solving, product improvement, information mastery and analytical capability based on exchange of goods and information between producers–users. In company A, company get information feedback from the customer about the idea to improve machine efficiency, and company responds the customer's feedbacks by assessing the scientific reason of the ideas. Company also succeed to create several machinery innovations based on consumer feedback i.e.: supplying control panel and the modification of fluidized bed combustion technique, those equipments have been implemented in several food industries in Indonesia. In the Company B, the evidence was the company ability to create product that generates higher satisfaction than that is demanded by its consumers. Company built a power plant with a capacity of 195 MW which was much higher than before which was only 0.25 MW.

5. Conclusions and Policy Implications

Conclusions

The ways of upgrading machines and related technologies in capital goods industry vary as follows: i) co-development of new capital goods between capital goods users firm and capital goods producers i.e. development of the modification of Fluidized Bed Combustion technique; ii) collaboration between user capital goods firms and capital goods producers, etc. to modify (upgrade) or customize standard machines, i.e. supplying control panel; and iii) development of manufacturing sectors related to capital goods (machines and tools) i.e. development of Nozzle Air Distributor, power plant, passenger boarding bridge and medical device namely ultrasoundgraph (USG).

The patterns of managing internal and external resources to bring process improvement in capital goods industry are: i) the main driver of technological learning in the capital goods companies is the vision of top management; ii) product innovation as the improvement of existing product can be the results of informal learning without doing formal R&D activity; iii) the limited co-operative arrangements i.e producer, supplier and consultant are sufficient for stimulating lower level of innovations, which is 'new to the firm' innovations — rather than 'new to the market'; and iv) the producers-users interaction in the forms of exchange of goods and information as well as cooperation will contribute to stimulate innovation in companies.

Policy recommendations

Knowledge sharing through innovation network has a central role in upgrading innovation capacity. It implies that the necessary policies to intensify the wiring innovation network in capital goods industry are: i) the establishment of intermediaries institution or network broker for training, facilitating and mobilizing of network formation; ii) government financial assistance for hiring external experts/ consultant to upgrade the innovation capacity of industry; iii) incentives (i.e.financial compensation, recognition and career advancement) for university and research institute professors working to upgrade the innovation capacity of industry; iv) government consultancy services and/or subsidized consultancy services from universities /research institutions to upgrade innovation capacity of indutry in the long run.

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