TECHNOLOGY TRANSFER FOR METAL BASED SMEs IN CENTRAL JAVA, INDONESIA

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ABSTRACT: In particular, this research investigated whether any formal knowledge and technology transfer programs conducted by government, businesses and universities were available in Indonesia. The fieldwork searched for evidence of technology transfer that had previously occurred. This involved the review of information about SMEs in base metal goods industry sector that had already been the recipient of technology transfer from government, universities and/or private businesses, and/or from foreign organisations (based on government to government agreements). The responsible department for technology policy in Indonesia recommended the districts of Ceper in Central Java, to the author, as being particularly involved in knowledge and technology transfer. Data from peak industry bodies and government departments, and information regarding national and provincial government policies from government departments, were sourced. Face-to-face interviews with small to medium enterprises (SMEs) and discussions with staff at a series of universities were completed. The accurate information was able to be collected from every person actively involved in existing knowledge and technology transfer programs in Java, especially in Ceper, Central Java.

Keywords: Knowledge, Indonesia, SMEs, Technology, Transfer

1. Introduction

Ceper, a mostly rural district in the Indonesian province of Central Java, is home to a significant number of SMEs in the metal goods industry sector. Some researchers use the word ‘cluster’ to describe an area with a significant number of SMEs (Klapwicjk, 1997; Schmitz and Nadvi, 1999; Sandee and Rietveld, 2001; Tambunan, 2007). Ceper was found to be the largest foundry cluster in Indonesia. The majority of the foundry-based SMEs in Ceper were small (i.e employs 5–19 employees). Examples of products being produced, as observed by the author, include: diesel generator-set components (e.g. fly wheels), automotive spare parts, gas stove components (e.g. head burners and brass cups), sewing machine components (e.g. supporting bar), water pumps, pipe fitting and clear water pipes.

Items produced were exported and also sold locally. About 300 SMEs in Ceper employed about 5,000 people, with the number of employees varying from 10 to 100 for each SME. The education level of both the owners and the employees varies widely. Generally, older staffs have, at best, an elementary school certificate, with many having received no formal education at all. Younger people have often completed senior high school and may even have university qualifications (e.g. bachelor or master degree). The SMEs in Ceper are operating based on customer orders (i.e. job shop model).

Cast iron production in Ceper has a long history, and is reported to have commenced in around 1740. Based on a story from a local resident, in the period of the Mataram Kingdom (one of the biggest Kingdoms in Indonesia, still in existence in Central Java), under the rule of The Great Sultan, foundry technologies for melting and casting were pioneered by a blacksmith named Ki Ageng Serang Kusuma and his three companions. They created agricultural tools such as ploughs to meet local demand (BPPT, 2005).

In the mid-1800s, in the time of the second Dutch colonization in Indonesia (1816-1942), the Dutch government built a series of sugar factories in Java. The Dutch government used SMEs in Ceper to participate in supplying components for those sugar factories. The production focus of Ceper SMEs was spare parts for the sugar processing factories, locomotive repair, agriculture tools and spare parts for "gunny sack" (a large bag) factories (BPPT, 2005). When the Second World War occurred, the Japanese army defeated the Dutch, and took control of Indonesia. During the Japanese occupation (1942-1945), the SMEs in Ceper were used to produce grenades for the Japanese army (BPPT, 2005).

Since 1945, when the Japanese occupation of Indonesia ended, the so-called Old Order Indonesian government was in power (1945-1965). In the year 1953, there was significant demand from the Indonesia Government Agriculture Department to produce agricultural tools. To improve production quality so as to match required product design specifications, the Indonesia Department of Industry supported local industries through knowledge and technology transfer programs. The SMEs in Ceper also started producing hand-powered water pumps in this period. SMEs in Ceper continued to thrive, particularly during the so-called New Order Indonesian government's (1966-1998) massive infrastructure and development agenda. Product demand increased and diversified, and SMSs attempted to improve their skills through the knowledge and technology transfer program supported by government.

In 1976, SMEs in Ceper voluntarily united and a cooperative organisation named Koperasi Batur Jaya was founded. SMEs formed Koperasi Batur Jaya due to their similar background, and common economic, social, cultural and aspirational focus. Koperasi Batur Jaya was jointly-owned and collectively-controlled. SMEs in Ceper enjoyed rapid growth within Koperasi Batur Jaya. For example, SMEs successfully obtained government projects to provide water pipe fittings for clear water installation projects (Figure 1).

SMEs in Ceper also supply components for heavy equipment, for example, forklift counterweights, and train drum brake shoes for Industri Kereta Api Indonesia (INKA) – a company that manages the train industry sector in Indonesia (Figure 1 and 2).

Figure 1 Pipe fitting manufactured in Ceper (Photographs were taken by the author during fieldwork)

Figure 2 Train brake shoes manufactured in Ceper (Photographs were taken by the author during fieldwork)

2. Knowledge and Technology Transfer

An example of knowledge and technology transfer for SMEs in Ceper was a project associated with the Divided Blast Cupola (DBC). A cupola furnace is used in foundries to melt iron and some bronzes. The DBC introduces air blasts into the cupola through two levels of tuyeres, one above the other, in order to achieve a more efficient combustion of coke. Each row of tuyeres has its own wind box and air flow meters that controls individual air blasts. The upper airflow assists the combustion in the preheating area, and the lower airflow supports the combustion in the melting area (BPPT, 2005).

3. Method of Technology Transfer

BPPT collaborated with the Metal Casting Laboratory in Ceper and also made use of the technical expertise of the Japan International Cooperation Agency (JICA). The transfer program resulted in DBC furnace being implemented to achieve a higher metal temperature, reduced coke consumption and improved melting rate compared to the earlier cupola design, i.e. the single tuyere cupola furnace design (Figure 3) versus the old Tungkik design (Figure 4).

Figure 3 Single tuyere cupola furnace in Ceper. (Photograph taken by the author during fieldwork).

Figure 4 Tungkik (early furnace design) in Ceper. (Photograph taken by the author during fieldwork)

The charge coke consumption was dramatically reduced using the DBC: a charge coke consumption of at least 12-15% was required to produce a tapping temperature of 1,500 ºC when operating with a single row of tuyeres, whereas using the DBC, the same temperature was attained with a charge coke consumption of 7-11%. In addition, the metal melting rate obtained with 15% charge coke was (BPPT, 2005): 1.4 tonnes per hour using a single row of tuyeres, 1 tonne per hour using Tungkik, and 1.8 tonnes per hour using the DBC.

The DBC arrangement improved production in all sizes of cupolas, with performance parameters improvement that includes: higher available metal melt temperatures; increased melting rate; reduced fuel consumption; and, overall reductions in the cost of melting graded cast iron, malleable iron and spheroidal graphite iron (BPPT, 2005). Cast components moulded from these metals were required for automobile and machine tool applications.

To best exploit transferred technologies, associated issues for the SME workforce were identified, for example:

- *Engineering drafting*: an improved drafting skill base within the Ceper SMEs would be required if high precision products were to be manufactured.
- *Production processes*: Production based employees required a system to enable them to achieve optimum fuel quantities and rates for correct cupola operation. Previously, informal experience and often 'mere guesswork' were relied upon.

The availability of technology, and demands from the SME customers challenged SMEs to improve their capability to produce a wider variety of products with increased precision and quality control. In dealing with customer demands, SMEs in Ceper were supported by government, businesses and universities to improve their skill base.

3.1 Transferors

Government-initiated knowledge and technology transfer in Indonesia is normally completed through government ministries and their associated agencies, inter-ministry departments and local government. Government ministries include the Ministry of Research and Technology, Ministry of Cooperation and Small to Medium Enterprises, Ministry of Industry, and Ministry of Trade.

Government-initiated knowledge and technology transfer programs have provided training programs and expertise transfer, as well as physical equipment (machinery and tools) to SMEs. Government has provided training centers for use by SMEs. Through government-to-government agreements, there is evidence of support from other countries. For example, Japan has provided expertise through the Japan International Cooperation Agency (JICA) to provide long-term collaborative SME programs in Ceper.

Government agencies from some ministries and local government have collaborated with SMEs in Ceper to build local institutions to the level of Polytechnic within the Ceper cluster. The institutions provide education and training, particularly for Ceper's SMEs in order to develop the technology capability of SMEs, and to broaden a pre-existing program for standardisation of processes and products.

LEs were found to be involved in knowledge and technology transfer to Ceper SMEs through human resource development in particular. LEs have provided highly focused training programs to SME employees. These training programs have, for example, sought to encourage improved capabilities in product standardisation, enabling SMEs to then supply products with the required quality to these larger businesses through improved competency.

The fieldwork of the researchers found that local universities also support knowledge and technology transfer to SMEs by conducting specifically targeted training programs in human resource development. The university-based training programs have the long terms goal of maximising the potential of SME employees. Universities were also found to collaborate with government in providing specific expertise for short-terms knowledge and technology transfer programs.

4. Informal Technology Transfer

It has been observed that Ceper also makes use of informal knowledge and technology transfer. Sandee and colleagues (2001) used the term ‘cluster’ to define a strategy for SMEs in the process of industrialisation and economic development in which SMEs share information and purchase raw materials together. Collaboration also occurred when orders became urgent. Sharing knowledge among SME owners has occurred through informal meetings and gatherings, for example, during the religious activity Pengajian (gathering to pray together, usually on a weekly or monthly basis). The SME owners were found to share knowledge during such gatherings based on their particular skill, or when they had recently acquired a knowledge or skill.

5. Barriers in Knowledge and Technology Transfer

There are many potential barriers to the knowledge and technology transfer process that can be caused by either the transferor or the transferee.

5.1 Transferor-caused Barriers

It is crucial in knowledge and technology transfers that: the transferor must actually possess the required knowledge and have a sensitivity to the transferee’s background and needs, and the transferor must be willing to provide the required knowledge.

The transferor’s needs must coincide with the transferee’s needs in such a way that a knowledge and technology transfer is a mutually advantageous transaction (Samli, 1985). As such, the transferor plays a very critical role in the whole process.

The author observed that, in some cases, there was a lack of motivation from transferors in transferring knowledge and technology. By way of example, transferors who were local government employees (state employees) with the responsibility to transfer knowledge obtained their salary from the Indonesian government. It did not matter whether the employees were successful or unsuccessful in completing a technology transfer process, as they received their salary regardless of outcome (i.e. no performance assessment).

Contrast the preceding example with knowledge and technology transfer programs driven by collaboration between government and another organisation. The knowledge and technology transfer program of Divided Blast Cupolas involved collaboration between BPPT as the government representative, JICA, and local TAFE institutions (BPPT, 2005). Every transferor involved in this collaboration expressed sufficient motivation, methods and skills during the knowledge and technology transfer program.

5.2 Transferee-caused Barrier

In order to achieve congruence among transferors, technologies and transferees, with reference to transferees, it is important to recognize the transferee’s needs and readiness (Samli, 1985). Transferees will have different needs and different priorities. For example, a transferee could be oriented to long term or short term goals. Political or economic imperatives may be apparent. Understanding the needs of the transferee may reduce the possibility of failure of a knowledge and technology transfer initiative.

It is important to recognize whether the transferee is ready and able, physically, intellectually and/or emotionally, to receive an available knowledge and technology opportunity. A significant aspect of readiness is associated with the transferee’s minimum knowledge and technology (Samli, 1985; BPPT, 2005)

A significant problem that occurred in the process of transferring the Divided Blast Cupola (DBC) technology is an illustration of misleading or inappropriate intention of transferees regarding knowledge and technology transfer. SMEs in Ceper, although they employed full time workers, also engage casual workers. SMEs needed casual workers because they employ a limited number of full time employees as a means of ensuring efficient production. Casual workers in Ceper were referred to as 'stockers'. Stockers were casual workers who worked in groups to support SME foundries. The significant problem occurred during the process of transferring the DBC technology. The stockers who were previously paid to work for 8 hours in a single day with an expectation that 12 metric tonnes of scrap would be processed using a single cupola, were unhappy when they were only paid for 6 hours to process the same 12 tonnes of scarp using the more efficient DBC. As such, the roll out of the DBC technology was not smooth due to the management of the change. Another problem was that stokers, historically, did not accurately measure the correct amount of scrap before putting it into the cupola as, prior to the introduction of the DBC, there was no adverse consequence. Again, management of change within SMEs was a key inhibitor to successful technology upgrade.

6. Another finding

During research, the author identified Ceper as a village with a burgeoning middle- and upper-middle class, complete with large, modern houses and expensive private cars – in other words, a growing prosperity. As SMEs formed an extremely high proportion of the wealth generating activities in Ceper, it was reasonable to presume that this prosperity was at least partially due to the success of SMEs in Ceper. This presumption was reinforced through formal interviews with SME managers and engineers in Ceper. However, during a particular interview, it was found that problems associated with raw material and fuel availability were occurring. The easy availability of scrap metal as a raw material was declining, and the price of coke and electricity was increasing. Means of ameliorating these emerging problems for SMEs in Ceper were being negotiated with the Indonesian government via changes to energy policy for manufacturing industries.

7. Conclusion

Technology transfer is believed to be a shortcut to increase technology performance for SMEs, this is particularly true for SMEs in developing countries, where these organisations face a lack of human resources, technology capability, research and development and capital. As a result, external resources are required to support their performance in developing technological capabilities, and thus so-called 'knowledge and technology transfers' are needed. Knowledge and technology transfers take the form of interactions between transferor(s) and transferee. During transfer of technology, problem that occurred in the process of transferring the technology is an inappropriate intention of transferees regarding knowledge and technology transfer. Whereas, a successful technology transfer that improve the technology capability of the transferee will contribute to their ability to produce high precision products to meet customers' needs. It means that SMEs will also improve their competitive advantage. The outcome of SMEs capability to improve their competitive advantage will be profitability and prosperity.

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