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A Technological Capability Assessment of Company in the Crude Palm Oil Industry in Indonesia

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Abstract. Indonesia is the world's largest producer of Crude Palm Oil (CPO). Accordingly, it is vital that Indonesian CPO industries diversify and add value to downstream products. Technological capability is a key component for agricultural-based industries to retain their global competitiveness and holds immense importance in facilitating product-based diversification. In terms of technological capabilities that are specific to agricultural-based industries, unique indicators and parameters have been identified and include research and development, human resources, strategic planning, technology infrastructure, and manufacturing. Having knowledge of organizational technological capabilities can contribute to expanding the range of available downstream Crude Palm Oil (CPO) products. However, the income generated from CPO in Indonesia is currently lower compared to that achieved by its competitors. The current study was conducted on 11 CPO companies in Sumatera Utara Province, Indonesia. The purpose of the study is to develop an assessment tool. The tool is proposed to measure the capability of technology in crude palm oil-based industries. The device developed is also to obtain empirical data in order to determine the capability of technology in CPO companies. The descriptive analysis approach is applied in this study.

Keywords: Crude Palm Oil (CPO) industries; Downstream products; Technological capability

1. Introduction

Industries in developing countries must secure their trade for survival. Globalization has not only allowed a reduction in the number of barriers to participation in international commerce, it has also enabled the proliferation of competitors. The global economy has meant that industries have had to modify their system of goods production in order to attain market hegemony. The Food and Agricultural Policy Research Institute has predicted that global Crude Palm Oil (CPO) consumption will increase by 30%, with total anticipated production of 60 million tonnes by 2020 (Robbani, Fahmi, and Suprayitno, 2015). An estimate of CPO global production of 315 million tonnes by 2030 was reported in the study by (Rifai *et al.*, 2014). It was anticipated that Indonesia would produce 30 million tonnes of CPO by 2020, of which 23 million tonnes would be assigned to the export market, but the

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production of 31 million tonnes of CPO was achieved in Indonesia in 2013 (Hoffmann *et al.,* 2015).

Technology is important to the economic development of countries. Technological developments and managerial capabilities are needed by countries to establish technological efficiency and stimulate economic growth (Chien, Wang, and Lin, 2011). Technology is vital to remaining competitive since the rapid advancement of technology accelerates global transformation. Technological evolution has meant that traditional organizational management strategies are no longer appropriate. Advanced technology is required to optimize productivity, ensure appropriate quality, reduce costs, and facilitate flexibility. Perpetual investment in technological developments, as a means of establish energetic capability, has been identified as a key approach to successfully competing in the global market in the twenty-first century. Perpetual investment in technological developments, aimed at establishing an energetic capability, has been identified as a key approach for achieving success in the global market during the twenty-first century (Chien, Wang, and Lin, 2011). There are three basic factors to sustain development, they are: management, design, and technology. They are very necessary and play roles for competitive advantage. The quality of products is solely relied on high patterns and technology (Suwartha *et al.,* 2018).

The technology-related capability of a country is assessed according to the implementation of new technology, technology infrastructure, and human development (Archibugi and Coco, 2004). Strategic planning, Research and Development (R&D), human resources, and technology infrastructure influence the technological capabilities of firms in developing countries (Madanmohan, Kumar, and Kumar, 2004). In previous research, the technological capability of Korea's Random Access Memory (DRAM) and Thin Film Transistor–Liquid Crystal Display (TFT–LCD) industries were assessed in terms of R&D, human resources, and technology infrastructure (Park, Choung, and Min, 2008). Technology capability is also used to examine the telecommunication industry in China (Wu *et al.,* 2014). Manufacturing industries have been evaluated based on their technology capabilities (Zahra and Nielsen, 2002), and a similar assessment has been conducted for firms operating in the tourism sector (Figueiredo, Gomes, and Farias, 2010). The technological capabilities of Finnish multi-industries have been assessed in terms of the availability of human resources, technology infrastructure, and manufacturing capacity (Kyläheiko *et al.,* 2011). R&D and strategic planning have been assessed in research to determine the technological capabilities of manufacturing industries (Lang, Lin, and Vy, 2012). South Korea's semiconductor industry develops new products through technological advances, such as R&D and technology infrastructure (Tzokas *et al.,* 2015).

Technological capability plays an important role in accelerating product diversification. The development of the technological capabilities of an organization is crucial to modernization and increasing its levels of competitiveness and productivity. At the company level, technological capabilities simplify innovation and advance productivity.

A survey was used in the present study to determine the technological capabilities of CPO-based industries in Sumatera Utara Province, Indonesia. The purpose of the study is to develop an assessment tool. The tool is proposed to measure the capability of technology in crude palm oil-based industries. The developed tool is to quantify and determine the classification of the capability of technology. It will evoke an awareness to develop plans on how to make the improvements. This then allows the company to increase some aspects of the capabilities of technology. The company may improve itself both theoretically and practically. The technological capabilities of 11 companies in the CPO-based industry (i.e., one multinational company and 10 locally owned corporations) were evaluated in the

current research. This Province is very potential for oil palm with 5.07 tonnes/year, which contributes 28.04% to Indonesia National production (Badan Kebijakan Fiskal, 2012).

Indonesia is the world's largest producer of CPO. However, the income derived from CPOs in Indonesia is less than that of its competitors, primarily because of the low value-added to derivative products. There is a need to diversify the downstream product range and create value-added products. Indonesia's main competitor has more than 100 types of downstream CPO products. The diversification of assorted downstream products and the creation of value-added products are needed. To be able to diversify its product range, the Indonesian CPO industry must first determine its technological capabilities.

2. Literature Review

2.1. Technological Capabilities

Technology is an emergence of human creativity and a generator mechanism for economic growth. According to (Berawi, 2015), technology is the way how to create, which supported by science from design to transformation and from prediction to production, model creation, continuous improvement, enhancement new distinctions are to increase the grade of technology for competitive advantage. Technology is not for industrial used only but also useful for business case. Likewise, (Berawi, 2018) proposed that technology may be used as a helpful tool for generating new designs of innovative business processes. He furthermore said that technology has been applied to organize society, products, and projects in over the world. The invention of new technology is crucial to encourage innovation in various developments of outcomes (Berawi, 2019). Technology cultivation may improve the circumstances economically that can rectify the life quality of human beings (Berawi, 2021).

Investment in technological capabilities is considered crucial because the latter is a viable response to dynamic market demands. Technological capability is a function of the ability to access, adapt, and manage technologies. (Schoenecker and Swanson, 2002) used various criteria to assess technological capabilities, such as R&D, expenditure, statistics for patented products and services, and data for newly introduced products. They considered the advantages and disadvantages of each and their validity in the chemicals, electronics, and pharmaceuticals industries. (Zahra and Nielsen, 2002) proposed that technological capability could be determined using four characteristics: (1) the frequency with which new products are introduced, (2) the speed at which new products are introduced compared to competitors, (3) the ability to create highly innovative novel products, and (4) the knowledge created by the organization (i.e., reflected in patents).

Three key components of technological capability have been identified; these are the creation of new technologies, technology infrastructure, and human skill development (Archibugi and Coco, 2004). These components are vital for the development of technological capabilities According to (Madanmohan, Kumar, and Kumar, 2004), the transfer of international technologies is considered the preferred method for acquiring technological capability. The process of technology transfer is characterized by several stages, including discovery, evaluation, acquisition, adaptation, and implementation. The ability of companies to utilize imported technology depends on their technical and organizational capabilities. In order to disseminate new technology effectively, the recipients must develop the in-house capacity to perform R&D and carry out training programs, as well as implement planning and control. Two main external resources, the government, and the national technology infrastructure, were identified as having the capacity to impact technological development (Madanmohan, Kumar, and Kumar, 2004).

Technology capability is a driving force for innovation in a company. It is defined as the

ability to utilize technological knowledge to duplicate and diffuse existing technologies, make new ones, and develop new processes and products in response to economic fluctuations (Park, Choung, and Min, 2008). Technological capabilities constitute the ability to execute all pertinent technical-related activities in a company, encompassing, but not limited to, the ability to make new products and implement novel processes to maximize the use of equipment. It has been proposed that technological capability is compatible with the growth of innovation because it implies that a wealth of knowledge is available to create and manage technical change.

The technology comprises substantial knowledge that has been mastered by people and organizations (Figueiredo, Gomes, and Farias, 2010). According to them that technological capabilities can be defined as an abundance of knowledge-based resources in four areas, namely, (1) techno-physical (i.e., capabilities manifested in the equipment, software, and databases), (2) organizational and managerial systems (i.e., capabilities developed by the organization through a set of routines that drive organizational activities, (3) people (i.e., capabilities reflected in formal education and tacit knowledge, such as experience, skills, and adroitness), and (4) products and services (i.e., capabilities that are evident in the organization's products and services, the latter of which have been designed, developed, manufactured, supplied, and commercialized by the company).

Zhou and Wu (Zhou and Wu, 2010) suggested that technological capabilities are evident in a company's ability to foster a new product and expedite the speed with which the product is developed. Technological capabilities are thought to denote the accumulated technological knowledge that a firm develops by introducing new products or services, making improvements to existing products, establishing technological expertise, and investing in machinery and manufacturing systems (Kyläheiko *et al.,* 2011).

Organizations with sound technological capabilities are characterized by high performance because they are able to implement state-of-the-art technologies. It enables them to produce innovative product emerging to competitive benefit. The organizations are also more innovative and may reach higher distinction by innovating products in responding to the fluctuated market atmosphere (Tzokas *et al.,* 2015). A company seeking to enhance its technological capabilities needs to invest in R&D to help it develop innovative products (Tzokas *et al.,* 2015). In one study, technological capabilities are also a significant indicator to describe the success of Korea in catching technology (Park, Choung, and Min, 2008). Similarly, (Khayyat and Lee, 2015) investigated the role of technological capabilities as a recent tool with which to measure standards of innovation in developing nations. Unsal and Cetindamar specifically employed this measure to assess the level of technology establishment within the information technology, defense, and banking industries in Turkey (Unsal and Cetindamar, 2015) China has succeeded in cultivating its technological capability by importing technology from abroad through foreign direct investment, joint ventures, and foreign-owned businesses. The potential for adaptive new thought is greater if a company invests in technological capabilities. Technological capabilities encompass numerous indicators and parameters. There are some indicators of technological capability in various sectors, such as the semiconductor, automotive, electronic, and manufacturing industries, are detailed in Table 1.

Table 1 Indicators of technological capability in various industries and sectors

Authors	Measurements	Sector
Zahra and Nielsen (2002)	Frequency with which new products are introduced The speed at which new products are introduced compared to competitors The ability to create highly innovative new products The knowledge created by the organization (reflected in patents)	Manufacturing
Schoenecker and Swanson (2002)	R&D expenditure Patents The introduction of new products	Chemical, electronics, and pharmaceutical
Madanmohan, Kumar, and Kumar (2004)	Internal factors: Planning and control, market orientation, training, R&D investment, and technical manpower Transfer of technology External factors: Governmental support and national technology	Firms in developing countries
Archibugi and Coco (2004)	The creation of technology Technology infrastructure Human skills development	The technological capabilities of countries
Park, Choung, and Min (2008)	Technology: R&D capabilities, the capacity to incrementally improve existing production processes and technologies, the ability to transfer technology from advanced countries, and timely investment in technology Human resources: The ability to recruit skilled labor and organize human resources Networks: The ability to link with suppliers and buyers, as well as establish global links for sales, production, and R&D	DRAM and TFT–LCD (Korea)
Figueiredo, Gomes, and Farias (2010)	Techo-physical: Equipment, software, and databases Organizational and managerial: Structures and systems Human resource: Experiences, skills, adroitness, and talent Products and services: Products and services designed, developed, manufactured, supplied, and commercialized by the firm	Tourism
Zhou and Wu (2010)	New product creativity Speed at which any products are Developed	Product innovation
Kyläheiko *et al.* (2011)	New products and services Improvements to existing products The technological skills of individuals and teams Processes Routines Technological assets, such as machinery, information, and manufacturing systems	Multi-industries (Finland)
Lang, Lin, and Vy (2012)	R&D and strategic planning	Manufacturing
Tzokas *et al.* (2015)	R&D and technology infrastructure	Semiconductor (South Korea)

R & D: Research and development, DRAM: Random Access Memory, TFT: Thin Film Transistor, LCD: Liquid Crystal Display

3. Methods

3.1. Indicators of Technological Capability in the Crude Palm Oil Industry

Suggested indicators of technological capability identified in the literature, were selected in the current study to conform to the palm oil-based industries. The chosen indicators mostly related to generating innovation aspect and mass production. Table 2 depicts chosen indicators of technological capability in the CPO industry. The proposed indicators were compiled to be a check sheet and utilized as a measurement tool (Table 3) to collect data about technological capability as indicated in indicators from 11 palm oil industries in Sumatera Utara Province, Indonesia. The palm oil-based industries are only

11 companies in this area, all of them were used as research objects. A survey was completed by company representatives (i.e. members of top or middle management/production managers). The purpose of the study was clarified by the researcher, who aimed to measure the capability of technology in order to ensure the acquisition of accurate and factual information. The participants were assured that the data would be used for research purposes only. Descriptive analysis approach is applied in this study. Descriptive statistics is to calculate and describe the actual characteristics of collected data in a logical, meaningful, and efficient way.

Table 2 Proposed Indicators of Technological Capability in the Palm Oil Industry

Indicators	Authors
R & D	Schoenecker and Swanson (2002); Madanmohan, Kumar, and Kumar (2004)
Human resources	Madanmohan, Kumar, and Kumar (2004); Park, Choung, and, Min, (2008); Figueiredo, Gomes, and Farias, (2010); Kyläheiko *et al.* (2011)
Strategic planning	Madanmohan, Kumar, and Kumar (2004)
Technology infrastructure	Madanmohan, Kumar, and Kumar (2004); Archibugi and Coco (2004); Park, Choung, and, Min (2008); Figueiredo, Gomes, and Farias (2010); Kyläheiko *et al.* (2011)
Manufacturing	Kyläheiko *et al.* (2011)

R & D: Research and Development

4. Results and Discussion

4.1 Results

Table 3 shows selected indicators were collated in a survey that was administered to the participants to obtain empirical data on the technological capabilities of companies in the palm oil industry. A check sheet was utilized in this study. The check sheet is a structured, prepared form for collecting and analyzing data. The indicators of technological capability value from 10 to 40. The empirical data obtained were formulated to describe the CPO-based industries.

Table 3 Indicators Selected for Application in the Current Study to Determine Technological Capabilities in the Palm Oil Industry in Indonesia

Variable	Indicators	Comp. A	Comp. B	Comp. C	Comp. D	Comp. E	Comp. F	Comp. G	Comp. H	Comp. I	Comp. J	Comp. K
Techological Capability	R & D	10	30	30	30	30	20	20	10	10	10	10
	Human Resources	30	40	40	40	40	40	30	20	20	20	10
	Strategic Planning	20	30	40	40	40	40	30	20	10	20	10
	Technology Infrastructure	20	40	40	30	30	30	20	10	10	10	10
	Manufacturing	20	30	30	40	30	30	20	10	10	10	10
	Overall Score	100	170	180	180	170	160	120	70	60	70	50

*Note: Excellent level of indicator = 40, Good level of indicator = 30, Fair level of indicator = 20, Poor level of indicator = 10

The empirical data obtained by means of the tool were then formulated to describe companies in the palm oil-based industries related to technological capability. A total score of 151 to 200 is considered a high category, while a score of 101 to 150 is considered a

medium category, and a score of 50 to 100 is considered a low category. The table above describes the level of technological capability of the palm oil-based industries.

A score of 20 to 40 was considered high, while 10 to 19 was a low classification; it indicated that 7 companies (64%) were in the low category, and four companies (36%) were in the high category for R&D. Seven and 36% of companies received high and low scores, respectively, for their technological capability in human resources. Five companies (45 %) achieved a poor score, and 6 (54%) companies attained a high score for strategic planning. A low score and a high score were realized by 6 companies (54%) and 5 companies (45%), respectively, for technology infrastructure. Six companies (54%) did not score highly for technological capabilities in manufacturing, compared to 5 companies (45%) that did. Based on the overall ranking of technological capability, 5 companies (45%) scored highly, and 6 companies (55%) were in the bottom category of technological capability. Scoring below 150 was deemed to be poor, which demonstrates the technological capabilities.

4.2. Discussion

Most companies in this study made an insignificant investment in Research and Development (R & D). R & D includes activities that companies undertake to innovate and introduce new products. It is often the first stage in the development process. Technological capability of the palm oil-based industries is supported by a high of human capital. The human resources are employees to assist in the process of attaining main objectives of the palm oil industries. Strategic planning is a little more than half in high category to espouse the capability of technology in this region. Strategic planning is a process of defining, directing, and making decisions on allocating the resources to pursue the strategy. It may also extend to control mechanisms for guiding the implementation of the strategy to maximize the products of the palm oil-based industry. Technology infrastructure is one of the most important things to support the operation in any industry. However, it is more than half of the palm oil industry in the low category of it. Technological capability is supported by less than half of the high category in manufacturing in this study. Actually, manufacturing is a notable thing that functions to transform goods, including crude palm oil into a raw material to be valuable products.

It is slightly more than half of the CPO industry in this region was in the low category and never considered modernizing their technological capabilities. The results of the survey demonstrate that most companies in the CPO industry rely on existing technology rather than creating novel innovations. In this region, the majority of CPO (Crude Palm Oil) industries focus solely on survival and often neglect the importance of modernizing and upgrading their infrastructure. In addition, the development of technological capabilities in Malaysia, which includes those in the CPO industry, is primarily undertaken by multinational companies. Investment in technological capabilities is applied to areas such as joint ventures, subsidiary-parent relationships, machine imports, technology cooperation agreements, and the acquisition of foreign companies (Hansen and Lema, 2019). In the past-changing technology era, the company should update itself to avoid lagging behind the others (Tatiana and Mikhail, 2020). This study will be the impression that the capability of technology is pivotal to escalating the value-added products for competitive advantage in worldwide competition.

5. Conclusions

In the current study, it was important to determine the technological capabilities of companies in the CPO industry because improvements cannot be made if the former cannot

be quantified. Measurement is a milestone for improvement. Historically, over the past decade, technological capabilities have been recognized as vital for positioning organizations to compete effectively against other companies within the industry. Performing a technological assessment helps managerial staff to make necessary improvements. Conversely, most CPO industries in this region are arguably assumed to survival basis only because they do not consider modernizing their technological capabilities since slightly more than half are in the low category of capability. Currently, the technology capabilities of the majority of CPO industries in Indonesia are not equivalent to, or capable of surpassing, those of similar industries in Malaysia. The Indonesian CPO industry continues to lag behind other countries (i.e. industrial front runners) due to numerous multinational companies in Malaysia. Accordingly, they are able to help Malaysia advance its technological capabilities. It enables to study the assessment tool for other agro-based industries for future research because the tool can be applied to those industries. The research data in this study is limited to a region, future research will be more valuable if it covers a whole region in a country.

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