Firms' ICT and Innovation in Jakarta Metropolitan Area

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***Abstract*— The aim of this study is to analyze the difference in innovations for firms that either do or do not use information and communication technology (ICT). In today's digital era not all firms using are ICT. It would be interesting to know the difference in innovation performance between companies with and without ICT usage. Data from the last wave of the Enterprise Survey for Indonesia 2015 was analyzed using descriptive statistics and a test of differences using the Chi-Square test. The region of focus for this paper is the Jakarta Metropolitan Area. Jakarta is the current capital city of Indonesia and the second most populous metropolitan area after the Tokyo urban area. The analysis shows that significant differences were observed in both product and process innovations. This study can be beneficial for understanding the role of ICT in firm innovation, especially for firms in metropolitan areas and emerging economies.**

Keywords—ICT, innovation, Enterprise Survey

I. Introduction

Innovation activities have been revealed by researchers as a driver of economic growth. In today's digital era and in regard to business organizations, rapid technological sophistication accompanied by the use of ICT has also come to the attention of researchers. Technology is believed to be a strategic source for a company's competitive advantage, as well as industry development. [1]. Company use of ICT has continued to increase and has come to the attention of various researchers in recent years [2]. Researchers suggest that ICT can be used to achieve excellence and should be the focus of entrepreneurs in order to survive in the era of e-business. [3]. It is also suggested that companies adjust their ICT capabilities to the latest business developments [4]. This needs to be supported by adequately-skilled human resources and directed strategic planning [5].

This study is interested in analyzing the differences in innovative performance between those companies that do or do not use ICT. The use of ICT is now considered necessary in this highly-digital business environment [6]. The use of ICT can also be applied to various functions within the company, as well as in various industries [7], [8]. The use of ICT is determined by company business strategy. More specifically, this study is interested in researching firm-level data in metropolitan areas and in the emerging economy, with a focus on the Jakarta metropolitan area in Indonesia. The Jakarta metropolitan area is a more recent capital city and an Indonesian business center. This region is the most populous in Indonesia with a population of about 30 million people and is the second most populous urban area in the world after the Tokyo urban area in Japan [9], [10].

This study can be useful to understand the role of ICT on innovative performance in metropolitan areas in emerging economies. In the Global Metro Monitor, metropolitan areas in emerging economies dominate the list of the fastest-growing economies in the world [11]. This paper begins with an overview of topics in the introduction section. Section two reviews literature regarding ICT and innovation, while the third section is concerned with the methodology and data used in this study. The fourth section presents the results of the study, including a discussion of the findings. Finally, the conclusion provides a summary, research limitations, and directions for future research.

II. Literature Review

Innovation is considered as a life blood for companies to survive and grow in business [12]. The literature on innovation has many variations in innovation definition [2], [13]. This is because innovation is studied by many disciplines and perspectives [14]. At the company level, innovation takes place in various sectors, industries and company sizes [15], [16]. It is found that innovation consists of various key attributes, including nature, type, stages, social context, means, and aim [17]. Therefore, not surprising with a variety of attributes, it is quite difficult to determine the definition of which is fully agreed upon. The classic and straightforward definition is proposed by Thompson in 1965 "Innovation is generation, acceptance, and implementation of new ideas, processes products or services" [18]. In its development, this definition and scope continue to grow, including the latest intersection with other fields such as sustainability [19]. Baregheh, Rowley & Sambrook found about 60 definitions of innovation from different fields with the most definitions coming from the business and management field [17].

Among those suggested by previous researchers, contributing to company innovation is ICT, in various forms of use of related technologies [20]–[24]. Morikawa (2004) is an early study that examines the relationship of ICT with company

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innovation in which it is revealed that companies that use computers are more likely to engage in innovation activities than those who do not use them [22]. In subsequent developments, it was found that ICT is an enabler for innovation activities through process improvement mechanisms or innovative product and service offerings for customers [24]. It was also found that the use of ICT affects the flexibility within the company [23]. A more recent study found that ICT is particularly useful for efficiency through cost reduction and website development shows the potential to contribute positively to product innovation [21]. These studies were carried out in the context of developed economies, namely Japan, Germany, the UK, and Europe [20]–[24]. Hence, this paper tries to provide a foundation for extending the various findings in these studies in the context of developing economy.

Nowadays, ICT becomes an inseparable part of daily life. Likewise, for companies, technology, including ICT is a vital part of the company's daily life [6]. Investment in ICT is a strategic decision that is influenced by the availability of resources within the company. Besides, the availability of these resources also affects investment in another related function such as R&D and employee training [25]. In the end, it also impacts the level of innovation throughout the company [2]. Companies with smaller resources such as small businesses have fewer budgets so that the allocation of funds to invest in ICT is less than for medium enterprises or large companies. Various aspects are considered in ICT investment both in terms of cost and benefits. The benefits that are generally expected are efficiency in operations and effectiveness in communication with the external stakeholders [2].

The use of ICT has had an impact on all industries and company sizes, also to different functions that exist within the organization both primary and supporting activities [7], [8], [26]. With these conditions, the integration of technology becomes the attention of practitioners and academics so that companies get the maximum benefit from their ICT investments. Issues and challenges faced by the company in pursuing this integration process can be minimized through careful planning [27]. In addition, ICT management which previously only concentrated on operational aspects now shows a trend of change to lead to both operational and strategic aspects. In this perspective, ICT becomes an essential part of company development both in the short and long term [2]. A study from UNCTAD (United Nations Conference on Trade and Development) in 2008 revealed that the ICT in the form of computer, the Internet and website usage could increase the level of sales per employee [28]. The concrete benefits gained are increased savings, efficiency, service delivery, market performance and reduced the costs of transaction [29].

III. Methodology

The approach used in this study is quantitative by using a statistical difference test. The data used is the last wave of Enterprise Survey for Indonesia in 2015 conducted by the World Bank [30]. This survey explores various business environment conditions in companies in Indonesia. Among the questions given to respondents were about ICT usage and innovation in the companies. Since the focus of this paper is on the Jakarta Metropolitan Area, the data used is narrowed to that region. Although this survey is anonymous, the characteristics of the company are included in detail in this survey. These characteristics include those used in this paper are the sector (manufacturing or services), size (based on the number of employee), and age (year of establishment) of the company. These characteristics were asked at the beginning of the survey questionnaire.

With regard to the ICT usage, the question items asked to the respondents are related to the use of email to communicate with external parties, and the use of company websites for various company purposes. The use of this item as a proxy for ICT usage is similar to that used by previous researchers, for example, including the recent research of Gërguri-Rashiti, Ramadani, Abazi-Alili, Dana, Ratten published on Thunderbird International Business Review in 2017 [2]. More precisely, the item asked to respondents was "At the present time, does this establishment use e-mail to communicate with clients or suppliers?" and "At the present time, does this establishment have its own website?" The answer to both questions is yes and no. Dummy variable is used where companies that use at least one of the two applications (e-mail or website) are given code 1 which means use ICT, and the rest are given code 2 which means not use ICT in their operations.

As for the company innovation, the type of innovation that is the focus of this paper is product innovation and process innovation. This paper also uses a proxy in the form of the same question items as suggested by the previous researcher [31]. Both types of innovation were asked in the survey questionnaire with the following redaction, "During the last three years, has this establishment introduced new or significantly improved products or services?" and "During the last three years, has this establishment introduced any new or significantly improved methods of manufacturing products or offering services?"

Analysis of the data used uses a combination of descriptive statistics, and differences test using the chi-square test for independence by involving Yates' continuity correction and Fisher's exact test. Descriptive statistics are used to describe the characteristics of the company. Dummy variable is used for firm age because the data scale is a ratio. The three age categories of the company used are young (<= 5 years) mid-age (6-10 years), and mature (>=11 years) [32]. Because there are only few young firms in the data (less than 5 companies), the young and mid-age categories are combined. Chi-square test for independence is used to determine differences in characteristics and innovations of companies that use and do not use ICT. This test is used considering the data not normally distributed. The use of this test for similar data types was carried out by previous researchers [33]. Yates' continuity correction used to enhance the chi-square test when analysis involves 2x2 comparisons. Fisher's exact test is used when the chi-square assumption regarding expected cell frequency is not fully met [34]. The IBM SPSS 25 statistical software package is used to assist the data analysis process.

IV. Results and Discussion

The profile of respondents can be seen in Table 1. Total sample of the survey in the Jakarta Metropolitan Area is 173 companies. The majority engaged in manufacturing that is 119

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companies or 68.8%; the remaining 54 companies are engaged in services consisting of two main groups namely retail and non-retail services (such as hotels and restaurants, service of vehicles, and construction). The sample composition based on company size is quietly evenly distributed. Large businesses are the most businesses, namely 67 companies, followed by medium and small companies, respectively 53 and 52 companies. By age, 88.4% of the sample companies are mature (over 10 years). The remaining 18% is a combination of young companies (less than five years) and mid-age companies (6-10 years). From 173 companies, it is known that around three quarters (128 companies or 74%) use ICT, and the remaining 45 companies do not use ICT in their operations.

TABLE I. RESPONDENTS PROFILE

Characteristic	Sub-characteristics	Frequency	%
Sector	Manufacturing	119	68.8
	Service	54	31.2
	Total	173	100.0
Size	Small	52	30.1
	Medium	53	30.6
	Large	67	38.7
	Total	172	99.4
Age	Young & mid-age	18	10.4
	Mature	153	88.4
	Total	171	98.8
ICT usage	Yes	128	74.0
	No	45	26.0
	Total	173	100.0

Source: data processed.
Note: N=173. Total may not equal 100% because of missing values.

Chi-square test of differences in company characteristics based on ICT usage shows some interesting results. In terms of sectors, a chi-square test for independence with Yates' continuity correction shows there is no significant difference between companies that use ICT and not use ICT, $\chi^2(1, n = 173) = 0.042$, $p = 0.839$. This indicates the role of ICT usage for both manufacturing and service companies is not much different [7]. By company size, the chi-square test indicates a highly significant difference between companies that use and do not use ICT at different company sizes with $\chi^2(2, n = 173) = 54.741$, $p = 0.000$. The proportion of large companies that use ICT is far more than medium or small sized companies. This shows alignment with the various findings in the literature that smaller companies have smaller resources so that their investment in ICT is more limited [2], [25].

For the age of the company, as in the sector, the results of the chi-square test with Yates' continuity corection and Fisher's Exact Test $\chi^2(1, n = 173) = 0.186$, $p = 0.572$ indicate there is no statistically significant difference between young and mid-age companies (1-10 years), and mature companies (more than 10 years). From these results, can be said that of the three characteristics analyzed, the only characteristic that is significantly different statistically is the size of the company which directly reflects the resources they have. A More complete results fromthe chi-square te of difference in company charactersitics by ICT usage can be seen in Table II.

TABLE II. CHI-SQUARE TEST OF CHARACTERISTICS DIFFERENCE BY ICT USAGE

Characteristics	ICT Usage				χ^2	df	Sig.
	Yes		*No*				
	f	%	f	%			
Sector							
Manufacturing	87	68.0	32	71,1	0.042[a]	1	0.839
Service	41	32.0	13	28.9			
Size							
Small	21	16.4	31	70.5	54.701**	2	0.000
Medium	40	31.3	13	29.5			
Large	67	52.3	0	0.0			
Age							
Young & mid	12	9.5	6	13.3	0.186[a]	1	0.572[b]
Mature	114	90.5	39	86.7			

Source: data processed.
Note: N=173. Total may not equal 100% because of missing values. [a]with Yates continuity correction, [b]with Fisher's exact test. ** and * respectively indicate significance at 0.01 and 0.05 level.

The difference in company innovation based on ICT usage is shown in Table III. Chi-square test results with Yates' continuity correction show there are significant differences between companies that use and do not use ICT in their innovation performance, both in product and process innovation. The level of significance in process innovation higher than product innovation. Chi-square test results on product innovation generate $\chi^2(1, n = 173) = 6.676$, $p = 0.010$ while the chi-square test results on the innovation process generate $\chi^2(1, n = 173) = 9.764$, $p = 0.002$. These results are in line with previous studies in the context of developed economies, which found that firms with ICT usage most likely to engage in innovation [20]–[24]. Highly significant difference in process innovation when referring to previous research may be related to the efficiency of processes both internally and externally, which helps companies increase their sales, savings, and overall performance [28]-[29].

TABLE III. CHI-SQUARE TEST OF FIRMS' INNOVATION BY ICT USAGE

Characteristics	ICT Usage				χ^2	df	Sig.
	Yes		*No*				
	f	%	f	%			
Product innov.							
Yes	25	19.8	1	2.2	6.676**	1	0.010
No	101	80.2	44	97.8			
Process innov.							

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Characteristics	ICT Usage				χ^2	df	Sig.
	Yes		*No*				
Yes	32	25.0	1	2.2	9.764***	1	0.002
No	96	75.5	44	97.8			

Source: data processed.
Note: N=173. Total may not equal 100% because of missing values. [a]with Yates continuity correction. ** and * respectively indicate significance at 0.01 and 0.05 level.

V. Limitations, and Further Direction

This study contributes to previous literature by enhancing knowledge about differences in innovative performance between companies that use and do not use ICT. This is a preliminary study to analyze the role of ICT in company innovation in the metropolitan area. This study has several limitations to be considered. First, this study analyzes differences on innovation performance based on company ICT usage. It is not analyzing the relationships between ICT usage and innovation performance. Future studies can be done by exploring the causal relationship between ICT and corporate innovation performance. Second, the proxy use of ICT in this study is limited to the use of email and websites. Although the use of this proxy is similar to previous research, if data is available future studies may include the use of other more advanced ICTs, such as enterprise resource planning (ERP), within the company. Third, this study focuses on one region, the Jakarta Metropolitan Area. Therefore, caution should be exercised when analyzing the results, which may not be transferable to other contexts. Future studies can be carried out on a larger scope, or in the context of similar metropolitan areas in other emerging economies.

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