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The case of ICT in Indonesia

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Unleashing Domestic Firms' Potential to Innovate - The Case of ICT in Indonesia

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Abstract

Indonesia is facing strong challenges of enhancing the innovation level of the ICT sector. There is a quickly growing domestic demand for ICT products and services in this country, however, domestic firms are not able to fully respond to this demand. This situation calls for more understanding of innovation practice in ICT firms in Indonesia, and accordingly the *first part* of the paper provides an analysis of firms' internal (specifically management) and firms' external conditions, using a survey of more than 200 ICT firms, mainly SMEs. Management factors, like ICT skills, manager's experience, cognitive capability, and market-related skills, are *positively* related to innovativeness. Regarding external conditions, collaborative networks in clusters and foreign direct investment also witness a positive association with innovativeness. In the *second part*, key quantitative findings are enriched with expert opinion revealing a main challenge, namely, to improve quality of the ICT education system with emphasis on modern management (entrepreneurial risk-taking).

Key words: Innovativeness, increasing returns, management, entrepreneurial ecosystem, ICT, Indonesia

1. INTRODUCTION

Several developing countries are facing a huge demand for innovative ICT services, while their domestic firms can only partially catch-up and respond to this demand, including Indonesia. To investigate why domestic firms (mostly small and medium-sized enterprises /SMEs) in Indonesia are not sufficiently able to catch-up and serve ICT markets, this paper intends to identify factors that influence innovation performance. While many studies have been devoted to foreign firms entering developing markets (e.g., Freeman and Sandwell, 2008), less attention has been paid to domestic firms attempting to innovate and catch-up.

At the country level, the economy of Indonesia is faced with a fairly low level of overall innovativeness, as evidenced by a relatively low R&D spending as a share of GDP - at less than 0.1 per cent, compared to 2.2 per cent in Singapore and 1.3 per cent in Malaysia (World Bank, 2017), in particular low intensity of business expenditure on R&D (BERD) (Aminullah, 2015). An important innovation challenge in Indonesia is the set of social-cultural values that affect innovation culture, hindering ones like high power distance, but also enhancing ones (Hofstede and Hofstede, 2005; Sriwindono and Yahya, 2014).

Like in many developing economies, SMEs in Indonesia encompass a large segment among enterprises, namely, 99 percent in 2016 (BPS, 2016b). With regard to innovation, already in 2012, some important difficulties of SMEs have been forwarded (Hamdani and Wirawan, 2012), which are partially repeated by World Economic Forum (2022) on SMEs in general. We mention a 'follower mentality' which tends not to work anymore, bad access to new ideas and low absorptive capacity due to poor education. Overall, ICT development in Indonesia is faced with huge potentials for growth due to sheer size of the market (large population), increasing middle-incomes, as well as the relatively low level at start of new developments (ITA US, 2022). It is exactly the contrast between modest capabilities of domestic SMEs and huge potentials to innovate and grow, why we aim to clarify the management situation and forward a broad solution to increasing innovativeness**.** In the ICT sector, management challenges are even more pressing, because ICT innovations become outdated very quickly and new disruptive ICT innovations emerge almost equally fast. Yet, specific *domestic creativity* could work in a positive way. For instance, some service firms have already used the latest ICT technology not only for e-commerce, but also for Internet of Things (IoT) and artificial intelligence (AI)-based solutions (Kristiono, 2016; Kusumawati and Suryanegara, 2016), which may enhance domestic innovation through spillover effects in local/regional networks. In addition, local *community-led initiatives* may also improve innovativeness, namely, through co-creation with local customers.

Against this backdrop, we investigate the issue of innovativeness of ICT firms in Indonesia, specifically of SMEs, by posing two main questions: *(1) In which ways and to what extent do firms' capability factors and external knowledge spill-overs influence firms' innovativeness? (2) What could be solutions for improvement?* Hence, this paper identifies several factors that may impact firm innovativeness by focusing on firms' core capability factors and on external factors related to knowledge spill-overs. To this end, we adopt a firm approach that focuses on essential knowledge developed internally by the firm itself and knowledge achieved externally (e.g., Grant 1996; Cohen and Levinthal, 2000; Cassiman and Veugelers, 2006) while accounting for domestic cultural values (Tehseen and Anderson, 2020).

In conducting the study, first, we use survey data of 260 ICT firms, and explore the idea of increasing and decreasing returns in learning and innovation practice (e.g., Arthur, 1996; Belso-Martinez and Molina-Morales, 2013; Siliverstovs, 2016). In a second part, the quantitative analysis is complemented with five expert interviews and additional literature study. By taking a comprehensive approach through quantitative analyses and qualitative inquiry, this study is new for Indonesia which may advance on and enrich the existing nascent studies of domestic innovativeness by Indonesian researchers (e.g., Dhewanto et al. 2015; Lita et al., 2018).

2. THEORY

2.1 Theoretical Foundation

Two main theories are used to build the theoretical foundation of the paper. First, we mention the theory of dynamic capabilities of the firm (e.g., Teece, 2006; Alonso et al., 2019), with a focus on knowledge and skills achieved internally and externally (Cassiman and Veugelers, 2006). Second, the dynamic capabilities theory is complemented with the theory of spatial knowledge spill-overs and related entrepreneurial ecosystems (e.g., Audretsch and Keilbach, 2007; Acs et al., 2013; McCann, 2013; Stam, 2015).

In essence, the firm's dynamic capabilities theory focuses on internal and external sources of competitive advantage that enable firms to adapt to and take advantage from changing business environments. In responding to external changes (opportunities), dynamic capabilities enable firms to identify, integrate, reconfigure, and renew their resources and abilities in line with these changes (Cohen and Levinthal, 2000; Zahra et al., 2006; Lin and Wu, 2014; Teece and Leih, 2016). Such alignment may increase the speed and efficiency of the learning processes, such as by creating an R&D unit or accessing external knowledge networks, thereby facilitating or even driving higher levels of innovativeness. Furthermore, different *domains* of knowledge need to be acquired and these come with uncertainty about getting adopted but also of getting outdated, and with challenges of unmet customer needs and new value-added (Hamdani and Wirawan, 2012; Autio et al., 2013; Mohr et al., 2014). In a situation where firms are missing any of such knowledge, innovativeness may be hampered. The second theory, that of spatial knowledge spill-overs, has an emphasis on entrepreneurial opportunities in regions. Accordingly, strong spatial concentration of economic activity and market demand in clusters and/or large cities creates advantages in innovation, due to among others, cross-fertilization in dynamic interaction between ICT firms and their customers, suppliers, and local research centres (Duranton and Puga, 2004; Hamdani and Wirawan, 2012). Additionally, according to the related and more recent approach of entrepreneurial ecosystems (EES), small high-tech firms act in myriads of networks and relationships which are partially in

close proximity (cities/regions). Well-developed ecosystems contribute to productivity of innovative entrepreneurship on the basis of institutional and organizational conditions. This refers to networks and institutions (values) enabling entrepreneurial opportunity recognition, pro-activeness and commercialization of opportunities in collaborative projects. According to Hermanto and Suryanto (2017), the components of such ecosystems in Indonesia are working but the activities are limited due to fragmentation in running the respective programs. This could mean that SMEs in large cities do invest in R&D and adopt creative ideas but miss positive influence from a developed (mature) ecosystem, including a gap between West and East Indonesia (e.g., Sihombing, 2019).

Our research design includes theoretical understandings on firm innovativeness and a preliminary theoretical framework with concomitant hypotheses (not presented in the current paper, but in Syamsuri, 2023). Our research framework includes internal firm capabilities and external entrepreneurial ecosystems, and we measure the constructs using a set of indicators displayed in Figure 1. Regarding *internal firm capabilities*, besides often used firm indicators (firm size, R&D organization, and R&D investment) we put emphasis on indicators that are specific to management (i.e., manager's ICT skills, experience, cognitive capability and market-related skills). In addition, we consider market knowledge and market-related skills (concerning market segmentation, value-propositions, marketing and managing higher innovation levels) as specific strategy-related characteristics (Mohr et al., 2013) that may be missing among small ICT firms in developing countries (Hamdani and Wirawan, 2012). Further, external conditions (summarized as entrepreneurial ecosystems) are addressed by using three indicators: level of urbanization, strength of networking within clusters, and amount of foreign direct investment (FDI). We added as a fourth indicator 'regulation', motivated by importance of broader regulation and institutional conditions, and the finding that in Indonesia many SMEs remain at low innovativeness and/or cannot survive because of a shortage in regulation and institutional conditions (Sato, 2000; BPS, 2016b). However, we account for firms' dealing with business regulation as enabled by access to specific knowledge, such as on taxation and ownership rights, and how this is related to firm innovativeness. Finally, to investigate interaction between external conditions and firm internal factors, we add two interaction effects to our research framework to explore how a firm condition may depend on an external condition in influencing firm innovativeness.

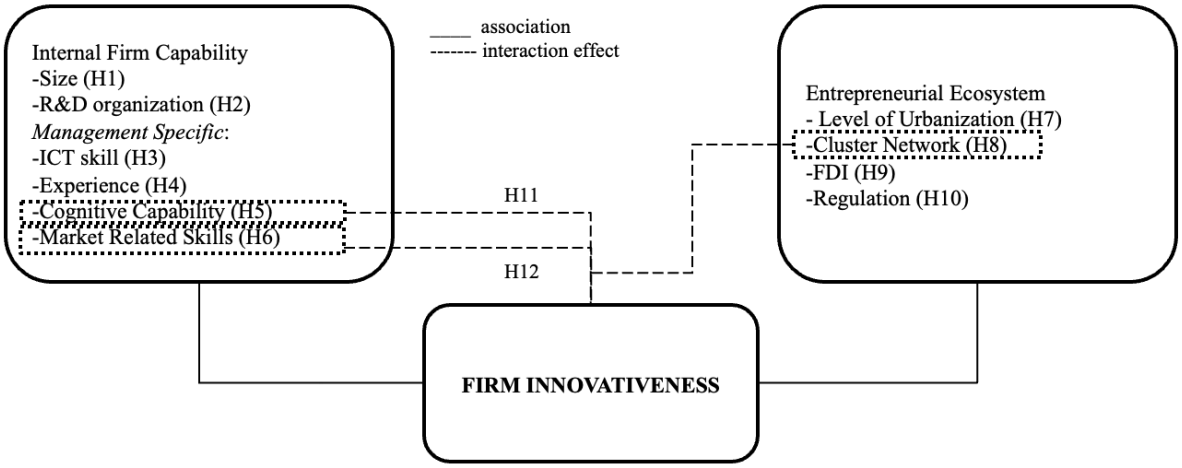

Figure 1. Research framework

3. EMPIRICAL RESULTS

3.1 Data collection and measurement

We conducted an email survey in Indonesia effectively starting in January 2017 and running to November 2017, by distributing a questionnaire to around 2,000 ICT-based firms. These were randomly selected from different areas: Jakarta as the largest city on Java, and Surabaya, Semarang, Yogyakarta, and Bandung as smaller cities on Java, and larger and smaller cities on other islands. With regard to firm size, we aimed to compose a survey including SMEs as well as larger firms, to explore the contrasts. The target respondents were the middle- or upper-level managers of large firms, and the top managers of SMEs, who have a good understanding of innovativeness of the firm. A response rate of 13.6 per cent was achieved. To gain regional representativeness of our sample, as much as possible, we used the firm population from the Economic Census 2016 of the Indonesian Central Bureau of Statistics. With regard to firm size, small firms turned out to be under-represented, while large ones are overrepresented. To address this issue, we used a post-stratification method that gives a large majority of SMEs (Appendix 1).

To determine the quality of the database we used several tests. For example, to detect influence of application of only one measurement instrument (mail survey) for all data (dependent and independent variables), we performed two tests, i.e. Harman Common Method test and non-response bias test. Both test outcomes are within critical boundaries. Further, we focused on internal consistency and/or outliers (e.g., very large companies), resulting in 231 valid cases. Next,

we checked the statistical assumptions for multiple regression analysis (Appendix 1), like model specification error, homoscedasticity of residuals and multi-collinearity. After removing firm age and network openness (multicollinearity), the variance inflation factor (VIF) is close to 4.0. In sum, it turned out that no parameter violated statistical assumptions. Finally, the model exploration cannot exclusively refer to one-directional influence, like from management quality to innovation newness. Such constructs were measured at the same time, meaning that endogeneity issues cannot be avoided. In the second part of the study, we collected in-depth qualitative data through six personal interviews, with managers of ICT firms and two industry experts (at university and government). The interviews took 45 to 60 minutes, and the results have been analysed using NVivo (George State University Library, 2019) as a qualitative data analysis software.

3.2 Descriptive results

Firm innovativeness is the dependent variable in our quantitative analysis, and we use degree of newness of innovation as a proxy. First, we measured number of innovations in the past two years. To avoid confusion about innovation, in the survey document, we mentioned important examples of different types of innovation, such that all respondents could have the same understanding of the activities called innovations. We realize that some over-estimation (*self-evaluation bias*) could have happened, by mentioning a somewhat higher number of innovations. We therefor also included the importance of the level of newness (ranging from merely new for the firm to new for the world). Accordingly, we multiplied each innovation by newness, measured in terms of 'new to who?' (Johannessen et al., 2001), divided into four levels, i.e., new to the firm, the region, Indonesia, and the world, and assigned weights to these levels, thereby assuming large efforts and extreme importance for 'new to the world'. Table 1 shows that 38 per cent of the sample is engaged at a very low level of newness, 34 per cent at a low level, and 27 per cent at higher levels of newness. Main data on firm internal and external conditions, are displayed in Table 1.

Table 1. Measurement and Descriptive Statistics

Variables	*Measurement scale (for binary variables including measurement results)*	*Avg*	*SD*	*Min-Max*
Dependent				
Newness of Innovations	Continuous, derived from weighing procedure using spatial coverage of newness	8.60	12.31	0-50
Independent				
Internal (broad)				
Firm size (2017)	Continuous, as number of full-time employees a)	125.68	699.6	1-4000
R&D organization	Binary: High level organization: 39%; Otherwise: 61%	-	-	-
Specific: Management Potentials				
Manager's ICT-skills	Continuous, derived from regional ICT skill level and managers' education level	0.95	0.47	0.25-2.02
Manager's Experience	Continuous, as years of employment in business	8.32	6.27	1-30
Managerial CC	Continuous, as overall level of capabilities (compound variable)	6.03	1.11	2.10-8.22
Market-related skills	Binary: Medium-strong 42%; Weak: 58%	-	-	-
External (EES)				
Urbanization	Binary: High Urbanization: 50%; Otherwise: 50%	-	-	-
Cluster Network Strength	Binary: Relatively strong intra-cluster network: 43%; Otherwise: 57%	-	-	-
FDI-share in ownership	Continuous, as share of investment in ownership	9.33	22.02	0-100
Dealing with Regulation	Binary: dealing positively: 46%; Otherwise: 54%	-	-	-

a) Continuous variables: prior to transformation

4. INNOVATION PERFORMANCE

4.1 Model results

Table 2 shows regression outcomes about firm innovativeness, if data allow, in linear and u-shaped relations. Model 1 is a partial model concerning firm size and one R&D-related indicator, while Model 2 is a partial model on management indicators. Model 3 is a partial model concerning firm external factors mainly related to knowledge spill-overs. Finally, Model 4 is a complete model, including (a) merely linear relations and (b) linear and interaction effect, and (c) linear and non-linear relations. We first discuss partial models and full models.

The strength of the management model (Model 2) tends to be similar to that of firm size and R&D organization (Model 1) using a linear model (R^2 of 0.26); however, the hybrid model (non-linear & linear) of Model 1 is stronger (R^2 of 0.30 versus 0.19). The strength of Model 3 (Entrepreneurial Ecosystem), as evidenced by R^2 of 0.17 and 0.13, is clearly weaker. Further,

interaction effects (Model 4) are significant and contribute considerably to explained variation of the full model (ΔR^2 of 0.13 and 0.09) for the linear models.

Overall, the above estimation results of the full models on newness of innovation are at a 'reasonable' strength (R^2 between 0.35 and 0.39) but remain behind estimation results when taking *R&D investment* as a dependent variable (R^2 between 0.51 and 0.55) (Syamsuri, 2023). Such discrepancies between intended innovation (R&D investment) and actual innovation may be explained by managers' modest knowledge on transforming R&D results and innovative ideas into innovation actually brought to the market and dealing with concomitant complexities (e.g., Kleinknecht et al. 2001; Edquist, 2010; OECD, 2018ab). We now proceed with individual indicators.

4.2 Results on Firm size, R&D, and Management

We observe with regard to firm size a significant linear as well as a non-linear relationship (Table 2). Firm size turns out to provide the strongest explanatory value in our analysis, including the full models**.** Regarding R&D organization, a positive and significant relationship in the full models suggests that a more professionalized R&D, through an own unit and/or external collaboration, tends to matter. With regard to manager's ICT skills, we observe a positive linear relation and some evidence of increasing returns. For manager's experience, we could have expected decreasing returns due to 'over-confidence' and lock-in after some years, but this tends not to happen. The main result is a positive and significant pattern in the partial model. Our next indicator, managerial cognitive capability, representing a broader learning, shows a similar pattern as experience, namely, positive and significant in the management model, including a trend of increasing returns. And finally, stronger market-related skills, including e.g., dealing with market segmentation and marketing techniques, tend to be positively related with innovativeness. Noteworthy, market-related skills turn out to be of special importance in innovativeness of ICT firms, given the relatively high coefficient and strong significance. On the whole of management factors (Model 2), manager's ICT skills and market-related skills are positive and significant in the partial and full models, however, experience and cognitive capability are not significant in full models. These results may indicate some ambiguity, potentially following from fast changing requirements and complexity in ICT innovation management.

4.3 Results on Entrepreneurial Ecosystem

The partial models concerning ecosystem indicators on knowledge spill-overs, give several results that are assumed, including positive relationships with cluster network strength and FDI, the last

indicating a trend of increasing returns. Different from our expectations, however, knowledge spill-overs in metropolitan areas tend to be weak in influencing actual level of newness of innovations. An explanation for this situation may include the following. Large cities in developing countries tend to be a favourable location for somewhat larger firms that can afford R&D investments and developing/adopting highly creative ideas. These firms do not benefit from substantial differences with smaller cities in knowledge spill-overs affecting management processes towards actual innovation output. In more detail, different from urbanization (location in large cities), strength of intra-cluster networks suggests a positive influence on innovation management practice. This finding is, in a way, in contrast to ideas about relatively poor and redundant knowledge circulation in intra-cluster networks (Bathelt et al., 2004; Gunawan et al., 2016). A negative influence on actual innovativeness is not visible in our results, which can be attributed to our specific measuring of internal network strength, including four different network partners, thereby already referring to some richness in knowledge. Still, the reason could also be that ICT networks are younger than those in a traditional business sector and not yet subject to 'wearing down' and redundancy (Gunawan et al., 2016). By contrast, the picture concerning share of FDI, and innovativeness provides a clear pattern. As assumed, there is a positive and non-linear (increasing returns) trend in the relationship with the newness of innovation. Finally, about regulation, a positive dealing with (regional) regulation tends to go along with higher levels of innovativeness. Concerning interaction effects, the results suggest that solid intra-cluster networks strengthen both the relationship of cognitive capability and that of market-related skills with the newness of innovation. These outcomes align with entrepreneurial ecosystems and knowledge spill-over thinking.

On the whole, first, turning to entrepreneurial ecosystems in the full models (Model 4), the above-mentioned influence connected to knowledge spill-overs tends to be weak, except for FDI share and dealing with regulation. A second general observation is that our results confirm weak u-shape relationships, namely, firm size, manager's ICT skills, manager's experience, manager's cognitive capability, and share of FDI, indicating a *systematic* influence of increasing returns. This means that first relatively strong efforts in increasing firm capabilities and external knowledge are required ('passing a threshold') before a substantial increase in higher innovativeness can be realized. An observation like this justifies looking for deeper understanding, which is addressed in the next section.

Table 2. Estimation Results on Newness of Innovations (OLS)

	Model 1 (Broad Internal)		**Model 2 (Specific Management)**		**Model 3 (External)**		**Model 4 (Full)**			
	Linear	Non-Linear & Linear	Linear	Non-Linear & Linear	Linear	Non-Linear & Linear	Linear	Linear+interaction		Non-Linear & Linear
Internal (broad)	β(s.e.)	β(s.e.)	β(s.e.)	β(s.e.)	β(s.e.)	β(s.e.)	β(s.e.)	β(s.e.)	β(s.e.)	β(s.e.)
Firm Size	.29(.01)†						.30(.01)†	.30(.02)†	.31(.00)†	
Firm Size squared		.29(.02)†								.28(.01)***
R&D organization	.08(.03)						.12(.05)**	.12(.01)**	.12(.05)*	
Specific: Management potentials										
Manager ICT-skills			.09(01)*				.07(.00)*	.08(.00)*	.06(.01)*	
Manager ICT-skills squared				.12(.03)*						.07(.02)*
Manager Experience			.05(.00)				.04(.03)	.09(.05)	.04(.02)	
Manager Exp. Squared				.16(.03)**						.03(.00)
Manager Cognitive Capabilities			.07(.01)*				-.07(.04)	-.08(.07)	-.08(.05)	
Manager CC squared				.07(.00)*						.04(.00)
Market-related skills			.23(.01)***				.13(.02)**	.08(.02)*	.18(.02)*	
External (EES)										
Level of Urbanization					.10(.07)		.03(.01)	.03(.02)	.02(.00)	
Cluster Network Strength					.08(.02)**		.03(.02)	.03(.00)	.06(.01)	
FDI Share					.07(.02)		.05.(.00)	.06(.01)	.06.(.02)	
FDI Share squared						.12(.02)*				.07.01)*
Regulation					.07(.02)*		.06(.02)*	.11(.03)*		
Interaction Effects										
Cognitive capability*Cluster network strength								.24(.04)**		
Level of marketing skills* Cluster network strength									.11(.01)*	
N	231	231	231	231	231	231	231	231	231	231
F	9.11†	10.46†	7.18**	5.50**	4.17**	4.24*	6.99***	6.35**	5.70**	7.63†
R^2	.26	.30	.26	.19	.17	.13	.38	.39	.35	.38
ΔR^2		.04	.00	.07	.09	.13	.12	.13	.09	.12

5. CHALLENGES IN INCREASING INNOVATIVENESS

We discuss several challenges, divided into firm capabilities, with a focus on management and entrepreneurial ecosystem, but also challenges derived from enhancing and inhibiting values in domestic (entrepreneurial) culture, not addressed in the previous model exploration. The section will conclude with an example of 'soft re-engineering' of innovation models.

5.1 Firm Capabilities

Important constraints on the side of firm capabilities are connected to small firm size. Different from the situation in developed economies, most small firms in Indonesia tend not to be flexible and creative (e.g., World Economic Forum, 2022). A small size prevents to increase R&D budgets and professionalize R&D organization. Respondents mentioned difficulty in developing new products/services that can compete with those of larger firms, both in quality and price (Van Geenhuizen et al., 2010). Accordingly, small firms only reach a higher level of innovativeness in niche markets by offering specialized products, for instance, e-commerce for ageing people or people with special needs. R&D for such market segments is, however, seen as rather complicated because the right features of the new service design may be missing, causing obstacles in the creation of new market demand. As managers involved are generally risk-averse, such niche innovation is not popular. The small firm segment tends also to be heterogeneous, both in age and size, requiring different strategies for improvement (World Economic Forum, 2022).

Further, regarding management conditions, respondents indicated that obstacles in raising innovativeness originate mainly from missing strong 'leaders' coupled with missing 'adequate business culture'. For instance, there is generally a low awareness among top managers on innovation (bad access to new information and ideas, and low absorptive capacity for smallest firms), even concerning processes within the firm; this aside from rather poor marketing techniques for new products and poor coordination between design and marketing within the firms. Respondents confirmed that market-related skills are of special importance in innovativeness of ICT firms, also because small firms used to collaborate with and trust middlemen in the past (e.g., Hamdani & Wirawan, 2012). Of course, there is sufficient ICT talent in the country, but the level of education is not yet able to compete with global levels. Low skill levels are also related to potentially inhibiting values in entrepreneurial culture (Veiga et al., 2001). In line with Hofstede (2017), Indonesian entrepreneurial culture is facing a 'strong power distance' (hierarchy) in somewhat larger SMEs meaning that lower-level staff members may propose good suggestions for innovation but face difficulty in bringing these into development, because top managers tend to act rather authoritative. Moreover, respondents mentioned that in a broader context, Indonesia

had a long history of rich endowment of natural resources and commodities which may have enhanced a culture of relatively low ambitions, low risk-taking and 'easy-going'.

It is noteworthy, that at the same time, positive values in Indonesian entrepreneurial culture were also pinpointed in the interviews such as the collectivism culture, creativity, and loyalty to friends and family. Nevertheless, although collectivism tends to be beneficial in commercialization of innovative ideas and individualism tends to be positively related to technology invention (Černe et al., 2013), individualism needs to be enhanced in Indonesian firms, in the view of some respondents. Accordingly, managers of innovation need to find a better balance between 'past' and 'new' experience in stimulating innovation. Overall, there is a large shortage of qualified managers that understand ICT management in Indonesia, and this situation is mainly due to deficits in the ICT education system. Up to 2019, this system provided no graduate studies for managers to achieve sufficient background knowledge and management skills at a global quality level. This pressing issue (e.g., Aryanto et al., 2015; Hartono, 2015) is also empirically shown in our model results on ICT skills, indicating a strong positive relation with innovativeness. The interviewees further asserted that due to difficulty to find 'leaders' who can create a sound and profitable big data business at the required quality level, many customers in Indonesia prefer global firms over domestic ones, which reinforces already existing obstacles to innovation among domestic firms.

5.2 Entrepreneurial Ecosystem

The relevance of ecosystem factors was reiterated in the interviews. Respondents addressed the 'digital divide' between Indonesia's Western part and Eastern part, as evidenced by a much smaller market of internet users and relatively poor ICT infrastructure in the Eastern part. The same holds for differences between Java and outer Java. Most larger ICT firms establish in Jakarta metropolitan area or other big cities in Java, where market demand is well-developed and where knowledge spill-overs tend to be relatively strong. Nevertheless, our results tend to be mixed, in that they failed to confirm influence of urban environment but indicated some influence of intra-cluster relationships. Respondents suggested that the situation could be improved outside Java by intensifying cluster formation through value-chain linkages, specifically collaboration with local research institutes and engineering schools in an overall upgrading.

Meanwhile, there is a misunderstanding that physical infrastructure alone is sufficient in enhancing innovativeness. Accordingly, the deployment of Palapa Ring will not automatically improve firm innovativeness without any follow up projects in utilization of the ICT infrastructure and management of innovation. About FDI, respondents clearly confirmed the importance for knowledge spill-overs and transfer, thus in catching up. Their opinion was however, that FDI could

increase its role if transfer of specific technology and management skills occurs in more 'tangible' ways, for example, by providing training and increasing learning capabilities of local entrepreneurs. In addition, knowledge spill-overs were seen as working better if the FDIs are embedded in networks of domestic firms (value chains).

5.4 'Soft re-engineering'

We suggest a way of 'soft re-engineering' of innovation models, particularly in preventing disadvantages from small firm size and solitary activity, and risk-aversive strategies (market risk). Admittedly, small firms in early stages have often difficulty in identifying the right target market, market needs (product/services), and how to fulfil needs at a profit (World Economic Forum, 2022). We use the term 'soft' because new models need to match with and take the best from domestic values, yet introducing new approaches (Aritenang, 2015). Some domestic values, including loyalty to family and friends, and to local community, can serve as a basis for a trustful and bottom-up inspired collaboration between local SMEs in specialized niche markets and communities. Such collaboration encompasses the sharing of not only financial resources but also risks, and includes vertical and horizontal value chain activity, and is also known as *community value creation* (e.g., Yunus, 2017).

Community value co-creation is already practised in Indonesia in creative industries and organic food production (e.g., Widjojo et al., 2019), thereby facilitating integration of collective resources and adoption of entrepreneurial marketing. As this model puts local communities at its heart, local people tend to be the best to come up with solutions to their own local problems and challenges (co-creation).

6. DISCUSSION AND FUTURE RESEARCH

Our study is one of the first to present empirical results on innovativeness of *domestic* ICT firms in a developing economy, derived from a mixed methods approach. To put the results in a broader context, the *contribution* to understanding of firm innovativeness in developing countries is fourfold. *First*, small firms have to last extra efforts in learning to increase innovativeness, calling for improvement of their management capabilities, in particular ICT skill level and market-related skills. This point connects with modest entrepreneurial values, like hierarchy within (small) firms, relatively strong risk-avoiding, a low ambition level and short in individualism, that are hampering management of innovation, including marketing. However, there are also values, like collectivism, creativity and high valuation of friendship, family relationships and local community that may

drive and stimulate innovation. *Secondly*, our study confirmed benefits from knowledge spill-overs in clusters. *Thirdly*, we identified a positive relationship between FDI and innovativeness, a relationship which so far has been presented with ambiguity in literature. *Fourth*, on the solution/policy-making side, we forwarded 'soft-engineering' of innovation models, particularly for small firms, with emphasis on community value-creation, which is relatively new.

On the question of generalization of our results on Indonesia, we can provide the following indicative answers. The fragmentation of the country in larger and many smaller islands is quite unique. However, market potentials, and social and cultural values, like hierarchy and low ambition level, may compare with some (parts) of other Southeast Asian countries, like Thailand, Malaysia, and Vietnam. Further, our study is not without limitations. First, a deeper understanding of low innovativeness in practice would be needed in follow-up surveys and modelling, such as by directly connecting to specific knowledge types and learning processes that are also influenced by entrepreneurial values (Lana et al., 2006; Autio et al., 2013; Hofstede, 2017; Rafiki et al., 2021). Another point is the relatively simple character of our modelling. The aim however, was to provide a *scan* and groundwork that in next step served to look at conditions of firm innovativeness in Indonesia in more depth. Future research could include for example, structural equation modelling (SEM) to investigate potentially important interrelationships between the model factors, but also to better determine causal relations by measuring innovativeness about several years later in a longitudinal approach. And lastly and more practically relevant, there is the challenge of extending 'soft re-engineering' of innovation models, mainly for smaller firms, through merging domestic values with some western ones. Such 're-engineering' requires practical collaborative experimentation and investigation, such as in living labs, finding ways of matching with local, bottom-up situations (e.g. Van Geenhuizen, 2019). Sheer size and fast growth of the domestic market in a country like Indonesia clearly justify such further research.

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Appendix 1

Linear Regression Diagnostics

Diagnostic	Type of test/method	Number of Innovations	Newness of Innovation
Detecting unusual and influential cases	Applying different methods, the study asses' outliers; residuals; scatter plots; leverage; Cook's D	Deleted outliers due to inconsistency and/or extreme values (firm size) (overall, 29 firms deleted)	idem
Reliability and Validity	Cronbach's Alpha Coefficient; Pearson Product Moment correlation	α= 0.81[>0.6] Corrected item total-correlation > r table	α= 0.80[>0.6] Corrected item total-correlation > r table
Normality of residuals	Kolmogorov – Smirnov Test	Monte Carlo sig: 0.82 [>0.05] p value = 0.02 [<0.05]	Monte Carlo sig: 0.76 [>0.05] p value = 0.04 [<0.05]
Homoscedasticity of residuals	Rvplot, graphical method with residuals plotted versus fitted/predicted values	rvplot, no pattern of – heteroscedasticity found No indication of – heteroscedasticity	rvplot, no pattern of- heteroscedasticity found No indication of – heteroscedasticity
Multi-collinearity	Variance inflation factor (VIF)	Mean VIF = 3.19[<10]	Mean VIF = 3.25[<10]
Model specification error	Ovtest	F: 0.49 [<10] p-value: 0.08 [>0.05]	F:3.47 [<10] p-value: 0.08[>0.05]