A Study of ICT Firm Innovativeness in Indonesia Influencing Conditions and Design of a Change Strategy

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A Study of ICT Firm Innovativeness in Indonesia Influencing Conditions and Design of a Change Strategy

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Summary of PhD Thesis

This PhD study investigates the challenges of and proposes potential solutions to relatively low innovativeness of small and medium-sized enterprises (SMEs) in the ICT sector in Indonesia. Since there is not much understanding of apparent 'missed opportunities' in Indonesia's ICT sector, there is a need to investigate internal conditions that affect innovativeness at the firm level (firm-specific managerial and competence factors) as well as external factors, such as networks' knowledge spillovers and foreign direct investment (FDI). Low innovativeness also indicates the urgency for the country to take necessary actions, such as improving ICT education to stimulate more ICT talent, enhancing strategies to attract more investment in the ICT industry, and reducing the digital divide between regions. Considering the geographical and cultural uniqueness of Indonesia, this thesis further proposes a set of change strategies to improve the innovativeness of the ICT sector in the country.

The study starts with the introduction and problem statement (Chapter 1). This is followed by a discussion of theories on Resource-Based View, Dynamic Capability, Agglomeration and Entrepreneurial Ecosystem, Culture, and Multi-actor theory (Chapter 2). Such broad approach is taken to enable a theory-underpinned broad scan of empirical reality. In this chapter several hypotheses are formulated that will be investigated in the empirical chapters that focus on the firm level. Next, Chapter 3 discusses the problematic situations and opportunities in the ICT sector in Indonesia (sector-level study). Although the ICT sector is a fast-growing sector in Indonesia, one of the problematic situations is that Indonesia is still a net-importer of ICT, which draws attention to innovativeness of domestic firms. In addition, the disparity of ICT infrastructure within the country is relatively wide between the western and eastern regions. The sector-level study in Chapter 3 is followed by a discussion on a set of conditions of ICT innovativeness at the firm level, including specific internal management conditions, and external and entrepreneurial ecosystem conditions in Chapter 4. The empirical results in this chapter are derived from an e-survey among 260 ICT firms (mainly small- and medium-sized), spread over Indonesia, and from estimation of multiple regression models. The findings suggest that firm capabilities and external knowledge spillovers positively influence firm innovativeness only after having reached relatively high values, as indicated by a quadratic relation. Moreover, the country's entrepreneurial culture faces a 'strong power distance' or hierarchy that needs to be transformed for developing innovation. Chapter 5 examines the development differences between the Jakarta area (core region) and the rest of Indonesia (non-core regions) and how each of the conditions influence innovativeness in these regions. The study in Chapter 5 indicates that core and non-core regions in the country show

differences in the entrepreneurial ecosystem and firm capabilities in various aspects. In the non-core regions, the innovativeness relationships with the management conditions and entrepreneurial ecosystem seem weaker than those in the core region. The most pressing outcome for non-core regions is that non-core regions have relatively modest firm-internal capabilities but also small potentials in the entrepreneurial ecosystem. The non-core regions also need to expend more effort on increasing innovativeness in terms of ICT skills and manager cognitive capability. Next, through change strategy formulation and in-depth understanding of innovativeness based on the empirical findings in Chapters 3, 4 and 5, the design of innovation change strategies in the ICT sector in Indonesia is explained (Chapter 6). This chapter provides direction for a set of solutions following empirical analysis at the firm level in the ICT sector for the entire country and two different regions. Chapter 6 also presents the elaboration of collaborative policymaking to improve policy implementation in Indonesia's ICT sector, including more attention for consultation and deliberation between stakeholders and for evaluation. Chapter 7 discusses suggestions for making the study transferable in practice and the key contributions of the study. Chapter 8 concludes the study with reflections on the whole PhD study and discussions of the limitations of the research and suggestions for future research.

Three key conclusions from the empirical part of the study can be mentioned as follows. First, compared to larger firms, small firms in Indonesia have to put extra effort into learning to increase innovativeness. In this regard, the study found some non-linear relations (mostly quadratic) in management capabilities, especially in the ICT skills. This situation calls for improvement of small firms' management capabilities, in particular ICT skills combined with market-related skills. Second, a relatively weak positive influence of urban environment and somewhat stronger positive influence of clusters can be found in the study. For example, the study could support theoretical ideas of agglomeration advantages (e.g., benefits of knowledge spillovers in metropolitan areas). The findings confirm the positive influence of networks within clusters. As the third conclusion, firm innovativeness tends to have a non-linear relationship with FDI, suggesting increasing returns (benefits), despite firm limitation to use FDI opportunities fully. In addition, the study found that the core and non-core regions in Indonesia differ in most firm-internal conditions, including management and entrepreneurial ecosystem conditions. For instance, ICT skill level is much higher in the core region than that in the non-core regions.

The key scientific contribution of this PhD study is in extending general innovation theories with a partially densely populated developing country like Indonesia, characterised by low technological level and low innovativeness mainly among small firms. The study reveals the extent to which the phenomenon in the developing countries can confirm or refute what has been

postulated for developed countries, for example, concerning ambitions to be innovative and power structure within firms. As the policy contribution, the study suggests a new (policy) approach to respond to the many challenges in Indonesia, namely, in improving policymaking concerning conditions for innovation. The related approach is collaborative policymaking, including all stakeholders involved, in particular those at the level of practical policy implementation, with more emphasis on consultation and deliberation between them. The study also suggests a new approach at the firm level referring to 'co-creation of inventions with customers', which is relatively new in innovation practice in Indonesia.

Further, some limitations are inevitable due to financial and time constraints during this PhD study, including survey tools and representation of particular regions (e.g., Papua), though attempts were made to overcome the limitations by interviewing practitioners and experts. The study provides a number of suggestions for future research, including: first, to tackle the reluctance of SMEs to act as respondents, future research may extend and complement the survey in this PhD study through other data collection techniques, e.g., via professional surveyor. Second, future research may consider conducting an in-depth survey and complement it with interviews to identify other important qualitative aspects that have remained beyond the study, for instance cultural influence in innovativeness. Third, to use an advanced model assessment technique, such as Structural Equation Modelling (SEM), to evaluate whether theoretical models, including complex interactions between influencing factors, are plausible when compared to observed data. Fourth, the use of agglomeration index to allow the evaluation of the intensity of spatial agglomeration in a single sector and make a comparative analysis among different sectors. Fifth, to obtain the outcome in improving management conditions through a cascading strategy because the cascades process allows the firm to overarch the strategy throughout the organisation and create a supporting strategy for the firm's entire value chain of activities to ensure the execution of management change. And sixth, a recommendation for collaborative experimentation to identify best practice, e.g., in co-creation.

Overall, this PhD research fills the gaps of innovation studies in Indonesia such as the incomplete focus of existing studies that are limited to a specific region of Indonesia (i.e., western Indonesia) and the limited follow-up for policy solution in practice. To the best of our knowledge, this PhD study is one of the few studies that covers large regions of Indonesia focusing on ICT sectors and also proposes policy and management solutions.

Samenvatting van het Proefschrift

Dit proefschrift onderzoekt de uitdagingen van en stelt potentiële oplossingen voor wat betreft de relatief lage innovativiteit van kleine en middelgrote ondernemingen in de ICT-sector in Indonesië. Aangezien er een tekort aan inzicht bestaat in kennelijk "gemiste kansen" in de Indonesische ICT-sector, is er behoefte aan onderzoek naar bedrijfsinterne omstandigheden die van invloed zijn op innovativiteit, bijvoorbeeld bedrijfsspecifieke management- en competentiefactoren, evenals naar externe factoren, zoals kennis spillovers van het netwerk en buitenlandse directe investeringen (FDI).

Lage innovativiteit wijst ook op urgentie voor het land om de nodige maatregelen te nemen, zoals ICT onderwijs verbeteren om meer ICT talent te stimuleren, verbetering van beleid om meer investeringen in de ICT sector aan te trekken, en het verminderen van de digitale kloof tussen regio's. Gezien het geografische en culturele unieke karakter van Indonesië, stelt dit proefschrift ook een reeks van veranderingsstrategieën voor om de innovativiteit in de sector in het land te verbeteren.

Dit proefschrift begint met de inleiding en probleemstelling (Hoofdstuk 1) en deze worden gevolgd door een uiteenzetting van relevante theorie, namelijk, het resources-gebaseerde perspectief en dat van dynamische leervaardigheden, agglomeratie- en ecosysteem voordelen, en cultuur- en multi-actor theorie (Hoofdstuk 2**)**. In dit hoofdstuk wordt ook een aantal hypothesen geformuleerd die in de hierop volgende empirische hoofdstukken met de focus op bedrijfsniveau worden onderzocht. Vervolgens bespreekt Hoofdstuk 3 de problematische situaties en kansen in de ICT-sector in Indonesië (studie op sectorniveau). Hoewel de ICT-sector een snelgroeiende sector is, blijkt een van de problematische situaties te zijn dat Indonesië nog steeds een netto-importeur van ICT is, wat de aandacht vestigt op de achterblijvende innovativiteit van binnenlandse bedrijven. Tevens is de ongelijkheid in toegang tot ICT-infrastructuur binnen het land relatief groot tussen de westelijke en oostelijke regio's. De studie op sectorniveau wordt gevolgd door bespreking van een aantal voorwaarden voor ICT innovativiteit op bedrijfsniveau, met inbegrip van specifieke voorwaarden voor intern R&D management en marketing, en specifieke voorwaarden in externe condities, waaronder het ecosysteem voor ondernemerschap. De bevindingen zijn gebaseerd op een steekproef van 260 ICT bedrijven (e-survey), verspreid over Indonesië, en op het schatten van een meervoudig regressiemodel. De resultaten van Hoofdstuk 4 suggereren dat de capaciteiten van de bedrijven en externe kennis spillovers pas invloed hebben op innovativiteit nadat deze relatief hoge waarden hebben bereikt (zoals in zwakke mate wordt aangegeven door een quadratische functie). Bovendien wordt de bedrijfscultuur van het land

geconfronteerd met een “sterke machtsafstand” of hiërarchie, die moet worden getransformeerd om innovatie verder te kunnen ontwikkelen. In Hoofdstuk 5 worden de ontwikkelingsverschillen tussen de Jakarta regio (kernregio) en de rest van Indonesië (niet-kernregio’s) onderzocht, inclusief hoe elk van de eerder besproken voorwaarden de ICT innovativiteit in deze regio’s mede kan beïnvloeden. De resultaten in Hoofdstuk 5 wijzen op een tendens dat kern en niet-kernregio’s op diverse aspecten verschillen vertonen in het ecosysteem voor ondernemerschap en de capaciteiten van bedrijven. In de niet-kernregio’s lijken de relatie tussen innovativiteit en management condities en het ecosysteem zwakker te zijn dan die in de kernregio. Het meest urgente resultaat voor niet-kernregio’s is dat de desbetreffende bedrijven relatief bescheiden bedrijfsinterne capaciteiten hebben, maar ook een kleiner potentieel in het ecosysteem voor ondernemerschap. Derhalve moeten de niet-kernregio’s ook meer inzetten op het vergroten van de innovativiteit op het gebied van ICT-vaardigheden en cognitieve vaardigheden van managers.

Vervolgens wordt het ontwerp van een innovatie veranderingsstrategie in de ICT-sector in Indonesië gepresenteerd en uitgelegd (Hoofdstuk 6) door middel van het omschrijven van gedetailleerde veranderingen en een diepgaand begrip van de innovativiteit op basis van empirische bevindingen in Hoofdstuk 3, 4 en 5. Hoofdstuk 6 bespreekt de richting van een reeks oplossingen na empirische analyse op bedrijfsniveau in de ICT-sector voor het hele land en de twee verschillende regio’s. Ook wordt de uitwerking gepresenteerd van gezamenlijke beleidsvorming om de beleidsimplementatie in de Indonesische ICT-sector te verbeteren, inclusief meer aandacht voor overleg en beraadslaging tussen stakeholders en voor tussentijdse evaluatie. Vervolgens bespreekt Hoofdstuk 7 suggesties om de onderzoek- en beleidsresultaten beter overdraagbaar te maken in de praktijk. In Hoofdstuk 8 wordt de thesis afgesloten met een reflectie op het gehele onderzoek en met een discussie van beperkingen in het huidige onderzoek met suggesties voor toekomstige onderzoekslijnen.

Drie hoofdconclusies uit het empirische deel van het onderzoek kunnen als volgt worden geformuleerd. Ten eerste, in vergelijking met grotere bedrijven, moeten kleine bedrijven in Indonesië extra moeite doen in leerprocessen om hun innovativiteit te vergroten. In dit verband vond de studie de tendens van enkele niet-lineaire relaties in management capaciteiten, vooral in ICT-vaardigheden. Deze situatie vraagt om verbetering van desbetreffende management capaciteiten, in combinatie met markt-gerelateerde vaardigheden. Ten tweede, een relatief zwakke positieve invloed van de stedelijke omgeving en een iets sterkere positieve invloed van clusters komen uit het onderzoek naar voren. Bijvoorbeeld, de studie lijkt theorie over agglomeratievoordelen te ondersteunen (zoals voordelen van kennis spillovers in grootstedelijke gebieden). De bevindingen bevestigen ook een positieve invloed van netwerken binnen clusters.

Als derde conclusie, innovativiteit van bedrijven vertoont de tendens een niet-lineaire verband te hebben met FDI, hetgeen duidt op toenemende innovativiteit pas na een bepaalde hoeveelheid FDI, hiermee verwijzend naar de beperking om FDI-kansen volledig te kunnen benutten. In aanvulling hierop blijkt uit de studie dat kern- en niet-kernregio's in Indonesië verschillen vertonen in de meeste bedrijfsinterne en ecosysteemomstandigheden. Bijvoorbeeld, het ICT-vaardigheidsniveau in de kernregio is veel hoger dan in niet-kernregio's.

De belangrijkste wetenschappelijke bijdrage van dit PhD onderzoek is het uitbreiden van algemene innovatietheorie met een gedeeltelijk dichtbevolkt ontwikkelingsland als Indonesië, gekenmerkt door een laag technologisch niveau en een lage innovativiteit, voornamelijk bij kleine bedrijven. De studie laat zien in hoeverre het fenomeen in ontwikkelingslanden kan bevestigen of weerleggen wat voor ontwikkelde landen is gepostuleerd, bijvoorbeeld over ambities van kleine bedrijven om meer innovatief te zijn en over machtsstructuur (management) binnen bedrijven. Als beleidsbijdrage presenteert de studie een nieuwe beleidsbenadering om de vele uitdagingen in Indonesië aan te pakken, namelijk het verbeteren van beleidsvorming met betrekking tot de voorwaarden voor innovatie. De voorgestelde benadering is gezamenlijke beleidsvorming waarin alle belanghebbenden worden betrokken en gekend, met name diegenen die zich op het niveau van de praktische beleidsuitvoering bevinden, met meer nadruk op onderling overleg en beraadslaging. De studie suggereert ook een nieuwe aanpak op bedrijfsniveau, verwijzend naar "co-creatie" van uitvindingen te samen met klanten, wat relatief nieuw is in de innovatiepraktijk in Indonesië.

Wat betreft sommige tekortkomingen van de studie, deze zijn te wijten aan financiële beperkingen en tijdsbeperkingen, inclusief de e-survey als tool en representativiteit van bepaalde regio's (zoals Papua), hoewel pogingen zijn ondernomen om nadelen te verminderen, door enkele ondernemers en experts te interviewen. De studie geeft een aantal suggesties voor toekomstig onderzoek, waaronder, ten eerste, om de terughoudendheid van kleine bedrijven om als respondent op te treden te verminderen, kan de dataverzameling met andere technieken worden uitgebreid, bijvoorbeeld in interviews door een professionele bemiddelaar. Ten tweede, in toekomstig onderzoek kan worden overwogen om aanvullend een meer diepgaande studie uit te voeren naar kwalitatieve aspecten van innovatie (processen) die buiten het huidige onderzoek zijn gebleven, bijvoorbeeld culturele invloed op innovativiteit. Ten derde, kan een meer geavanceerde modelschattingstechniek worden gebruikt, zoals Structural Equation Modelling (SEM), om te evalueren of theoretische modellen, inclusief complexe interacties tussen beïnvloedende factoren en latente variabelen, geloofwaardig zijn in vergelijking met de waargenomen modelresultaten. Ten vierde, als aanvulling op de tweedeling (kern- en niet-kernregio) het gebruik van een gedetailleerde agglomeratie-index om de sterkte van ruimtelijke agglomeratie in enkele sectoren

te evalueren en een vergelijkende analyse (ICT en andere sectoren) mogelijk te maken. Ten vijfde, kan meer resultaat worden verkregen in het verbeteren van de management omstandigheden door een cascade strategie toe te passen, waarin het bedrijf via het cascadeproces in staat is de verbetering door de hele organisatie te implementeren en een ondersteunende strategie te creëren die doorwerkt in de gehele waardeketen van het bedrijf om managementverandering te waarborgen. En ten zesde, een aanbeveling voor experimenten in samenwerking tussen bedrijven op het vlak van co-creatie, waarbij "best-practices" worden geïdentificeerd.

Over het geheel genomen, vult deze PhD studie enkele lacunes van innovatiestudies in Indonesië, zoals de focus van bestaande studies die gericht is op een specifieke regio (zoals West-Indonesië) en de beperkte uitwerking van beleidsoplossingen in de praktijk. Voor zover wij weten, is deze studie een van de weinige die grote regio's van Indonesië bestrijkt en gericht is op de ICT-sector, en hiernaast ook praktische beleids- en managementoplossingen voorstelt.

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I would like to express my gratitude to my supervisors Prof. dr. Marina van Geenhuizen and Dr. Zenlin Roosenboom-Kwee, who patiently gave me the golden opportunity to do this wonderful project on ICT innovation in Indonesia. This research project also opened up the opportunity for me to do empirical research in which I was able to learn so many new things.

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Returning to campus after several years of working was quite challenging for me. Moreover, my PhD topic (even though it is still related to my current employment) pinpoints the necessity for me to develop new skills and acquire new knowledge. Nevertheless, the topic has been very interesting because it helps me shift from ‘practical thinking’ as an ICT practitioner to ‘conceptual thinking’ as an ICT strategist, thereby adding multidimensional insights to my merely technical insights. The topic also enabled me to meet many fellow researchers from all over the world during my conferences in Asia and Europe. Aside from my professional challenges, I also encountered many personal challenges during my PhD, from the culture shock of living in a foreign country and difficulties in finding housing to missing my family who live far away from me. Fortunately, I managed to overcome those challenges through the help of all the people around me who supported me in almost everything. I am really grateful to them.

Last but not least, I would also like to thank my family (my mother, my husband Chris and my children Fia, Nad and Orchid) and friends too numerous to mention individually, who helped me a lot in finalising this project within the given time frame.

Delft, May 2023

Chapter 1 Introduction

1.1 Research Background and Motivation

There are four reasons why a study on innovativeness of domestic ICT fims in Indonesia is important. First, Information and Communication Technology (ICT) is widely regarded as having a crucial role in reducing operational cost (increasing efficiency), enhancing productivity and boosting future economic growth. Secondly, ICT in Indonesia is a fast-growing sector faced by huge market demand increase in recent past and in the near future. Thirdly, at the same time, the markets in Indonesia are to important degree served by foreign firms, pointing to challenges of improved innovation and quality levels among domestic firms. And as a final point, there are many knowledge gaps on causal background of low innovation level in Indonesia and on ways to change the situation. These points will be addressed below, but first the sector needs to be defined (following official statistics).

The definition of the ICT sector (Information and Communication Technology) in Indonesia, as provided by BPS (Badan Pusat Statistik) or the Indonesian Central Statistics Agency, refers to the utilization of electronic devices, computer systems, and telecommunication networks for the purpose of processing, storing, transmitting, and receiving digital information. ICT encompasses various technologies, including computers, software applications, telecommunications equipment, and digital networks, which facilitate the creation, management, and exchange of information. This definition is broad, including production of hardware and of software and combinations. In Indonesia, ICT is undoubtedly a fast-growing sector as can be seen in its rapidly increasing share in the domestic economy. The development is illustrated by the following statistics: the ICT sector took 4.79-6.56% of the whole of Indonesia’s economic sector and has been a rapidly growing sector in the last five years (9.98-10.7% growth) among all economic sectors in Indonesia (BPS, 2016). Based on the World Economic Forum (2016), Indonesia is undoubtedly primed for market growth as the world's fourth-largest population, with its middle class being expected to rise to 90 million by 2021.

Although Indonesia's ICT sector is growing very fast, it is constrained by a limited number of skilled workers, limited access to technology and limited innovative production of domestic ICT products and services at the national level (BPS, 2016). As a consequence, Indonesia tends to be a market for foreign companies to sell their ICT products and services (Ministry of Communication and Information Technology of Indonesia , 2013). This situation indicates a continued short in innovativeness by domestic firms in Indonesia. The knowledge gaps involved are mainly related to measurement of innovativeness in developing countries, the role of firm

management in the context of Indonesia's culture and with regard to regional disparities (e.g. between the west and east of the country), lack of a comprehensive approach to causal background of firms' low innovativeness, and lack of follow-up studies focussing on change strategies.

Therefore, a comprehensive study is urgently needed to investigate the problem of low innovativeness of domestic ICT firms with the aim of providing recommendations for policymaking and implementation. It is also essential to note that there is a difference in progress between regions in Indonesia. In particular, Indonesia's geographical conditions contribute to the digital divide between core and peripheral regions (Puspitasari & Ishii, 2016) and these two regions need a different strategy to address the issue of innovativeness. For example, the massive development of ICT infrastructure strategy may fit well with the non-core regions, while the core region may need stakeholder-aligning strategy. The different advancements encompassing, among others, infrastructure upgrading, a rise in economic level, and education quality, make it important to analyse the situations at different levels. Accordingly, the study is conducted at two levels of analysis, i.e., at the country level (aggregate ICT sector and individual firms) and at the regional level (individual firms). The study at the regional level explores the impact of the digital divide on the innovativeness of firms, including influence from agglomeration (large cities) and clusters.

In addition, the strength of influence and interaction of innovativeness conditions are typically different within countries like Indonesia due to culture, politics and business ties (Zhang et al., 2018). So far, most empirical studies on innovation have taken place in developed countries, not in the context of emerging or developing countries. Moreover, studies on influencing conditions of innovativeness in Indonesia are relatively small in number and make use of a limited empirical basis (e.g., Isnasari and Prasetyoputro, 2020; Mahendra et al., 2015), especially in the ICT context. However, the number has recently rapidly increased (Van Geenhuizen et al., 2019). Hence, this PhD study adds to the literature regarding a detailed understanding of conditions that tend to influence innovativeness and the interactions between them that contribute to innovativeness in the Indonesian ICT context.

1.2 Research Scope

1.2.1 Introduction

This section discusses several knowledge gaps regarding innovativeness in ICT firms in Indonesia, in particular at the sector-level and at the firm-level in different regions and in the country as a whole. The problematic situations lead to the main research question and its elaboration.

1.2.2 Knowledge Gaps

Innovation and its management are inevitable strategies in high-tech and innovative firms such as in the ICT sector. Innovation keeps firms competitive, be it through improved user value or through lower costs (Tidd and Bessant, 2020). Innovation is also becoming a subject for rapid progress and development in developing countries like Indonesia. Compared to developed countries, most innovation in developing countries is limited, due to e.g., firm internal factors such as small firm size, management issues, business culture (hierarchy) and technology lag. According to Ali, Ullah, & Khan (2009), innovation and technology environments in emerging countries are problematic by nature, as indicated by political instability and unstable governance conditions, poor business models, low education levels and lack of world-class research universities, an underdeveloped and mediocre physical infrastructure, and lack of a solid technology base and skilled human resources.

Moreover, Indonesia's vast archipelagic geography contributes to the difficulties of infrastructure development, such as road and broadband infrastructure. In addition to a lagging physical infrastructure, other challenges exist, such as the difference in input into policymaking between central and local government, entrepreneurship culture and education system background. Because of the many problematic situations, it is important to define the most crucial factors in ICT innovation in order to enable improvement of the influencing conditions and identify which change strategy (or transformation) is most realistic, given the availability of country resources. These crucal factors and their background constitute the overarching knowledge gap.

Most innovation studies are undertaken in developed economies characterised by high-technology innovations, with innovation activity both on input-side (R&D) and output-side (patents, realised new product/processes), and related data measurements are officially provided. Meanwhile, those studies in developing countries are usually only applicable to a specific country and often different from what has been postulated in advanced countries. With regard to innovation, in Indonesia, existing studies typically looked at the western part of Indonesia, which is more developed than the eastern part. Accordingly, differences within Indonesia are an important point of missing knowledge and understanding of innovation.

The study fills several other knowledge gaps as follows. It measures innovation in a developing country both at the input-side and output-side of the innovation process and investigates innovation in the ICT sector in Indonesia for both the western and eastern parts of the regions. Secondly, the study fills the knowledge gap by addressing the role of firm management in the context of Indonesia’s culture and the difference in a regional agglomeration that may influence level of innovativeness. Thirdly, existing studies (e.g., Dhewanto et al., 2015; Aryanto

et al., 2015) do not comprehensively cover the factors that determine the ICT innovativeness in Indonesia. This PhD study is the first study that investigates these more comprehensively by focusing on firm internal, external, and specifically management conditions that influence ICT firm innovativeness in Indonesia.

Fourthly, existing studies (e.g., Haryanto & Gaffar, 2016; Gunawan & Pawitan, 2012) stop at identifying and assessing strength of conditions (or factors) influencing (hampering) innovation but have not included a change strategy. This PhD study extends the empirical problem analysis with a design part on the change strategies.

1.2.3 Research Questions

Given the problem statement discussed above, this study investigates the innovativeness of ICT firms in Indonesia based on the resource-based view through an empirical study of innovativeness to identify an appropriate strategy for change. The main research question is as follows:

"In which ways and to what extent do firm internal (management) and external conditions influence and differentiate the profile of the ICT firms in terms of innovativeness at the country and region level of Indonesia, and what strategies could be designed and implemented to overcome the problematic situations?"

Given a set of national sector conditions, firm conditions and location-based conditions investigated in this study, a group of more detailed questions on innovativeness is formulated:

1. *What at the sector level are the problematic situations and influencing conditions that contribute to the lagging behind of the ICT innovativeness in Indonesia?*

   Despite the vast growth of the ICT sector, Indonesia is more likely an import market of ICT products than a self-sustained ICT developer and producer. The country is also facing an imbalance of access to ICT infrastructure (or connectivity) among the regions. Through this question, this PhD thesis further investigates these problematic situations and relationships that explain why the ICT sector in Indonesia is lagging behind. This research question has theoretical background from agglomeration theory and ecosystem entrepreneurship.

2. *What is the level of innovativeness among ICT firms in Indonesia?*

   For the distinction between innovations at low, medium to high levels, there are as many constructs in the literature as there are different approaches to measuring innovativeness. In developing countries, measurements of innovation are commonly not undertaken by Central Statistics (Martinez-Roman, Gamero, & Tamayo, 2011); therefore, the measurement of the level of firm innovativeness in this study depends on a firm survey and additional quantitative

and qualitative information from in-depth interviews and from BPS (Indonesia Central Statistics). The study uses an input indicator (R&D intensity) and an output indicator of realised innovation, including newness in the measurement of innovativeness, to give as complete a picture as possible. Resource-Based View (RBV) and dynamic capability are the theoretical background for this second resource.

3. *In which ways and to what extent do firms' capabilities and entrepreneurial ecosystem influence firms' innovativeness?*

   The theoretical background of this question is the resource-based view and dynamic capability both in terms of resources that are owned by the firm and resources that can be accessed through networks and directly through the local/regional ecosystem. The study explores the influence of a set of specific firms' conditions, as indicated by firm size, firm R&D organisation, and R&D intensity, on firm innovativeness. Regarding management conditions, the study uses four manager characteristics: ICT skills, experience, cognitive capability and level of market-related skills. Meanwhile, with regard to entrepreneurial ecosystem, the study employs four conditions: level of urbanisation (agglomeration), strength of cluster networks, Foreign Direct Investment (FDI) and regulation.

4. *In what respect is the entrepreneurial culture in Indonesia different from those assumed in common innovation theory and what could be the implication of such differences?*

   In the empirical chapter on firm innovativeness on the country level (Chapter 4), the issue is raised as to what extent entrepreneurial culture in Indonesia is different from other countries and may influence firm level innovativeness. According to some interviewees, the domestic culture may hinder the country's cultivation of ideas and innovation. At the same time, solutions from developing countries may not work and call for adaption to domestic cultural situations. This part of the analysis also discusses some solutions that may help the country overcome cultural challenges based on culture theory.

Further, according to agglomeration and cluster theory, it can be assumed that the regions in Indonesia are different in terms of innovativeness; therefore, the study posed the research question:

5. *What are the differences between core and non-core regions in Indonesia with regard to ICT firms' innovativeness, and to what extent and how do the influence of firm internal (specifically management) and external conditions on firm innovativeness differ between various regions of Indonesia?*

   Given the geographic situation in the country, in which facilities and development are mainly performed in Java and specifically in Jakarta, the assumption is that a huge gap between core

region and non-core regions occurs. However, in which conditions and how strongly they differ remain unknown. The study investigates the differences between the regions to provide different insights for change strategy.

Finally, to address and design the change process - from existing conditions to desired conditions (higher innovativeness) - a research question is provided as follows:

6. *What would the content and processes (steps) be in a change strategy*? *How should the change strategy be designed and implemented and what are the implications for the design of the policies?*

   A change strategy (or transformation) is typically unique for each identified challenge and is expected to have a significant impact on resolving specific shortcomings that have been identified in the innovation process. In addition, the change strategy should be designed in a collaborative way and in an appropriate timeline for effective results, aside from a set of requirements. Chapter 6 will discuss how to design such a strategy, the processes, and potential implications if the strategies are implemented.

1.3 Theoretical perspectives

1.3.1 Introduction

There is a need to understand firm's low innovativeness in Indonesia and to explore the design of a policy strategy that may lead to increase of innovativeness. Different from previous research, this study takes the position that understanding firm's innovativeness requires the use of theoretical approaches that cover both the firm's internal conditions and conditions in the environment (system) in which it operates, while understanding potentials of change strategies requires the use of several theories on its own. This means that the study adopts as the first a broad theoretical framework in order to scan the relevance of each of the underlying frameworks.

In this section, the study's main theoretical views on firm innovativeness, including the resource-based view, dynamic capabilities (firms), agglomeration (cluster) theory and entrepreneurial ecosystems (firms-environment, interaction). Theories supporting the design of a change strategy, including culture theory, multi-actor approach and collaborative policymaking, are also briefly discussed in this section (further details of the theories are provided in Chapter 2). Table 1.1 shows how the RQs, and theory are connected. In this section, the reason for the selection of these theories is forwarded first.

Resource-based View (RBV) and Dynamic Capabilities (DC) theories have mostly been used in previous studies on innovation to reveal the antecedents of innovativeness. RBV helps

investigate how firm resources and capabilities make a difference in business performance (e.g., Barney, 2001; Wernerfelt, 1984). RBV posits that not all the resources of a firm will be strategic resources. Competitive advantage occurs only when there is a situation of resource heterogeneity (different resources across firms) and resource immobility (the inability of competing firms to obtain resources from other firms). Therefore, individual firm's management needs to 'create' different resources across the firm and ensure that those resources are immobile (or fixed to a firm). As an extension of the RBV theory, DC theory, according to some authors (Teece, 2007; Zollo & Winter, 2002), disentangles the process, routines and activities through which organisational resources can be transformed into capabilities to identify and use opportunities and obtain a sustainable competitive advantage, among others in innovativeness. The two theories do not address advantages of firms located in spatial proximity to each other (large metropolitan areas or agglomeration) and which resources are involved. The approaches do not address how this may also facilitate or hinder innovativeness, such as through knowledge spillovers (Siahaan, 2017). This is the reason why agglomeration (cluster) theory will be used in this study to address the issue of differences in regional/urban innovativeness. This theory will help in explaining agglomeration advantages, where highly urbanised regions and clusters of activity boost the productivity and innovativeness of firms located within them and in turn differentiate the innovativeness between the core and non-core regions in Indonesia. The digital divide, as a spatial concept, will also be discussed in the research.

With regard to entrepreneurial ecosystem, Stam (2015) provided insight on entrepreneurial ecosystem as "an interdependent set of actors that is governed in such a way that it enables entrepreneurial action". The entrepreneurial ecosystem concept according to Stam (2015) indicates that entrepreneurship takes place in a community of interdependent actors, while the heart of the ecosystem is the systemic conditions. Meanwhile, Audretsch and Belitski (2017) (p. 2) argue that entrepreneurial ecosystem defines systems of entrepreneurship (further ecosystem) as institutional and organisational as well as other systemic factors that interact and influence identification and commercialisation of entrepreneurial opportunities. The emphasis is stronger on entrepreneurial activity and dynamic network interdependency and interaction embedded in institutional layer(s), compared to above mentioned theories.

Further, with regard to theory underpinning the design of a change strategy, the following can be mentioned. Culture (anthropology) theory (e.g., Hofstede & Minkov, 2010) will be used in the study to understand the specifics of national culture and to determine which approach is most suitable to face the cultural barriers regarding innovation. Finally, a multi-actor approach (Enserink et al., 2010) is used to identify which actors are involved in the innovation ecosystem,

what their network position is and what may influence the role of each actor in a *collaborative* approach to policymaking (Ansell, Sørensen, & Torfing, 2017) on improving national innovativeness.

Table 1.1 Relationships of RQs with Theory used in the study.

	Firm-centred theories		External (environment) centred theories		Theories of policy/strategy design	
Research Question (RQ)	RBV	Dynamic capability	Agglomeration/ Cluster	Entrepren. Ecosystem	Culture	Multi-actor and Collaborative policymaking
RQ 1 What at the sector level are the problematic situations and influencing conditions that contribute to lagging behind of the ICT innovativeness in Indonesia?			X	X	X	X
RQ 2 What is the level of innovativeness among ICT firms in Indonesia?	X	X	X	X	X	
RQ 3 In which ways and to what extent do firms' capabilities and external knowledge spillover influence firms' innovativeness?	X	X	X	X		
RQ 4 In what respect is the entrepreneurial culture in Indonesia different from those assumed in common innovation theory and what could be the implication of such differences?					X	
RQ 5 To what extent and how do the influence of firm internal (specifically management) and external conditions on firm innovativeness differ between various regions of Indonesia?	X	X	X	X		
RQ 6 What would the content and processes (steps) be in a change strategy? How should the change strategy be designed and implemented, and what are the implications for the design of the policies?	X	X	X	X	X	X

1.3.2 Resource-Based View and Dynamic Capabilities

The term 'innovativeness' relates to how the firm can be involved in innovation and how skilfully the firm introduces new processes, products, or ideas in its organisation (Koc & Ceylan, 2017). This capacity to innovate is among the most significant factors impacting business

performance (e.g., Hurley et al., 1998). RBV is an organisational framework used to determine the strategic resources to deliver a firm's comparative advantage. The firm can exploit these resources to achieve a sustainable competitive advantage.

Innovation is a means for changing an organisation and improving products and processes to achieve a unique competitive edge, whether as a response to changes in its internal or external environment or as a pre-emptive move to influence an environment. Because environments evolve, firms must adopt innovations over time. The most important innovations, like novel product functionalities and lower cost production or service providing, allow the firm to achieve some competitive advantage, thereby contributing to its performance (e.g., Damanpour, 1991; Henard & Szymanski, 2001). Hence, regarding the complementarity between strategy and resource-based perspective, these perspectives complement each other in enhancing business performance (Barney, 2001).

Dynamic capabilities are seen as enabling organisations to develop, expand and adjust their resources and capabilities to adapt to rapidly changing environments related to absorptive capability (Teece, 2007; 2009; 2016). The basic assumption of the dynamic capabilities' framework is that core competencies should be used to modify short-term competitive positions that can be used to build longer-term competitive advantage. Both capabilities (dynamic and absorptive capability) are related to management capabilities.

1.3.3 Agglomeration/Cluster Theory

According to more recent agglomeration theory (e.g., McCann & Van Oort, 2009) the accumulation of knowledge spillovers, specialised human capital, actor, specialised services and extensive consumer markets - as advantages of large cities - are indicated as prominent sources of positive externalities, among others, enabling entrepreneurs of small firms to better identify and exploit opportunities of innovativeness. However, externalities can also be *negative*, specifically in cities where high density of living and economic activity leads to increased real estate prices, traffic congestion and low levels of living standards (poor air quality, lack of urban green, etc.) (Frank, 2005; Schleicher, 2012).

In Indonesia, economic development and population are heavily concentrated in Java, especially in the capital city of Jakarta and its metropolitan area (Anggoro, 2015). This situation tends to cause differences in agglomeration advantages between regions. Unlike Java and Jakarta, particularly in disadvantaged regions (mostly outside Java), the infrastructure and equipment for digital communication and information are underdeveloped or unavailable. According to Hohlfeld et al. (2017), the digital divide may result in a literacy gap. It causes an 'innovation divide' due to

obstacles for the external acquisition of new knowledge and other inputs for the innovation process. The digital divide may cause a relatively low level of innovativeness in specific regions. However, much has remained unknown on agglomeration advantages and disadvantages in practice.

1.3.4 Entrepreneurial Ecosystem

Fostering entrepreneurship has become a core component of economic development in all countries around the world, and the environment or ecosystem in which an entrepreneur is operating, directly and indirectly, affects entrepreneurial success. Rodríguez-Aceves et al. (2019) refer to an entrepreneurial ecosystem as several entrepreneurial actors, organisations and institutions following a process to connect, mediate and govern the performance of the entrepreneurial environment. From this perspective, risk-taking small ICT firms can be seen as increasingly benefiting from a myriad of supporting networks, industry diversity and institutional settings that enhance progress in technology development and market introduction, mainly in metropolitan areas (most probably, to a smaller extent in rural and remote regions) (Spigel 2016; Audretsch and Belitsky 2017; Audretsch et al. 2019; Stam and Van der Ven, 2021). In particular, access to networks enables small firms to better scan opportunities in the market and align innovation with customer demand. It may be concluded that the entrepreneurial ecosystem approach is rather comprehensive by including firms and other actors (stakeholders), and by including selected conditions (knowledge, networks and institutions, etc.) in the external environment, with a focus on dynamic interaction between firms and such conditions.

1.3.5 Culture Theory in Problem Understanding and Design of Solutions

There are several definitions from scholars about cultural dimensions that capture different shared values in societies or nations. Hofstede (1984), for instance, differentiates four cultural dimensions: power distance, uncertainty avoidance, individualism/collectivism and masculinity/femininity. An alternative classification is given by Hampden-Turner & Trompenaars (1993) by distinguishing between seven national cultural dimensions to understand diversity in the global culture. In the current study, culture theory will help in understanding the diversity involved in business management culture (trend of hierarchical decision-making) and policy-making structure, particularly the latter, because of involvement of many different actors and the challenge of a collaborative approach.

1.3.6 Multi-Actor Approach to Problem Understanding and Design of Solutions

The multi-actor system theory provides a theoretical basis for analysis and structuring multi-actor problems. Multi-actor problems are characterised by the presence of many different societal actors that have differing or conflicting interests and perceptions of a problem situation and act strategically to get the best out of that situation (Enserink et al., 2010; Bryson, 2004; Bryson, 2017). The study by Enserink et al. (2010) addresses policy problems and processes that involve multiple actors (parties) in Western Europe. In such situations, no single actor can impose its desired solution; therefore, it is required to form some cooperation between parties. Advantages of using multi-actor system theory in the design of solutions is the attention to what actors are involved in the problem situation, their power position, the possible alternatives and how to obtain support from important actors and build supportive coalitions. The multi-actor system theory is often used by policy analysts to deal with systems involving many different actors (stakeholders), which will be used in this study to investigate various parties' roles in improving innovativeness, among others by using a collaborative policymaking approach.

Table 1.1 indicates the relationships between the research questions and the theory used to approach and discuss the questions. Accordingly, the level of innovativeness of ICT firms in Indonesia will be discussed from resources and dynamic capability perspective, and from an agglomeration/cluster and entrepreneurial ecosystem perspective. In the empirical part of the study concerning firms' innovativeness (Chapter 4 and Chapter 5) the main concepts and constructs from these theoretical perspectives will be operationalized and measured, and it will be explored which parts of the theories are most relevant in Indonesia's context. In the chapter on change strategy and policy design (Chapter 6), the underlying concepts are not measured but taken as a given situation, derived from literature study and several in-depth interviews.

1.4 Contribution of this PhD Study

There are several contributions provided by the study. A main contribution is the application of the underpinning theories in an emerging economy such as Indonesia's, which reveals the extent to which the phenomenon in the developing countries can confirm or disconfirm what has been postulated in developed countries. A comprehensive empirical analysis of innovativeness on the level of firms in a developing country is relatively new, in particular by including firm internal (in particular management) and several firm external conditions. Accordingly, as one of the first, this study had to deal with investigating low technological

innovations (e.g., R&D intensity), measurements of innovation traditionally used in developed countries which are not applicable, and the collection of most data by researchers themselves (Martinez-Roman et al., 2011).

The main contribution of the study to theory is confirming that a comprehensive approach, namely through using *entrepreneurial ecosystems*, is most relevant. In this approach, firms' innovativeness benefits (or suffers) from own resources and capabilities (specifically firm size-related and management-related) and from the external environment through knowledge spillovers and (cluster) networks, and systemic interaction between the firm and selected external conditions, embedded in an institutional layer. The attention for institutions also links the theory with change strategy. Within this broad approach, the trend was confirmed of relatively strong influence of firm size, firms R&D organization, marketing skills, and of relatively strong interaction of managers' cognitive capability with cluster networks. Emphasis on institutional and organisational dimensions of the approach also appeared to be linked with potentials for a change strategy.

In more detail, different from what could be expected from small firm resource-based and capability theory concerning the developed world, small firm size tends to act as a disadvantage, while strength of cluster network interaction with managers' cognitive capability tends to act positively, which is different from what could be expected in developed and developing world (cluster network theory on weakness of strong ties). Firm capabilities and network theory could be more nuanced concerning developing world (small firm size), and concerning traditional and new economic sector clusters like ICT (strong internal cluster networks) in developing countries.

The contribution to empirics is as follows. The *first* contribution is a trend that small firms have to expend extra efforts in learning and improving dynamic capabilities aimed at increasing innovativeness. This situation complies with low professionalisation of R&D and with entrepreneurial values, such as hierarchy, risk-avoidance and modest ambitions, that may hamper learning and innovativeness. A *second* contribution, concerning regional innovation, is a relatively weak positive relation between innovativeness and urban environment and a somewhat stronger positive relationship between innovativeness and cluster networks. Accordingly, whereas the study could not support ideas of agglomeration advantages (knowledge spillovers) particularly in metropolitan areas, it could (weakly) support a positive impact from cluster networks. As above indicated, the last contradicts potential 'dark' sides of knowledge networks in clusters, most probably due to relatively young (ICT) clusters where 'dark sides' have not yet emerged. The *third* contribution refers to FDI and innovativeness. Innovativeness tends to increase with firm-level FDI, suggesting increasing returns (benefits) from an important source of novel learning and knowledge transfer, thereby contradicting part of existing empirical studies on FDI. Next, as a

fourth contribution to empirics, the core (metropolitan) area and non-core regions in Indonesia tend to differ in most firm-internal conditions, including management, and in entrepreneurial ecosystem conditions. As an important example, in the metropolitan core area, the relationship of innovativeness with management capabilities tends to be much stronger than with external conditions (entrepreneurial ecosystem).

As indicated above, a further important contribution is to the regional study of innovativeness in Indonesia. Existing innovation studies often only covered the western part of Indonesia. This PhD study covers both the western and the eastern parts of Indonesia. The current study is one of the first to investigate differences in innovativeness of ICT firms between several regions in Indonesia.

With regard to validity in the empirical firm level study, it can be stated that internal validity - referring to whether the analysis is valid for the population and sample being studied – is relatively strong. One issue could however not be fully solved and that is response bias by small firms, eventually based on positive self-evaluation. Also, due to using a small number of indicators in measuring external environment/entrepreneurial ecosystem, this part's internal validity tends to be somewhat weak. External validity - referring to whether the results can be generalized to similar populations that were not sampled (representativeness of the sample), tends to be at reasonable level. This is because the sample was made as representative as possible in post-stratification procedure (urbanization level and firm-size).

In terms of policymaking, an important contribution of this PhD study is the extension of the empirical problem analysis with an evidence-based proposal of solutions in terms of a change strategy for policymaking and management. Existing studies stop at studying factors (or conditions) but do not yet include change strategies. This PhD research extends the problem analysis with designing a part of the change strategies. The study also provides understanding on how policy transfer as part of change strategy may work in improving innovativeness in the ICT sector and sharpens the implementation of innovation co-creation in the ICT sector of the country. The transferred policy which eases co-creation processes, can be imitated and modified elsewhere based on local situations, to encourage such collaborations.

1.5 Research Approach and Outline of the Study

1.5.1 Research Approach

In this study, a review of relevant literature on firm innovativeness is the first step towards identifying the latest state of research in the field and building the theoretical constructs of the

study. (See Appendix 1 Chapter 1). Based on this theoretical foundation, a number of hypotheses related to firm innovation activities are formulated. With regard to empirical data for testing the hypotheses on innovativeness and answering research questions on background situations and context, the study draws on two data sets: a questionnaire to 260 firms as given in the tables of regression estimation throughout all the regions in Indonesia and in-depth interviews with the managers of firms, experts and academics. The hypotheses are tested using linear and non-linear regression models focusing on revealing the influences of each firm-specific and external condition to innovativeness. To gain a deeper insight into situations in practice and to help design a change strategy, this PhD study also uses the qualitative insights from the mentioned interviews.

2.5.2 Outline of the Study

The study is organised in eight chapters, as illustrated in Figure 1.1, and includes a compilation of three empirical papers (sector level and firm level-national, and firm level regional), Chapters 3 to 5. The theory and concepts are elaborated and the hypotheses, the methodology and the operationalisation of the ideas are discussed in Chapter 2. Then, Chapter 3 discusses the general situation of the ICT industry in Indonesia to answer RQ1 on the problematic situations at sector level. The picture of firm innovativeness in ICT firms is investigated in Chapter 4 to answer RQ2 on level of innovativeness and RQ 3 on the influence of internal, external, and specific management conditions on innovativeness. Chapter 5 discusses the situation in the regions of Indonesia in answering RQ 5 on the influence of each condition at regional level. Next, in Chapter 6, an innovation change strategy for ICT firms in Indonesia is proposed and investigated using qualitative analysis to answer RQ 6 on the design strategy and on conditions to implement the strategy. The study is summarised with an overall interpretation of the results in Chapter 7, and finally, Chapter 8 concludes with the reflection on the limitations of the study and the suggestion for future research.

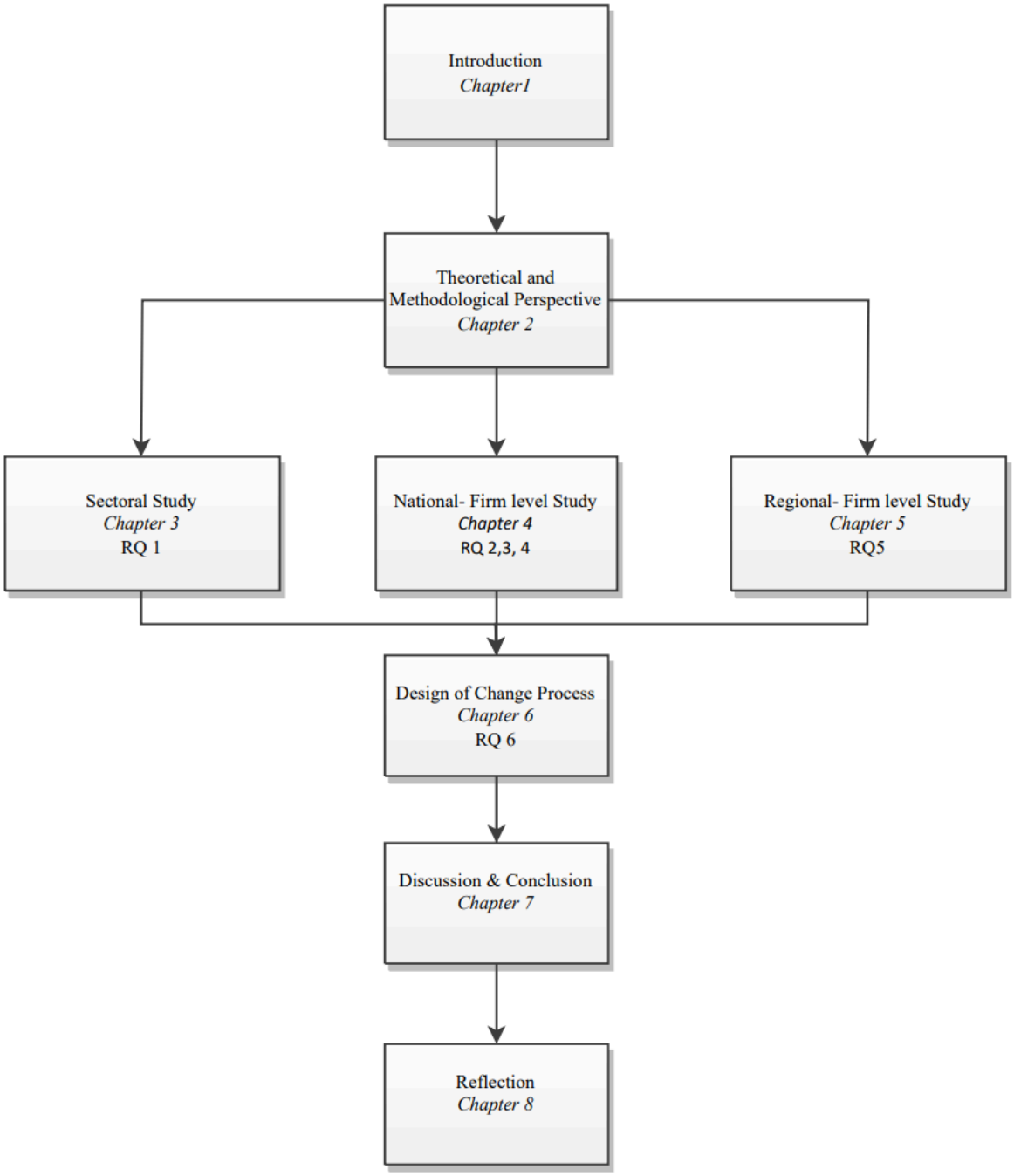


Figure 1.1 Outline of the study on Innovativeness of ICT firms and Design of a Change Strategy

Chapter 2 Theoretical Foundations, Methodology and Research Design

2.1 Introduction

In this chapter, the focus is on the main theories, methodology and research design used in the study. The knowledge spillovers, absorptive capacity, and dynamic capabilities theory as an extension of resource-based view (RBV) are discussed and the concept of culture and multi-actor theory is added to propose the appropriate policy. For instance, knowledge spillover will help to explain the process of knowledge exchange which triggers innovation. Meanwhile, absorptive capacity and dynamic capabilities provide understanding of the processes within firms in building innovation capability. The relevant concepts of agglomeration are described and connected with firm innovation at the national and regional levels, and knowledge that circulates there and can be useful for innovating firms. Agglomeration theory may help to answer questions on the different innovativeness level among the regions in Indonesia, that associated to specialized labour market and knowledge movement. This argument particularly refers to high urbanization in part of the country. The study also introduces the concept of entrepreneurial ecosystem, which is closely related but focusses on young firms in innovation activities and advantages of institutions and networks that help them to perceive and grasp opportunities. Culture theory is also introduced to address whether culture matters in innovativeness, particular in change strategies. Meanwhile, multi-actor approach theory helps to identify the actors involved and how they could better interact with each other to improve entrepreneurial ecosystem. Further, in the methodology section, the research approach, databases used in the empirical part of the study and methods of analysis, i.e., multiple regression analysis, are discussed.

The chapter begins by addressing the concepts of innovation (section 2.2), followed by a discussion of knowledge spillovers, absorptive capacity, dynamic capabilities, agglomeration theory, culture theory, multi-actor theory, and entrepreneurial ecosystem. How the theoretical frameworks are used in the individual chapters of this study is discussed next, along with a set of hypotheses (section 2.3). The research approach, the methods, and techniques that are applied in this study are briefly explained in section 2.4. The chapter closes with a conclusion on the theoretical foundations, methodology, and design used in this study.

2.2 Theoretical Foundations

Concept of Innovation

In a business organization, Zahra and Covin (1994) suggest that innovation is perceived as the lifeblood of the continuation and advancement of a firm. In this regards, innovation helps to

sustaining firm competitive advantages and creating new value. In the same line, Bessant et al. (2005) argue that innovation represents the core renewal process in any organization. In terms of competitive advantage, innovation may act *in two broad ways*, namely, to bring a novel product onto the market or to introduce a new process/way of doing things in the firm that is more cost-efficient. Innovation is considered as an essential driver of competitiveness and economic dynamics and also the centre of economic change, causing explosion of "creative destruction" (Schumpeter, 1942). Dividing the innovation process into four stages: invention, innovation, diffusion, and imitation, Schumpeter argued that the invention phase or the fundamental innovation has less impact, while the diffusion and imitation process have a much more significant influence on the state of an economy. In terms of economic growth, the diffusion of basic innovation is more important than discovering fundamental innovation (Freeman, 1987), which can be suitable for the Indonesia case. Like any other country, the majority of business, including those in ICT sector are SMEs, and the existing policy cannot be fully implemented because it is designed for large company only (Sipahutar et al., 2020). The existing policy could be revised to accomodate the small ones. The diffusion period refers to the period when imitators begin to realize the profitable potential of the new product or process and start to invest heavily in the technology concerned (Mohr et al., 2014) thereby improving the product or process quality and decreasing the price for consumers.

Innovation may involve a wide range of different types of change, depending on the organization's resources, capabilities, strategies, and requirements. Innovation processes also have different patterns and styles in different regions and countries in the world (Jensen et al., 2007). In other words, one size does not fit all regions due to different social-economic and cultural contexts. In a situation of lack of uniformity between the concepts of innovation, some studies (e.g., Kauffeldt, 2012) focussed on the overlapping aspects between innovation. For instance, product innovation may involve some process innovations, or a process innovation might lead to product innovations (Rowley et al., 2011). The different conceptualizations, classes and overlap between them cause diversity in approaches to measure the level of innovations. The distinction between products and processes may be rather clear with respect to goods; however, when it comes to services, it may be less clear, as the production, delivery and consumption of many services may occur at the same time.

2.2.1 Theoretical Approach

All theoretic approaches used in the study will be discussed in this section, including RBV, Dynamic Capability (firm-centered theories); Agglomeration/Cluster and Entrepreneurship

Ecosystem (EES) (external system and interaction); Culture theory, Multi-actor approach and collaborative policymaking, and requirements to design (theories of policy/strategy design). It needs to be emphasized that such a broad theoretical approach in the study is motivated by enabling to underpin the scanning of a broad spectrum of influences in the empirical part and zoom into ones important for design of a change strategy.

I. Firm-centered Theories

Resource-Based View (RBV)

Resource-Based View is a theory that emerged in 1980s and 1990s after several, from among others Wernerfelt (1984), Barney (1991, 2001) and Rothaermel (2013). The theory seeks to understand why firms grow and diversify. In RBV it is argued that firms should look inside themselves instead of looking at competitive environment to find the sources of competitive advantage. According to RBV, organizations should rely on two types of resources: tangible and intangible that must be heterogeneous and immobile. The resources should have the specific attributes to become VRIO resources. VRIO stands for Valuable, Rare, Inimitable and Organized. In early work, Barney (1991) has identified VRIN framework that examines whether resources are valuable, rare, costly to imitate and non-substitutable. According to Barney, the resource must be: a) valuable in the sense that it provides opportunities or neutralizes threats to the institution's environment; b) rare among an institution's current and potential competitors; c) imperfectly imitable- hard to copy, and d) non-substitutable – there cannot be a strategic equivalent substitute for the resource that is valuable but neither rare nor imperfectly imitable.

The framework of VRIN was later improved to VRIO after the work of Rothaermel (2013) by adding the question whether an institution organized to capture the value of the resources or not. The resources that meet all four requirements can bring sustained competitive advantage for the organizations.

Dynamic Capabilities

Absorptive capacity is important in relation to dynamic capabilities, and therefore it is important to start with absorptive capacity explanation. Absorptive capacity is a firm's ability to identify, assimilate, transform, and apply valuable external knowledge (Cohen & Levinthal, 1990). Put in another way, absorptive capacity indicates the rate or quantity of scientific or technological information that a firm can absorb. Conceptually, it is similar to information processing theory, but at the firm level rather than the individual level. Cohen and Levinthal introduced absorptive capacity in 1990. Zahra & George (2002) extended the theory by specifying four distinct

dimensions to absorptive capacity: acquisition, assimilation, transformation, and exploitation. In contrast, Todorova & Durisin (2007) question Zahra and George's reconceptualization of absorptive capacity. When absorption limits exist, Todorova & Durisin (2007) provide one explanation for firms to develop internal R&D capacities. They revisit Cohen and Levinthal's model, and suggest that transformation does not follow assimilation, but rather an alternative process. As a result, they define ACAP as an organization's ability to value, acquire, assimilate or transform, and exploit external knowledge. With regard to internal R&D capacities in a firm, this task can be done by R&D departments. R&D departments can not only conduct development along lines they are already familiar with, but they have formal training and external professional connections that make it possible for them to evaluate and incorporate externally generated technical knowledge into the firm. In other words, a partial explanation for R&D investments by firms to improve the absorptive capacity constraint.

It is useful to note that almost all organizational literature, including Cohen and Levinthal's (1990) original work, treats absorptive capacity as an organizational-level construct (Lane, Koka, & Pathak, 2006). Although absorptive capacity does have antecedents and consequences. Cohen and Levinthal (1990) argue that firms cannot benefit from external knowledge flows by simply being exposed to them. Firms need instead to develop absorptive capacity, the ability to recognize the value of new basic knowledge, assimilate, and apply it to new innovations. A firm's capability to integrate the external and its internal competence, according to Teece (2007) is called dynamic capability. Dynamic capability view focuses on those capabilities which enable a firm to overcome organizational inertia and innovate continuously (Teece, 2007). Meanwhile, knowledge-based competence can stay with the firm. Accordingly, a firm can create a competitive advantage by coordinating and integrating the specialized knowledge that its (individual) employees develop. DC theory helps to investigate the level of absorptive capacity of firms in Indonesia and how to increase the capabilities in Chapters 3, 4, and 5. It must be noted, although the notions of absorptive capacity and dynamic capability are important, the study nowhere measures them directly. Rather a set of indicators has been developed to measure indirectly.

Moving attention to related theory, dynamic capability (DC), according to Teece et al. (2007) is the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments. DC can be distinguished from operational capabilities, which pertain to the current operations of an organization. In contrast to operational capabilities, DC refers to "the capacity of an organization to create, extend, or modify its resource base purposefully" (Helfat, et al., 2007; p. 4). The basic assumption of the dynamic capability's

framework is that core competencies should be used to modify short-term competitive positions that can be used to build longer-term competitive advantage. In addition, in a recent study, Teece (2018) asserts that dynamic capabilities and strategy are interdependent. The strength of a firm's dynamic capabilities helps shape its proficiency at a business model design associated with the strategy design. Teece's concept of dynamic capabilities essentially says that what matters for business is corporate agility: the capacity to (1) sense and shape opportunities and threats, (2) seize opportunities, and (3) maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets. Over time, a firm's assets, like physical assets, human resources, and intellectual property, may become co-specialized (uniquely valuable in combination). According to (Teece, 2003; Douma & Schreuder, 2013), the combination gives a company a more sustainable competitive advantage. If capabilities are dependent on co-specialized assets, the coordination task of management of the firm will be difficult. Therefore, the optimal configuration of assets should be taken into account. DC theory will be discussed in the empirical part as an important extension of resource-based theory (Chapter 4). DC theory also provides one of the grounded understandings for the study to propose the 'fittest' strategy for innovation of the firms in Indonesia in Chapter 6.

II. External (Environment) centered theories.

Agglomeration Theory

According to Marshal (2009) the agglomeration of firms in close geographical proximity could have two different impacts. On one side, Porter (1990) with his cluster theory and Krugman (1991) argue that agglomeration creates greater economic performance, increasing returns, and economic development. In another side, the agglomeration could create a substantial negative impact on the development of firms, cities, and regions. In other side, firms could receive increasing returns from the three elements of agglomeration economies: a local pool of skilled labour, local supplier linkages, and local knowledge spillovers (McCann, 2005). With regard to a negative side, in line with Marshall, Martin (2006) argues that if agglomeration is dependent on only one industry (but not always the case), firms are likely to suffer from diminishing returns, and may get into 'extreme depressions' later on.

Among the three elements of agglomeration, knowledge spillovers is commonly known as exchanging ideas among individual firms facilitated by physical proximity and informal encounters. It is considered as necessary for creativity, economic growth, urban development, and promoting the growth of high technology industries in specific regions. At the firm level, benefits

from knowledge spillovers occur when recipient firms combine the knowledge of an originating firm with other experience (Agarwal, Audretsch, & Sarkar, 2010).

The agglomeration theory is also related with core-periphery thinking, with power asymmetry as another issue correspondence with. According to Friedmann (1963) in his theory, differences between core and periphery increase due to selective migration from periphery to core (young, well-educated adults leave the periphery for the core). There are however limits to this migration due to high density (congestion) in the core-area affecting land availability and availability of cheap facilities.

Entrepreneurial Ecosystem Theory

Entrepreneurs (small firms) are essential for innovation (Acs & Audretsch, 1988). To grow and innovate, an entrepreneur may take advantage of the ecosystem (Jacobides, Cennamo, & Gawer, 2018) known as an entrepreneurial ecosystem. An entrepreneurial ecosystem is a social and economic environment affecting the local or regional entrepreneurship. According to Acs et al. (2017), the entrepreneurial ecosystem approaches two dominant lineages: the business strategy line and the regional development line. Both lines share common roots in ecological systems thinking, focusing on the interdependence of stakeholders in a particular community to create new value and as such a novel approach to the industrial organization has been developed over the last decades. The entrepreneurship ecosystem consists of several domains: culture, enabling policies and leadership, availability of appropriate finance, quality human capital, venture-friendly markets for products, and a range of institutional and infrastructural supports (Isenberg, 2010). In more modern versions of entrepreneurial ecosystems, the emphasis is put on facilitation of risk-taking entrepreneurship, opportunity recognition of innovation and market introduction mainly through access to many interacting networks (Audretsch and Belitsky, 2017; Stam and Van der Ven, 2021).

As the external environment tends to be rather broad but also may overlap in above theories, the study will focus attention on the entrepreneurial ecosystem (EES) approach and specific conditions herein, among others covering agglomeration and cluster networks, but also regulation.

III. Theories of Policy and Strategy Design

Culture Theory

The dimensions of culture form an important influence on the context of innovation. Hofstede's work serves as the base for research in cross-cultural psychology, inviting several researchers to

study different aspects of international business and communication. The overview of the six Hofstede's cultural dimensions (Hofstede, 1984; Hofstede, 2011).

a. Power Distance: This dimension explains the extent to which members who are less influential in a society accept and expect that the distribution of power takes place unequally.
b. Uncertainty Avoidance: It is a dimension that describes the extent to which people in society are not at ease with ambiguity and uncertainty.
c. Individualism vs. Collectivism: The focus of this dimension is on the question regarding whether people prefer being left alone to look after themselves or want to remain in a closely knitted network.
d. Masculinity vs. Femininity: Masculinity implies a society's preference for assertiveness, heroism, achievement, and material reward for attaining success. On the contrary, femininity represents a preference for modesty, cooperation, quality of life, and caring for the weak.
e. Long-Term vs. Short-Term Orientation: Long-term orientation describes the inclination of a society toward searching for virtue. Short-term exposure pertains to those societies that are strongly inclined toward the establishment of the absolute truth.
f. Indulgence vs. Restraint: This revolves around the degree to which societies can exercise control over their impulses and desires.

In this study, the analysis will use two dimensions, in Chapter 6, to improve innovativeness, namely Power Distance, and Individualism vs. Collectivism, derived from several culture studies. These dimensions are also the most distinguishing dimensions in Indonesia compared to other developing countries, according to some studies in company culture in Indonesia (Irawanto, 2009; Suharnomo and Syahruramdhan, 2018; Mangundjaya, 2013; Hofstede Insights, 2019).

Multi-Actor Approach in Design of Solutions

Innovation systems are complex and involve many stakeholders. Assuming that "… no individual single actor will be able to unilaterally impose their desired solution onto the others" (Enserink et al., 2010, p. 79), stakeholders are interdependent, and they must cooperate. Thus, knowing who the stakeholders are and understanding their role in the national innovation system is vital for mapping their interests and influence (power). Chapter 6 assumes that mapping stakeholders will support information for strengthening the policy process regarding different interests and influences of stakeholders in the innovation system (Enserink et al., 2010). The

chapter will introduce the multi-actor perspective on public policy and elaborate on the consequences of this perspective for analysis, evaluation, and improvement of public policy concerning increasing the level of innovativeness of ICT firms. Many studies have shown that there is often a considerable gap between the planned outputs and outcomes of policy implementation and what occurs in reality.

As an alternative approach for policymaking to be forwarded here, multi-actor collaboration based on deliberation tends to bring forth relevant knowledge, stimulate processes of mutual learning and build joint ownership over the new solutions. As such, policy design should be seen as an ongoing process that flexibly adapts as implementation challenges unfold (Ansell and Torfing, 2017).

Collaborative Approach in Policy Design

According to Ansell, Sørensen & Torfing (2017) policy designs can be improved through collaboration between upstream and downstream stakeholders, including elected politicians, public managers, service providers, user groups and relevant interest organizations and advocacy groups. Collaborative policy dialogue is far from the dominant policy discourse, nor is it suited to all policy conditions (Innes and Booher, 2003). Collaborative dialogue on a large scale requires skills, training and adherence to a set of practices that run counter to the norms of discussion to which many people are accustomed.

Taking a more collaborative approach to designing and flexibly adapting public policies tends to blur the sharp lines of demarcation between design and execution, top and bottom, and public and private. Moreover, it helps to realize that implementation problems are not easily solved by managerial commands aiming to clarify and communicate the policy objectives, plan the implementation process, evaluate performance and reward high performers/punish low performers (Ansell, Sorensen and Torfing, 2017).

To ensure that the strategy will be effectively implemented, the study follows Howlett (2018) in matching the character and context in policy instrument choice that include 3 (three) criteria. The criteria are:

a) Consistency, the ability of multiple policy tools to reinforce rather than undermine each other in the pursuit of policy goals).
b) Coherence, the ability of multiple policy goals to co-exist with each other and with instrument norms in a logical fashion, the relationships within the shaded area in figure), and

c) Congruence, the ability of goals and instruments to work together in a uni-directional or mutually supportive fashion).

When it comes to policy design in innovation, there are several theories that can be compared to gain a better understanding of the most effective approaches. Resource-based view (RBV) and dynamic capabilities (DC) focus on the internal capabilities and resources of a company, while agglomeration theory emphasizes the benefits of firms locating in close proximity to each other (in cities). Entrepreneurial ecosystem theory looks at the broader context of firm innovation, including the role of government and other stakeholders, and institutional conditions, while culture theory considers how cultural values can impact innovation (though this seems to mainly affect internal capability) and also looks at decision-making on change. Multi-actor and collaborative approaches are used more directly in the policy design part, namely, in engaging a variety of stakeholders in the policy design process to ensure a diverse range of perspectives. By understanding these different theoretical perspectives and the empirics concerned, policymakers can make better informed decisions about how to support and promote innovation.

2.3 Related Hypotheses

The second part of this chapter is a discussion of the hypotheses used in the study. The study repeats the main research question from the previous chapter as follows:
"In which ways and to what extent do firm internal (management) and external conditions influence and differentiate the profile of the ICT firms in terms of innovativeness at the country and region level of Indonesia, and what strategy should be designed and implemented to overcome the problematic situations?"

Several hypotheses have been developed in this study which will be explained below, while the detailed motivation of how the hypotheses is formulated, will be discussed in each of the respective chapters.

From RBV and DC, it can be inferred that the amount of productive resource the firm employs for its activity, among others, may influence innovation (Alonso, 2018). In addition, Alves et al. (2016) reveal that organizational sizes influence the impact of dynamic capabilities on performance. Concerning firm size, Prajogo (2016) and Biemans (2018) argue that larger firms would be better able to bear the uncertainty surrounding innovation and realize the rewards from innovation. Meanwhile, Shefer & Frenkel (2005) observe relatively large numbers of small firms engaged in innovative activity, particularly in the high-tech industry. There is also a possibility of

quadratic relationships between size and innovativeness like forwarded by Tsai (2005) in the Taiwan ICT industry.

Theory	Level	Hypothesis	Chapter
Resource-Based View, Dynamic Capability	National	*1.1: Firm size is positively associated with innovativeness (linear)* *1.2: Firm size is positively associated with innovativeness (quadratic)*	4

R&D activities are difficult to imitate and substitute, and lead to competitive advantages (Branco & Rodrigues, 2006). RBV and Dynamic Capability theory are ideal to study such conditions because those theories recognize the importance of intangible resources. In addition, some studies regarding R&D organization, especially in R&D collaboration (e.g., Huizingh, 2017; Lucena & Roper, 2016) observe that firm collaboration enhances learning experience effects and information exchange, particularly knowledge recombination that, in turn, gives impact to firm innovativeness.

Theory	Level	Hypothesis	Ch
Resource-Based View, Dynamic Capability	National	*2: A higher level of R&D organization is positively associated with innovativeness*	4

The managerial skills are one of such resources of the firm that drives growth and process. In particular, the RBV argues that the nexus of managerial skills with different dimensions, like planning, investment and motivation of employees, can further improve the firms' competitive advantage by utilizing their resources. The studies on managerial skills (e.g., Helfat & Peteraf, 2015; Van Leeuwen & Földvári, 2016; Swann, 2018) provide the underlying assumption that there is a relationship between higher skills (particular academic qualification) and innovation. Highly skilled managers tend to be more ambitious and creative than others and tend to act more often as 'leaders' better able to plan long-term and manage uncertain innovation processes, a picture that is also applicable to the ICT industry and ICT skills. Besides, in this respect, there is the possibility of a quadratic relationship.

Theory	Level	Hypothesis	Ch
Resource-Based View, Dynamic Capability, Culture	National	*3.1:Manager's ICT skill level is positively associated with innovativeness (linear)* *3.2:Manager's ICT skill level is positively associated with innovativeness (quadratic)*.	4

RBV and Dynamic Capability theory acknowledge the managerial skills that can be a combination of among others, formal education, training and on-the-job experience. Regarding manager experience, Mascitelli (2000) provides a positive role of learning-by-doing and

knowledge accumulated through lifetime experience. Meanwhile, Martínez-Ros & Labeaga (2002), Beckman et al. (2007), Dencker et al. (2009) forward that the effect of managerial experience becomes even smaller after a certain period of engaging in innovation (inverted quadratic relation).

Theory	vel	Hypothesis	Ch
Resource-Based View, Dynamic Capability, Culture	National	*4.1: Years of managers experience is positively associated with innovativeness (linear)* *4.2:Years of managers experience is negatively associated with innovativeness (quadratic, inverted)*	4

With regard to management capability, which can be seen as a broader capability than that derived from experience, Ruiz-Jiménez et al. (2016) and Helfat and Peteraf (2015) support the idea that cognitive capability affects the sensing of meaningful opportunities and how to respond to them in innovation processes in many ways. It is plausible that the larger the managerial cognitive capability is, the higher innovativeness will be, in a linear model. However, Powell et al. (2006) and Huizingh (2017) reveal that prior (subjective) beliefs or cultural influences may distort perceptions, mainly when information and learning are ambiguous. Distortion in perception may reduce/increase managerial cognitive capability, thus make its relationships with innovativeness is not linear.

Theory	Level	Hypothesis	Ch
Resource-Based View, Dynamic Capability, Culture	National	*5.1: Manager's cognitive capability is positively associated with innovativeness (linear)* *5.2: Manager's cognitive capability is positively associated with innovativeness (quadratic).*	4

Further, by following recent studies on level of marketing skills (e.g., Hurley and Hult, 1998; Slater et al., 2010; Lukas and Ferrell, 2000; Luca and Atuahene-Gima, 2000; Mohr, Sengupta and Slater, 2014), the study assumes that the stronger a firm is oriented to the market, the higher the innovativeness of the firm. Firm orientation in this respect includes openness in dealing with meaningful market segments, value propositions, and marketing/promotion techniques.

Theory	Level	Hypothesis	Ch
Resource-Based View, Dynamic Capability, Culture	National	*6: A stronger level of marketing skills is positively associated with innovativeness*.	4

The dynamic capabilities view as extention of RBV focuses on the issue of competitive survival in response to rapidly changing external business conditions part of which falls under entrepreneurial ecosystem. Combined with agglomeration theory, firm's competitive advantage

depends critically on its internal resources and capabilities, as well as external resources that can be accessed through a specific location of the firm. In the following three hypotheses, entrepreneurial ecosystems (EES) are addressed by moving attention to specific external circumstances of knowledge spill overs involving levels of urbanization, network interaction of firms in clusters and relationships with multinational firms, through FDI, and also regulatory issues. With regard to urbanization, Duranton & Puga (2004), Christensen & Drejer (2005), and McCann (2008) argue that proximity in large urban locations provides abundant opportunities for tacit knowledge circulation and informal business meetings. Proximity in urban areas is conducive to entrepreneurial ecosystems that are associated with innovativeness.

Theory	Level	Hypothesis	Ch
Resource-Based View, Dynamic Capability, Agglomeration and Entrepreneurial ecosystems	National a)	*7: Level of urbanization is positively associated with firm innovativeness*	4

a) (Duranton & Puga, Micro Foundations of Urban Agglomeration Economies, 2004)

The advocates of cluster theory (e.g., Porter, 2000; Eisingerich & Bell, 2010) emphasize benefits for firms from the competition with similar firms and close relations with specialized suppliers and customers, including local research institutes (universities). All these networks provide potential access to resources in clusters, which would otherwise be beyond the scope of a single firm associated with innovativeness.

Theory	Level	Hypothesis	Ch
Resource-Based View, Dynamic Capability, Agglomeration Entrepreneurial ecosystems	National	*8: Strong intra-cluster networks are positively associated with innovativeness.*	4

Tambunan (2007) observes that FDI is important as a source of knowledge transfer to firms in Indonesia. However, as Fromhold-Eisebith & Eisebith (2002) argue, the emergence of such positive impacts may take quite some time in situations of relatively flat learning curves, causing the need for strong efforts in the upgrading of firm capabilities as is indicated by *a quadratic relation.* Such need for strong efforts in the upgrading of firm capabilities often includes management practices in innovation.

Theory	Level	Hypothesis	Ch
Resource-Based View, Dynamic Capability, Entrepreneurial ecosystems	National	*9.1: FDI share is positively associated with innovativeness (linear)* *9.2: FDI share is positively associated with innovativeness (quadratic)*	4

Next, Fromhold-Eisebith and Eisebith (2002) and Tambunan (2007) highlight a general influence of regulation on firm innovativeness. Particularly, SMEs face several common problems, such as cumbersome and costly bureaucratic procedures, like obtaining licenses to operate and regulatory changes that generate market distortions, for instance, related to monopoly or duopoly.

Theory	Level	Hypothesis	Ch
Resource-Based View, Dynamic Capability	National	*10: Better (perceived) quality of regulation is positively associated with innovativeness*	4

The study also explores two interaction effects between management factors and the external environment. The more recent approach of the entrepreneurial ecosystem (EES) justifies such exploration (Spigel, 2016; Feld, 2012; Acs et al., 2017). While incorporating older ideas on the nursery cities (Duranton and Puga, 2004) and previously mentioned agglomeration economies and cluster network advantages, the EES approach emphasizes the quality of institutional and organizational conditions. In particular, it can be assumed that a wide variety of networks interacting with firm's capabilities and skills, is supporting entrepreneurial identification of opportunities and their commercialization, including dealing with risks (Feld, 2012; Vedula & Kim, 2019).

Theory	Level	Hypothesis	Ch
Resource-Based View, Dynamic Capability Entrepreneurial ecosystems	National	*11.1: Interaction between manager's cognitive capability and intra-cluster network strength is positively related to innovativeness.* *11.2: Interaction between level of marketing skills and intra-cluster network strength is positively related to innovativeness.*	4

With regard to regional studies, comparing firm innovation in core metropolitan regions with firm innovation in remaining area, the study again makes use of agglomeration theory and theory on EES. The first posits advantages of (proximity to) knowledge spillovers, specialized services, and high-quality labour, in core-metropolitan regions, the second adds emphasis on advantages from supportive networks and institutional quality favouring entrepreneurship and innovation, including risk-taking, presumably also in core-metropolitan regions. Regarding the

last, a set of studies by Shearmur (2011); Davies et al. (2012); Barasa et al. (2014) reveals that regional institutional quality reinforces the positive effects of firms' research and development on innovative output. Therefore, core region is likely to have better innovative output and more innovation due to better regional institutional quality.

Theory	Level	Hypothesis	Ch
Agglomeration, Resource-Based View, Dynamic Capability, Entrepreneurial ecosystems	Regional	*R1: ICT firms in the core region are more innovative than those in non-core regions*	5

With regard to firm size, Berlemann & Jahn (2014), in their research in Germany, found a significant influence of the region on relative innovative capacity. Further, with regard to R&D organization, studies on different regions (e.g., Pavlínek, 2017; Budiarto & Bachrudin, 2018; Indarti & Wahid, 2013) reveal the urgency to overcome the barriers in developing strong collaboration between industry, local government, and universities (research institutions), especially in the non-core regions. This situation indicates better developed clusters and networks surrounding universities in core-region. In addition to this, based on innovation studies in developing countries (cross-country), Cirera & Maloney (2017) reveal differences in firms' management conditions between regions, most probably resulting in different levels of innovativeness. Further, Kusumaningtyas & Suwarto (2015) found that in a core region - with better ICT infrastructure and ICT skills - innovativeness tends to be stronger than in non-core regions, which in turn make them better enabling innovation activity to flourish.

Overall, previously discussed theory (agglomeration and EES in combination with firms' managerial capabilities) indicates that firm internal conditions are stronger developed in core-regions compared to non-core regions, presumably coming with regional differences in how firm internal conditions affect level of innovativeness. This may hold, for example, for marketing skills to promote innovation, and with regard to the ecosystem, for strong presence of FDI in the core-region.

Theory	Level	Hypothesis	Ch
Agglomeration, Resource-Based View, Dynamic Capability, Entrepreneurial ecosystems	Regional	*R2: The relationship between firm-internal conditions and innovativeness in the core-region is stronger than that in non-core regions*	5

Meanwhile, for internal firm conditions, and specifically management conditions, another hypothesis seems relevant:

Theory	Level	Hypothesis	Ch
Agglomeration, Resource-Based View, Dynamic Capability, Entrepreneurial ecosystems	Regional	*R3: The relationship between management conditions and innovativeness in the core region is stronger than that in non-core regions.*	5

Based on research in Indonesia, Tambunan (2007) and Mckinsey (2015) also highlight that better regulation is needed to improve innovative performance, reducing the disparities between core and non-core regions. Refer to agglomeration theory, the difference between core and non-core regions creates different ecosystem in entrepreneurial.

Theory	Level	Hypothesis	Ch
Agglomeration, Resource-Based View, Dynamic Capability	National & Regional	*R4: The relationship between firms' entrepreneurial ecosystems regulation conditions and innovativeness in the core-region is stronger than that in non-core regions*	5

Following the study on the national level, the set of variables indicating internal resources conditions include firm size and R&D organization. For management conditions, the study uses the manager's ICT skills, manager's experience, manager's cognitive capability, and level of marketing skills. Meanwhile, for external conditions, the study uses levels of urbanization, intra-cluster network strength, FDI share in firm ownership, and regulation. The study expects that the various conditions can be profiled using specific statistical tools.

To check the moderation effect among the conditions, especially between the management conditions and other conditions, the study posed two hypotheses as follows:

Theory	Level	Hypothesis	Ch
Agglomeration, Resource-Based View, Dynamic Capability	National & Regional	*R5: The moderation of cognitive capability to cluster network in its association with firm innovativeness, is stronger in the core region than that in non-core regions.* *R6: The moderation of marketing skills to cluster network in its association with firm innovativeness, is stronger in the core region than that in non-core regions*	5

2.4 Methodology and Design of Empirical Study

2.4.1 Databases

Two datasets are used in this study, firstly, a dataset derived from the large-scale firm survey in Indonesia that is used for quantitative analyses, and secondly, a dataset of interviews with the firms and various experts that help reveal qualitative insights. Both datasets were developed as part of the PhD study.

Firm Survey and Questionnaire

The study conducted an email survey in Indonesia from December 2016 until November 2017. Accordingly, a questionnaire was mailed to around 2,000 ICT-based firms randomly selected from clusters in different regions inside and outside Java. The areas include Jakarta, Bandung, Surabaya, Semarang, Yogyakarta (Java); Medan, Pekanbaru, Batam, Padang, Palembang, Lampung (Sumatra); Makassar and Manado (Sulawesi); Denpasar (Bali); Pontianak and Balikpapan (Kalimantan) (see: Figure 2.1), including all firm sizes.

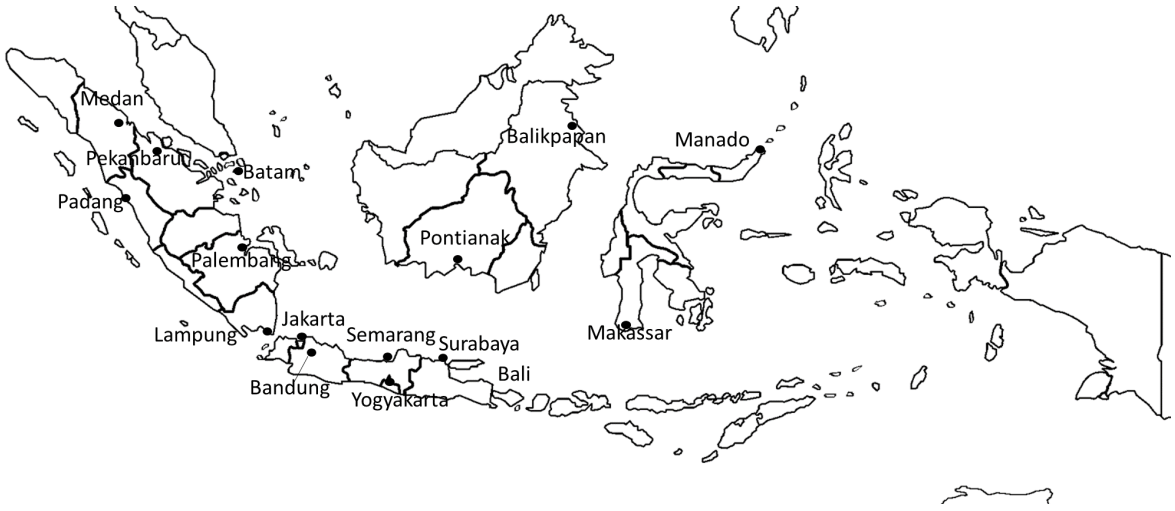


Figure 2.1 Survey Area

Due to the absence of a single statistical source of the population of ICT firms, the database of the firms is collected by using various sources such as Statistics of Indonesia, Yellow pages of business, Ministry of Information and Communication of Indonesia, and the Chamber of Trade and Industry of Indonesia in 2017. The target firms were the ICT firms (as defined by the Indonesian Central Bureau of Statistics), all around Indonesia, which have office email address. The target respondents were the middle- or upper-level managers of large firms and the top managers in the small/medium-sized segment (SMEs) who have a good understanding of innovativeness of the firm. The choice was made for an email-survey because of its cost-effectiveness and ease of performing over a large distance, compared e.g., with telephone inquiry. The response rate was around 13.6 percent which is a satisfactory result as indicated by Sivo et al. (2006) considering that 'impersonal' mail and internet-based surveys might in principle cause a

low response rate. Indeed, many managers failed to respond, in our case, due to business confidentiality issues (Rothenberg, et al., 2016). In addition, particularly in the context of developing countries, there is low propensity to provide firm data due to some constraints, especially respondents may be afraid to be exposed to tax payments, or they may feel ashamed for being involved in business failure or low performance.

It needs to be mentioned that application of post-stratification method was necessary (Johnson, 2008; Biemer & Christ, 2008) for correction reasons, due to underrepresentation of the small firms in certain regions. Post-stratification adjusts the sampling and weighting in such a way that the joint (corresponding probability) distribution of a set of post-stratifying variables matches the known population joint distribution (see Chaper 4 for details).

The survey posed 22 questions in the questionnaire, including questions that need short open answers about respondents' opinion (Appendix 5). The main content of the surveys is about the firms' activities in innovation, firm internal and external characteristics, and also firms' opinion regarding regulation and networks. In the process of selection of indicators, the study faced the challenge on how to make the theoretical concepts measurable in a reliable way. The most important challenge encountered in the study is the data validity issue e.g., perception bias. This is because positive or negative distortion may happen, certainly if there are no written firm records and annual reports, which is common among large parts of the SMEs segment in developing countries.

In-depth Interviews

The purpose of the interviews is to obtain in-depth information about obstacles and challenges faced by the firms in innovativeness, which could not be collected via the previous mail-survey. In total, the study conducted 23 (twenty-three) interviews with managers of small, medium-sized, and large-scale firms, government officials, and academics (see Appendix 2). These managers represent the situation in Jakarta, other cities in Java (Bandung, Solo), and outside Java (Palembang and Balikpapan). When selecting the interviewees, special attention has been given to firm size and regional location. Twenty-three interviews were conducted with managers of ICT firms, three with academics at university, six interviews with government officials, and one with a financial institution. The top managers (nine) represent large companies, medium-sized firms, and small firms**.** It needs to be mentioned that the interviewees have been selected consciously, to avoid including those that intend to push forward strong personal opinions, potentially causing systematic bias.

Interviewees are codified by the alphabet (code of interviewee position) and number. The profile of the selected interviewees is listed in the appendices. Further, with regard to type of interview, a semi-structured interview method has been used in such a way that the interview questions could be aligned with the findings of the quantitative analysis and that there was some room for free interpretation and reactions by individual respondents. Each interview lasted 45-60 minutes, and the answers in transcripts of interviews were codified based on the questions.

2.4.2 Research approach and methods of analysis

This PhD study consists of three empirical chapter (Chapters 3-5). Each empirical chapter starts by reviewing relevant literature to evaluate the mainstream theory, the current state of research on innovativeness in developing countries in general and in Indonesia in particular and the barriers to innovate in practice.

Next, the primary constructs (based on theory) of each chapter are discussed and conceptual models are developed and translated into measurable units (indicators). Various hypotheses have been developed (already addressed in Chapter 2, section 2.3) and these are discussed based on the results of Chapters 4 to 5.

Table 2.1 Research approach, methods of analysis and design

Chapter/Study	Data	Source	Method/analysis
Chapter 3 (*Sector* study)	Quantitative and Qualitative	Literature, Central Statistic & other official data	Descriptive
Chapter 4 National level (Firm study)	Mixed methods	Firm survey by researcher; Interviews	Regression analysis
Chapter 5 Regional level (Firm study)	Mixed methods	Firm survey by researcher	Regression analysis
Chapter 6 Change Strategy (Design)	Qualititive	Empirical findings from Chapter 3-5 Literature and Interviews	Descriptive analysis and Policy design

Chapter 3 introduces the national ICT sector situation in Indonesia, using primary data from Central Statistics and other official data from the government. It reveals the problematic situation behind the specific case in ICT development in Indonesia. Further, in an attempt at the firm level to identify relationships between variables, multiple regression analysis (ordinary least squares, OLS) is used in this study (Chapter 4 and 5). OLS regression is selected because it is easy to use as first exploration or groundwork. However, regression analyses may reveal relationships among variables but do not imply that the relationships are causal. Multiple regression allows

assessment of strength of the relationship between an outcome (the dependent variable) and several 'predictor' variables as well as the importance of each of the predictors to the relationship. Instead of merely one-way causality, in some parts of the modelling, there are good reasons to assume that the relationships indicate 'reversed causality'. In addition, instead of a continuous pace of increase/decrease of the dependent variable, the relationships could be non-linear (quadratic) in nature. As a response to the last point, application of somewhat different regression models, exploring mainly u-shaped relationships was performed. The u-shaped relationship is dealing with increasing returns in which, first, there seems no or weak relationship between the 'predictor' variable and innovativeness but at higher values of this variable, the increase is disproportionally large. The study also tested several interaction effects between variables to investigate influence of some variables to other variables. Interaction effects occur when the effect of one variable depends on the value of another variable. For example, the effects of cluster network strength to innovativeness could be reduced or increased by the cognitive capability of the managers in clusters.

In Chapter 4, OLS regression technique is used as mentioned before. This chapter provides a broad scan at the firm level by considering firms' internal (specifically management) and external conditions. A sample of 260 ICT firms (mainly SMEs) is used to explore the influence of these conditions on innovative performance, including non-linear influences. In Chapter 5, OLS is employed to investigate the influence of each condition on the regional level. The same survey of 260 ICT firms is used**,** with the following numbers of firms per region: 130 firms in Jakarta region, 101 firms in Java outside Jakarta and 29 firms outside Java (merged due to the small numbers).

In Chapter 6, culture theory, multi-actor theory and the collaborative approach in policymaking are used to formulate a change strategy in improving innovativeness. The influence of culture on innovation has been recognized as a critical factor in international management and organizational development, given its relevance and contribution to business and economic development (e.g., Verspagen, 2006; Rohlfer and Zhang, 2016). Meanwhile, empirical findings from Chapters 3-5 and a multi-actor approach are employed to determine the role and the capacity of each stakeholder to reach goals in improving innovativeness. Meanwhile, collaborative policy-making is applied by involving related parties in decision-making process.

Qualitative analysis

Chapter 4 and 5 are mainly quantitative, but in the qualitative parts and in Chapter 6 the study disentangles the barriers for innovation in practice and develops recommendations for the firm and policy for the authority to take some important actions.

For this study, using in-depth interviews, QDA Miner Lite is applied that provides basic CAQDAS features. The study make use of this basic qualitative analysis software.The tool helps to manage and shape information from the interviews. With purpose-built research tools for classifying, sorting, and arranging information, this tool gives the opportunity to identify themes, clear insight, and develop meaningful conclusions.

QDA Miner Lite is a free computer-assisted qualitative analysis software which can be used for the analysis of textual data such as interview and new transcripts, open-ended response, etc. It offers basic features such as importation of documents from plain text, as well as data stored in Excell, CSV, Tab-delimited text files, importation from other qualitative coding software such as Nvivo as well as from Reference Information System (.RIS) files. It also provides intuitive coding.

Mixed method approach

With regard to *validity of results*, the following needs to be mentioned. Concerning the survey results, a test was performed to detect non-response bias, with the outcome that there was no need for concern. The same is true for a test to determine sufficient coherence within the survey results, thereby detecting systematic response bias. Further, the survey has been part of a mixed-method approach as follows. To integrate the analysis of the survey outcomes, a series of interviews, desk study, and other data sources were used in a systematic approach. First, the study identified the common themes and patterns that emerged from each data source. Then, it compared these findings to see where they overlapped and where they differed. The study also looked for any gaps or inconsistencies in the data that needed to be addressed. Next, the information was synthesized into a cohesive narrative, highlighting the key insights and takeaways. It used visual aids, such as charts and graphs, to help illustrate the findings and make them more accessible to interview respondents. Throughout the process, the study remained open to new information and adjusted the analysis as needed. By taking a comprehensive approach to analyzing the data, the study was able to generate robust conclusions that were grounded in evidence and insights from multiple sources and angles.

2.5 Conclusion

This chapter discussed the theory and outlined empirical studies in describing and exploring firm innovativeness, as well as the design of a strategy for changing the situations. The theories discussed were selected to enable a broad, theory-based empirical scan of innovativeness and underlying conditions. In addition, 17 (seventeen) hypotheses have been derived from detailed theoretical argumentation of relevance and direction of assumed relationships, to be explored in

each of the respective chapters. Next, the methodology and design of empirical study have been elaborated, including databases, firm survey and questionaire, in depth interviews, research approach and methods of analysis, including a qualitative analysis. How the mail survey and in depth interviews have been performed, is also briefly discussed in this chapter, including the survey area and profile of the respondents. Chapters 4 and 5 present a detailed discussion of the empirical results on innovativeness and an exploration of the assumed relationships. But first, Chapter 3 deals with the sector situation of ICT advancement, shortcomings, and challenges in Indonesia.

Chapter 3 ICT Sector in Indonesia

3.1 Introduction

This chapter consists of the ICT industry's description in Indonesia to see the 'big picture' of Indonesia's firm innovativeness. To this purpose, the chapter addresses the first sub-question (Chapter 1.2.4): *What are the problematic situations and influencing conditions that contribute to the lagging behind of ICT-sector innovativeness in Indonesia?*

Indonesia's ICT industry is witnessing several digital technology innovations, such as online on-demand transportation services, e-commerce businesses and ticketing services in recent years. However, large segments of the Indonesian population still do not have sufficient technical skills in using information technology (IT) (BPS, 2020a) and this lack of skills also holds true for producers in ICT Indonesia. Accordingly, the industry depends heavily on ICT products and services from abroad (BPS, 2020b). Though the BPS (Statistics Indonesia) reports do not mention skills in developing IT, Bodrogini (2018) reveals that across the ICT firms in Indonesia, both larger and smaller companies have the same complaint: ICT talent is hard to find. Software and IT service businesses offer great opportunities for innovation and national business. However, top-level software companies that cover 60% of the ICT market are only software developers (BPS, 2020b), while the hardware producers are in the minority, leaving the hardware problems unsolved.
Related to the Networked Readiness Index (the propensity for countries to exploit the opportunities offered by information and communications technology) of the World Economic Forum (WEF), for 2015, Indonesia ranked only 79th among 143 countries in 2015, behind its regional peers Singapore (Rank 1), Malaysia (32), Thailand (67) and the Philippines (76). The Networked Readiness Index measures countries' ICT performance by considering a wide range of aspects: the regulatory framework, the business and innovation environment, ICT infrastructure, consumer affordability and skills, ICT usage by individuals, businesses and the government, and the economic and social impacts of ICT.

The following section covers several characteristics of Indonesia's ICT industry, including challenges (digital divide, education, deficit balance trade) and opportunities. The chapter also includes the challenge of a labour market with a weak education system, including low innovation at management level (soft skills). The investment in the ICT sector is also discussed because small firm segments currently receive little to no investment. This topic is addressed in subchapter 3.2. Next, subchapter 3.3 discusses the uneven spatial distribution of the ICT sector in the country along with the different urban agglomeration advantages across the country.

3.2 Challenges in Indonesia's ICT

3.2.1 Introduction

As global e-commerce industry grows enormously nowadays, Indonesia has a high potential in the future ICT industry. Nevertheless, the potential is hindered by two contradictory situations in ICT industry development: regulation and productivity. These contradictory situations contribute to regulatory enforcement by the Indonesian regulators that may create an uneven playing field between the local and global platform providers (Rumata and Sastrosubroto, 2020). Meanwhile, the productivity contradiction can arise when an organisation has issued a large budget or investment for ICT implementation, but it is not followed by an increasing level of productivity. One of the reasons is regulation at international level. Currently, Indonesia is one of the biggest net importers in ICT services with a deficit of 339 million USD in 2019. The international agreements (especially ITA and WTO Ministerial meetings) mean that the local ICT producers are not able to produce IT products competitively due to ITA and WTO Ministerial meetings (Rumata and Sastrosubroto, 2019). Consequently, efforts are needed to put Indonesia's innovation activities on the right track through another approach.

Several themes are discussed in this section, including growth and size of the ICT industry, trade pattern (exports and imports of ICT), labour market factor and investment in the ICT sector. Growth and size of the ICT industry is important to estimate how big/small the industry is. Trade pattern is addressed to understand the trade balance in the country, which may show how the country can be self-sufficient with own innovativeness. Labour market factor may contribute to predicting innovativeness from the human factor, while investment in the ICT sector may estimate attractiveness of the country from an investor's perspective.

3.2.2 Growth and size of the ICT industry

The Information and Communication Technology (ICT) industry in Indonesia has started to grow only since the early 2000s. Despite the vast growth of firms, the share of the ICT sector in GDP has remained very low, i.e., 4 per cent (BPS, 2016), in particular when compared with neighbouring countries, such as Malaysia, reaching 13.1 per cent of GDP (ITA, 2019). The modest performance of the ICT industry in Indonesia is in contrast with the dynamic growth of its domestic market. With an estimated number of around 141 million middle-income consumers (roughly half of the population) in 2020 (BCG, 2012) as a considerable emerging purchasing power, Indonesia is becoming a big market for the ICT industry.

Further, based on Table 3.1 from BPS (2011-2019), the ICT sector grows quicker than the other sectors in Indonesia and even reaches double digits until 2014. After 2014, the growth slightly decreased but still remained above the GDP growth.

Table 3.1 The ICT sector and GDP growth for all sectors and share of ICT sector to GDP

Year	Percentage growth of GDP (%)	ICT (%)	Share of ICT sector to GDP (%)
2011	6.20	12.64	3.60
2012	6.03	12.28	3.61
2013	5.56	10.39	3.58
2014	5.01	10.12	3.50
2015	4.88	9.69	3.52
2016	5.02	8.87	3.68
2017	5.01	9.81	3.78
2018	5.17	7.04	3.77
2019	5.02	9.71	4.04

(Source: Biro Pusat Statistik (Statistics Indonesia), 2011-2019)

The above table shows that Indonesia's ICT sector grew stronger than the development of all other sectors from 2011-2019, even though there is a trend of declining growth from 2011-2018. The shrinking of the economy at large caused a decrease in demand for ICT services in Indonesia, but the ICT sector is still one of the leading growth sectors in Indonesia.

However, ICT firms in Indonesia serve only a small domestic demand for ICT products and services. A balanced trade deficit in ICT products is worth around 5 billion USD, whereas ICT exports only account for 6 million USD. The number of ICT exports was only 55 per cent of central government's target (BPS, 2016). This situation indicates the nationwide dependency on innovative ICT products from other countries. Many ICT firms in Indonesia use hardware and software mostly imported from abroad. However, some changes are emerging. Several 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 (Kusumawati & Suryanegara, 2016) and this could enhance domestic innovation through spillover effects.

In the remaining subsection, the discussion will focus on the size of the ICT sector in Indonesia, including indicators such as the number of ICT firms, ICT employment, and productivity. According to BPS (2016), there are 634,000 ICT firms in Indonesia, consisting of 625,800 small firms and 8,200 medium-sized and large firms. The small firms employ 1.3 million workers while medium-sized and large firms employ 300,000 workers.

The structure of the ICT industry according to the Economic Survey (BPS, 2016) and based on the number of firms is as follows: telecommunication, computer programming, consultancy, broadcasting, publishing and the distribution activities make up the large majority (98.3%); followed by other IT services/repair and maintenance (1.46%) and wholesale (0.2%); and manufacturing as the smallest segment (0.02%). This pattern indicates an overwhelming majority of service firms.

3.2.3 Trade Pattern (Exports and Imports of ICT)

This subsection discusses the trade patterns and trade balance deficit of ICT in Indonesia. Due to the small proportion of manufacturing in the ICT industry (less than 2%, BPS 1999-2018), domestic demand is mostly fulfilled from abroad. The United Nations Conference on Trade and Development (UNCTAD) reported that the value of Indonesia's import of ICT goods (including telecommunication equipment) was twice that of the export. In contrast, the value of the import of telecommunication (telco) equipment (ICT goods for telecommunication purposes only) was six or seven times higher than the exported product (Figure 3.1). During 2015-2016, the market was dominated by China's imports and by Singapore as the second importer (UN Comtrade, 2017). Figure 3.1 indicates that there was an increasing trend in the import of ICT goods and telco equipment from 2009-2012 but this slowly decreased from 2013 to 2016 because of local content regulation. The regulation requires around 30-40 per cent of local content for 4G/LTE equipment by 2017. As it stands, foreign companies that want to sell their 4G/LTE products in Indonesia must build their factory in the country or find local a manufacturer as their business partner.

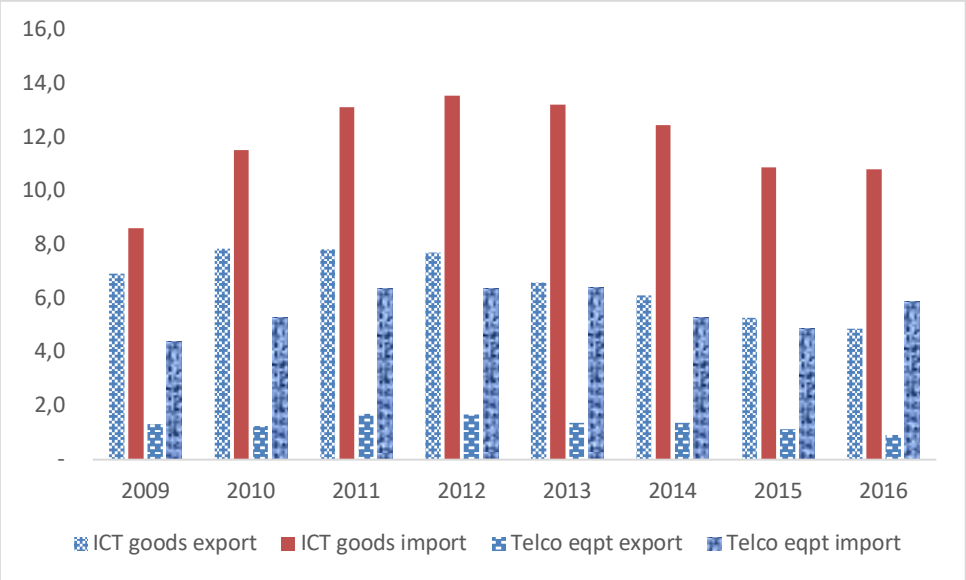


Figure 3.1 Indonesia ICT Goods and Telecommunication export & import (Source: UNCTAD, 2009-2016)

The situation indicates that the country cannot compete with foreign ICT players for various reasons, including low innovativeness. Therefore, this study will complement other innovation studies (e.g., in Indonesia by focusing on the ICT industry).

According to Frost & Sullivan (2018), Indonesia's massive ICT market attracts many reputable ICT manufacturers to sell their products in the country.

	2017	2018	2019	2020	2021	2022
Cyber Security	$321.7	$349.7	$380.0	$413.0	$448.9	$487.9
Digital Services	$1,811.5	$2,952.0	$4,237.2	$5,749.6	$7,506.0	$9,528.4
Telecoms	$22,129.6	$22,739.9	$22,850.1	$22,692.2	$22,611.2	$22,537.3

Figure 3.2 ICT Market Forecast of Indonesia, including three subsectors 2016-2022
(Source: Frost & Sullivan, 2018)

The figure (published in 2018) predicts a sharp increase in the subsectors of cyber security, digital services and telecommunications as part of the ICT industry due to high demand and development in these subsectors. Nowadays, government organisations and financial institutions are becoming more vulnerable to cyber-attacks as they produce, accumulate and exchange data for administrative purposes and online services, triggering the business of cyber security.

3.2.4 Labour Market

One of the challenges in the ICT sector in Indonesia is to decrease the shortage of skilled and semi-skilled ICT labour in the country. To date, the ICT sector has not attracted a large amount of foreign direct investment (FDI), and one reason for this may be the shortage of specialised labour and a lack of investment in digital economy skills. Kristiono (2016) foresees that Indonesia will have a shortfall of 9 million skilled and semi-skilled workers until 2030. In a similar vein, Bodrogini (2018) explains that across the ICT firms in Indonesia, both larger and smaller firms have the same complaint: ICT talent is hard to find. The latter study also reveals that only 30% of

the workers' ICT skills curriculum was useful for the company they joined, indicating a mismatch between labour supply and demand. With regard to employment, on average, small ICT firms employ 1.54 workers, while large firms employ 164.07 workers. In more detail, the World Bank Group (2018), using the reference from ICT nomenclature of OECD, reveals an important but often overlooked gap in Indonesia of complementary skills such as the soft skills of leadership and communication and familiarity with business marketing. Therefore, according to Bodrogini (2018), there should be a strategy to include additional training and internships, collaboration with local communities and tapping into the expertise of international professionals.

Concerning ICT education, the role of ICT skills in the development of the information society is significant. Therefore, integrating ICT into the development of ICT skills curricula is important (Abbiss, 2008). In contrast to this idea, Indonesia implemented the 2013 curriculum, resulting in the elimination of ICT as a mandatory school subject (Kemdikbud, 2013). Accordingly, ICT skills will be taught at the implementation level, thus integrated into other topics. The 2013 curriculum is still not equipped with supportive learning resources, such as syllabi, teaching materials, scoring system, etc. (Elmunsyah, 2014). Elmunsyah (2014) also asserts that improving ICT implementation in the curriculum is crucial in the preparation of ICT workers. In the newest curriculum (No 7/2022), however, ICT is still not on the list.

Despite the shortcoming in the curriculum, considering rapid technological changes and innovations in management practices, it appears that Indonesian students place a relatively high value on ICT jobs. Accordingly, International Labor Organization/ILO (2017) reveals that a larger proportion of Indonesian students were studying business, finance and ICT than in other countries in the ASEAN area. Among university students, ICT was studied by around 10% of university students, while among TVET (technical, vocational, ICT skills training), the share was 24%. However, among TVET students, ICT is not the most desired sector of employment (only 10.4 per cent) compared to university students (15.5 %). The implication of this situation is the shortage in the ICT workforce in Indonesia in general.

Another challenge is to increase the limited use of ICT equipment in order to support Indonesia’s learning and education (see Appendix 3). It needs to be mentioned that the share of students who can access the internet in school, namely 71.7% of all students, is measured at the national level. However, most of them are in fact students in Java and Western areas. These characteristics confirm that disparity, particularly between regions, is one of the underlying problems affecting workers' digital skills levels and their ability to improve their digital literacy (ICT skills).

In Indonesia, the ICT sector employs 998,000 workers (2019), with the sector being defined based on ISIC Rev. 4 as including broadcasting and movie activities but excluding ICT manufacturing, trade and repair (BPS, 2018). Among all workers, around 500,000 were employed as ICT professionals and in technician roles as of 2018 across all sectors. Growth has been more remarkable in other industries that use ICT than in the ICT sector itself, such as in e-commerce.

An important condition for innovativeness of ICT firms in Indonesia seems to be the educational level of ICT specialists (Table 3.2). Half of all ICT specialists in Indonesia (50.1%) hold a degree from a senior high school known as Sekolah Menengah Atas (SMA) or a secondary vocational high school known as SMK. Fifteen per cent of ICT workers have completed a level of education lower than high school. In comparison, 10 per cent have an upper vocational institution diploma and 23 per cent have a bachelor's degree from an academic institution. At present, only 2 per cent of ICT specialists hold a master's or doctorate. The study assumes that completing an ICT-specific education program provides workers with the theoretical and practical knowledge required to progress within occupations with a high level of ICT intensity. According to ILO (2022), policy dialogues and FGDs/interviews with GoI ministries/institutions found that private institutions tend to favour ‘advanced’ ICT skills. The term ‘advanced’ refers to an individual’s ability to use theoretical ICT knowledge and analytical skills to solve digital problems. The GoI has calculated the need for 9 million digital talents by 2030 or 600 thousand digital workers on average per year, which means that there is a significant shortage of advanced skilled talent in the field of ICT.

Table 3.2 Workers in ICT by educational level – Indonesia 2018

Educational level	**%**
Junior High School and below	15.4%
Senior High School or vocational school	50.1%
Diploma (upper vocational education)	9.8%
Bachelor’s degree	22.9%
Master’s and doctorate	1.9%

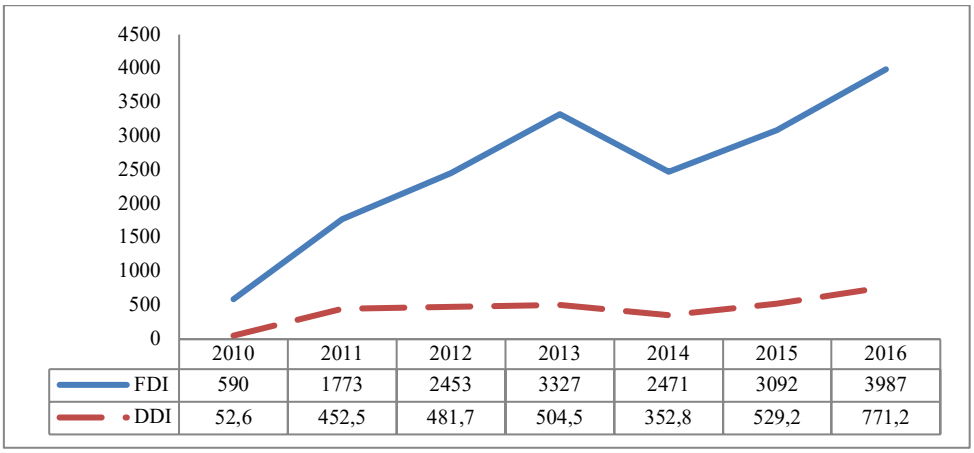
(Source: BPS, 2018)

3.2.5 Investment in the ICT sector

In general, according to various studies assessing the needs of SMEs in Indonesia, a major issue remains access to finance (from domestic or overseas). Due to the absence of transparent financial management or a lack of managerial and financial capability, many SMEs are not yet bankable (sufficiently mature to access capital investment and being able to pay back) either.

The growth of the ICT industry around the world triggered the growth of the sector in Indonesia. The situation is encouraging Indonesian enterprises to invest in various information and communications technology domains. Indonesia has received foreign investments and witnessed

several joint ventures between foreign and local companies. Badan Koordinasi Penanaman Modal (BKPM, 2017) reported the significant increases in the investment in the ICT sector in Indonesia, both in Foreign Direct Investment (FDI) and Domestic Direct Investment (DDI) from 2010 onwards. In 2014, the investment was decreased due to the political situation (General Election 2014), which caused several investors to 'wait and see' (BKPM, 2017). After 2014, the growth of investment was higher than in the previous years. In addition, Figure 3.3 indicates that FDI was always higher than DDI. Even in 2016, FDI was five times higher than DDI. This means that Foreign Direct Investment (FDI] plays an important role in Indonesia's economy, especially in the ICT industry



	2010	2011	2012	2013	2014	2015	2016
FDI	590	1773	2453	3327	2471	3092	3987
DDI	52,6	452,5	481,7	504,5	352,8	529,2	771,2

Figure 3.3 FDI and DDI in Indonesia's ICT sector (in USD million)
Source: BKPM, 2017 (Indonesia Investment Coordinating Board), 2010-2016

3.3 Entrepreneurial ecosystems (new opportunities)

3.3.1 Spatial distribution of the ICT sector

This subsection discusses the spatial distribution of the ICT industry in Indonesia, with regard to concentration and dispersed patterns, and special attention to firm size. The industry is mostly concentrated in Java (Jakarta and West Java 24.1%, East Java 17.7% and Central Java 12.7% as number of firms). The composition of the firms is as follows: small and medium-sized firms - including micro firms - account for 98% of the population. Further, most large firms are located in Jakarta and West Java (22.4% and 16.2% of all large firms, respectively), especially in South Jakarta as the centre of business in Jakarta. *(Source: own elaboration from the Economic Survey 2016 of Statistics Indonesia).*

Also, many West Java firms are located in the border-area of Jakarta (see Appendix 4) to benefit from the close proximity to Jakarta compared to the West Java capital (Bandung). The

smallest population of ICT firms is in the North Kalimantan (0.02%), in the border area of Indonesia with Malaysia. This pattern suggests very different opportunities from agglomeration advantages across the country. Interestingly, 62% of industry workers are not officially paid, indicating that many firms are family firms.

3.3.2 ICT infrastructure

ICT infrastructure in Indonesia is well developed mainly in Java. Internet penetration in Indonesia has reached 40 per cent of the population, mostly through mobile and smartphones, rather than desktops in offices and at home (McKinsey, 2016). Although the internet penetration rate is lower than in many countries in the Asia-Pacific, Indonesia was one of the countries with the highest number of internet users (due to its high population) in 2016. Around 132.7 million out of the country's total population of almost 260 million were active internet users.

For internet connectivity, the wireless connection has reached 91 per cent of villages across Indonesia but the internet connection quality is not very good. The situation explains the high demand for telecommunication mobile phone (cellular phones) and telco companies' high growth. There are also large differences in connection speed across the country. In Java, the speed can reach up to 7Mbps, but in Maluku and Papua (Eastern Indonesia), rates are regularly still under 1Mbps for each download. Indonesia's complex geography (over 17,000 islands) makes the build-up of cable infrastructure difficult and costly.

In general, satellite-based communications flourished after the liberalisation[1], and today there are many satellite communication operators. To facilitate the technology development in this field, optical communication was established as the new system of telecommunications. The government started the program with the Fibre Optic (FO) backbone development program called Nusantara 21, launched in 1997. Nusantara is Indonesia's cultural name; hence the plan is to connect the whole of Nusantara, all the main islands of Indonesia, with FO, which is then integrated with the satellite backbone.

Since the cost to develop this FO backbone was exceptionally high, the government invited private parties to build the backbone jointly. However, only Telkom (state-owned enterprise) took part in the venture. The Nusantara 21 program has undergone several changes and is currently known as the Palapa Ring Program. However, the technical program is similar: that is, to connect all main islands of Indonesia with FO (Setiawan et al., 2017). Figure 3.2 shows the Indonesian

[1] The telecommunications industry has consequently been progressively opened to private operators. In 1995, the cellular market and value-added services were opened up to private operators. In the meantime, the privatisation of state-owned companies was also launched. (Rasyid, 2005)

archipelago with FO ring coverage. Due to the vastness of the archipelago, the FO Palapa Ring Program and the domestic satellite are an absolute necessity.

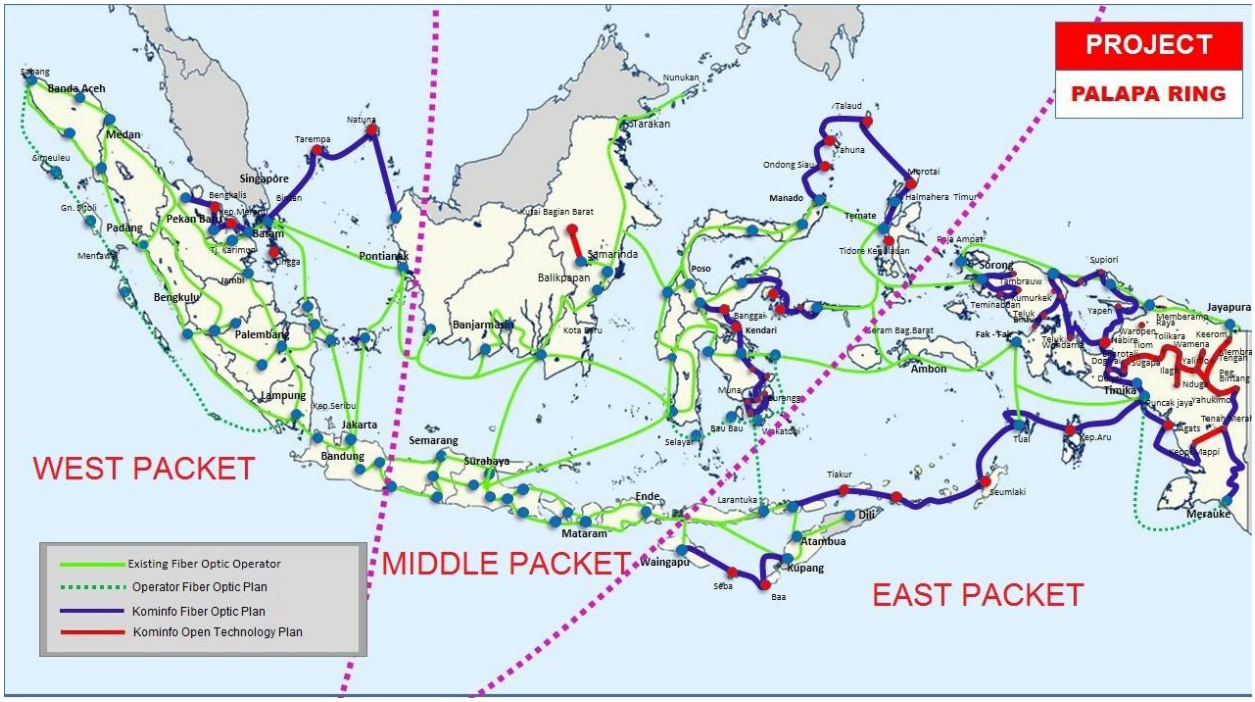


Figure 3.4 Palapa Ring Project in Indonesia
Source: Setiawan, et al. (2017)

The digital divide in Indonesia as a developing country has been addressed in many studies. The digital divide according to Steele (2019) is the gap that exists between individuals who have access to modern information and communication technology and those who lack access. For instance, the digital divide especially causes women (e.g., Wahyuningtyas & Adi, 2016) and villagers to suffer (e.g. Subiakto, 2013). The gap in internet access between rural-urban and West-East remains a primary challenge, although Indonesia stays at the top rank of social media users. MCIT (2016) compared the percentage of those with internet access in rural and urban areas as being 26.3% and 48.5%, respectively. Meanwhile, other studies discuss the ways of narrowing the digital divide (Purbo, 2017) and the impact of the digital divide in growing digital industries (Azali, 2017). Different from studies on 'hard' infrastructure, these studies emphasise the needs of Indonesia to address the digital reach beyond infrastructure issues. Education, the community, institutional structures, and governance and digital skills should be taken into account.

The digital divide between rural and urban studies rarely goes beyond media and/or infrastructure issues. Hence, this chapter offers a material cultural perspective to discuss the digital divide beyond infrastructure. This chapter focuses more on the ways people use the internet to define their culture. Besides, the interconnection between rural and urban life for bridging the

digital divide has generally been overlooked in most studies. The rural-urban linkages were initially suggested for overcoming the rural-urban divide through five types of rural-urban flows: people, production, commodities, capital and information (Douglass, 1988).

3.3.3 Institutional Policy Layer of Indonesia Entrepreneurial Ecosystem

During 2000-2016, the number of patents approved in Indonesia shows a positive trend from the aggregate ICT sector patents and particular patents. At the same time, patent applications in the ICT sector are 1/3 of all patents.

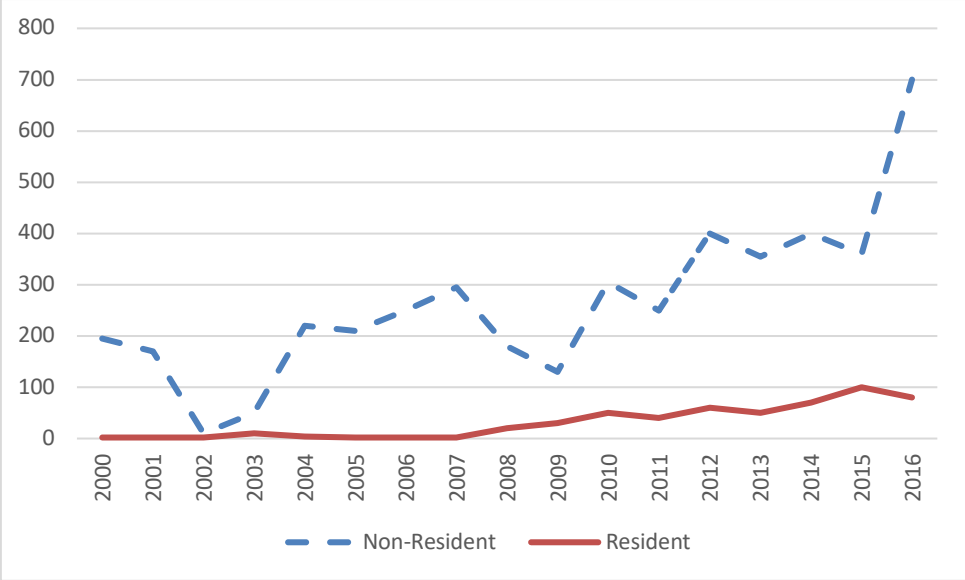


Figure 3.5 Approved ICT Patents in Indonesia
Source: Directorate General of Intellectual Property Rights (2017)

Figure 3.5 highlights the important message that non-resident patent applications has always been above resident patent applications and the gap is increasing, particularly since 2015. This again points to the low innovativeness of the ICT sector in Indonesia. However, the government attempted to improve the situation using different incentives for R&D, i.e., the enactment date of Government Regulation No. 45 Year 2019 which introduced the super deduction program on 29 July 2019. Certain R&D activities carried out by a taxpayer on or after 26 June 2019 focusing on promoted sectors may qualify for a super deduction of up to 300% of the R&D costs incurred, based on the following qualifying conditions (separately or in aggregate): a) 100% ordinary deduction for actual qualified costs incurred; b) 50% bonus deduction if patent or plant variety protection rights (PVT rights) are registered in Indonesia; c) 25% bonus deduction if patent or PVT rights are registered in both Indonesia and overseas; d) 100% bonus deduction if R&D

activities reach commercialisation stage; e) 25% bonus deduction if R&D activities involve collaboration with Indonesia's government R&D institution(s) and/or higher education institution(s) in Indonesia.

According to Indef (2020), ICT Patent and investment by non-residents have a stronger effect (increasing GDP by 0.5%) and thus need to be strongly encouraged and specifically pursued. Meanwhile, ICT Patent by residents (increasing GDP by 0.05%) need to be promoted to domestic industry as well. In particular, patent registration should be easier and faster (now still 3-5 years from first application).

Fiscal incentives are implemented in several neighbouring countries at a level that is much more beneficial than in Indonesia. For example, in Malaysia a tax holiday is imposed for five years on firms that have signed a contract implementing R&D. A tax credit is given for R&D activity costs of 50 per cent - 70 per cent is taken from statutory income in Malaysia. The current situation (in 2020) on the design of R&D incentives in Indonesia is as follows. The Ministry of Industry and the Ministry of Finance, under the supervision of the President of Indonesia, are preparing an incentive scheme in the form of a tax allowance of 300% for companies that build their research centre in Indonesia. This policy draws on experiences in Thailand, which is successfully building a research-based industry through such an incentive scheme (Kimura, 2020).

3.4 Conclusion

This chapter discusses the ICT sector's situation in Indonesia, including the development, potential, challenges and problems to be solved. The chapter answers the question of *what the problematic situation is and the influencing conditions that contribute to the lagging behind of ICT-sector innovativeness in Indonesia*. The major problem in Indonesia's ICT is the digital divide, which causes disparities in ICT education and workforce readiness. Also, the lack of ICT talent may prevent growth in innovative segments of the ICT industry, causing a high dependency on ICT products from abroad. All-in-all, the description of challenges in the ICT sector (as summarized in Table 3.3) is needed to understand the situation better and provide a way to catch up the lags with other economiesin Asia. This chapter also discusses some efforts in studying innovativeness in the ICT sector from other countries to provide benchmarking for Indonesa. The next chapter will first give an empirical analysis of influences on innovativeness at firm level, and next it provides indications of potential improvement.

Table 3.3 Challenges in ICT Sector

Challenges in ICT sector (limitations)	**Main theme**	***Potential* influence on domestic firms' innovativeness**
3.2.1 Growth and size of sector	Fast growth but low contribution to GDP	Large imports cause competition in innovation
3.2.2 Trade pattern of sector	Trade balance deficit	Large imports cause competition in innovation
3.2.3 Labour market quality and education	- Shortage of (semi)skilled labour (due to lack of investment in ICT skills) - Mismatch between ICT education and firm needs - Lack of complementary (soft) skills - Limited use of ICT equipment in education	Low level of innovativeness, and low level of management of innovativeness
3.2.4 Investment in ICT sector	- Small firm segment is facing low R&D investment. - Dominance of FDI over DDI	Low level of R&D Knowledge spillovers of FDI, increasing innovativeness (a)
Entrepreneurial ecosystems		
3.3.1 Location of ICT sector (constraints outside Java)	- Strong differences in density of firms between Java (Jakarta) and other regions (non-core) - Overrepresentation of small firms in non-core regions	- Relatively strong influence of agglomeration advantages and cluster networks in Java - Less abilities and R&D investment in non-core regions
3.3.2 ICT infrastructure (constraints outside Java) -Palapa Ring	- Mainly well-developed in Java, underdeveloped elsewhere. - Improved future access to ICT services (entire country)	- Stronger innovativeness in Java compared to non-core regions - Improved innovativeness (entire country)
3.3.3 Institutional layer (national policies)	- National policy to attract R&D (incl. FDI) - National E-commerce Road Map: integrative approach to improvement policy (b)	- Growth of R&D (and innovativeness) - Improved conditions for ICT application and domestic innovativeness

(a) No consensus in literature

(b) Including e.g., funding, focused ICT skills, infrastructure, cybersecurity, etc.

Chapter 4 Firm-Level Study of ICT Innovativeness in Indonesia

4.1 Introduction

Even though the ICT sector grows more quickly than any other sector in the last decade, Indonesia faces some problematic situations in the country. The unbalanced situation consists of, among others, the location of the ICT industry, where most of them located on Java Island (BPS, 2016). With regard to structure of the ICT sector, the growth is mainly in ICT services, while ICT manufacturing tends to shrink. At the same time 99 percent of ICT service firms are SMEs (BPS, 2018), a situation that is common in many other developing countries. With regard to the market situation, the growth of demand for ICT products cannot be fulfilled by domestic firms, and it seems that the unbalanced trade pattern (BPS, 2016) will remain the forthcoming years. In more detail, the labour market of ICT is faced with lack of ICT experts, as a consequence of the low quality of ICT education in Indonesia (BPS, 2020a). A further main challenge in ICT education in the country is the digital divide between Java and outside Java, and also between the western part and eastern part of Indonesia. While Java Island and some parts of the western of Indonesia enjoy a decent quality of ICT infrastructure, the conditions are different in the eastern region. Due to geographical conditions that make the roll-out of ICT infrastructure very expensive, most of the eastern part has poor internet connectivity, also impacting ICT education. A very similar situation can be seen in ICT investment patterns in Indonesia. The growth of investment mainly goes to Java Island (BPS, 2016), which benefits from a relatively better infrastructure and ICT infrastructure specifically. Furthermore, in contrast to the exponential growth of internet service users in Indonesia (mostly from Java -or Jakarta area to be more precise). There is a missing link between ICT use and domestic production of innovative ICT equipment and services. Indonesia is a way behind other countries in Asia in terms of ICT production (Martawardaya, Satrio Nugroho, & Heri Firdaus, 2018). A low level of patent registration compared to neighbouring countries also indicates that Indonesia struggles with innovation and innovation policy.

The above situation reflects the urgency to give special attention to Indonesia's ICT sector, involving ICT education, investment in ICT industry, and reducing the digital divide between regions. However, there is not much understanding of apparently ‘missed opportunities’ in Indonesia's ICT sector, indicating the need to pinpoint at the firm-level which conditions affect innovativeness, more specifically by investigating firm-specific managerial and educational factors and external factors, like networks’ knowledge spillovers. Against this backdrop, this chapter explores innovativeness of ICT firms in Indonesia through the following questions:

What is the level of innovativeness among ICT firms in Indonesia?
In which ways and to what extent do firms' capabilities and external knowledge spillovers influence firms' innovativeness?
In what respect is the entrepreneurial culture in Indonesia different from the ones assumed in common innovation theory and what could be the implication of such differences?"

By taking a comprehensive approach, namely, by focusing on firms' internal – capabilities related to size and R&D, as well as management-specific capabilities – and external conditions (entrepreneurial ecosystem) – knowledge spillovers in large cities, cluster networks, FDI and regulation issues firms deal with – using a sample of 260 ICT-based firms in western and eastern Indonesia, this study is new for Indonesia. Equally new is that, by elaborating on increasing and decreasing returns in learning and innovation practice, non-linear relationships of innovativeness are explored (Arthur, 1996; Beckman & Barry, 2007; Brettel et al., 2011). Our study's contribution to literature on firm innovativeness in developing countries is twofold, first, the understanding of low-level absorptive capacity conditions, which require extra efforts to increase innovativeness in the small firm's segment. This situation is connected to commonly adhered values like hierarchy, risk-avoiding, and modest ambitions and secondly, the understanding of a relatively weak but positive influence of the entrepreneurial ecosystem (urban size/cluster influence).

The remaining of the chapter is structured as follows: the next section introduces the theoretical approach, the model, and hypotheses (section 4.2), followed by methodology aspects of the empirical study including data collection and measurement using a large-scale survey (section 4.3). Next, descriptive results and results of the model exploration are presented and discussed (section 4.4), followed by in-depth qualitative insights derived from interviews with entrepreneurs and industry experts (section 4.5). The chapter concludes with the implications of the results, indicating future research and recommendation.

4.2 Theory and Hypotheses

4.2.1 Theory on innovation

In line with existing empirical studies (e.g., Fernandes, et al., 2017; Quan, 2018), the background theories of this chapter are the one on dynamic capabilities of the firm (Cohen & Levinthal, 2000; Teece, 2007; Teece and Leih, 2016; Lin and Wu, 2014; Wójcik, 2015; Alonso and Kok, 2018) and the spatial knowledge spillover theory of entrepreneurship (Acs, Audretsch, & Lehmann, 2013; Capello, 2007). Part of resource-beased view will be addressed under firm-size

and firm organization of R&D and theory of dynamic capabilities. The background theories are discussed below.

Dynamic capabilities are the result of among others education, working experience, personal and team characteristics. The theory of dynamic capabilities focuses on competitive survival and adjusting the firm to changing business situations. In responding to external changes (opportunities), like in markets and technology, dynamic capabilities – in particular knowledge absorptive capacity – enable the firm to identify, integrate, reconfigure, and renew its resources and abilities in line with these changes (Cohen and Levinthal, 2000, Zahra and George, 2002; Teece and Leih, 2016). Such alignment may change the learning processes, e.g., by attracting more employees (larger firm size), creating an R & D unit or accessing external networks, thereby increasing speed and efficiency, potentially contributing to higher innovativeness levels. In these respects, the study assumes that knowledge absorption and learning for innovation are culturally different between parts of developing economies and developed economies, such as in taking risks, anticipating, and planning, and dealing with authority (power) within firms (Hofstede & Hofstede, 2005; González-Pernía et al., 2015; Huizingh, 2017). The last may potentially cause the need for more outstanding efforts in increasing innovativeness. Also, different knowledge domains may be involved in orientation of absorptive activity, including knowledge about unmet needs (apparent in using a product/process) concerning technical ICT solutions and expertise on market challenges and marketing, and how to manage a technology company (Lane et al., 2006; Autio et al., 2013). In a situation of missing one of them, the level of innovativeness may be relatively modest and contribute to overall low efficiency.

The second background theory emphasizes the importance of knowledge as a source of entrepreneurial opportunities in regions. The theory is in line with the ICT sector's location pattern in Indonesia, which is mostly in the core region of the country on Java. The spatial concentration of economic activities creates advantages in innovation due to dynamic interaction between customers and suppliers, an advanced labour market, and synergy between local research centers and local production units (Duranton and Puga, 2004; Audretsch and Keilbach, 2007; Capello, 2007). While the knowledge spillover theory is most often applied in studies on developed countries, it is less known how the underlying learning and innovation processes work in firms, mostly SMEs, in developing countries (González-Pernía et al., 2015). Circumstances tend to be different, among others, shortages in human capital and differences in inflows and availability of knowledge, e.g., between large and small firms in clusters and between universities and firms. In addition, agglomeration benefits may be limited when crowding in large cities exceeds certain

levels (Duranton, 2012), while knowledge may also be used differently and less efficient compared to developed countries.

According to the related and more recent approach of Entrepreneurial Ecosystems, small high-tech firms act in myriads of networks and relationships, which are partially in close proximity (city/region). Well-developed ecosystems contribute to the productivity and persistence of high-growth entrepreneurship based on institutional and organizational conditions, particularly networks that enable entrepreneurial identification and commercialization of opportunities, including positive outcomes on risk-taking choices (Spigel, 2016; Acs, 2017). For example, well-developed ecosystems may provide educational opportunities and channels for financing innovative projects. According to Hermanto & Suryanto (2017), the components of such an ecosystem in Indonesia are working. Still, the activities are limited due to running the respective programs by stakeholders, like ministries and agencies, universities, communities, and activists of entrepreneurship and the financial institutions, with limited synergy. Based on cluster theory, the synergy in innovation ability of industry clusters can be improved in three ways. *First*, by the tacit knowledge spill overs facilitated by proximity of firms *within the same* industry, indicating how well knowledge travels among firms to enable innovation and growth. *Secondly*, the (complementary) knowledge sharing facilitated by proximity of firms *in different industries*, also enabling innovation and growth. And *thirdly*, the interactive learning mechanism between the firms and several other organizations (financial, consultancy, policymaking) and the behavioral changes concerned that enhance collaborative (cooperative) innovation in the cluster area.

The study uses a research framework in which the two 'sides' of our study – internal firm capabilities and external conditions with emphasis on entrepreneurial ecosystems - are included as follows (Figure 4.1). With regard to firms' knowledge capabilities, the study uses the indicators firm size and firm R&D organization and zooms in on management capabilities by using indicators of manager's ICT skills, his/her experience as a manager, and management cognitive capability. Also, the study considers level of marketing skills as a specific characteristic in absorbing new knowledge and reaching particular market segments through higher innovation levels. External conditions (entrepreneurial ecosystems) are widely addressed using three indicators: level of urbanization, the strength of networking within clusters, and foreign direct investment (FDI); the last because of potentially inserting new knowledge in firms and their production networks. With regard to broader regulation and institutional conditions, the study realizes that in Indonesia, many small and medium-sized firms do survive despite shorts in regulation and institutional conditions (Sato, 2000; BPS, 2016). However, the study accounts for firms' dealing with specific business

regulations, such as taxation and ownership rights, and how this may influence firm innovativeness. Finally, to investigate the interaction between external conditions and firm capabilities, the study also explores interaction effects.

In the next section, the model components are discussed in more detail, and hypotheses are presented. The logic in developing hypotheses is as follows. First, the study indicates the assumed sign of the relationship in sub-hypotheses drawing on a linear model. Second, suppose there are sufficient arguments for non-linear situations, e.g., relatively low absorptive capacity and needs for strong efforts in learning to increase innovativeness to pass a threshold (Aslesen & Harirchi, 2015). In that case, the study develops sub-hypotheses on a u-shape trend. However, practically, non-linear trends can only be investigated in our study if variables are measured at a continuous scale, and this is limited to firm size, manager's ICT skill, manager's experience, manager cognitive capability, and FDI share. As a third point, the study needs to mention that the study cannot exclude reversed causality, like concerning situations in which low innovativeness presses the firms to increase R & D expenditure or strengthen the cluster networks. The reversed causality is why the study formulates hypotheses in terms of positive or negative associations.

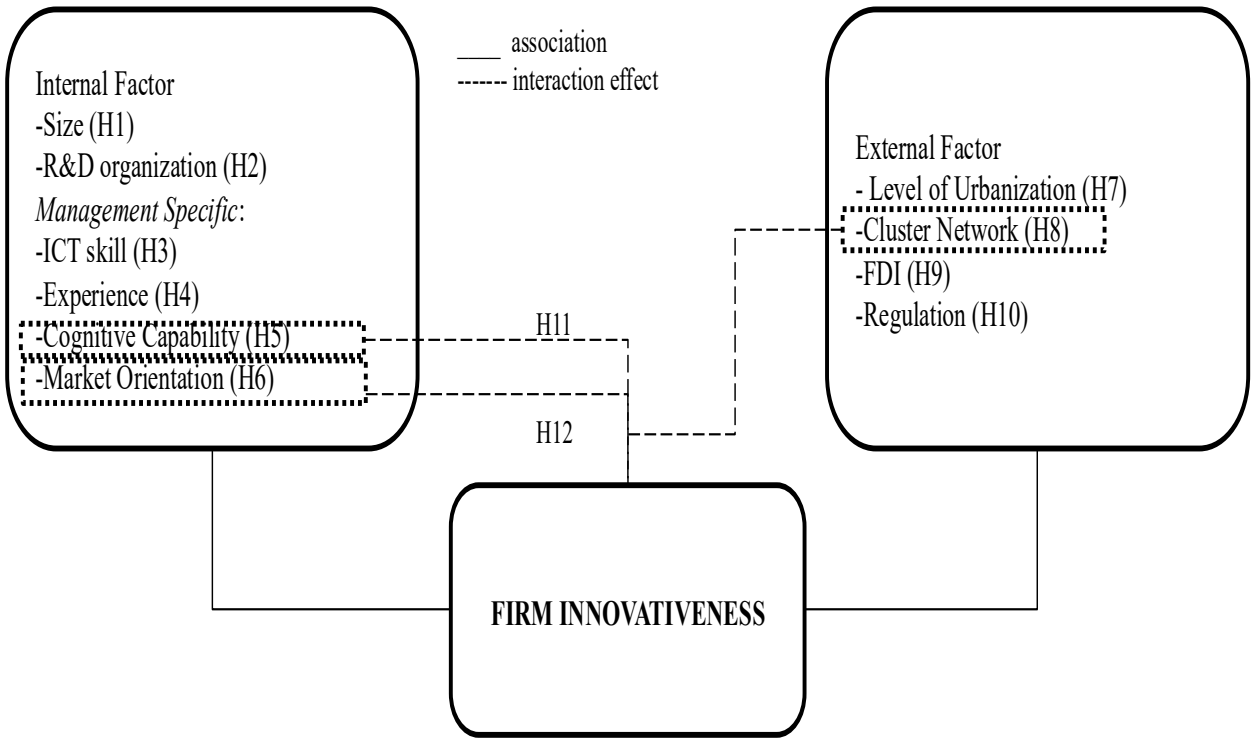


Figure 4.1 Conceptual Model of the Study

4.2.2 Hypotheses

With regard to firm size, Schumpeterian thinking (Schumpeter, 1942) suggests that the larger the firm, the more actively and efficiently innovation is carried out. A larger size could mean better access to novel knowledge and financial sources to innovate, and a stronger ability to absorb new knowledge. In addition, larger firms would be better able to bear the uncertainty surrounding innovation and realize the rewards from innovation (Prajogo, 2016; Biemans, 2018). In contrast, Shefer and Frenkel (2005) observe relatively large numbers of small firms engaged in innovative activity, particularly in the high-tech industry. In a similar vein, Qian and Li (2003) emphasize that small firms are better innovators due to their flexibility Additionally, Tsai (2005), investigating Taiwan ICT industry, observes non-linearity, approximately as a u-shape relationships between firm size and innovative output, indicating that both large and small firms have a higher competitive advantage than medium-sized firms. Furthermore, some studies (e.g., Acs, Audretsch and Feldman, 1994; Audretsch and Vivarelli, 1996) found that knowledge spillovers appear to be more critical for small-firm innovations than for large-firm innovations. In summary, this field's debate remains open, but there is a possibility of a u-shape relationship. The study recognizes that while all u-shaped relationships are quadratic, not all quadratic relationships are u-shaped. Accordingly, the study hypothesizes as follows:

H1.1: *Firm size is positively associated with innovativeness (linear)*

H1.2: *Firm size is positively associated with innovativeness (quadratic)*

With regard to the organization of R&D, an inevitable professionalization in management of R&D and diversity in new knowledge and learning processes (e.g., including complementary knowledge) derived from collaboration tend to be essential points (Huizingh, 2017). Professionalization increases by establishing an R&D department (unit) that applies management/planning in dealing with uncertainty and uses ‘formalized’ positions and responsibility of researchers/developers, while the diversity of knowledge may increase through collaboration with other firms, at the same time sharing impacts from uncertainty (Belderbos et al., 2017; Lucena and Roper (2016) observe that firm collaboration enhances learning experience effects and information exchange, particularly knowledge recombination. Given limited internal resources and capabilities, small firms in developing countries often rely on external knowledge through collaboration. Still, many of them cannot build and manage such collaboration and tend to remain low innovative. The previously mentioned studies are in line with Cohen and Levinthal (2000), who acknowledge that R&D plays a vital role in learning. Aside from the development of

domain knowledge and application knowledge, it increases a firm's absorptive capacity and ability to assimilate knowledge from the environment. The study uses the type of R&D organization as an indicator of the professional level of R&D and phrase:

H2: *A higher level of firms R&D organization is positively associated with innovativeness*

The study now move attention to the management indicators as part of firm internal conditions in our framework. With regard to managers' skills level, given the need for absorbing knowledge spillovers and other types of learning, there is a consensus that relatively high skills (ICT for ICT industry) are a precondition for innovation. Differences in education, skill level, and experience between firms may lead to differences in perceiving opportunities and risks of innovation and inefficiency in innovation activities (Helfat and Peteraf, 2015; Van Leeuwen & Földvári, 2016). For instance, there is a relationship between higher skills (particular academic qualification) and innovation: highly skilled managers tend to be more ambitious and creative compared to other ones and tend to act more often as 'leaders' better able to plan on the long term and manage uncertain innovation processes (e.g., Swann, 2018). While this applies in general to new technology fields, it may also apply to the existing ICT industry and proved ICT skills. In addition, also in this respect, a 'lock-in' situation may exist due to overconfidence and lack of openness (Beckman & Barry, 2007; Dencker et al., 2009) cause the possibility of a quadratic relationship. Accordingly, the study hypothesizes as follows:

H3.1: *Manager's ICT skill level is positively associated with innovativeness (linear)*

H3.2: *Manager's ICT skill level is positively associated with innovativeness (quadratic*).

Arguments concerning the role of managers' experience tend to be ambiguous in literature. Some studies have emphasized the importance of manager's experience for innovation, increasing their knowledge absorptive capacity. For instance, Mascitelli (2000) observes a positive role of learning-by-doing and knowledge accumulated through lifetime experience. In contrast, Romijn and Albaladejo (2002) find evidence on managers' long working experience that pushes small firms to be more innovative than others. In a similar vein, Martínez-Ros and Labeaga (2002) forward that the effect of managerial experience becomes even shorter after a certain period of engaging in innovation. After a positive development of innovation, accumulated years of experience lead to a 'lock-in' situation based on increased self-confidence and lack of openness among managers (Beckman et al., 2007; Dencker et al., 2009). Unlike other knowledge absorptive capacity situations discussed in this chapter, such processes may cause a decline of efficiency, indicated by emerging decreasing returns, approximating an inverted quadratic relation. Accordingly, the study phrases the following:

H4.1: *Years of managers experience is positively associated with innovativeness (linear)*
H4.2: *Years of managers experience is negatively associated with innovativeness (inverted quadratic)*

With regard to management, in a recent study, Ruiz-Jiménez & del Mar Fuentes-Fuentes (2016) confirm that management capabilities affect both product and process innovation positively. In this context, Helfat and Peteraf (2015) emphasize mental activities, what they name 'managerial cognitive capability.' Accordingly, cognitive capability affects the sensing of meaningful opportunities and how to respond to them in innovation processes in many ways, where to get the best knowledge (advice) and most favourable investment capital and spend it efficiently, thereby avoiding or mitigating uncertainty. Following this line, the study may expect that the higher the managerial cognitive capability, the higher innovativeness will be, in a linear model. However, prior (subjective) beliefs or cultural influences may distort perceptions, mainly when information and learning are ambiguous (Powell et al., 2006; Huizingh, 2017), causing the need for relatively strong building knowledge absorption efforts learning. Therefore, only after a certain level or threshold, the cognitive capability will turn to influence innovativeness positively, and such a situation makes us phrase:
H5.1: *Manager's cognitive capability is positively associated with innovativeness (linear)*
H5.2: *Manager's cognitive capability is positively associated with innovativeness (quadratic).*

Furthermore, a set of studies highlight the need for firms to build a stable level of marketing skills and thinking ahead in increasing the level of innovativeness (Atuahene-Gima, 1996; Hurley and Hult, 1998; (Slater, Mohr, & Sengupta, 2010). Level of marketing skills has been shown to enhance firm performance in a variety of organizational and industrial contexts. If the level of marketing skills is combined with dynamic capabilities (Zahra et al., 2006) to connect with other firms and customers (e.g., in marketing), innovation may be more successful and performance enhanced (Lukas and Ferrell, 2000; Luca and Atuahene-Gima, 2007). According to this reasoning, the study assumes that the stronger a firm is oriented to the market, dealing with meaningful market segments, value propositions, and marketing/promotion techniques (Mohr, Sengupta and Slater, 2014) innovativeness will be higher, and phrase as follows.
H6. *A stronger level of marketing skills is positively associated with innovativeness*.

In the remaining section, entrepreneurial ecosystems (EES) are addressed by moving attention to knowledge spillovers' specific external circumstances (Acs et al., 2013). The study

focusses on general levels of urbanization, specifically on actual network interaction of firms in clusters and in relationships with multinational firms, through FDI. With regard to urbanization, e.g., Duranton and Puga (2004), Christensen and Drejer (2005), and McCann (2008) argue that proximity in large urban locations provides abundant opportunities for tacit knowledge circulation and informal business meetings, which are conducive for entrepreneurial ecosystems (Stam, 2015). In addition, large cities are endowed with high-quality facilities and services, providing better access to diversified and specialized knowledge than elsewhere. Favourable knowledge spill-over conditions are missing in small towns at a distance of the economic core; also, such towns are faced with a relatively small local consumer market. In this vein, Amara and Landry (2005), Shefer and Frenkel (2005), and Iammarino and McCann (2015) argue that a positive innovation 'milieu' is most likely found in a more densely populated area, enabling high-tech firms to be significantly more innovative than firms in peripheral regions. Research in Indonesia confirms these general understandings (Van der Eng, 2004; Farole, 2013; Tan and Amri, 2013; Van Leeuwen and Földvári, 2016), despite an emerging danger of overcrowding in large cities (Duranton, 2012). Accordingly, our next hypothesis is formulated as follows:

H7: *Level of urbanization is positively associated with firm innovativeness.*

In cluster theory (Porter, 2000), an emphasis is put on benefits for firms from the competition with similar firms and close relations with specialized suppliers and customers, including local research institutes (universities), all increasing access to knowledge and new knowledge creation. Eisingerich and Bell (2010) stress potential access to resources in clusters that would otherwise be beyond a single firm's scope. In a similar vein, Bell (2005) argues that repeated local interactions enable firms to assess their partners' resources better, making complementarities more visible and helping firms to organize transactions in more efficient (low cost) ways. More specifically, social and trust-based relationships among firms in a cluster may enhance collective learning, thereby facilitating more specific knowledge spillovers with customers and potentially increasing knowledge absorptive capacity and innovation (Audretsch and Feldman, 2004; Bell, 2005; Doh and Acs, 2010; Dakhli and De Clercq, 2004). Overall, networks within clusters provide institutional support (e.g., skill development, funding) for entrepreneurial activities (Isenberg, 2016).

In contrast to such benefits, problematic situations have also been forwarded and confirmed in the literature, for example, quite early by Grabher (1993) and later by Bathelt et al. (2004). Such problematic situations may emerge in clusters when the relationships between partners (have) become tight. Tight trust-based relationships may 'blind' partners through social processes that

cause overreliance and repeated confirmation of a common world view that precludes creativity and competing opinions on innovation opportunities (Morgan, 1986; Czernek & Mitręga, 2016) Such a situation would call for developing other global networks. Doubt on positive impacts of tight intra-cluster networks has been cast more recently in Indonesia, connected to firms' overreliance on redundant cluster information (e.g., Gunawan et al., 2016). However, while this may occur in older and traditional clusters, the study expects that in the relatively young ICT clusters in Indonesia, knowledge circulation is not yet affected by negative (lock-in) influences and that relatively strong networks enhance ICT innovation. This idea is in line with Aslesen and Harirchi (2015).

H8: *Strong intra-cluster networks are positively associated with innovativeness.*

Foreign direct investment (FDI) refers to investments made to acquire a lasting or long-term interest in enterprises operating outside the borders of the economy of the investor (IMF, 2004). FDI may bring knowledge spillovers in the country of investment. For example, when local firms imitate imported technologies and adopt new management practices, or foreign firms start developing supplier relationships in the local economy (González-Pernía et al., 2015). However, there is no consensus in the literature about FDI and the innovativeness of domestic firms. For example, Fromhold-Eisebith and Eisebith (2002) argue that, since technology-driven multinationals usually exploit cheap and low-skilled labour in developing countries for export production, FDI does not enhance domestic absorptive capacity and innovation. In contrast, Tambunan (2007) observes that FDI is important as a knowledge transfer source to firms in Indonesia. FDI may help to upgrade firms' capabilities and learning opportunities and improve their innovation performance.

Similarly, Zhang et al. (2010) stress the importance of knowledge transfer through FDI in acting as a significant source of entrepreneurial opportunities and absorptive capacity. However, the emergence of such positive impacts may take quite some time in situations of relatively flat learning curves, causing the need for strong efforts in the upgrading of firm capabilities (including management practices). Accordingly, the amount of FDI may start to be effective only after a certain FDI threshold has been passed, indicating a u-shape pattern. The possibility of a quadratic relation makes us phrase two hypotheses:

H9.1: *FDI share is positively associated with innovativeness (linear)*

H9.2: *FDI share is positively associated with innovativeness (quadratic)*

Next, the study mentions business regulation as a set of critical external conditions affecting innovation practices. However, there is no consistent picture of influence on innovativeness in the literature (e.g., Baldwin et al., 2012; Blind, 2012). Fromhold-Eisebith and Eisebith (2002) and Tambunan (2007) highlight a general influence of regulation on firm innovativeness. Particularly, SMEs face some common problems, such as cumbersome and costly bureaucratic procedures, like obtaining licenses to operate and regulatory changes that generate market distortions, for instance, related to monopoly (Mitchell, 2016). Further, high taxation of important ICT equipment bought abroad may make domestic firms reluctant to innovate. Inline, Isenberg (2016) states that in general, at least three issues are key in entrepreneurial ecosystems, namely the ease of doing business, promoting "business-friendly" legislation and policies, and taxation policy, particularly for small and medium enterprises (SMEs). Van der Eng (2004) also mentions differences in local business regulation in Indonesia, such as taxation practice and registration of Intellectual Property, a situation complying with what the World Bank indicates as different performance of local branches of national agencies country (World Bank, 2015). In such circumstances, some firms tend to adapt themselves by accessing the specific information needed on regulation changes, thereby balancing advantages and disadvantages.

In contrast, other firms are affected by constraints in innovation efforts. The study may assume that a firm's ability to access the right information on regulation also enhances its spirit and motivation to be more innovative. Accordingly, the study phrases:

H10: *Better (perceived) quality of regulation is positively associated with innovativeness*

Finally, the study explores two interaction effects between management factors and the external environment. The more recent approach of the entrepreneurial ecosystem (EES) justifies such exploration (Spigel, 2016; Acs et al., 2017). While incorporating older ideas on the nursery cities (Duranton and Puga, 2004) and previously mentioned agglomeration economies and clusters, the EES approach emphasizes the quality of institutional and organizational conditions. In particular, on a wide variety of networks interacting and supporting entrepreneurial identification of opportunities and their commercialization, including dealing with risks (Feld, 2012; Vedula and Kim, 2019). In practice, it may also refer to places or programs for nurturing and early growth of newly established firms, including attraction of investment capital, and places for experimentation with inventions and design of novel solutions, eventually with users. Accordingly, the study assumes that the influence of the overall capability indicator (managerial cognitive capability) and, specifically, level of marketing skills interacts positively with intra-cluster networks' strength. Accordingly, the study formulates:

H.11. *Interaction between manager's cognitive capability and intra-cluster network strength is positively related with innovativeness.*
H.12. *Interaction between level of marketing skills and intra-cluster network strength is positively related with innovativeness.*

4.3 Data Collection and Measurement

4.3.1 Data Collection

The study conducted an email survey in Indonesia in the period December 2016 until November 2017, by distributing a questionnaire to around 2,000 ICT-based firms covering all sizes, 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. An email survey was selected for the following reasons. Email surveys are cost-effective in the sense of low cost-level and large absolute numbers of returned responses, different e.g., from telephone inquiry. Also, it provides standard answers and ease of first analysis for the researcher. In more detail about benefits, on the side of respondents, advantages are ease of responding and convenience of responding at available time, which may increase response rates. However, there may still be considerable non-response, namely due to respondents' remaining aversion against transfering firm data to written sources given fear for taxes, or due to remaining feeling of being ashamed to be involved in low firm performance or failure. The concomitant non-response bias may have affected representativeness of the survey (particular cities, regions; specific firm size segments). Accordingly, several bias needs to be checked and repaired, which applies to the current study (see Appendix 1). In any case, influence of selective non-response has been mitigated by using post-stratification.

Discussion of contruct validity, like concerning firm's innovativeness and managerial capability, along with the discussion on internal and external validity issues, is enclosed in Appendix 1. To ensure both validity and reliability of a survey instrument, it is important to consider potential social influence on the constructs being measured. This implied for the current study conducting pilot testing to ensure that the questions are clear and relevant to the target population (involvement of 10 (ten) representative people (ICT experts and firms). It is important to note that construct validity is not a one-time assessment, it is an ongoing process that requires continual refinement and improvement as more evidence is gathered. Expert input and theoretical considerations play a crucial role in establishing and refining construct validity, and ultimately in improving understanding.

The target respondents were the middle-or upper-level managers of large firms and the top managers of small/medium-sized firms. This selection was made because of good understanding of the innovativeness of the firm among these managers. The response rate was around 13.6 percent. To establish representativeness of the sample, as much as possible, the study used firms from the Economic Census 2016 of the Indonesian Central Bureau of Statistics (*Badan Pusat Statistik/BPS*) as the population to be surveyed. This means that with regard to small firms, merely registered ones have been included. Importantly, the cities of Bandung and Surabaya are underrepresented, while the others are overrepresented. In addition, small firms are under-represented with regard to firm size, while large ones are overrepresented. To compensate for this situation, as indicated previously, the study used post-stratification methods (Johnson, 2008; Biemer and Christ, 2008) (Appendix 6).

Further, a non-response bias test has been performed using the independent sample t-test, in order to see the respondents' differences between who return the questionnaire on time with respondents and who were late returning the questionnaire. Suppose Levene's test shows a significance level above 0.05, it can be concluded that there is no significant difference between the mean scores between two groups of respondents, or the groups come from the same population. In this test, the study uses parameter Newness of Innovation and Firm Size (see Appendix 10). To further test the dataset (Appendix 10), the focus has been on internal consistency and as a result found sufficient reliability. The study deleted 12 outliers due to inconsistency and extreme values (e.g., huge companies with more than 5,000 employees), all-in-all resulting in 260 valid cases.

Next, the study checked whether our database satisfies the statistical assumptions for multiple regression analysis, like model specification error, homoscedasticity of residuals and multicollinearity. After removing the variables firm age and network openness (multicollinearity issues), the variance inflation factor (VIF) of the remaining model variables is close to 4.0. In sum, it turned out that no parameter violated the statistical assumptions (see Appendix 7). For correlation test see Appendix 9.

In the second part of the empirical study, in-depth qualitative data have been collected through a set of personal interviews, following analysis of the quantitative results. The purpose of the interviews was to obtain additional information and insights into obstacles and challenges faced by firms in efforts of increasing innovativeness, especially related to entrepreneurial culture. In the sampling strategy, interviewees have been selected with special attention to representativeness for specific firm size and regional location, thereby also avoiding interviewees that were ‘pushing’ their (personal) opinions and may cause bias. Triangulation method was also used to cross-check data from multiple sources to ensure its validity. To triangulate interview data,

the responses from different interviewees were compared to identify common themes or discrepancies. Additionally, the interview data was compared with information from other sources, such as observations or documents, to gain a more comprehensive understanding of the topic. Accordingly, the study conducted six interviews, of which four with managers of ICT firms, small and larger ones, and two industry experts from university and government. The four interviewed managers 'represent' Jakarta and Bandung and, outside Java, Palembang. Using a semi-structured questionnaire, the interviews have been aligned in content with the findings of the quantitative analysis in the first part of the study but were different for firms compared to experts. The interviews took 45 to 60 minutes, and the results have been analysed using NVivo, qualitative data analysis software. The benefits of using Nvivo. The advantages of the tool, among others, are that it reduces researcher bias by allowing for a systematic and transparent analysis process and has a range of tools for analyzing qualitative data, including visualizations and reports, which can help identify themes and trends in the data. However, some researchers have criticized Nvivo for being too rigid and not allowing for the flexibility needed in qualitative data analysis (Hoever and Koeber, 2009).

A final remark about *robustness check,* e.g., of innovativeness: the two indicators used in the study tend to be different, and cover divergent aspects of innovativeness, as stated above. Given the richness of results and the qualitative data collected in the next stage, it was decided not to check for each of the two innovativeness indictors' robustness.

4.3.2 Measurement and descriptive results

The study used two indicators to measure firm innovativeness: **1)** R&D intensity as the amount of R&D investment as a (process) characteristic on the input side, and 2) Newness of Innovations as a characteristic on the output side of innovation (Table 4.2 and Table 4.3). Based on Baumann and Kritikos (2016), a consistent finding across studies is that the likelihood of actually being an innovator is positively associated with R&D intensity. However, the magnitude of the effect of R&D on innovation differs. In the current study, R&D intensity appears, on average, almost 20 percent of sales, but there is quite some variation. One third (33 percent) is at the lowest level (spending less than 10 percent of sales), and a slightly higher share (38 percent) is at the next level of 10-25 percent of sales. Following Cooper & Merrill (1997) and the European Commission (CEC, 1995), the study took a limited period of two years in measuring number of innovations. A minority, 20 percent of the firms in our sample, are on the lowest level, while most (55 percent) have undertaken between 2 and 5 innovations in the last two years. In the survey

document, important examples of different types of innovation were mentioned in such a way that all respondents had the same understanding of the activities called innovations.

Further, to picture relevant details of output of innovation processes, the study follows Garcia and Calantone (2002) using the degree of Newness of Innovations as a proxy, given the lack of statistical data (such as patents) in the developing world. It is realized that some over-estimation (*self-evaluation bias*) could have happened among small firms, particularly by mentioning a somewhat higher number of innovations. While it is difficult to correct this, the study attached importance to the level of newness (ranging from new for the firm only to new for the world), thereby introducing a realistic evaluation context of the number of innovations. Accordingly, the study multiplied each innovation by newness. Newness was measured in terms of 'new to who?' (Johannessen et al., 2001), divided into four levels: (1) new to the firm, (2) new to the region, (3) new to Indonesia, and (4) new to the world. For instance, a new application in transport to ordering motorbike taxi (namely Gojek or Grab) is new to Indonesia, however, it is not new to the world. A change in firm procurement from paper to paperless, using a specific App, is new to the firm, but not new to the region, etc. Next, after some experimentation and sensitivity analysis, the study selected the weights to be assigned to the four levels as follows: 1, 2, 4, and 16, respectively. Accordingly, the study assumed great efforts and extreme importance for innovation, which is new to the world. Using this way of ranking innovations, after sensitivity analysis, it appears that 38 percent of the sample is engaged at a very low level of newness, 34 percent at a low level, and 27 percent at higher levels of newness. It is also important to mention that most large firms (65%) deal with hardware besides software/services. Meanwhile small and medium-sized firms are mainly dealing with software/services. Remarkably, while comparing the two above dependent variables, it appears that at the country level, no significant correlation can be observed (Appendix 9). Thus overall, investing in R&D tends to be different from producing innovations at certain level of innovativeness.

The study now discusses the independent variables. Firm size, small and medium-sized firms - between 1 and 100 employees - are the large majority (75 percent) in our sample. Large enterprises are present at a share of 25 percent. Note that the larger firms typically operate with a substantial number of employees in labour-intensive work, causing the average of firm size to be relatively high. Next, the firm's organization of R&D consists of three categories: high level of R&D organization, without such level organization, and without R&D. The different classes are as follows: 39 percent is at a professional level of R&D organization often with an R&D unit; almost half of the firms (49 percent) are without any such organization while still employing R&D,

and about 10 percent is without R&D. This would mean that about 60 percent deals with a relatively poor situation of planning and management of innovation.

With regard to indicators of management potentials, the study first discusses ICT skills. The manager's ICT skills pattern is dominated by a medium (44 percent) and low level (40 percent). Due to absence of standard skill levels in ICT education, the study was forced to develop an own education level indicator. Accordingly, manager's ICT skill level is a composed variable derived from regional data on ICT skills (BPS, 2018b) and individual manager's level of education (Appendix 8); the last mainly consisting of bachelor (48 percent) and Master/higher degree holders (42 percent). Further, the managers' average years of experience are less than ten years, following the relatively recent ICT sector growth in Indonesia. However, there is some differentiation, as evidenced by the categories' short experience (35 percent), medium experience (35 per cent), and very long experience (30 percent). The next variable, managers' cognitive capability (CC), is a compound variable (see Appendix 8). It reflects broader learning capabilities by including a diversity of sources, namely a specific firm's expertise, the building of collaboration outside the cluster, and dealing with institutional arrangements. A (very) low level is found among 40 percent of the sample, while the remaining 60 percent is active on a medium level.

Further, marketing skills is seen as partially connected to innovation spending (customization for particular market segments), focused on cluster relationships and openness in such relationships, eventually enabling co-development customers. Twenty-five percent of the firms have adopted a weak market-orientation and 66 percent a medium market-orientation, while only nine percent are relatively strongly oriented to the market. Though level of marketing skills was not directly measured, the scores could mean that thinking about market segmentation, value proposition, open relations, and co-development with customers, etc. is not yet well developed, particularly among smaller firms (Mohr et al., 2014).

The next set of indicators refers to the firms' external conditions and is focussed on knowledge spillovers. Data on urbanization were partially derived from the Asia Competitiveness Institute (ACI) Competitiveness Framework (Tan & Amri, 2013). This framework considers, among others, microeconomic, government and institutional setting, quality of life and infrastructure development, and, most importantly, population size in the area. Regarding the level of urbanization, 50 percent of the firms are at the highest level, 39 percent at the lower level, and 11 percent at the lowest level. Next, with regard to knowledge spillovers in clusters, a relatively strong network within the cluster is faced by a good 40 percent of the firms.

Further, the pattern of FDI, seen as a source of knowledge spillovers in this study, indicates average foreign ownership of firm shares of almost 10 percent. In comparison, nearly 70 percent

is very low, with less than 5 percent or absence of FDI. Such a large percentage of firms suggests a low potential of knowledge spillovers through the channel of FDI. Only 12 percent of firms deal with an FDI share of more than 25 percent, and these are typically larger firms. And finally, to measure whether the firms deal with regulation in a positive (favourable) way, the study divided them into two categories: positively and otherwise. Almost 50 percent of firms tend to deal with regulation in a positive manner.

Table 4.1 Measurement and Descriptive Statistics

Variables	*Measurement scale (for binary variables including measurement results)*	*Avg*	*SD*	*Min-Max*
Dependent				
Firm R&D intensity	Continuous, as firm expenditure in % of sales	19.58	21.79	0-90
Newness of Innovations	Continuous, derived from weighing procedure using spatial reach of newness	8.62	13.34	0-52
Independent				
Firm Internal (broad)				
Firm size (2017)	Continuous, as number of full-time employees	130.15	708.3	1-4500
Firm R&D organization	Binary: High level R&D: 39%; Otherwise: 61%	-	-	-
Specific: Management Potentials				
Manager's ICT-skills	Continuous, based on regional ICT skill level and managers' education level (b)	0.97	0.48	0.28-2.34
Manager's Experience	Continuous, as years of employment in business	8.41	6.47	1-31
Managerial CC	Continuous, as overall level of capabilities (compound variable) (b)	6.13	1.30	2.33-8.66
Marketing skills	Binary: Medium-Strong Marketing Skills 42%; Otherwise: 58%	-	-	-
External (EES)				
Urbanization	Binary: High Urbanization level: 50%; Otherwise: 50%	-	-	-
Cluster Network Strength	Binary: strong intra-cluster network, compared with extra-cluster network (43%); Otherwise (57%) (b)	-	-	-
FDI-share in ownership	Continuous, as share of investment in firm ownership	9.77	22.92	0-100
Regulation	Binary: dealing positively with regulation (48%); Otherwise (52%)	-	-	-

(a) Continuous variables: prior to transformation; (b) See Appendix 8.

4.4 Model Exploration

4.4.1 Introduction

Given the use of two indicators of innovativeness in our study (R&D Intensity and Newness of Innovations), the study presents two model estimation results. Table 4.2 shows the outcomes for R&D Intensity, while Table 4.3 shows these for Newness of Innovations. The study used OLS in both cases, for estimating the unknown parameters in a linear regression model. The

goal is minimizing the differences between the collected observations in some arbitrary dataset and the responses predicted by the linear approximation of the data. Further, Model 1 is a partial model concerning broad firm internal indicators related to firm size and R&D organization. Model 2 includes a specific partial model of management indicators. Model 3 is a partial model involving firm external indicators mainly related to knowledge spillovers, while Model 4 is a full model showing the results, including (a) merely linear relations and (b) linear and non-linear relations, and (c) linear and non-linear relations in *interaction effect*. The study first discusses the strength of the partial models and full models and then move to individual indicators.

4.4.2 Outcomes of Model Exploration

Comparing the partial models on R&D Intensity and on Newness of Innovation (Table 4.2 and Table 4.3), the study finds a trend of relatively strong significance of the set of management indicators, only for R&D Intensity, as evidenced by R^2 of 0.49 and 0.25 in a linear model and 0.50 and 0.19 in hybrid (non-linear & linear) model, respectively. The partial external models (Model 3) tend to be weaker, as evidenced by R^2 levels of 0.27 and 0.15, respectively (linear) and 0.25 and 0.12 (hybrid), respectively. Further, interaction effects are significant but contribute (very) weakly to explained variation. Overall, the estimation results of the full models (Model 4) are more robust for R&D Intensity than for Newness of Innovation (R^2 0.54 and 0.39, respectively of the linear model). This result points to a basic difference between the two indicators (also indicated by lack of significant correlation, see, Appendix 9). This situation may be explained by a shortage of knowledge among managers on transforming innovative ideas and R&D investment into actual innovations and to deal effectively with the impact of manifold influences on actual innovation (Edquist, 2010; Huizingh, 2017; OECD, 2018a, 2018b).

By focusing on individual indicators, the study observes for firm size a non-linear relationship in the two innovation models, suggesting increasing returns of capabilities on innovativeness. With regard to R&D organization, a significant relationship - remarkably somewhat stronger in the R&D intensity model - suggests that a more professionalized R&D, through an own unit and/or external collaboration, tends to matter. About management characteristics, the relationship with ICT skills is significant for both R&D Intensity and Newness of Innovations, be it weaker in the last model. The study also observes a non-linear trend of increasing returns. The subject matter of key ICT skills - like mathematics, communication science, electro-technical engineering, design of software, big data, ICT management, and marketing – is essential in the innovation process, be-it relatively stronger after passing slightly higher skills level.

Further, the relationship with managers' years of experience is significant in models on R&D intensity, but much less for models on Newness of Innovation. Indeed, like what the study assumed, a negative non-linear influence is visible, suggesting decreasing returns. The decreasing return conforms to Martínez-Ros and Labeaga (2002) and Beckman et al. (2007), who assert that the positive influence of longer experience gets weaker after some point, probably because of 'lock-in' situations, causing less efficiency. For next indicator, managerial cognitive capability (MCC), representing broader learning, shows a significant relationship in partial and full models, except for the full model for Newness of Innovation. Simultaneously, a non-linear relation is suggested for the R&D intensity indicator (increasing returns). Apparently, a positive influence of cognitive capability is faced with a certain threshold, after which there is a substantial increase in benefits in innovation activity. And finally, the stronger the market-orientation, including knowledge on market-segmentation and marketing techniques, the higher the innovativeness, as expected. Remarkably, in the R&D Intensity model, level of marketing skills shows a relatively large beta-coefficient (around 0.40). The relatively large beta-coefficient would mean each unit increase (1-3) in level of marketing skills, R&D intensity (ranging from 1 to 100%) increases by 0.40 units, everything else being equal, which tends to be substantial.

With regard to external conditions, indicating knowledge spillovers, the partial and full models give results that are assumed, including positive relationships with level of urbanization and cluster network strength. However, this only holds true for R&D Intensity, not for Newness of Innovation. Apparently, knowledge spillovers are influential in developing strategies and plans on innovation but tend to be weaker in influencing innovation efforts' actual results. As far as R&D Intensity is concerned, apparently, many ICT firms enjoy favorable urban conditions providing particular knowledge inputs, which remain behind in sites outside the large metropolitan area, particularly outside Java. The results on the strength of intra-cluster networks also suggest a positive influence of knowledge spillovers on learning and innovation practice. However, this is much less so in the Newness of Innovation model (not significant, except for one partial model). The last result only partially conforms to literature emphasizing positive impacts from knowledge circulation and spillovers within large cities and clusters (or regions), namely for R&D intensity. However, it contrasts with ideas about relatively poor and redundant knowledge circulation in intra-cluster networks (Bathelt et al., 2004; Gunawan et al., 2016). However, a negative influence on actual innovativeness is also not visible in our results, keeping this discussion partially unsolved. Maybe the difference originates from our specific measuring of internal network strength, including four different network partners, which already refers to some richness in knowledge. Still, the reason could also be that the networks in ICT are younger than those in a

traditional sector, and not (yet) subject to 'wearing down' and redundancy (Gunawan et al., 2016). By contrast, the picture concerning the relationship between FDI, and innovativeness is clear. As assumed, there is a positive and non-linear (increasing returns) trend in the relationship with R&D Intensity and with Newness of Innovation, in partial and full models. Finally, with regard to regulation, a positive dealing with regulation tends to go along with higher levels of innovativeness; however, in full models only for Newness of Innovation. Broadly, the pattern suggests that ease in dealing with regulation and being able to access appropriate knowledge, e.g., concerning property rights and taxes on ICT imports, may enhance innovativeness.

Regarding the comparison of influence between management model and external model, both indicators (R&D intensity and Newness of Innovation) show that the management model always tends to be stronger than the external model, hence emphasizing the need of improvement in managerial capability. With regard to interaction effects, the results suggest that the entrepreneurial ecosystem (cluster networks) strengthens the relationship between management capability (CC) and level of marketing skills to innovativeness. And this holds true both for R&D Intensity and Newness of Innovations. However, looking back, it should be noted that the strength of relationships between external conditions and innovativeness is much weaker than those of management potentials. Apparently, external conditions do influence firm innovation performance, but the significant challenges come from firm internal, mostly managerial, capabilities, and potentials.

Table 4.2 Estimation Results on Firm R&D intensity (OLS)

	Model 1(Broad internal)		**Model 2 (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
Firm 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	.05(.04)						.02(.01)	.03(.00)	.03(.00)	
Firm Size squared		.05(.01)*								.04(.01)*
Firm R&D organization	.25(.01)†						.11(.03)***	.12(.01)***	.11(.04)**	
Specific: Management potentials										
Manager ICT-skills			.15(.08)**				.31(.01)**	.30(.02)**	.29(.01)**	
Manager ICT-skills squared				.13(.01)**						.16(.03)**
Manager Experience			.22(.06)†				.21(.05)†	.23(.04)***	.20(.04)***	
Manager Exp. Squared				-.17(.03)***						-.16(.03)***
Manager Cognitive Capability			.10(.04)*				07(.01)	.08(.10)	.05(.01)	
Manager CC squared				.04(.01)*						.06(.01)*
Marketing Skills			.38(.02)†				.34(.04)†	.36(.02)†	.41(.02)†	
External (EES)										
Level of Urbanization					.13(.02)*		.21(.04)*	.18(.02)*	.19(.02)*	
Cluster Network Strength					.18(.02)**	.	.07(.02)*	.05(.02)*	.12(.03)*	
FDI Share					.08(.06)		-.07(.05)	-.07(.07)	-.05(.03)	
FDI Share squared						.06(.01)*				.22(.01)*
Regulation					.10(.03)*		.04(01)	.02(.02)	.07(.04)	
Interaction Effects										
Cognitive capability*Cluster network strength								.09(.00)*		
Marketing skills* Cluster network strength									.06(.03)*	
N	260	260	260	260	260	260	260	260	260	260
F	9.66†	8.67†	12.58†	17.01†	6.01**	3.87**	9.07†	8.42†	8.34†	11.31†
R^2	.26	.27	.49	.50	.27	.25	.51	.54	.53	.53
ΔR^2		.01	.23	.24	.01	.01	.25	.29	.27	.27

* p<0.1; ** p<0.05; ***p<0.01; † p<0.005

Table 4.3 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
Firm 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	.28(.02)ŧ						.29(.02)ŧ	.30(.01)ŧ	.30(.01)ŧ	
Firm Size squared		.28(.01)ŧ								.29.01)***
Firm R&D organization	.07(.03)						.13(.04)**	.11(.02)**	.11(.05)*	
Specific: Management potentials										
Manager ICT-skills			.08(02)*				.06(.01)*	.09(.01)*	.05(.01)*	
Manager ICT-skills squared				.11(.01)*						.06(.01)*
Manager Experience			.04(.01)				.02(.04)	.08(.04)	.03(.03)	
Manager Exp. Squared				.15(.01)**						.02(.00)
Manager Cognitive Capabilities			.06(.01)*				-.06(.05)	-.07(.07)	-.09(.06)	
Manager CC squared				.06(.01)*						.03(.00)
Marketing Skills			.22(.01)***				.12(.01)**	.09(.01)*	.19(.01)*	
External (EES)										
Level of Urbanization					.09(.08)		.02(.01)	.02(.02)	.01(.00)	
Cluster Network Strength					.09(.01)**		.02(.01)	.03(.01)	.05(.01)	
FDI Share					.06(.01)		.04.(.01)	.05(.01)	.05.(.02)	
FDI Share squared						.11(.01)*				.06(.01)*
Regulation					.06(.01)*		.05(.01)*	.10(.03)*		
Interaction Effects										
Cognitive capability*Cluster network strength								.23(.05)**		
Marketing skills* Cluster network strength									.10(.01)*	
N	260	260	260	260	260	260	260	260	260	260
F	9.17ŧ	11.46ŧ	5.18**	5.56**	4.97**	3.24*	4.99***	6.95**	5.70**	6.63ŧ
R^2	.25	.29	.25	.19	.15	.12	.37	.39	.33	.35
ΔR^2		.04	.00	.06	.10	.13	.12	.14	.08	.10

* p<0.1; ** p<0.05; ***p<0.01; ŧ p<0.005

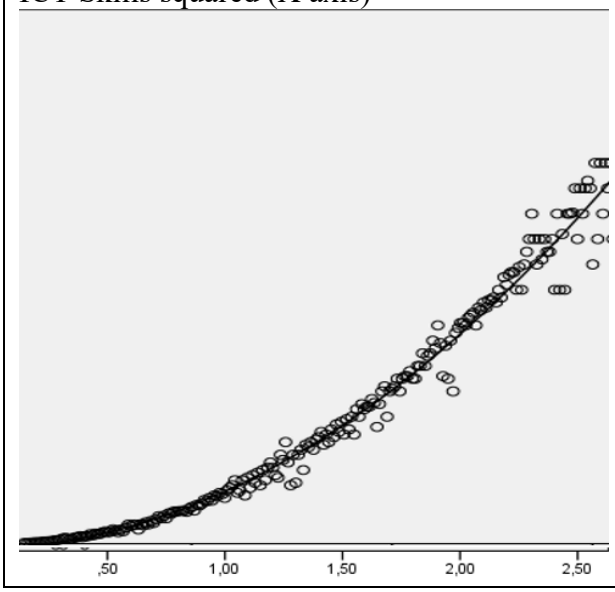
A summary of the exploration of the hypotheses, as formulated in section 4.2.2**,** provides the following results while considering *full models*.

1. *Firm capabilities' indicators*. Firm size shows a u-shaped relationship for both innovativeness models (R&D Intensity and Newness of Innovation), thereby confirming Hypothesis 1.2. R&D organization is only explored in a linear relationship, and the positive association mentioned in Hypothesis 2 is approved for both models. Confirmation for both models also hold true for ICT skill level (linear and non-linear referring to increasing returns) in Hypotheses 3.1 and 3.2 and for level of marketing skills, i.e., a positive relationship explored in a linear model mentioned in Hypothesis 6. Managers' cognitive capabilities show a non-linear (increasing returns) pattern for R & D Intensity's full model (confirming Hypothesis 5.2, but not for Newness of Innovation). A 'remarkable outcome' is indeed the negative relationship between years of experience and innovativeness, thereby confirming our 'a-typical' Hypothesis 4.2 (decreasing returns); however, it is only for R & D Intensity, not for Newness of Innovation.
2. *Firm external conditions (mainly knowledge spillovers).* Positive (linear) relationships with level of urbanization and strength of intra-cluster networks, as addressed in Hypotheses 6 and 7, can be confirmed only for R&D Intensity, not for Newness of Innovation. The FDI level indicates for both full models a trend of increasing returns, thereby confirming Hypothesis 9.2. Ease of dealing with regulation tends only to be associated with innovativeness, in the Newness of Innovation Model, meaning that Hypothesis 10 can only partially be confirmed. And finally, Hypothesis 11 and 12 can be confirmed as there tends to be a positive interaction between firm cognitive capability and internal cluster networks' strength in influencing innovativeness.

The study observes two main trends derived from our exploration of hypotheses:

a) Many weak *quadratic* relationships, namely, concerning firm size, ICT skills, managers' cognitive capability, and FDI share, indicate a (weak) influence of increasing returns. Apparently, relatively strong efforts in increasing firm capabilities and external knowledge supply are required ('passing a threshold') before an increase in innovativeness can be reached. This pattern is illustrated in Figure 4.2, part A. However, with regard to one variable – management experience - the study could observe an inverted pattern, indicating decreasing returns (part B).

A. Dependent variable: R&D intensity (Y axis)	B. Dependent variable: Newness of Innovations (Y axis)
ICT Skills squared (X axis)	Manager's experience squared (X axis)



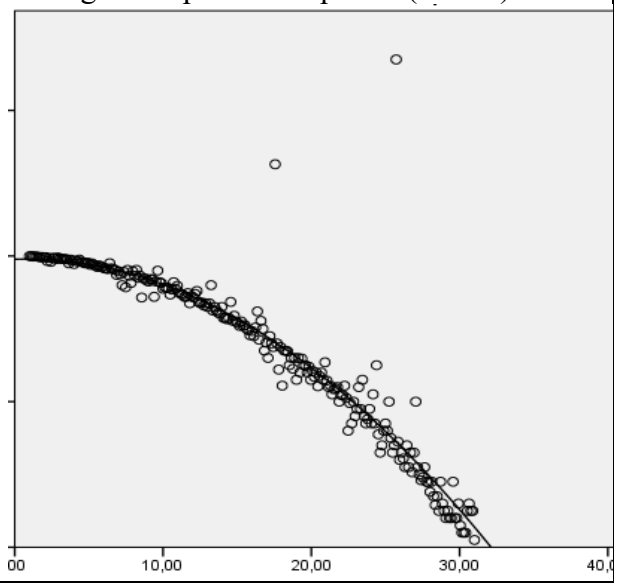


Figure 4.2 Non-linear relationships

b) Some assumed relations tend to be positive and significant only for one of the full models, namely R&D Intensity, not for both, indicating a difference between innovation intentions and actual innovation outcomes (newness). Confirmation only for R&D Intensity holds true for: years of managers experience, managers cognitive capability, level of urbanization, and cluster strength (only R&D Intensity), while ease of being engaged with regulation has only a significant positive influence in the Newness of Innovation Model.

4.5 Qualitative Understandings of Low Innovativeness

Qualitative insights into firms' dynamic capabilities and ecosystem conditions in innovativeness were collected through six in-depth interviews (as explained and motivated in section 3.1). The study observed relatively large shares of the sample being engaged in low or modest innovativeness, namely, one-third spending less than 10 percent of sales to R&D and almost 40 percent involved in a very low level of their newness products/services.

Constraints to innovation activity as forwarded as the study's urgency, including education issues, appeared to include limited potentials in management mainly. In the in-depth interviews, respondents have put specific emphasis on lack of ability to increase small R&D

budgets, missing ‘strong leaders’ and skilled talent, and constraints in entrepreneurial culture (Table 4.4).

The modeling results indicated a relatively strong influence of firm size and R&D organization on innovativeness. Mainly for small firms, respondents confirmed problems of non-professional R&D and mentioned that budget limitations cause difficulty in developing new products/services that can compete with those of larger firms, both in quality and price. As a result, small firms may only reach higher innovativeness by being active in niche markets and offering specialized products/services, for instance, e-commerce for aging people or people with special needs. R&D for such market segments is, however, more complicated than for other segments because the innovation may lack the right features of the new service design and cause obstacles to create new market demand. The non-professional R&D and avoidance of specific niche markets both connect with managers being generally risk averse.

Further, regarding management conditions, it was forwarded that obstacles in raising innovativeness originate mainly from missing strong ‘leaders’ coupled with ‘adequate business culture’. For instance, there is generally a low awareness among (top) managers with regard to innovation, even concerning processes within the firm; this aside from somewhat limited marketing techniques for new products/services, including poor coordination between design and marketing/promotion. In a situation in which level of marketing skills turned out to be of particular importance in ICT firms' innovativeness, this may work as a substantial obstacle to increasing innovativeness. Of course, there is sufficient ICT talent in the country, but the level of education needs to be increased to global levels.

As respondents indicated, there is a massive shortage of qualified managers that understand ICT management in Indonesia, and this situation follows from deficits in the ICT education system. Currently, this system provides no graduate studies for managers to achieve sufficient background knowledge and management skills in ICT business or learn about the firm's necessary transformation. For instance, many larger (domestic) firms have already implemented big data technology. However, it is difficult for them to find a ‘leader’ who can create a sound and profitable big data business at the required quality level. Therefore, many customers in Indonesia prefer global firms over local firms, which reinforce already existing obstacles to innovation among the last ones.

Low skill levels are also related to constraints in an entrepreneurial culture. In line with Hofstede and Hofstede (2005), Indonesian entrepreneurial culture faces a ‘strong power distance’ or hierarchy. A strong power distance means that lower-level staff members may forward good suggestions or proposals for innovation. Still, they face difficulty bringing these

into development because (top) managers tend to act rather authoritatively. In low power hierarchy countries, new innovations may come from any level in a firm. In contrast, in Indonesia, new innovations mostly come from the highest firm level, which is not always the best. Moreover, it was forwarded that in a broader context, Indonesia has a long history of the rich endowment of natural resources and commodities, which may have enhanced culture of relatively low ambitions and 'easy-going.'

Given the above situation, there is a need for 're-engineering' or transformation of entrepreneurial culture to start with managers who take on the role of leader and improve planning and management of innovation, including marketing. At the same time, in such complicated processes, essentials of Indonesian culture need to be respected, including the collectivism culture, creativity, loyalty to friends, and family (Hofstede and Hofstede, 2005), and these may eventually be merged with principles from developed countries. For example, Černe, Jaklič, & Škerlavaj (2013) argue that collectivism is beneficial for commercializing innovative ideas, while individualism is positively related to technology invention. Accordingly, managers of innovation in Indonesian firms need to find a balance in stimulating invention where extra effort is required while increasing commercialization advantages. One of the values that qualify to be emphasized in 're-engineering' is loyalty to family and friends as a basis for a trustful collaboration between small firms in R&D. Such collaboration enables sharing financial resources and sharing risk failure gains. And it seems that collaborating firms are more attractive for financial subsidies and loans than stand-alone small firms. More importantly, taking market risks can be reduced if potential customers (envisaged market segments) are involved in the design process of new services from the beginning (co-creation), like in living lab constructions (Van Geenhuizen, 2019). Of course, models of collaboration and co-creation need to be 'backed' by a certain institutional design, which first requires experimentation on best approaches.

Table 4.4 Qualitative understandings of low innovativenss of ICT firms in Indonesia

Factors	*Challenges in low innovativeness*	*Firm segment*
Firm capabilities	Limited research budget causes R&D to be relatively expensive (Not able to professionalize R&D) - Too strong competition with large firms - Niche market R&D causes uncertainty in reaching the market (managers are also risk-averse)	Small
Management Potentials	Strong leaders are missing, overall lack of skilled talent in ICT - Low awareness of innovation - Weak coordination between firm departments/units (design and marketing) - Poor marketing techniques	Small and larger
	Constraints in local business culture - Large power distance (part of firms) - Low risk-taking in innovation - Low ambition level to innovate - Mainly collectivism	Small and larger
External (EES)	Constraints in the situation outside Java - Small local consumer market (internet users) - Poor ICT infrastructure	Mainly small
	Constraints in using cluster benefits -Small use of opportunities of collaboration, in particular with local research institutes and with customers	All
	Constraints in FDI -Often, without specific technology spillovers and management skills transfer -Limited embedding in local/regional economy	Small and medium

The study also focused the interviews on potential shortcomings in Entrepreneurial Ecosystems (EES), namely urban conditions, the role of clusters, and FDI as a source of knowledge spillovers. The overall role of external factors in innovativeness appeared to be relatively weaker compared to management potentials. However, EES relevance was confirmed in the interviews. Respondents first addressed the 'digital divide' between Indonesia's western part and eastern part, derived from a much smaller market of internet users and relatively poor ICT infrastructure in the eastern part. The same holds for differences between Java and other parts of Indonesia. Most larger ICT firms establish their offices in Jakarta metropolitan area or other big cities in Java, where market demand is and where knowledge spill overs tend to be relatively strong, like from customers, competitors, and specialist service firms. Respondents indicated 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. However, this only works if these institutes and schools' quality levels are

upgraded to the global quality level. The experimentation addressed above on small firm R&D collaboration (co-creation) could be part of a value-chain collaboration. 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.

Respondents also confirmed the importance of FDI for knowledge spillovers and transfer. Still, at the same time, their opinion was that FDI could increase importance if the transfer of specific technology and management skills occurs in more tangible ways, for example, by providing training and demonstration of firm capabilities. Knowledge spillovers also tend to work better if the foreign investments take place embedded in domestic firms' networks, thereby also matching regional specialization, but this is not how it often works in practice. At the same time, respondents also indicated the need for better protection of intellectual ownership, which also refers to foreign innovations.

4.6 Discussion and Future Research

The study is one of the first empirical research on the innovativeness of ICT firms in Indonesia, derived from a mixed-methods approach, including a large-scale survey, desk-research, and in-depth interviews.

To answer the question: *What is the level of innovativeness among ICT firms in Indonesia?* The study found that in Newness of Innovation (Table 4.1) the average only 8.2 from 52 (max). In addition, only 39% of the respondents have high level R&D intensity, less than 50% have high marketing skills with other indicators relatively middle to low in scale. In conclusion, most of ICT firms in Indonesia as represent in the survey have medium to low innovativeness.

Meanwhile, to answer the research question: *In which ways and to what extent do firms' capabilities and external knowledge spillovers influence firms' innovativeness?* The study argues that firm capabilities and external knowledge spill overs positively influence firm innovativeness until a certain degree. After the degree has passed, the influence will be zero or negative. Meanwhile, to answer the question: "*In what respect is the entrepreneurial culture in Indonesia different from the ones assumed in common innovation theory what the implication of such differences could be*?" The study argues that Indonesian entrepreneurial culture faces a 'strong power distance' or hierarchy that may hinder innovation; therefore, entrepreneurial culture's adjustment is advised.

To put the results in a broader context of developing countries, the contribution to understanding firm innovativeness in developing countries is threefold. First, the understanding of low-level absorptive capacity, that requires extra efforts in learning given 'counter-productive' values like hierarchy, risk-averse, and modest ambitions. And secondly, the understanding of a relatively weak but positive influence of relationships in clusters (only for R&D Intensity) that support theoretical ideas on agglomeration advantages. Thirdly, the two models' exploration indicates that R&D according to intentions (R&D Intensity), is different compared with Innovativeness as realized innovations (Newness of Innovation).

With regard to the first contribution, the results provided support for quadratic relations between various firm capability-related indicators and innovativeness, like R&D expenditure, manager's experience, and FDI share (already indicated by Cohen and Levinthal, 2000; Teece, 2007; Nuryakin et al., 2017). According to 'standards' in developed economies, obstacles also originate from a low level of professionalization of R&D (management of innovation). It causes short of awareness on opportunities (like user-needs) and lack of R&D funding and lacks in planning and difficulty in risk-taking, mainly in small firms (World Bank, 2015; Long et al., 2017). Low levels of professionalization are connected to lack of typically sector-specific education, through which ICT innovation awareness and ICT absorptive capacity (managing innovations) are enhanced.

Regarding the second contribution**,** the study supported theoretical ideas on agglomeration advantages, among them benefits from knowledge spillovers, particularly in Jakarta Metropolitan Area, and also lack of such advantages elsewhere, causing obstacles to increasing innovativeness (Christensen and Drejer, 2005; McCann, 2008; Iammarino and McCann, 2015). A similar trend was observed for clusters and their internal networks, and theoretical ideas on favorable impacts from a varied knowledge transfer based on trustful relations with proximate firms and institutions (Bathelt et al., 2004; Dakhli and De Clercq, 2004; Doh and Acs, 2010; Pratono et al., 2016). The results did not support the work by Bathelt et al., 2004 and Gunawan et al. (2016), who emphasize the potential 'dark' side of internal cluster knowledge transfers, as the danger of circulation of old and redundant cluster knowledge. Still, our results did also not confirm the relationship (Newness of Innovation model). In addition, parts of developing economies may have relatively young clusters where such 'dark sides' have not yet emerged. The region/cluster is an essential source of new knowledge and knowledge creation (Aslesen and Harirchi, 2016). But our results justify a more in-depth analysis of the merits of relatively strong networks within ICT clusters.

With regard to the third contribution, a relatively limited explanatory power of the Newness of Innovation model, shows that the association is not so strong, can be explained as follows. While R&D intensity seems to be influenced by knowledge and technology transfer activities (Arvanitis et al., 2008), the realisation of innovation is different. It is more influenced by the presence of an internal champion (top manager) within the firm and the support of external agencies that can provide support to the implementation (Unsworth et al., 2009).

Overall, relationships between external conditions and firm innovativeness tended to be not as strong as management capability. Also, such a situation may be typical for developing economies where external conditions do have an influence. However, most challenges come from internal management of innovation, which is not yet well developed and professionalized among most firms (SMEs).

Differences with developed countries do not detract attention from the two enormous challenges which the Indonesian government is facing, namely, upgrading the ICT infrastructure and increasing literacy and ICT skills of the population, including skills in the management of innovation in ICT firms (World Bank, 2015; OECD, 2018a). Both have already been addressed in national policy-making, and new policies have started to be implemented. However, inter-ministerial and inter-government level policy coordination's mechanism and practice become crucial to ensure successful policy implementation (Saner and Winanti, 2015; Trippl et al., 2016) in overcoming problems of a weak and fragmented innovation system.

Regarding education, the aim should be to develop and implement training for local managers to work with models of planning and management of ICT innovation that are aligned with uncertainty and unpredictable outcomes (e.g., Aryanto et al., 2015; Hartono, 2015; Huizingh, 2017) and to 're-engineering' entrepreneurial culture towards smaller power distance ('softer' hierarchy) and stronger ambitions. However, such alignment preferably, also includes valuable aspects of Indonesian business culture self, like the importance of family ties and collectivism. Small firms focus on market niches, and collaboration with other (small) firms could help improve their position, eventually along family lines. Such larger entities, preferably without strong hierarchy, could benefit from larger dynamic capabilities and collaborate with users/customers to prevent risks in the market and provide higher service levels. Besides, concerning regulation issues, the study may suggest stronger protection of property rights (IO) to improve attractiveness for inbound FDI (World Bank, 2015) and transfer knowledge and skills to domestic SMEs.

Overall, it seems that Indonesia's policies have to deal with specific situations in many (parts of) developing countries. Further, about the nature of policymaking, the government may

adopt the idea of the ‘middle-through approach’. Policy/management of innovation comes from top-level and accommodates ‘the bottom’ voice, where much of the implementation occurs. Such ‘collaborative approaches’ in policymaking have been designed in developed economies and tend to be culture dependent (Torfing & Ansell, 2017). It is worth designing experiments for small ICT firms' collaboration and trust in which such models are developed in Indonesia (to be elaborated in Chapter 6 of this dissertation).

The study is subject to four limitations suggesting further research. First, some small firms refused to act as respondents in the survey, potentially causing bias in the results. Non-response among (very) small firms is difficult to avoid because of scarce human resources or feeling ashamed for poor conditions (Bartholomew and Smith, 2006). The study already compensated non-response by in-depth interviews with small firms and experts, while in further research, other ways in data collection may be applied. Second, a deeper understanding of low knowledge absorptive capacity would also be in place in follow-up surveys and modelling, for example, by directly connecting to specific knowledge types and learning processes that are missing in the survey except for level of marketing skills (Lane et al., 2006; Autio et al., 2013). Third, a further point is the relatively simple character of our modelling, as the study aimed to build a groundwork to look at current conditions of firm innovativeness in Indonesia. Future research could include structural equation modelling (SEM) to investigate the model factors' many interrelationships. And finally, there is a need to rigorously test the relationships in this study and design a longitudinal approach that may better open ways to understanding causality. The sheer size and fast growth of the domestic market in Indonesia justify such further research.

Chapter 5 Regional Differences in Firm-level ICT Innovativeness in Indonesia

5.1 Introduction

Regional disparity in economic growth within a country has become an issue of great interest among policymakers and researchers in Indonesia (World Bank, 2012; Tirtosuharto, 2013; Mokoginta, 2018). The main point of concern when innovation challenges are not resolved by national, regional and local economic development is that regional disparities in economic growth and living standards may lead to adverse effects like unemployment-related social problems, political tension, etc. Development plan in Indonesia often does not take into account the geographical economic which may enhance or intensify the core-periphery pattern (Fredman, 1963) within a country, so development tend to be centered on a "territory" rather than spread out (Darnilawati, 2018).

Regional disparity in Indonesia is characterized by the economic and infrastructure gap between the Java region that includes the capital district Jakarta (core region) and periphery (non-core) regions - regions outside of the Java region – (Tirtosuharto, 2013) and the gap between Jakarta and other regions in Java itself (Akita and Miyata 2013). Attention to the regional disparity is consistently addressed in countries all over the world. According to some research (e.g., Giannetti, 2002; Gurgul and Lach, 2011; Đokić et al., 2015; Chen et al., 2017), inequality between regions contradicts fairness and become the primary source of social tension; namely, an increase of socio-political instability across regions, a negative influence on innovation in the non-core regions and make an unpleasant impact on overall national economic growth. As a developing country, Indonesia may also face such a situation. This chapter intends to provide some empirical evidence of such regional differences in the ICT innovativeness of Indonesia.

The Economics Census of Statistics Indonesia indicates that some regions of Indonesia (e.g., Maluku and West Papua in eastern Indonesia) contribute a small portion (like Maluku only 2.2% in 2018) to the national economy in terms of the national product. This contribution is much smaller than other regions (e. g. Java Island contributes a much bigger portion of 58.5% in 2018). According to BPS (2016), the core regions in Indonesia (Jakarta and Surabaya) play a critical role in driving economic growth. The situation exists due to agglomeration concentration in those two agglomeration regions.

Specifically, regarding the ICT sector, Indonesia's digital economy is of great potential for innovations, as shown by the rapidly growing ICT-based firms' new services (Hariani, 2017;

BPS, 2016; see also Chapter 3), especially in the western area of the country where the ICT infrastructure is much better than the rest of the country. For instance, in Java Island internet connections can reach more than 7 Mbps while in eastern regions these are still under 1Mbps. The situation indicates that the potential of innovation is limited by infrastructure shortage.

The challenge in Indonesia's ICT sector can be explained as follows. On the one hand, based on BPS (2016) and the study of Azuari (2010), the ICT sector grows convincingly. It contributes significantly to Indonesia's GDP so that the sector can be used as one of the critical sectors in boosting economic growth in areas outside the core region (especially outside Java Island). On the other hand, Agustina and Pramana (2017) observe that even though the ICT development index of every region in Indonesia shows an increase, most areas except Jakarta are still in a low category of ICT development. The study by Agustina and Pramana (2017) confirms earlier results from Giap et al. (2015), which reveal that Jakarta is an outlier to other regions in Indonesia in infrastructure, economic development, and competitiveness derived from agglomeration advantages that enable higher innovativeness level. Accordingly, concerns have emerged among researchers about low levels of innovativeness in ICT outside Jakarta and that ICT innovations do not contribute to the regional development of non-core regions but rather widen inequalities across the country (Onitsuka et al., 2018).

In recent years, an increasing number of studies address regional disparities, especially in ICT infrastructure and use in Indonesia context (e.g., Mokoginta, 2018; World Bank 2012; Purbo 2017), but only a few of them focus on regional differences in ICT innovativeness. For instance, an empirical study of Aritenang (2013) provides insights into unequally distributed ICT innovation activities over Indonesia's regions in which the innovation activities are more concentrated in the core region. In the same vein but searching for underlying causes, other studies (e.g., Budiarto and Bachrudin, 2018; Handayani et al., 2018) reveal essential impediments to strengthening regional innovation systems in certain regions outside the core-region in Indonesia. For instance, a poor synergy between stakeholders (cluster members) and their differences in knowledge levels, especially local government and central government, offer challenges for improvement. The central government usually has less knowledge and less understanding of region innovation system than the local government. Because the initiatives for policy improvement often come from the local government, this requires collaborative decision-making (Ansell & Torfing, 2016).

Apart from non-core regions' handicaps due to geographical access or other infrastructure limitation, there is not much understanding of differences in innovativeness between ICT firms in the core region and those in non-core regions. In particular, the kind of

differences in ICT innovativeness, such as the Newness of Innovations, is unknown, which holds also true for the causal or contextual background of eventual differences. Accordingly, the study formulates the following research question: *What are the differences between core and non-core regions in Indonesia with regard to ICT firms' innovativeness? To what extent and in which ways does the influence of firm-internal and firm-external factors on firm innovativeness differ among these regions?*

Based on agglomeration theory, practice, related core-periphery thinking, and firm dynamic capability theory, the study in this chapter contributes to the understanding of local ICT context in Indonesia by providing empirical evidence of significant differences in innovation-related factors (e.g., management conditions, FDI inflows, entrepreneurial ecosystem) between core and non-core regions. Hence, our theoretical contribution includes extending the understanding of the influence of internal, management capability and entrepreneurial ecosystem to innovativeness between core and non-core regions in the local context of Indonesia. In practice, the study contributes to understanding how Indonesia's regional-economic disparities relate to firm innovativeness, especially in the ICT sector, that has been often overlooked to date. In particular, the study also examines the differences in the goal of innovativeness development between the east and the west regions of Indonesia.

The chapter is structured as follows: the next section (Section 5.2) introduces selected key differences in economic development and ICT enabling factors between Jakarta and the rest of Indonesia. It is followed by Section 5.3 on theory in which a preliminary model on innovativeness is given similar to the previous chapter (Chapter 4) and hypotheses are presented. Section 5.4 describes the methodology, as well as the data used. Section 5.5 provides the results of descriptive analysis and statistical tests regarding the differences between the two regions (Jakarta and the rest of the country), including regression analysis of the relationships between the innovativeness and a set of conditions. The final section provides a discussion of the results, followed by some recommendations.

5.2 Development differences between Jakarta area and remaining Indonesia

According to Akita and Miyata (2017), Jakarta has the largest GDP among 26 provinces in Indonesia; and contributes significantly to interprovincial inequality in the Java-Bali region and the whole country. As the region with the strongest urban expansion, Jakarta transformed into Jabodetabek megacity. The primacy of Jabodetabek, as it has increased agglomeration advantages due to the increase of population and production market, and due to its position as

the center of national politics and economy, is indicated among others by its 20% share in GDP. Jakarta is also the region with easier access to the global economy due to better communication infrastructure, global flight connections, and foreign headquarter offices.

In this section, statistics on regional economics from Statistic Indonesia (BPS) will be presented, namely labour productivity and investment rate in the ICT sector to deepen the picture of the disparities between regions. The study will also discuss the difference between education quality (especially in ICT) between the regions due to infrastructure gap. Statistics Indonesia (BPS, 2019) released that Jakarta still has a reasonably high unemployment rate (5.1% of population aged 15-65 years). However, there is a large difference between the regions in labour productivity. According to Rustiadi et al. (2015), Jabodetabek had a labour productivity IDR 48.5 million per worker per year. In contrast, the rest of Indonesia had a labour productivity of IDR 11.6 million per worker per year. Further, an indicator that shows differences in attractiveness and investment opportunities is FDI capital. The total FDI capital accumulated in Jabodetabek (including Jakarta, West Java and Banten) from 2006-2020 reached USD 4.595 million or 40.89 percent of the entire FDI Indonesia (33 other regions).

Furthermore, Sabur et al. (2021) found an education gap regarding literacy, enrollment rates, and the highest education level as part of the factors influencing GDP and labor productivity. For instance, in more recent years, while the illiteracy rate among 15-years-old and over was just 0.4% in Jakarta in 2017, the comparable rate outside Jakarta was 4.5% (BPS, 2020a). Observation of educational attainment disparities among the different provinces shows that Jakarta has the best qualified human resources with the highest average in years of 15-years-old attending school (10.9 years) which is above the average of the remainder of Indonesia (8.6 years). In general, in Jakarta most of the labour force has had at least junior high school level of education.

Regarding enabling factors related to ICT use, the share in the population of 15-59 years old with ICT skills in Jakarta reaches 58.4%, which is substantially higher than the remaining of Indonesia (29.8%). In addition, 99% Jakarta region is connected by a strong coverage cellular network whereas the remaining regions are only covered by 66% on average (due to among other geographical barrier). It also appears that 85.7% of Jakarta households have internet access, while outside Jakarta the share is much lower, i.e., 53.3% on average.

Next, the study also examines Broadband Density which is defined as the number of broadband subscribers as a proportion of the population. The statistics on broadband subscribers were taken only from the broadband subscriber of PT Telkom Indonesia (brand: Indihome) as the major player (90% market share) in Indonesia**.** In line with the previous indicators, Jakarta

is the region with the highest broadband density[2] (4.92) compared with other regions (1.79). Not surprisingly, Jakarta is also leader in Indonesia's overall ICT Development Index, as published by the United Nations International Telecommunication Union (ITU) based on internationally agreed indicators on access, use, and skills. In Table 5.1, the differences between Jakarta and regions outside Jakarta are summarized.

Table 5.1 Selected indicators on economic performance, and ICT infrastructure and development

Indicator	Jakarta Greater Area	Outside Jakarta Greater Area
Economic output: Productivity		
Contribution to National GDP (2018)	20.0%	2.6%
Labour Productivity (Rupiahs million/worker/year in 2016)	48.5	11.6
Enabling factors: Education and FDI indicators		
Illiteracy Rate 15+ years old population (% share) (2017)	0.4%	4.5%
Average number of years of 15+ years old population attending school (2016)	10.92	8.57
FDI capital/firms (million USD in 2020)	5,3	1,03
ICT Enabling factors		
Population of 15-59 years old with ICT skills, % share (2016)	58.4%	29.8%
Households with internet access, % share (2016)	85.7%	53.3%
Cellular coverage of households % share[3] (2016)	99.9%	66.0%
Fixed Broadband Density, % of population (2018)	4.92	1.79
Overall ICT Development Index (2017)	7.41	4.25

Sources: BPS, 2019

In summary, the study observes significant gaps in terms of economic and ICT development between Jakarta greater area and other regions[4]. In economic indicators, Jakarta is the largest contributor to Indonesia's GDP. Jakarta also performs the best with regard to ICT indicators, mostly fixed broadband density. However, it is also important to bear in mind that

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the roll-out of broadband infrastructure in most Indonesia regions is very challenging due to geographical constraints. While Jakarta region is mostly flat, most of the remaining areas outside Jakarta region cover parts of oceans and/or mountainous areas. Jakarta is much better equipped than the rest of Indonesia in terms of internet access (either cellular or fixed broadband), making it easier to obtain new knowledge needed in the innovation process and reach markets at a distance. This situation indicates that firms in Jakarta as the core region have the potential to make a continuous multifaceted improvement in innovativeness, while the remaining regions experience obstacles to do so.

5.3 Theory and Hypotheses

This section discusses the study's underlying theory followed by formulating the hypotheses. Differences in regional innovation can be approached in many ways. The approaches used in the chapter are from the theoretical perspectives of agglomeration theory and entrepreneurial ecosystems. Based on agglomeration theory, for example, Buzard and Carlino (2013) show that innovative activity is spatially concentrated in larger cities. In a similar vein, Capello and Lenzi (2014) find that the engine of innovation activities, namely the benefits from new knowledge, are spatially concentrated. Related to core and periphery regions, however, some authors (Eder and Trippl, 2019; Eder, 2019) argue that peripheral regions might be able to provide an innovative environment for small- and medium-sized enterprises (SMEs) whereas large enterprises rely on the more prosperous environment usually found in core region. In this case, Eder (2019) also mentions that periphery regions are the regions with low accessibility and lack of a critical mass of actors.

Based on entrepreneurial ecosystems (defined in this study as the social and economic environment affecting the local (regional) entrepreneurship emphasizing positive influence of networks and institutions), the argument is that young and risk-taking firms located in a place serving as 'incubators' for creativity, innovation, and entrepreneurship, have more opportunities to succeed than those located in other areas (Spiegel, 2017). Regional economic and institutional conditions not only vary but will play a crucial role in the entrepreneurial process (Gartner, 1985). Stam (2015) suggests that the entrepreneurial ecosystem approach will help regional policy enhance entrepreneurship by creating a context and a system in which productive entrepreneurship can flourish. According to Mason and Brown (2014), entrepreneurial ecosystems typically include the following: a core of large established businesses, including some that have been entrepreneur-led, entrepreneurial ‘recycling’ –

whereby successful cashed out entrepreneurs reinvest their time, money, and expertise in supporting new entrepreneurial activity; and an information-rich environment in which this information is both accessible and shared. Entrepreneurial ecosystems drive local economic vibrancy and national economic growth by building fertile environments for new and growing companies.

5.3.1 Regional Differences in Innovation Level

In practice, core region is more innovative and likely to have better innovative outputs, as the firms are often located near to each other, for example, enabling knowledge spillovers. The firms can benefit from nearby competitive suppliers, specialization of labor, thus can decrease production costs while attracting more suppliers and customers than a single firm could achieve. Core region is also benefitted from the the quality of governance and institutions which is typically higher than those ini non-core regions (Barasa et al., 2014; Samadi and Aliporian, 2021)

In general, study of innovation in core and non-core areas has received increasing attention especially over the last decade. These studies mostly argue that innovation efforts have different outcomes in innovation output for other regions, particularly between core and non-core regions within countries in Europe (e.g., Shearmur 2011; Davies et al., 2012). In addition, these authors argue that firms in the non-core areas are predominantly innovation followers and not leaders, with leaders mainly located in core region typically with a higher level of innovativeness, as apparent in R&D effort and Newness of Innovation. Accordingly, the study hypothesizes:

HR1: ICT firms in the core region are more innovative than those in non-core regions.

5.3.2 Relationship of innovativeness with firm internal conditions

This section discusses potential influence of firm-internal conditions (firm size, R&D organization and intensity) on innovativeness, in particular management capabilities (ICT skills, experience, cognitive capability, and level of marketing skills). With regard to firm size, Mei & Shao (2016), in their study in China, found that firm size, particularly in its efficiency, has a linear relationship with regional innovation, the bigger the firm, the more innovative and the smaller the firm, the less innovative. Tsai (2005) found contrary results in the Taiwan ICT industry. Using the extended Cobb-Douglas production function, Tsai (2005) observes approximately a U-type relationship between firm size and innovative output, especially in the core region, indicating a possibility of positive quadratic relationships. Further, with regard to

R&D organization, studies on different regions (e. g. Pavlinek, 2017; Budiarto and Bachrudin, 2018; Indarti and Wahid, 2013) reveal the urgency to overcome the barriers in developing strong collaboration between industries, local government, and universities (research institutions) especially in the non-core region, because R&D organization in the non-core areas lacks particular firm resources which urges firms there to collaborate. Meanwhile, according to some study in industrialized countries (e.g., Eder, 2019; Eder & Trippler, 2019) reveals that R&D activities are performed in the core of the country, with peripheral regions receiving less than their proportional share. It can be interpreted that R&D intensity in the core-region is stronger than those in non-core regions. To summarize, due to many differences in firm-internal conditions between the core region and non-core regions, the study formulate the following hypothesis:

HR2: The relationship between firm-internal conditions (i.e., firm size, R&D organization and intensity) and innovativeness in the core region is stronger than that in non-core regions.

Based on the research of innovation in developing countries (cross-country), Cirera & Maloney (2017) reveal that management capabilities (e.g., manager's experience, skills, and other capabilities) play a more important role in determining a firm level of innovativeness than any other conditions. Accordingly, differences in management conditions between regions most probably result in different levels of innovativeness. In more detail, regarding the manager's level of education, the enrollment in formal education, which is considered as a key driver for the breadth and depth of knowledge (Hausman, 2005) of the managers, is expected to enable the better realization of innovation in the firms. For ICT sectors, the development and strengthening of ICT skills tend to be an important enabling factor of innovativeness (ITU Full Report, 2018; Kusumaningtyas & Suwarto, 2015). Due to better educational conditions in a core region, stronger ICT skills will enable innovation activity to flourish, much better than the non-core areas. Better educational conditions allow managers in the core region to obtain better experience in learning. Regarding manager's experience, Romijn and Albaladejo (2002), Martínez-Ros and Labeaga (2002), and (Dencker et al. 2009) argue that the effect of managerial experience becomes smaller after specific periods of engaging in innovations due to a 'lock-in' situation, causing a negative quadratic pattern. In general, innovation activity develops earlier in core region than non-core regions (Leick & Lang, 2018), allowing the establishment of many firms, which also enables firm managers to build more experience than their fellows in periphery regions. The difference in experience may cause discrepancies in dynamic capabilities of innovation activities because managers in a core region have already dealt with

a larger variety of challenges and enable them to explore various solutions. In this sense, the study may expect that the higher the managerial cognitive capability, the higher the level of innovation activities. However, subjective prior beliefs may distort perceptions, particularly when information is ambiguous (Powell et al., 2006), resulting in thin and weak social fabrics outside the core-region. Accordingly, the study may expect that the influence of managers' cognitive capability is different between entrepreneurial ecosystems in core and non-core regions due to differences in social fabrics.

Regarding the level of marketing skills, some studies highlight the need for firms- especially in the core region to respond to typically demanding markets - to build a strong level of marketing skills to promote innovation (Atuahene-Gima, 1996; Hurley and Hult, 1998; Slater et al., 2010). In those studies, level of marketing skills has been shown to enhance firm performance in various ecosystem contexts. If it is combined with organizational capabilities, these efforts may improve innovation (Lukas and Ferrell, 2000) or enhance performance (Luca and Atuahene-Gima 2007).

In sum, regarding management conditions, the peripheral area's situation seems even worse due to infrastructure shortages, like transportation and communication access limitation, and limitation of education facilities. Although ICT management skills and marketing skills improvement can be enhanced (ITU Final Report, 2018; Kusumawati and Suwarto, 2015), the required education facilities and practical learning as enabling factors are only weakly present in non-core regions. Drawing on the factual situation in non-core regions as shown in Table 5.1 (smaller ICT skills, lower ICT development index), this study may assume weaker management potentials among firms in non-core regions. Accordingly, the study hypothesizes:

HR3: The relationship between management conditions and innovativeness in the core region is stronger than that in non-core regions.

5.3.3 Relationship of innovativeness with firm external conditions (entrepreneurial ecosystem)

The following conditions connected to the external environment, like the social fabric derived from local relations with customers, competitors, subcontractors, etc. may be different between entrepreneurial ecosystems in core region compared with those in non-core regions. From a theoretical perspective, network and social capital theory posit that information exchanges are important conditions for knowledge creation and diffusion processes. These exchanges are made possible by strong social and trust-based relationships among firms (Audretsch and Feldman, 2004; Bell, 2005; Doh and Acs, 2010; Dakhli and de Clercq, 2004). Lavie (2006) indicates that a firm's embedded network relations provide resources that give

strategic opportunities and positively affect the firm's legitimacy and strategic behaviour useful for innovation. In most developing countries, the networks outside core region are less dense than in core areas, potentially causing less positive influence of networks on innovation outside the core (Mao et al., 2014). Accordingly, agglomeration and network benefits from trust-based relationships and concomitant strategic opportunities for information exchange and innovation are more likely to exist in core region (Audretsch and Lehmann, 2017).

Regarding FDI, Effendi & Soemantri (2003) found that FDI in Indonesia is positively correlated with economic growth, especially in the core region. FDI helps to upgrade firms' capabilities and hence to improve their performance. FDI can enhance benefits from cluster externalities and productivity, and their activities in a nation or state contribute directly to local employment and investment (Irawati, 2007). This finding could be confirmed for the ICT sector at large in Indonesia (Chapter 4). However, there is a big *regional* difference in FDI inflow in Indonesia, meaning a larger part is invested in the core than in the non-core regions (World Bank, 2012; BPS, 2018). In general, FDI may be connected with important knowledge spillovers (knowledge transfer) in innovation activity, but in non-core regions, this could be a question mark (Karno, 2017). The results for the national ICT sector at large (Chapter 4) indicate u-shape relation between foreign ownership and firm innovation performance, suggesting that after a growing amount of FDI innovativeness starts to strongly increase. As mentioned before, FDI in the non-core regions is smaller in amount, and so the study may expect a weaker quadratic relationship between FDI share in firms (ownership) and firm innovativeness in non-core regions.

With regard to business regulation, according to Van Leeuwen & Földvári (2016), there are many differences between regions in Indonesia after the decentralization era in 1999 (prior to 1999, Indonesia follows centralization in the government system). The differences include overlapping regulations between central and regional governments, especially in entrepreneurship policy. According to Mirzanti et al. (2015), there are several regulations related to entrepreneurship, but these have not yet been implemented in government programs at meso-levels, such as incentives for start-ups business or micro and small business. Based on research in Indonesia, Tambunan (2007) and McKinsey (2015) also highlight that better regulation is needed to improve innovative performance, which would reduce the disparities between core and non-core regions. However, according to Barasa et al. (2014), the positive effects of firms' R&D on their innovative output is reinforced by the regional institutional quality that provides innovation-friendly regulations. The non-core regions typically have lower

institutional quality than the core region and this situation may cause differences in innovation output between core and non-core regions (Rodríguez-Pose, Di Cataldo & Rainoldi, 2014).
HR4: The relationship between firms' entrepreneurial ecosystems' regulation conditions and innovativeness in the core-region is stronger than that in non-core regions.

5.3.4 Interaction effects

It is commonly accepted that the effect of a condition on innovativeness may differ if it meets other requirements (e.g., Hatak et al., 2016). Another way to put this is that one condition's effect may depend on the level of the other conditions. Therefore, the study also investigates the interaction effects between management conditions (manager's experience, manager's cognitive capability, level of marketing skills) with other conditions, namely R&D organization, and FDI. Therefore, the study explore management conditions in the interaction effect with other internal and external conditions as follows.

Manager's experience

Experience is a prime source of learning, leading to a stronger knowledge base and learning different ways of doing things which foster innovations (Buckley & Ghauri, 2004). Managers of internationally diversified firms, as typically giant firms, have a richer knowledge base than domestic firms (which are typically smaller) and this facilitates the first to access richer knowledge sources and develop stronger technological capabilities for innovation activities (Cohen and Levinthal, 1990). In this respect, the study expects a moderation effect of firm size on the association of manager's innovation experience.

Manager's Cognitive Capability

According to Helfat and Peteraf (2014) and Teece (2018), a manager's cognitive capability (CC) is associated with the ability to sense opportunities and deal with uncertainty. Cluster networks provide access to new opportunities. Therefore, management with high cognitive capability, facilitated by R&D activities, may lead to higher innovativeness. In this sense, the study expects that cognitive capability moderates the relationship of cluster network strength on innovativeness.

Level of marketing skills

According to a study by Ellis (2010) in Hongkong, level of marketing skills is affected by both firm size and the firm network's diversity. Increasing network diversity boosts a firm's level of

marketing skills in small and low diversity networks. It will cause unfavorable consequences for level of marketing skills in larger and high diversity environments (external cluster). Additionally, in a study in China, Hong (2014) disentangles that FDI leads to innovation and forces firms to be competitive and market-oriented—the ability to serve customer's current and future needs. In a similar vein, Zhao and Zhang (2010), also in China argue that FDI can directly influence the host country's productivity by introducing capital goods (equipment), new processing practices, new products, and new management skills and such knowledge stimulate innovation, which firms use to be market oriented. In this regard, the study expects the existence of interaction effects between level of marketing skills and cluster network strength, and level of marketing skills with FDI in relationships with innovativeness.

HR5: The moderation of cognitive capability to cluster network in its association with firm innovativeness is stronger in the core region than that in non-core regions

HR6: The moderation of marketing skills to cluster network in its association with firm innovativeness is stronger in the core region than that in non-core regions.

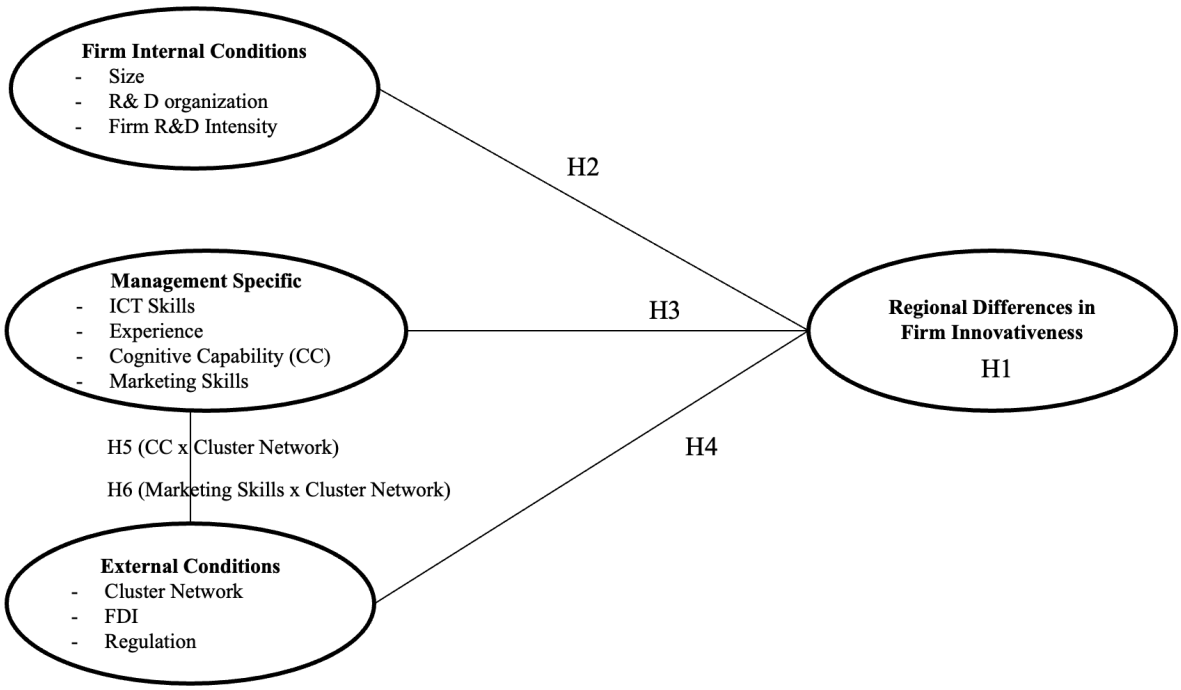


Figure 5.1 The Conceptual Framework in the regional study including Interaction Effects

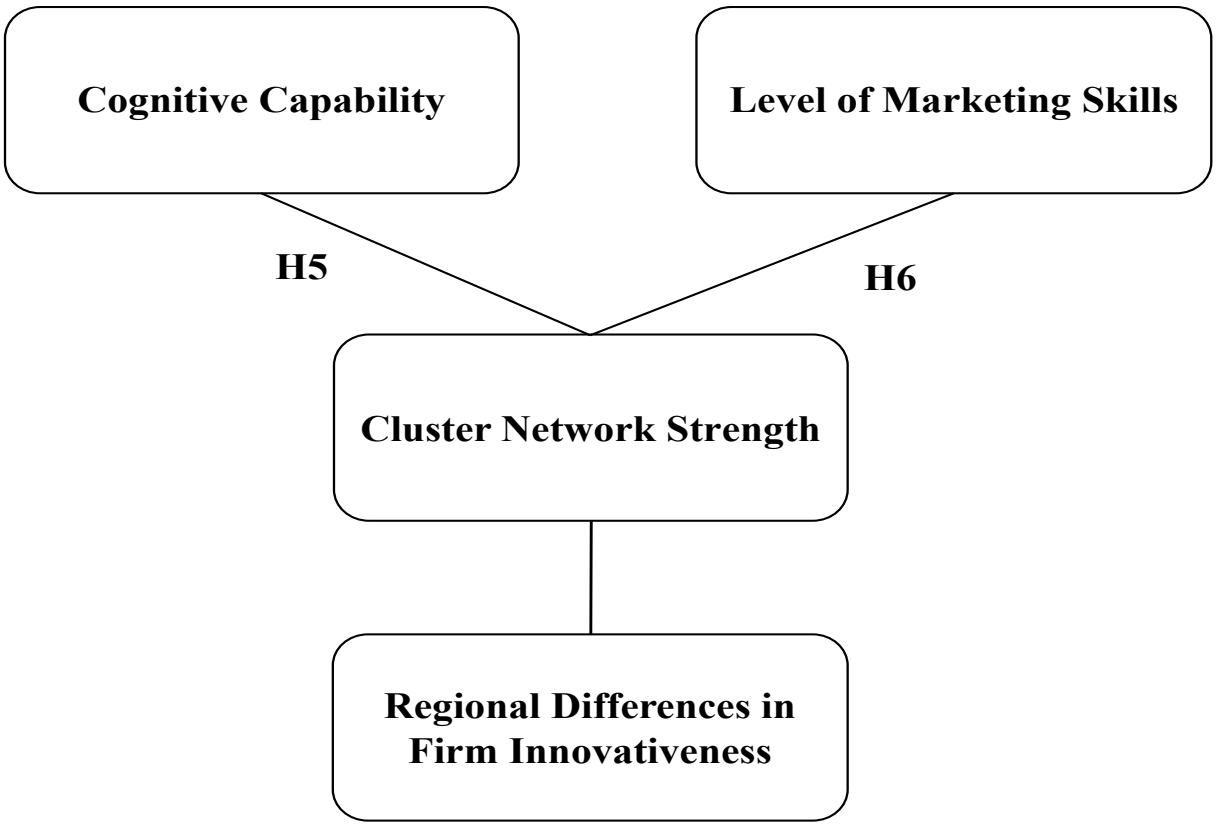


Figure 5.2 Interaction Effects

5.4 Methodology and Data Collection

The data are derived from the ICT- firm email survey in November 2017 until June 2018 in some larger and smaller cities in Indonesia. The survey is comprising Jakarta, Bandung, Semarang, Yogyakarta, Surabaya (Java Island), Bandar Lampung, Palembang, Padang, Batam, and Medan (Sumatra); Banjarmasin and Balikpapan (Kalimantan), Makassar and Manado (Sulawesi), and Denpasar (Bali). The survey delivered around 2,000 questionnaires and received 13.6% (272 questionnaires) back. After checking the data on consistency and extreme values, the study decided to delete 12 questionnaires, resulting in a final set of 260 qualified responses.

In the empirical part of the study, given the data availability, the study classified Indonesia's regions into Jakarta Greater Area (region 1) and outside Jakarta Greater Area (region 2) rather than the western and eastern regions. Our classification matches the considerations of differences between Jakarta Greater Area and other regions (World Bank, 2012; Giap et al., 2015; Agustina and Pramana, 2017). Accordingly, the study divided the sample based on firm location, namely, region 1 comprising firms in Greater Jakarta regions

(Jabodetabek – the abbreviation of Jakarta, Bogor, Depok, Tangerang, Bekasi) as the core region and region 2 comprising firms in the non-core regions.

The study has checked for multicollinearity issue for both datasets (Jakarta and outside Jakarta) and found no issue on multicollinearity for both of them (see Appendix 12 & 13). For correlation test see Appendix 14.

In the descriptive analysis of regional differences, the study used various statistical tests. The different measurement levels of the variables the study used, call for specific statistical tests to determine significance of differences between the two regions. Ratio variables will be tested using *Mann-Whitey U test*, ordinal variables using the *Spearman Rank Correlation test,* and categorical variables using *Z-test* and *Chi-square test* (see Appendix 10).

Further, in the investigation of relationships between firm-internal and external factors (EES) and innovativeness, the study employed multiple regression analysis using two dependent variables: Firm R&D Intensity and Newness of Innovations, reflecting the input-side and the output-side of innovation processes, respectively. R&D intensity is typically considered an input factor of an innovation trajectory since own financial investment in R&D may lead to additional new (and exclusive) knowledge of the firm, and absorption of this knowledge would result in innovations. Accordingly, large R&D investment helps a firm build a competitive advantage by creating unique products, services, or technologies that competitors cannot easily replicate. R&D investment can also help a firm develop new skills and capabilities, to absorb and apply new knowledge, for example to be used in making the production process more efficient such that prices for customers can decrease or stabilize. High R&D intensity can also foster a culture of creativity, risk-taking, and learning within the firm which influences the innovation trajectory by encouraging employees to propose new ideas, experiment with different approaches, or seek out new challenges. The previous discussion indicates that it is not only the size of financial investment in R&D itself, but the many ways of contribution to higher levels of innovativeness. While a significant correlation between the two innovation indicators could not be observed on the country level (Chapter 4), there is a significant correlation for the Jakarta region (Appendix 13). This pattern may indicate a stronger capability to transform R&D investment in higher level innovation by firms in Jakarta region than elsewhere.

The remaining chapter specifically explores the differences between core and non-core regions, focus on linear and quadratic relationships (if the measurement level allows or measures with ratio scales) and explore interaction effects between selected variables.

5.5 Results

5.5.1 Regional Differences in Innovativeness and Influencing Conditions

The presentation of the results is organized as follows. First, the study presents the descriptive analysis, the differences between regions in innovativeness (three indicators) and differences between regions in conditions that may influence innovativeness. Secondly, the study presents a comparative analysis of the two regions regarding conditions that may influence innovativeness, with a focus on Newness of Innovations as the dependent variable.

Differences in innovativeness between ICT firms in regions are explored using two indicators: Newness of Innovations and R&D Intensity (see Appendix 14 and 15 for R&D intensity). The study observes a weak trend of a higher degree of newness for the core region, as indicated by 8.9 versus 7.6, respectively (Table 5.2). However, this difference in newness is not significant at $\alpha = 0.05$ but at the 0.1 level. Further, R&D intensity shows a significant difference in being more positive in the core region compared to other regions. It is also observed that the number of innovation projects in regions 1 and 2 is significantly different (7.6 versus 5.3). Overall, ICT firms tend to be more innovative in the core-region than other regions, but most clearly regarding R&D intensity and amount of innovation, and much less regarding level of newness.

With regard to differences in conditions related to innovativeness, the study observes the following. The difference between the regions tends to be huge regarding firm size, as indicated by an average of 252 versus 90 employees, which is confirmed by statistical significance. In both regions, the percentage of SMEs is higher than that of large firms (LFs), where region 1 has a higher percentage of LFs (32%) than region 2 (14%). This pattern is in line with Karlsson and Olsson (1998) in Sweden in that larger firms are more likely to be located in the core region while smaller firms are more likely in non-core regions. Regarding R&D organization, the descriptive analysis shows a slightly more positive trend in the core region compared to other regions, however, without significant difference.

Focusing on specific management conditions, there is a sharp distinction between the manager's ICT skills between the core region and non-core regions, which is statistically significant. This complies with studies by Winardi (2017) and OECD (2013) that address the gaps in school facilities and a number of teachers, including the digital divide between the core and other regions. Regarding manager's experience, the disparity between the two regions is apparently strong, which is also confirmed statistically. Further, management cognitive capability tends to be somewhat stronger in the core region, but the difference is not significant. And finally, the last management condition, level of marketing skills, medium-strong level is

higher in the core region (49% vs 38%) while otherwise is lesser in core region (51% vs 62%) Again, the study found a significant difference between firms in the core region and those in non-core regions.

Differences in external conditions (entrepreneurial ecosystem) reveal divergent results. From the statistical tests, the study may conclude that there are differences in the strength of internal cluster networks between the core-region and outside that region, namely, more frequently strong in the core network than non-core regions (73% vs 58%), Unlike Juhász & Lengyel (2017), who argue that there will be less cluster network strength in a more competitive region, the study found a contrasting result. Our findings show that Jakarta, the more competitive region, has stronger networks than in regions outside Jakarta. Regarding FDI, it is well-known that the core region receives larger inward FDI than non-core regions (BKPM, 2018), due to reasons like ease of access and availability of high-class amenities. The data confirm a difference in FDI inflow. As shares in firm ownership, FDI shows a clear distinction between the two types of regions, which is statistically significant. Meanwhile, there is no strong evidence that firms in the core region are dealing more positively with regulation compared to firms located outside the core for regulation. In other words, the study may assume that the firms in both regions have similar perceptions of regulation that may influence innovativeness.

Next the relationship of ICT skills and innovativeness in both regions are strong and positive. Those relationship in core region is slightly stronger than those in non-core regions. In quadratic relationships, the study found that in model 2 the influence of ICT skills appears to be slightly higher in region 1 than in region 2. It may reflect that in region 2 firms need to reach higher skills in ICT to boost innovativeness than region 1. For managers experience, only in region 1 has negative quadratic influence whereas there is no influence for region 2. The situations show that experience has a non-significant influence on innovativeness after it reaches certain degree for the firms in core region, but it has no different influence for non-core region firms. Next, the influence for cognitive capability (CC) is positive for both regions, but unlike other conditions, CC is slightly stronger in non-core regions. However, the study found that in quadratic relationship, region 2 need higher CC to boost innovativeness. The level of marketing skills is also positive for both regions, and as expected those in region 1 is stronger than in region 2. Regarding entrepreneurial ecosystem, all the influence are in positive direction for all regions with there are some variations in the strength of influence. The influence of cluster network strength is stronger in core region, similar in the FDI but weaker in the regulation condition.

In sum, given the above results, the study can confirm H1 in that ICT firms in the core region are more innovative than those in non-core regions, given most conditions. The study can also confirm H2 in regard that the relationship between firm innovativeness and internal conditions is stronger in core regions than those in non-core regions in all conditions (firm size, R&D intensity, R&D organizations). With regard to H3 (on management conditions), the study also confirms that the relationship of management conditions and innovativeness in core region is stronger than those in non-core regions. However, for entrepreneurial ecosystems (H4), the study cannot confirm that the relationships between the external conditions and innovativeness in core region is stronger than those in non-core regions. For interaction effect, the study confirms H5 in regard that the moderation of manager cognitive capability to cluster network strength on innovativeness is stronger in core region than those in non-region. However, H6 cannot be confirmed by the study means that the moderation of level of marketing skills to cluster network strength on innovativeness is not stronger in core region than those in non-regions (can be similar or weaker). All-in-all, the conclusion is that the conditions that potentially influence innovativeness are only for a part significantly different between the core-region and non-core regions, namely internal and management conditions.

Table 5.2 Descriptive Statistic and the Statistical Test

Number of firms	260		142	118	
Newness of Innovations	Continuous variable derived by multiplying number of innovations with newness weighting value	Mean (SD)	8.9(9.9)	7.6(9.5)	MWU= 7611
		Min-Max	2-52	0-48	α=0.07*
Firm R&D Intensity	Continuous variable as percentage share of sales	Mean	24.7(22.8)	17.7(20.6)	MWU=6176.5
		Min-Max	0-90	0-80	α=0.01**
Innovation projects	Continuous variable indicating the number of innovations projects undertaken in the last 2 years	Mean (SD)	7.6(10.6)	5.3(8.4)	MWU= 6850
		Min-Max	0-31	0-27	α= 0.05**
Firm Size	Continuous variable as number of full-time employees in 2017	Mean (SD)	251.8(645.2)	90.1(293.9)	MWU=4535.00
		Min-Max	1-4500	1-2700	α=0.00†
R&D Organization	Binary Variable	High Level of R&D	39%	40%	$z = 1.24 \leq z_c = 1.64$
		Otherwise	61%	60%	$p = 0.8 \geq 0.05$ Pearson Chi Square=1.27 α=0.23
Manager's ICT Skills	Continuous variable derived by multiplying percentage of ICT skilled populations of each region with managers degree of education	Mean (SD)	1.1(0.5)	0.8(0.4)	MWU=7321.
		Min-Max	0.6-2.4	0.3-1.6	α=0.01****
Manager's Experience	Continuous variable as number of years of employment in business	Mean (SD)	9.3(6.9)	7.7(5.7)	MWU=6442.5
		Min-Max	1-31	1-26	α=0.03**
Managerial Cognitive Capability	Composite variable derived from manager experience, perceived importance of regulations, network characteristics	Mean (SD)	6.3(1.9)	5.0(1.1)	MW U=7276
		Min-Max	2.3-8.7	2.3-6.3	α=0.47
Level of Marketing Skills	Binary Variable	Medium-Strong	49%	38%	$z = 2.73 > z_c = 1.64$
		Otherwise	51%	62%	$p = 0.01 < 0.05$ Chi Square=3.35 α=0.06
Cluster Network Strength	Binary variable	Strong	73%	58%	$z = 2.47 > z_c = 1.64$
		Otherwise	37%	42%	$p = 0.00 < 0.05$ Chi Square=4.25 α=0.04
FDI-share	Continuous variable as percentage of investment by foreign companies in firm's ownership	Mean (SD)	20.11(20.44)	6.89(18.12)	MWU=6105.5 α=0.05**
		Min-Max	0-100	0-85	
Perception of Regulation	Binary variable	Dealing positively	47%	49%	$z = -0.24 \leq z_c = 1.64$
		Otherwise	53%	51%	$p = 0.6 \geq 0.05$ Pearson Chi Square=1.24 α=0.32
Urban area (only for region 2)	Binary variable	Urban		33%	
		Otherwise		77%	

*Significant at α<0.1 ** significant at α<0.05 *** significant at α<0.01 † significant at α<0.001.

Table 5.3 Results of Ordinary Least Squared (OLS) Regression

Dependent Variable: ***Newness of Innovations-Region 1***

	Model 1(Internal)		**Model 2(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	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	.34(.00)†						.28(.00)†	.29(.01)†	.30(.00)†	
Firm Size sq.		.35.00)†								.29.00)***
Firm R&D organization	-.08(.07)						.12(.07)	.14(.04)	.12(.09)	.11(.07)
Firm R&D intensity	.13(.01)**						.09(.01)**	.09(.00)**	.08(.01)**	
Firm R&D intensity sq.		.14(.01)**								.15(.05)**
Specific: Management										
Manager's ICT skills			.18(03)**				.14(.01)**	.19(.00)**	.14(.03)**	
Manager's ICT skills sq.				.16(.03)**						.16(.02)**
Manager's Experience			.07(.02)				.04(.1	.09(.01)	.02(.03)	
Manager's Exp. Sq.				-.07(.02)*						-.08(.00)*
Manager's CC			.05(.01)*				.09(.05)*	.08(.01)*	.13(.03)*	
Manager's CC sq.				.04(.00)*						.05(.00)*
Marketing skills			14(.01)***				.30(.01)***	.19(.01)**	.18(.01**	
External (EES)										
Cluster Network Strength					.06(.01)*		.07(.01)*	.07(.01)*	.08(.01)*	
FDI Share					.10(.03)*		.08.(.02)*	.09(.02)*	.09.(.01)*	
FDI Share sq.						.10(.01)*				.13(.01)*
Regulation					.09(.01)*	.	.09(.01)*	.09(.03)*	.15 (.02)*	.14(.01)*
Interaction Effects										
Cognitive capability*Cluster Network Strength								.25(.03)**		
Marketing skills*Cluster Network Strength									.09(.01)*	
N	144	144	144	144	144	144	144	144	144	144
F	9.70†	10.94†	11.39**	6.48**	9.89**	3.80**	11.23†	8.23†	8.24†	8.03†
R^2	.34	.38	.29	.28	.15	.09	.44	.46	.47	.45

p<0.1; ** p<0.05 ;p<0.01;†p<0.005**

Table 5.4 Results of Ordinary Least Squared (OLS) Regression

Dependent Variable: ***Newness of Innovations-Region 2***

	Model 1(Internal)		**Model 2(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	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	.22(.05)**						.28(.01)ŧ	.29(.02)ŧ	.29(.01)ŧ	
Firm Size sq.		.24(.01)**								.29(.00)***
Firm R&D organization	-.13(.10)						-.09(.01)	-.18(.04)	-.11(.06)	-.09(.03)
Firm R&D intensity	.09(.03)*						.09(.01)	.09(.03)	.09(.1	
Firm R&D intensity sq.		.11(.01)*								.18(.01)**
Specific: Management										
Manager's ICT skills			.15(01)**				.09(.01)*	.07(.01)*	.09(.01)*	
Manager's ICT skills sq.				.19(.00)**						.09(.00)*
Manager's Experience			-.07(.05)				-.06(.04)	-.09(.04)	-.04(.01)	
Manager's Exp. Sq.				-.07(.11)						-.01(.00)
Manager's CC			.09(.01)*				.11(.01)*	.10.02)*	.11(.05)*	
Manager's CC sq.				.10(.01)*						.17(.00)*
Marketing skills			.07(.02)**				.12(.01)**	.09(.00)**	.09(.01)**	
External (EES)										
Cluster Network Strength					.09(.02)*		.13(.02)*	.09.01)*	.09(.01)*	
FDI Share					.09(.01)*		.07.(.04)	.09(.02)	.07.(.04)	
FDI Share sq.						.10(.01)*				.10(.00)*
Regulation					.17(.01)**		.08(.02)*	.11(.03)**	.09(.00*)*	
Interaction Effects										
Cognitive capability*Cluster Network Strength								.15(.03)*		
Marketing skills*Cluster Network Strength									.09(.02)**	
N	116	116	116	116	116	116	116	116	116	116
F	454**	4.16**	5.78**	4.33**	7.69**	4.74**	9.67***	5.87**	6.11**	7.03**
R^2	.25	.26	.21	.24	.19	.21	.48	.47	.41	.38

p<0.1; ** p<0.05 ;p<0.01;ŧp<0.005**

5.5.2 In search of conditions that help explain the disparity of core vs non-core regions

The study investigates the association between ICT firms' innovativeness and the firm internal, management, and external (entrepreneurial ecosystems) conditions. Here, the variable *Newness of Innovations* is used to measure innovativeness. The reason is that these variable measures the output-side and the quality of innovation.

Similar to Chapter 4 - on the national level - the study investigates four models: model 1 refers only to internal firm conditions without management, model 2 is concerned with specific management conditions, while model 3 only comprises external conditions (entrepreneurial ecosystem). Model 4 is the full model, including interaction effects. The study discusses the strengths of relevant single indicators, partial models internal (firm size and R&D organization), and the strength of the partial model 'external' (entrepreneurial ecosystem); the studyalso explore curve-linearity in relationships.

With regard to Newness of Innovations, the study used an OLS model both for the core region (Region 1, Table 5.3) and for non-core regions (Region 2, Table 5.4). With regard to firm-internal conditions, the relation with firm size is positive and significant in the core region (region 1, Table 5.3) and remaining regions (Region 2, Table 5.4). This also holds for the non-linear nature of the relationship indicating that firm size plays a significant role in increasing returns in both types of regions. In contrast, R&D organization tends not to matter much in both regions, while R&D intensity does matter in both regions at increasing returns. While these patterns indicate similarity between the two types of regions, the partial model of firm internal involved is slightly stronger in the core region than other regions, as evidenced by R^2 levels of 0.38 to 0.36 versus 0.21 to 0.22, respectively. As concerns, specific management conditions, manager's ICT skills, cognitive capability, and level of marketing skills are significant in a positive relationship in both regions. However, manager's experience is only significant in the core-region, particularly in the inverted u-shape relationship. In contrast, the relation with manager's experience is not significant in non-core regions. Further, the relationships between external conditions and innovativeness in the two regions turn out to be different. The association is somewhat stronger in non-core regions as compared to the core region (R^2 of 0.18 to 0.19 versus 0.10 to 0.08, respectively), indicating a somewhat stronger reliance on the quality of the entrepreneurial ecosystem among ICT firms in non-core regions.

And finally, two interaction effects are weakly significant without a difference between the two regions. This indicates that internal capability is moderating the influence of external capability on Newness of Innovation; however, on a relatively modest level only. ICT skills shows a positive and significant role in both regions, while the studyhave seen that the skills level is significantly weaker in non-core regions (subsection 5.5.2).

In summary, the results show the following differences between the two regions regarding Newness of Innovations. Outside the core, firm internal factors (firm size and R&D characteristics) tend to be less important in the non-core regions compared to the core region. At the same time, while managerial conditions are broadly similar in the two regions, firms in the core region tend to face negative influence of decreasing returns of manager's experience.

When the study broadly compares with *R&D Intensity* as the input indicator of innovation (see Table 5.3 and 5.4), the following picture emerges. In non-core regions, the R&D organization does not seem to matter, while it matters strongly in the core-region. The picture is the other way around with regard to firm size: it tends to matter strongly in non-core-regions but not in the core region. In terms of strength of partial models, managerial conditions, tend to be less important in non-core regions. The last result complies with the relatively smaller importance of firm internal conditions in non-core regions for the innovation indicator Newness of Innovations.

As a preliminary conclusion, the results point to a stronger dependence of ICT firms in non-core regions on qualities in the entrepreneurial ecosystem while at the same time these qualities (mainly networks) in the non-core regions tend to be relatively weak compared to the core-region**,** due to the lack of positive externalities, e.g., infrastructure, easiness of access, strong networks with partners using distinct skills and interests (Akita and Miyata, 2017; Lassen and Laugen, 2017). ICT firms in non-core regions thus seem to 'suffer' from barriers on *two sides*, first, less developed internal capabilities that prevent these capabilities from playing a strong positive role (Cirera and Maloney, 2017) and, secondly, less developed entrepreneurial ecosystems in terms of cluster networks and foreign investment networks.

Given the above results, there is also a need to present the findings (mainly on networks) into a broader perspective. In particular, the suggestion by Budiarto and Bachrudin (2018) in that the barriers to innovation collaboration exist not only in non-core regions but also in the core region of Indonesia due to less commitment and different perception of each actor on the collaboration. In a similar vein, Indarti and Wahid (2013) suggest the challenge in building R&D

intermediate organizations in all Indonesia regions, especially between industry and universities, given the differences in orientation in innovation between the two. Industry demands more applied innovations for running the business, while academic researchers are often more interested in theory and in basic innovations.

Concerning the result on the often positive and significant relationship of level of marketing skills with innovativeness, Sugiharti et al. (2017) reveal that most tech-firms in Indonesia, despite the regions, are more locally than internationally oriented when it comes to customers and markets. This is evidenced by most of their value-added contributions (88%) being local. Accordingly, while the study reveals some important differences between the types of regions, other studies take a broader perspective, thereby overlooking some of our results. Because the difference between the core region and non-core regions are relatively sharp, it is important to set different goals in improving innovativeness. In other word, no one-size-fits-all approach, each region should be treated differently based on their distinctive characteristics.

5.6 Discussion and Recommendation

Given the results of the analysis, the research question "*What are the differences between core and non-core regions in Indonesia with regard to ICT firms innovativeness?"* can be answered as follows: core and non-core regions differ in most conditions of internal, management and entrepreneurial ecosystem conditions. Firm innovativeness in the core region is more strongly influenced by internal and management conditions than external conditions, while firm innovativeness in non-core regions is more strongly influenced by the external condition (entrepreneurial ecosystem) than internal and management conditions. Although the findings show that internal and management conditions have more influence on innovativeness in core region, it is important to emphasize that the difference in management conditions and entrepreneurial ecosystem in the two regions is very little. It can be an indication that the management and ecosystem entrepreneur situation are almost the same between the core and non-core regions in Indonesia. Meanwhile, the difference in the influence of internal conditions is significant, due the presence of big scale firms in core region which have sufficient resources to run R&D activities. For all conditions, the direction of the influence is positive.

The second research question, "*To what extent and in which ways are the influence of internal and external factors on firm innovativeness different among these regions?"* can be

answered as follows: the differences refer to all conditions in Table 5.2, including firm size, R&D intensity (internal conditions), on manager's ICT skill & experience (management condition) and on the FDI share and regulation (entrepreneurial ecosystem). As mentioned previously, because of the favourable situations, larger firms tend to establish their office in the core region where they can more easily establish their R&D activities. The influences on innovativeness are positive in both regions with regard to internal condition. Table 5.5 provides a key summary of the differences in the conditions between core (Region 1) and non-core (Region 2) regions and their resulting influences on innovativeness.

Table 5.5 Difference between Core (Region 1) and Non-Core (Region 2)

Item	Conditions		Influence on innovativeness	
	Region 1 (Core)	Region 2 (non-core)	Region 1 (Core)	Region 2 (non-core)
Firm size	More Large Firms	Mostly SMEs	High Influence	Moderate Influence
Firm R&D Organization	Not different	Not different	No significant influence	No significant influence
Firm R&D Intensity	Higher R&D intensity	Lower R&D intensity	Slightly higher influence	Slightly lower influence
ICT skills	Medium to High	Low to Medium	Slightly higher in linear relationships	Slightly higher in quadratic relationships
ICT experience	Slightly higher than non-core	Slightly lower than core	Negative influence in quadratic relationship	No significant influence
CC	Stronger than non-core	Weaker than core	Lower influence	High influence especially in quadratic relationships
Marketing Skills	High	Medium	Strong influence	Low influence
Cluster strength	Strong	Medium	Slightly lower	Slightly stronger
FDI	High FDI	Low FDI	Not different	Not different
Regulation	Not different	Not different	Low influence	High influence

Although regional-economic disparities in Indonesia have already been addressed and analyzed in the literature (Mokoginta, 2018; World Bank, 2012; Aritenang, 2013), how these relate to firm innovativeness, especially in the ICT sector, has often been overlooked to date. This study is new as it disentangles the differences between core and non-core regions of Indonesia concerning innovation and a set of firm-internal and external conditions regarding innovation activities. The study in this chapter demonstrates significant differences in the influences of firm-internal and external conditions on Newness of Innovations and R&D intensity between firms in those two types of regions, however, differences in Newness of Innovations tend to be smaller. The last finding may indicate that firms in all regions undertake a low level of newness (only new to the firm or new to the region), with some exceptional firms in the core. This situation seems understandable considering that for developing countries, the relation to the contexts (local

improvements, development of competitive industries, innovations of global significance) is important and particularly relevant (Aubert, 2005).

Core and non-core regions have differences in the entrepreneural ecosystem and firm capabilities in many ways. Their innovativeness relationships with management capabilities are much stronger in the core region than those with external conditions (entrepreneurial ecosystem). Meanwhile, in the non-core regions, the innovativeness relationships with the two conditions seem weaker for firms outside the core. The most pressing outcome for non-core regions is that non-core regions have relatively modest firm-internal capabilities but also small potentials in entrepreneurial ecosystem. Non-core regions also need more efforts to push out innovativeness, in terms of ICT skills and manager cognitive capability.

Limitations and Recommendations

Despite the empirical contribution to a regional study in the local and sectoral Indonesia ICT context, our study also contains some shortcomings as follows. First, the division of core and non-core regions may not precisely represent Indonesia's actual situations. Nevertheless, despite Indonesia's official data on region agglomeration, the approach resembles other research (i.e., World Bank, 2012) regarding core and non-core regions disparities. In future research, a *regional agglomeration indicator* should be included in a detailed division of the country into relevant regions. In this regard, the attention may focus on the challenging conditions in core region, namely entrepreneurial ecosystem. Such special treatment will give non-core regions the opportunity to at least limit the gap with the core region or even beyond the advancement of core region. Second, some small firms refused to act as respondents in the survey caused by scarce human resources or being ashamed for poor conditions (Bartholomew and Smith, 2006). However, this study has checked the influence from non-response bias in the previous chapter and found no serious influence from such bias. In addition, there has been compensation with in-depth interviews with small firms and experts (see the previous chapter). This study argues that core and non-core analysis is also about decreasing or increasing differences between the two types of regions and suggests more research on other conditions that may cause differences between core and non-core region to better understand the discrepancy between regions, especially on supportive networks and institutions in the entrepreneurial ecosystem. The next chapter (Chapter 6) will focus on provisional policy lines that follow from the national (sector) analysis (Chapter 3 and 4) and the regional analysis in this chapter.

Chapter 6 Design of Innovation Change Strategies in the ICT Sector in Indonesia: Towards a Stronger Firm Innovativeness

6.1 Introduction

The aim of this chapter is to design a change strategy to increase firm-level innovativeness in Indonesia and improve underlying conditions. The major problem or challenge at ICT firm-level, as appeared in Chapter 4 and Chapter 5, can be summarised as firm size and shortage in innovation management, in particular for non-core regions' relatively modest firm-internal capabilities but also small potentials in entrepreneurial ecosystem.

In general, each policy or change strategy that will be designed needs to satisfy a set of criteria to make them effective. Effective because these strategies need to solve the problems and address the challenges involved at a sufficient level. With regard to type of criteria, the chapter deals with general policy criteria to increase effectiveness (e.g., Howlett, 2018) and specific ones following from the transfer of policy concepts that originate in developed countries to be applied in developing countries. In more detail, Howlett (2018) suggests three related criteria in developing an effective strategy: consistency, coherence and congruence. Consistency includes the ability of multiple policy tools to reinforce rather than undermine each other in the pursuit of policy goals; coherence involves the ability of multiple policy goals to coexist with each other and with practical instrument norms in a logical fashion; and congruence encompasses the ability of goals and instruments to work together in a uni-directional or mutually supportive fashion. Furthermore, policy aims and solutions established in developed countries facing different cultures, value-systems and institutions compared with developing countries (Hofstede 2010, 2011), need to be adapted in a certain way to make their adoption and implementation realistic (e.g., De Jong et al., 2007). In this context, 'transferability' may include incrementally introducing new ways of decision-making, namely more collaborative ones.

In addition, importantly, this chapter incorporates the findings from Chapters 3, 4 and 5 by developing innovation change strategies that are context dependent. The results of these chapters confirm that management conditions play a significant role in influencing innovativeness; for example, about 50 per cent of R&D intensity can be explained by conditions in management, including ICT skills and level of marketing skills of the firm. In principle, ICT innovation in Indonesia faces challenges concerning culture and mindset in innovation activity management.

More specifically, Indonesia faces major challenges in the ICT sector's infrastructure and social networks, such as bridging the digital divide (Puspitasari and Ishii, 2016) and sufficient education of ICT talent and leading entrepreneurs. The digital divide reduces access to ICT, which hinders the production, use and transfer of knowledge (Giebel, 2013).

National policy and regional policies have already been formulated and implemented mostly using a top-down approach (Article 4 of Law No. 25/2004 on National Development Planning, the National Long-Term Development Plan/ RPJPN 2005-2025), however, with little results. In 2021, after encountering the Covid-19 pandemic, the Government of Indonesia (GOI) released five focus areas in ICT: 1) the expansion of access and increase in digital infrastructure; 2) digital transformation in strategic sectors; 3) national data centre integration; 4) digital talents and 5) digital transformation planning (e.g., financing). Despite the intentions of governments, there remain regulatory issues (trade) at international level that may hamper the competitive production of local ICT firms (see Sector Chapter 3). For that reason, even stronger efforts are needed to enhance Indonesia's innovation activities, as will be suggested in this chapter.

This chapter is one of the very few studies to improve the shortcomings in Indonesia's ICT innovation development. Other studies, e.g., Gryseels et al. (2015), propose some ideas to maximise the socioeconomic impact of ICT in Indonesia by, among other things, developing a national ICT agenda and roadmap linked to Indonesia's economic and social development priorities. However, the study by Gryseels et al. (2015) does not provide detailed steps or strategies to realise the ideas. This chapter focuses on detailed steps in designing a change strategy to promote innovation activities in the ICT industry in Indonesia to facilitate the implementation of modernised innovation effectively. The chapter highlights several subject matters, such as entrepreneurship development and ICT curriculum and infrastructure, and key policy design in collaborative policymaking, including policy transfer approach, to have new policies on entrepreneurship and innovation management implemented. Hence, this chapter helps fill the knowledge gap in contextualisation of change strategies, i.e. how different national contexts and economic, geographic, and institutional factors affect ways in which ICT innovation change strategy may be formulated, designed and implemented. Accordingly, the following question on what a change strategy would look like, is addressed:

What would be the content and processes(steps) in a change strategy? *How should the change strategy be designed and implemented and what are the implications for the design of the policies?*

This chapter, which is exploratory in nature, contributes to the literature by extending the analysis of innovation strategy and implementation in the ICT industry context, particularly in emerging economies like Indonesia. It will be assumed that changes in specific sectoral strategy by the central government may improve innovativeness of ICT-based firms in Indonesia if designed and implemented in a more collaborative way, thereby increasing effectiveness. With regard to the methodology followed, the key findings from a literature study on innovation and results from a survey and interviews on innovation in ICT-based firms in Indonesia are presented, and a change strategy with a better translation into innovation programs is explored. The change stategy inspired by key literature on problem analysis, system change, collaborative and adaptive policymaking. The study carefully selected the necessary ingredients for this methodology, considering the unique needs and challenges of the situation at hand. During the interview process, thoughtful discussions with various stakeholders (including practitioners, manager representing firm size and regional academicians) were engaged to gather their insights and perspectives. The study employed various techniques, including triangulation (between survey results, interview and official documents) and text interpretation, to ensure the resulting strategy was comprehensive and practical. The study inserted some more relevant characteristics of the text-interpretation programs. The study developed an impactful change strategy by leveraging the best practices and insights from the literature, combined with the valuable input and feedback from the interviewees.

The rest of the chapter is structured as follows. The next section (Section 6.2) introduces the methodology behind this chapter, and discuses selected theories on culture and value systems in society and also includes relatively new perspectives and approaches to the design of new policy, such as a multi-level perspective on transitional change, multi-actor approaches, and collaborative and adaptive policymaking. Section 6.2 also discusses arguments of 'policy transfer'. The section closes with a practical example of new innovation models, i.e., co-creation between producers and customers. Further, Section 6.3 presents the design methodology of change strategy, including structure and steps of the methodology. Detailed steps are discussed, such as problem analysis and actor-and-network analysis, followed by the formulation of a preliminary strategy aimed at addressing the ICT sector challenges, with a focus on Entrepreneurship Development and ICT Infrastructure and ICT Curriculum. The chapter proceeds with insights on the evaluation of the proposed methodology, given several design criteria and the idea of policy transfer (Section 6.4) and it closes with a summary and conclusion (Section 6.5).

6.2 Theoretical Perspectives on Design of a Change Strategy

6.2.1 Methodology behind results

The practical foundations (empirical sources and input) underlying the design methodology will be explained as follows. The design process draws on 21 interviews in specific social and economic circles, such as ICT practitioners, academicians, development experts and government (see Chapter 4 and Appendix 2 for detail). The interviews focused on the challenges and opportunities in ICT sectors and opinions on tackling the issues. In most interviews, open-ended questions were posed, including the interviewee's advice about general innovation activities in Indonesia and a few specific situations like FDI and firms' management capability. Interviews were conducted in two rounds. The first round encompassed questions similar to those used in Chapter 3, while the second round encompassed semi-structured interviews including aspects that were not previously covered, like the ICT education system in Indonesia. Next, the firm survey (Chapter 4) and the interview results on problems and challenges have been combined with results from other (data) sources, such as desk-research including studies on ICT innovation in Indonesia.

The interview results have been processed in Nvivo and coded using two subjects: 'challenge' and 'solution'. Further in the analysis, three categories were identified covering 1) entrepreneurship development, 2) ICT curriculum and infrastructure, including coordination, and 3) collaborative (adaptive) policymaking (Figure 6.1). In this way, a basis is provided to investigate the problem/challenges followed by possible solutions as strategies for change based on the interviewees' perspectives.

As previously indicated, there are three policy requirements (three related criteria) (Howlett, 2018): (1) consistency, the ability of multiple policy tools to reinforce rather than undermine each other in the pursuit of policy goals; (2) coherence, the ability of multiple policy goals to co-exist with each other and with instrument norms in a logical fashion, the relationships within the shaded area in figure, and (3) congruence, the ability of goals and instruments to work together in a uni-directional or mutually supportive fashion. The methodology is expected to satisfy these three criteria as much as possible and also the criterion of policy transfer (transferability, adaptation) in solving the challenges observed in the empirical study.

Attention will now move to theoretical approaches underpinning design, including culture and value system, multi-level perspectives on Transition and National Innovation Systems, Multi-

Actor situations, Collaborative Policymaking and Adaptive Policymaking, policy transfer and co-creation model. Each theory contributes to the understanding of innovation and system change and the implementation of the change strategy.

6.2.2 Culture and Value Systems

National culture and value systems are often seen as influencing policymaking, management, developing new ideas, etc. (see also Chapter 2 (2.2)). Accordingly, scholars put a different emphasis on cultural dimensions that capture shared values in societies or nations. Hofstede (1984), for instance, differentiates between four cultural dimensions: power distance, uncertainty avoidance, individualism/collectivism and masculinity/femininity. More recently, Hofstede et al. (2010, 2011) added 'long-term orientation' as a fifth cultural dimension. In an alternative classification (Trompenaars and Humpden-Terner, 1993), the dimension of communitarianism/individualism is almost similar to Hofstede's collectivism vs. individualism. Furthermore, according to Hofstede's study, Asian countries typically have a high score on Power Distance and a low score on Individualism. Specifically, Indonesia has the highest score on Power Distance and the lowest score on Individualism compared to Asian countries on average. Therefore, considering these extreme scores, the study focuses on the cultural dimensions involved and describes them as follows (Hofstede et al., 2010): (1) *Power Distance,* as the degree to which members of a society accept that power in organisations and institutions is unequally distributed; this dimension indicates that power structure and hierarchical relations are considered essential and legitimate in a given community; (2) *Individualism/Collectivism,* as the degree to which members of a society value an individual's preferences and interests versus those of a group. The two dimensions will be used to analyse the adoption of change in matching a different culture, especially in terms of leadership and innovativeness.

6.2.3 Multi-Level Perspective (MLP) on Transition and National Innovation Systems (NIS)

Change in technological innovation can be discussed using two main approaches: transition study and Innovation Systems perspective. There are many approaches within transition study, such as the Multi-level Perspective (Geels, 2002), Strategic Niche Management (Raven and Geels, 2010) and Transition Management (Loorbach, 2010); all three focus on system transition to higher levels of environmental sustainability, while Innovation Systems (Freeman, 1995) focuses on improving the behaviour of innovation actors, institutions and relationships in production systems.

The Multi-Level Perspective (MLP) is an evolutionary approach that conceptualises a structural change pattern on socio-technical regimes and consists of three levels: landscape factors, regimes and niches (Rip and Kemp, 1998; Geels, 2002). The first level, the socio-technical landscape, is the broader context, like new international visions/policies on climate change, as an outcome of World Conferences. As the second level, the socio-technical regime forms the 'deep structure' that accounts for the stability of an existing socio-technical system mainly by avoiding radical innovation of the system (Geels, 2004). At the third level, one can observe niches as 'protected spaces' of experimentation such as R&D laboratories, subsidised demonstration projects and small market niches where users have particular demands and are willing to support emerging (radical) innovations (Raven & Geels, 2010; Geels, 2011). If all three levels are taken together, if tensions arise, a radical innovation may take advantage and break through on the regime level and may replace what constitutes the regime. This will be followed by broader changes (e.g., policies, infrastructures, and user practices). However, change at the regime level is most often 'blocked' or just includes incremental change due to sunk investments, vested interests, habits, bureaucracy, and other factors that support stability and, at the same time, constrain flexibility and opportunities for radical change.

Different from MLP, which uses socio-technical transitions perspectives mainly applied in sustainable energy change, the National Innovation System (NIS) uses a systematic approach to (technological) innovation, like biotechnology and artificial intelligence (AI), etc. In NIS, innovation actors, institutions and relationships are conceived as essential elements of national production and innovation (Lundvall, 1992; Woolthuis et al., 2005). Innovation actors encompass universities, research institutes, industrial firms, private and public research organisations, governmental bodies (e.g., ministries or city councils), intermediaries, investment banks, venture capitalists and angel investors (Edquist, 2011). Universities and researchers in public or private research institutes conduct research and train a technical and scientific workforce (Patel and Pavitt, 1994; Watkins et al., 2014; Mudde et al., 2017), while they interact with industry sectors (firms) in generating and demanding innovation. In addition, the industry operates as a central actor to commercialise novel knowledge and bring it to market, be it a large multinational company (MNC) or a small university spinoff firm (Patel and Pavitt, 1994). In particular collaborating innovation actors are connected through networks, and these may differ in cognitive, organisational, personal, institutional and geographical dimensions and network characteristics like 'closeness' between

actors and hierarchy. To stabilise (smoothen) activities in these relationships, several 'rules of the game'or institutions have been issued in an NIS, e.g. laws, regulations and codes of conduct (Edquist, 2010, 2011). Further, NIS approaches are multi-level in various respects, including industry sector level versus individual firms and governance at the national level versus regional/local level, and resemble, in a way, multi-level perspectives (MLP), though MLP is basically seen as a non-spatial perspective.

Similar to MLP, there is a certain resistance to change or improvement in an NIS system, and such resistance also varies according to the incremental or radical nature of the intended change. The current study uses these perspectives because of the need for innovation systems in Indonesia to change, in order to increase the level of innovativeness. Incremental change is clearly preferred, to learn on the way and experiment with the new processes of consultation and deliberation in a multi-actor context.

6.2.4 Multi Actor System, Collaborative Policy and Adaptive Policy

The multi-actor system theory provides a theoretical basis for analysing and structuring multi-actor problems. Multi-actor problems are characterised by the presence of many different social and/or economic actors that hold divergent or conflicting interests and perceptions of a problem situation and act strategically to get the best out of that situation (Enserink et al., 2010; Kauffeld-Monz & Fritsch, 2013; Bryson et al., 2017). The approach addresses policy problems and processes that involve multiple actors (parties) in Western Europe who are typically organised in a network rather than in a classic hierarchy. No single actor is able to impose their desired solution; therefore, it is necessary to form some cooperation among parties. One of the advantages of the multi-actor system approach is analysing what (the type of) actors are involved in the problem situation and their interests, goals and power positions. The multi-actor system also analyses what possible alternatives are perceived if there is a conflict and how to obtain support from important actors and build supportive coalitions.

According to Ansell and Torfing (2017), implementation problems, as defined by the failure to turn public policies into practice and deliver the intended results and effects in implementation, are pervasive at all government levels. Public decision-makers spend a lot of time and effort creating public policy solutions that can gather support in parliamentary assemblies and then leave policy implementation to public administrators and expect that the desired results will be achieved. However, many studies have shown a considerable gap between the planned outputs

and the actual public policy outcomes (Teddy et al., 2016). The deliverable of public policies is highly problematic as it may undermine the authority and governing capacity of democratically elected politicians and, as a consequence, tends to leave pressing societal problems unsolved.

Taking a collaborative approach to public policymaking may solve the problems of authority and governing capacity and societal pressures. Ansell, Sørensen & Torfing (2017) argue that collaboration between bottom-up and top-down policy actors will spur processes of mutual learning and policy innovation and create a flexible adaptation of the content of public policies and the plans for implementation to match the conditions on the ground. Multi-actor collaboration based on consultation and deliberation tends to bring forth relevant knowledge, stimulates mutual learning processes, builds joint ownership over the new solutions and increases trust. Since the implementation of well-crafted policy designs cannot be ensured through traditional top-down implementation based on command and control, the collaborative design process should be extended to enable the adaptation of the initial policy design to better reflect local conditions, emerging problems and challenges in local practice.

6.2.5 Policy Transfer

According to Hulme (2006), policy transfer is a strategy to deal with changing circumstances, rationally and politically. By searching from readily available definitions and responses from other countries that have been tried and tested, and by searching from the past, the policy makers in receiving countries may put their learning into effect.

Policy transfer refers to a process in which knowledge about institutions, policies, delivery or regulatory systems, including production models, in one sector and/or level of governance, or countries, is used in the development of institutions, policies, delivery or regulatory systems at another level of governance or in a different country (Evan, 2009). However, according to Cairney (2012) policy transfer is a complex process and not an easy ‘copy and paste’ operation. According to Wicaksono (2018), Indonesia has a longstanding tradition of appointing academics into public office, namely ‘Academic-administrator entrepreneurs’, who enable the process of importing foreign policy ideas. These officials influence processes of change governance in such a way that importing selected foreign policy ideas may help renew domestic policymaking, whereby social, political and knowledge resources are made available.

On the other hand, policy transfer is criticised for its weakness in increasing comprehensive understanding of the complex interaction between domestic and foreign culture and institutions (Afifudin, 2010). In particular, policy transfer pays little attention to how cultural assimilation in the implementation process informs the outcomes of transfer. The attention of policy transfer to the interaction between indigenous policy actors and policy borrowers is also limited. An interesting example of transfer of a model of production is co-creation between producers and customers, as it may prevent market risks, specifically for small ICT firms (see Chapter 4).

6.2.6 Co-creation as an Innovation Model

Co-creation comes in the picture as change strategy in this study along two lines, first, to improve opportunities of firm innovativeness in ICT business sector, and secondly, to improve opportunities of use of ICT technology in local application to increase quality of cities as living places and entrepreneurial ecosystems ('Smart Cities').

Co-creation in the ICT business sector will be discussed in this subsection, while co-creation in policies of urban solutions will be discussed following explanations of the new approaches, in subsection 6.3.4.

Co-creation in ICT Business Sector, between producers and customers, nowadays has become a key approach to facilitate achieving positive customer experience and long-lasting relationships (Payne & Frow, 2008). Piller et al. (2012) explain co-creation as an active, creative and social partnership process between producers (designers of innovation) and customers (users). Rajah et al. (2008) consider that co-creation happens when the consumer and the firm work together to create a consumer experience that adds value to the buying process. Zwass (2010) defines co-creation as the participation of consumers with producers in the creation of innovation and value in the market. Most studies on the co-creation process have concentrated on the interaction between customers and providers in the basic service-dominant logic (S-D logic). S-D logic stresses the role of customers; that is, each customer is recognised as an active co-creator of knowledge and service value.

Based on several studies in Indonesia (e.g., Novani, 2016; Aristiawan, et al. 2021; Syah & Olivia, 2022), customers have a positive intention with adopting co-creation, while producers still face some challenges regarding implementing the model, such as concerning intellectual ownership (IO) of the newly created knowledge (innovation) or misunderstanding between partners. In further detail, the study by Aristiawan et al. (2021) indicates which processes and

values in Indonesia need to be better developed to fully enjoy the benefits of co-creation as business model. Such situation mainly refers to dialogue and risk assessment derived from values like openness (transparency) and trust and leaving hierarchy behind. For example, dialogue tends to be more than simply listening to customers. It also encompasses collaborative planning and collaborative analysis of problem/challenges between two equal problem-solving actors (customers and producers).

6.3 Methodology of Change Strategy

The detailed steps of the methodology designed are shown in Figure 6.1. The methodology is intended to address challenges in entrepreneurship development, ICT education and infrastructure, and policy-making characteristics (collaborative and adaptive). It must be noted that the five consecutive steps are not mutually exclusive and may partially overlap, like actor- and network analysis and problem formulation, while monitoring takes place over all steps.

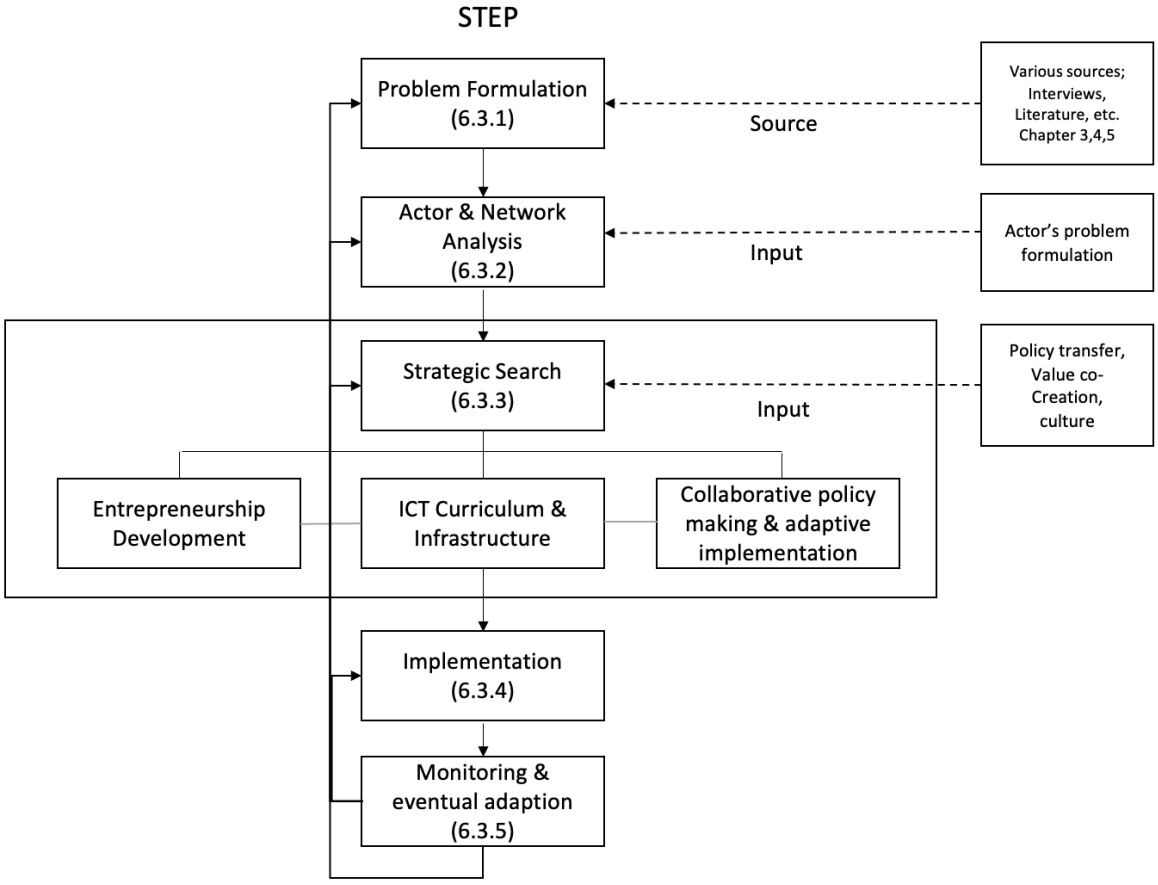


Figure 6.1 Steps in Change Strategy Formulation
(Including Sources and Input)
(Adapted from Bowman, 2003)

Next, in subsequent sections, the change strategy formulation will be discussed step-by-step, starting from problem formulation and ending with monitoring and eventually an adaptive approach to the policymaking process.

6.3.1 Step: Problem Formulation

As mentioned in Section 6.1, there are several main shortcomings concerning business innovativeness in Indonesia, e.g., low-level innovativeness overall in the country due to missing aspects in firm management, imperfections within the culture and education system, and missing agglomeration advantages in regions outside Jakarta region (digital divide). This section discusses several challenges and gaps that need to be addressed by policymakers in Indonesia. The obstacles and gaps are connected to several issues the study has already discussed in Chapters 3, 4 and 5, including differences in ICT infrastructure, general differences in agglomeration advantages and poor human resources (related to culture and education). Chapter 3 emphasised the digital divide, disparities in ICT education and workforce readiness. Chapter 4 presented an analysis of the firm-specific and firm-external conditions influencing innovativeness in the sector at national level, and Chapter 5 focused on regional differences, i.e., between the core region and other regions, in particular on firm-internal conditions (management) and entrepreneurial ecosystem conditions.

Drawing on literature review, it is necessary to add a few other challenges for improvement: poor coordination between Ministries and between different government levels. This poor coordination has been recognised by the Ministry of Communication and Information Technology of Indonesia and the National Development Planning Agency (Iskandar and Idris, 2014). However, following a regime change in 2014, the recognised problems do not get much attention from the new regime. With a shortage in problem-recognition by stakeholders involved, elaborating the design of solutions will be rather complicated.

Figure 6.1 indicates that the steps of Problem Formulation, Actor and Network Analysis and Strategic Search will focus on three ‘material’ challenges: Entrepreneurship Development, ICT Infrastructure, and ICT Education and Culture. The challenge of Collaborative and Adaptive Policymaking, as a characteristic of policymaking, will be discussed under Directions for a Solution (Section 6.3.3). The three ‘material’ challenges will be discussed in more detail below.

(1) Entrepreneurship Development

With regard to problem formulation (recognition), the following can be mentioned. Entrepreneurship suffers from low management potentials and poor skills, e.g., financial management and market(ing) skills, low ambition and uncertainty avoidance (failure) in management of innovation activity. Overall, being an entrepreneur is not popular in Indonesia. Accordingly, there is a need to change entrepreneurial culture. The whole point of entrepreneurship development in Indonesia is to increase the number of entrepreneurs, particularly innovative entrepreneurs that bring new technology to the market in a competitive manner and improve the nation's competitiveness. The development of innovative local Indonesian entrepreneurs in ICT will strengthen domestic competitiveness in such a way that, in the long term, dependence on foreign markets can be reduced.

(2) ICT Infrastructure

With regard to problem formulation (recognition), the following can be mentioned. As a nation with a broad differentiation between regions, Indonesia recognises the existence and impacts of the digital divide, especially in the country's eastern part due to its remote location. With regard to regions, Java is much more advanced than other regions; especially Jakarta is the most developed region in Indonesia. As the capital city of Indonesia, Jakarta is a popular and attractive location for establishing firms or business entities. Based on findings in Chapter 5, the Jakarta region can clearly be regarded as more innovative than the rest of Indonesia, witness R&D expenditure of 24.7 per cent of turnover versus 17.7 per cent in other areas, and level of innovativeness of 9.0 versus 7.6 with a maximum 10.6. Our findings are confirmed by official data from Statistics Indonesia in 2018 (see appendices Chapter 5). In this regard, the lack of ICT access (connectivity) in regions outside Java contributes to the low level of knowledge and skills in ICT, which makes it challenging to undertake innovation activity. However, both (low ICT connectivity and low ICT knowledge and skills) reinforce each other, which makes it difficult to change. In sum, the digital divide creates not only challenges in human resources (managerial) problems, but also challenges in innovation development.

(3) ICT Education System and Culture

It is recognised that challenges in Indonesia's human resources are connected to specific cultural traits and imperfections in education systems (see Chapter 4 for country results and Chapter 5 for regional differences in Indonesia). Challenges in culture are reflected in behaviour such as low ambition to increase innovativeness and acting according to high power distance. Another challenge is the building of a culture of innovation. Most schools and university systems do not encourage curiosity, exploration, or inquisitiveness (showing an interest in learning things), which would be beneficial attitudes for creating an ambitious innovation culture.

Some gaps across professional profiles reinforce this situation: computer skills followed by analytical thinking and behavioural skills, typically communication, organisation, teamwork and leadership skills (Di Gropelo et al., 2011). Studies also reveal critical gaps in creativity, computing and some technical skills (e.g., computer literacy and electronics) among young workers, according to Suprapto (2016). An interesting measurement in this context is scientific literacy using The Programme for International Student Assessment (PISA) emphasising four related aspects: context, knowledge, competencies and attitudes (OECD, 2013). In terms of background, students must be able to recognise the real-life situation involving science and technology. According to PISA, in regard to the Indonesian knowledge and position when it comes to understanding and application, the students still have less knowledge of the natural sciences and knowledge about science itself. Turning to competencies, Indonesian students are not taught to identify scientific issues, explain phenomena scientifically and use scientific evidence. Finally, the students do not perform well in supporting scientific inquiry, motivation and acting responsibly towards natural resources and environments as part of the attitudes dimension.

With regard to culture, as indicated above, Hofstede's analysis of Indonesia points to a very high-power distance with offsetting low individualism (Hofstede, 2019). A high-power distance situation indicates a high level of inequality of power and wealth within society, which is typical for Asia (Dissayanake, 2015), including acceptance of power coming from the top without further justifications. Meyer (2017) shows Indonesia to be the most hierarchical society in cross-country research, with hierarchical and top-down approaches to innovation and governance (authority). This situation makes innovation difficult because innovation is not a one-man-show and takes place in different collaboration formations, horizontally and vertically within firms and between firms (Bjerke and Johansson, 2015). Another study of innovation in Indonesia also finds that

people tend to avoid mistakes related to uncertainty avoidance (Verhezen and Abeng, 2016). Therefore, the process of decision-making goes very slowly. Innovation, however, is a trial-and-error process that requires some flexibility in the management of the innovation process, causing Meyer (2017) to argue that the problem situation has little to do with technology and innovation but everything to do with culture and mind-set, which is different from common perceptions. Changing the mind-set is much more complicated and slower than buying and implementing new technology.

In this context, Santosa (2014) points out two additional but significant problems of culture: 1) low recognition and appreciation of the entrepreneurial profession and 2) a family culture which is less appropriate when applied in an entrepreneurial environment with challenges but also risks. With regard to the first point, Indonesian people tend to attach more value to other professions considered as promising for the future, such as civil servants, doctors and engineers. Therefore, young people are not prepared to become entrepreneurs. With regard to the second point, 'family culture' causes a mixture of financing for personal use with that of business purposes. If one family member succeeds as an entrepreneur, he/she will become the breadwinner of the extended family. In sum, the challenges in human resources related to ICT education and business culture can be indicated as hindering the ICT innovation performance in the country.

The focus of attention now returns to steps in the Change Strategy Formulation (Figure 6.1), namely Actor and Network Analysis and Strategic Search for (directions of) solutions.

6.3.2 Step: Actor and Network Analysis

The second step in the Change Strategy Formulation is to analyse the actors and their networks (including resources) in Indonesia's innovation system. This step may partially overlap with the previous one, as problem formulation and understanding also require a solid understanding of actors and their networks. The discussion involves actors at the national and regional levels.

According to the Centre for Innovation Policy and Governance (CIPG) and Nesta (2019), the National Innovation System of Indonesia consists of many actors, including several ministries in the central government, such as the Ministry of Industry (MoI), Ministry of Research and Technology (Ristek), Indonesian Academy of Sciences (AIPI), National Research Council (DRN), National Innovation Committee (KIN) and a set of private organisations, e.g., large multinationals, as displayed in Figure 6.2.

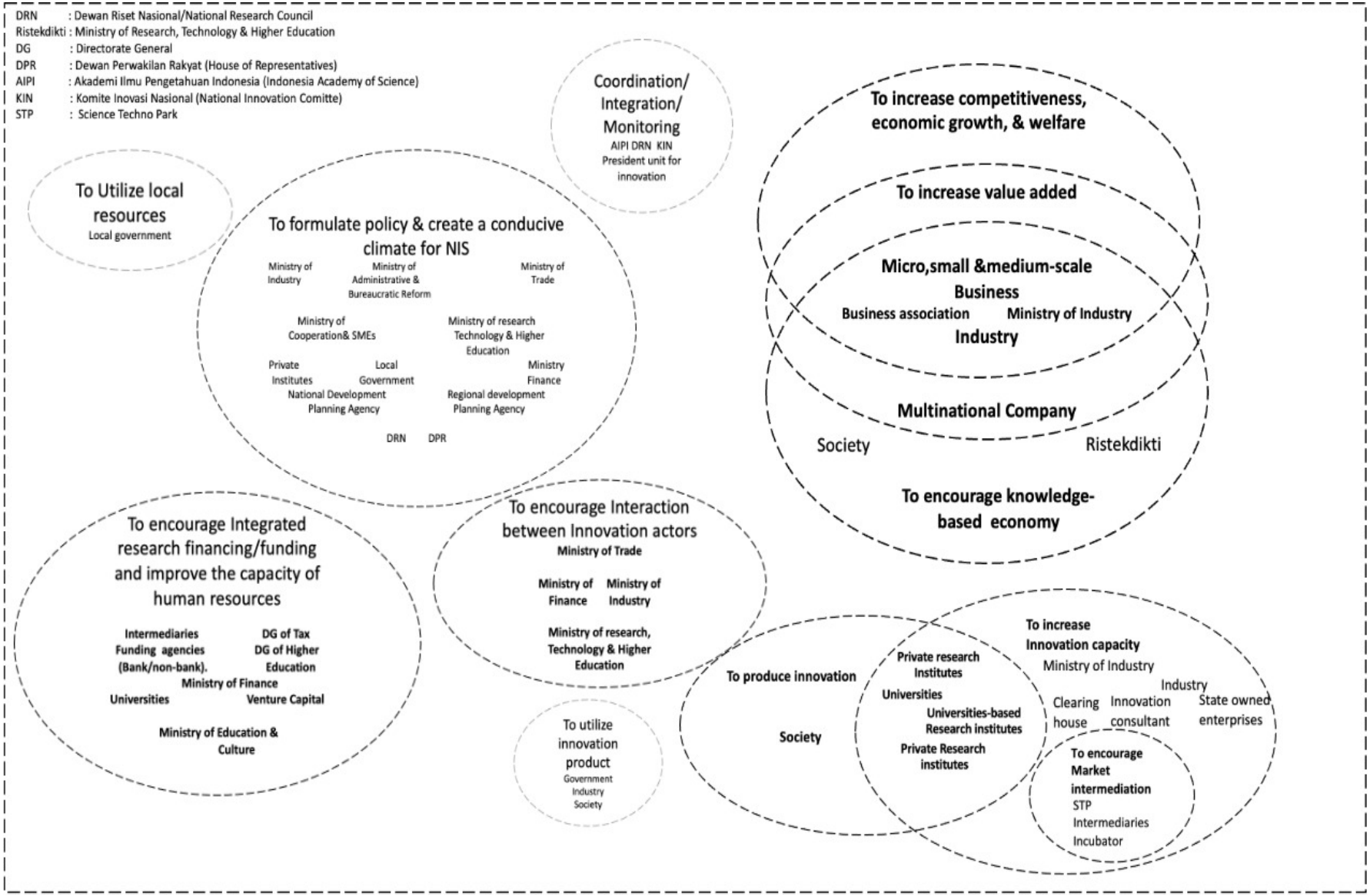


Figure 6.2 Activities in Indonesia National Innovation System
(Source: CIPG, 2017)

Figure 6.2 shows the many actors in the Indonesia Innovation System, including overlap between their activities. After the economic and political crisis in 1998, Indonesia adopted a wide range of social reforms from a centralised approach to wide-ranging decentralisation by giving both greater political power and budgets to lower-level governments. As a result of some choices, the 'government' actors encompass central government, including several ministries and committees (as main actor) and regional government. Other actors are the firms, NGO and universities/research institutions, which have less authority (fewer powers). Appendix 17 shows the level of authority (national, regional or firm), the subject area addressed (entrepreneurship development, policymaking or ICT infrastructure), each actor's objective for each area, the existing or expected situation and the gap between the current and expected situation. It also shows essential resources owned by each actor and/or provided to other actors and potential tension between them. The next paragraph will discuss the roles of the main actors.

As the main actor, the central government deploys power and provides directives to influence coordinating, financing and regulating the innovation at the national and regional levels. However, in a change process, the participation of other actors in designing policies and decision-making tends to be important in achieving the ultimate goal of efficient implementation. Each actor at lower level has different resources, such as human resources, finance and organisation, and unique knowledge and understanding of regional/local situations. Therefore, the study proposes that policy from the central government should be designed collaboratively with other actors to address the needs of all actors involved. However, this is not that easy because actors may have different objectives, eventually causing tension between them. For instance, in entrepreneurship development, the central government will focus on those regions where high potentials can be developed. In contrast, the regional government will focus on the development of its region only. As a result of the central government's selection, some regions will lag behind and existing gaps will continue to exist. Using actor analysis, mapping each actor (including the resources they have) can identify and mitigate the potential tension that needs to be addressed in formulating the solution, especially for central government. The main benefit of a mapping is to get a visual representation of all actors who can influence the activity, eventually with different viewpoints and interests, and how they are connected. Such an overview may also be helpful in organising consultation on a challenge and on evaluation of implemented policy.

6.3.3 Step: Strategic Search for Solutions

Next in developing a change strategy is the search for (directions of) solutions given the problem formulation and results of actor and network analysis. In line with the recognition of problem areas in Section 6.3.1, three directions of solutions are presented, namely *Entrepreneurship Development, ICT Infrastructure Development and ICT Curriculum Improvement*, and separately and with a stronger focus *Collaborative and Adaptive Policymaking* as a new characteristic of policymaking processes.

Entrepreneurship Development

Based on Bessant and Tidd (2016), entrepreneurship development is the process of improving entrepreneurs' skills and knowledge through specific training and classroom programs. The whole point of entrepreneurship development in Indonesia is to increase the number of entrepreneurs, particularly innovative entrepreneurs.

Indonesia's central and regional/local governments have already initiated several strategies to facilitate entrepreneurship development. However, the implementation is hampered by limitations, like poor coordination, especially between central and local government, and a shortage of funds to implement the programs. To tackle the issues, collaboration in the design of the policy and its implementation with business and research institutions will be needed. Meanwhile, to address the management problem, a training set specialised in ICT management can be prepared using various tools in public or private training institutions. Further, to improve an ICT innovation leader mindset, on-the-job training can be organised among groups of firms that want to participate under central/local government coordination. The state-owned company involved can initiate this specific program to ease the coordination with the responsible government institutions. If the program succeeds, it can attract other private firms to join/create similar programs, thereby improving collective knowledge.

Meanwhile, several actions can be undertaken to tackle the problem of business culture mentioned in 6.3.1, such as adding entrepreneurship curriculum at elementary school which may raise the desire among children at young age to become an entrepreneur. Similarly, financial management education should be urgently added to the curriculum to equip young people with the financial knowledge needed for when they are ready to get involved on an entrepreneurial journey.

ICT Infrastructure and ICT Curriculum Improvement

Improvement of ICT infrastructure is already a substantial policy at national level, with the realisation of the Palapa Ring (Chapter 3). The issue to be discussed here is the taking advantage of an overall improved ICT connectivity in the country, with regard to increasing innovative entrepreneurship through improved education.

Improving education in general would mean changing the curriculum to tackle the fundamental barriers: low ambition, lack of creativity and curiosity, and avoidance of failure. The use of ICT in education is still low in Indonesia (Munir, 2010; Hermawan et al., 2018). Although schools in Indonesia use ICT, it is still limited in scope especially in regard to the cultivation of ideas and learning. Such limitation is a significant issue in Indonesia's education development policy. To catch up, the government issued some strategic plans through the Department of National Education in 2018. Despite good intentions, the strategic plan still needs to be expanded and intensified regarding the use of ICT, including ICT as a curriculum material and as a medium in the interactive learning process (Hermawan et al., 2018). In more detail, ICT as a curriculum material was meant to be implemented in the 2004 curriculum. Competency-based curriculum (called KBK) and the 2006 curriculum (Education Unit Level Curriculum, called KTSP) have both made ICT a compulsory subject in secondary schools. However, there is a lack of implementation because of the still existing digital divide in ICT connectivity. In this case, lack of ICT education is caused by the digital divide; however, the lack of education and knowledge of ICT also adds to the list of causes of the digital divide. Regarding directions of solutions, therefore, the central government needs to balance and combine the implementation of the ICT curriculum with infrastructure development. Limited communication and lack of access to information in schools are significant barriers to improving Indonesia’s e-education in various fields, mainly in East Indonesia. The provision of ICT infrastructure has the potential to enhance current and ongoing initiatives and enable new initiatives designed to take advantage of school capacity building. However, to achieve this goal, the implementation plan requires the standardisation of ICT installations for different types of schools and uses, support for improved procurement practices, and the procurement and installation of computers and network hardware in schools across the remote regions. Further, the implementation of the ICT curriculum needs to overcome challenges within education culture. For instance, the education system's high power-distance often positions

the teacher as the centre of attention and overlooks the student's potential. Tackling this challenge can be done by improving a teacher's capability and skills.

In sum, although the problems and challenges in education, in general and specifically regarding ICT, are recognised by the government, solutions are hampered or delayed by the lack of hardware and software in schools in remote regions, (technical) standardisation issues between schools and lack of focus on students' talents and creativity.

Focus on Collaborative and Adaptive Policymaking

The above indicated directions of solutions are preferably designed in a collaborative way with sufficient room for consultation and deliberation along the way (OECD, 2020). Adopting such a new model of policy design should take place in small steps providing sufficient time for building trust between top-down, medium level and bottom-up actors. In detail, policy design can be improved through collaboration between top-down and bottom-up actors, including elected politicians, public managers, service providers, user groups, and relevant interest organisations (like local firms) and advocacy groups. Multi-actor collaboration and participation based on deliberation tend to bring forth relevant knowledge, stimulate mutual learning processes and build joint ownership over the new solutions. OECD (2020) states that deliberation requires that participants are well-informed about a topic and consider different perspectives. This is important in order to arrive at a public judgment (not opinion) about what the study can strongly agree upon. Since the implementation of well-crafted policy designs cannot be ensured, e.g., due to some remaining 'comment and control' and overall uncertainty, the collaborative process should be extended with the monitoring of all steps to enable eventual adaption of the initial policy design to better reflect local conditions and emerging (unexpected) practical developments. As such, policy design should be seen as an ongoing process that flexibly adapts as implementation challenges unfold.

The collaborative policymaking process as proposed in this study for the innovation system in Indonesia has been designed using the framework of Ansell, Sørensen, and Torfing (2017), as presented in Figure 6.4. Adaptive policymaking, as forwarded by Walker et al. (2001) as an answer to many-sided uncertainty, can be seen as incorporated in this model, particularly in implementation.

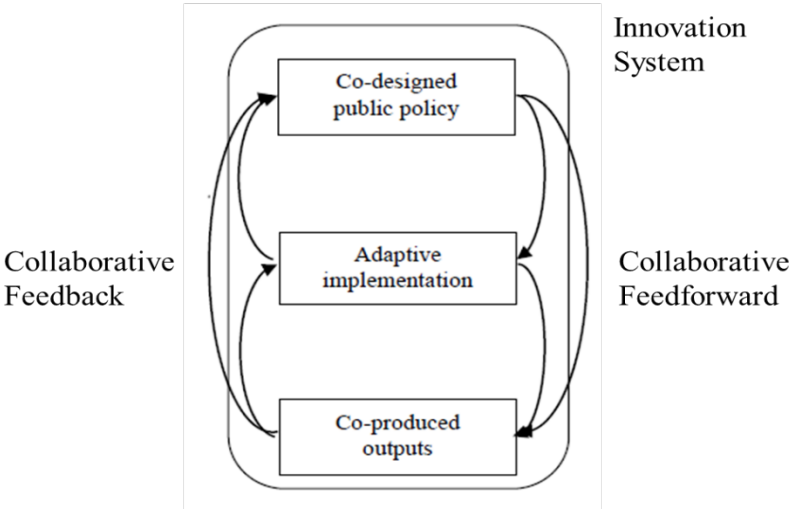


Figure 6.3 Collaborative policymaking for innovation system
(Ansell, Sørensen and Torfing, 2017)

Figure 6.3 and Figure 6.4 indicate that collaborative policymaking is closely intertwined with implementation through collaborative feedback and collaborative feedforward relations. This means broadly that a check is done during the implementation process on whether the realised solutions work in practice as foreseen, and whether some new policy is needed in the near future to improve implementation (monitoring). Further, details concerning Figure 6.5 - Policy Implementation (part B of the figure) will be addressed in section 6.3.4.

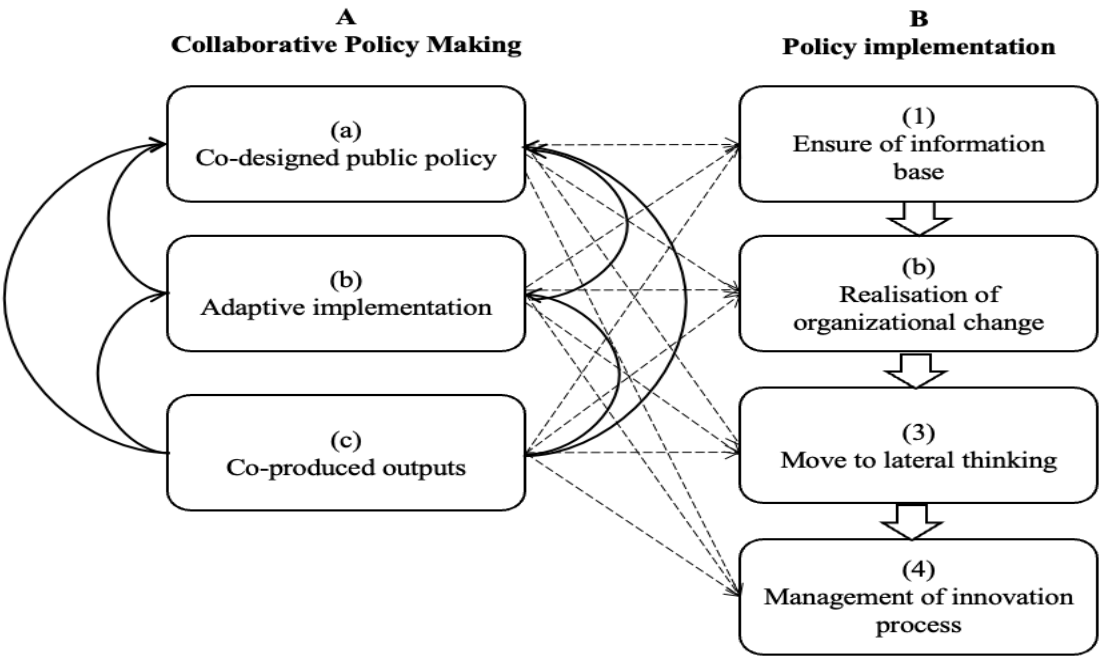


Figure 6.4 Relationship of collaborative policymaking, policy implementation and eventual adaption
(Source: author's interpretation based on Ansell, Sørensen and Torfing, 2017)

One of the barriers to collaborative policymaking in Indonesia is the previously mentioned important dimension of national culture, namely, high-power distance. As a balance, however, another national culture dimension, namely collectivism, can act as the driver of implementing the collaborative policymaking innovation model. In a high-power distance society, the persons at higher levels of governance or management (firms) dominate the process of policymaking; hence it is difficult for persons at a lower level to participate in the process, even if they propose innovative ideas. Aycan (2006) showed that in a high-power distance culture, subordinates respect a superior leader in key competencies (knowledge, skills and expertise) and moral standards. Meanwhile, collectivism culture requires a decision that should be agreed by all of the parties and not merely the decision of a specific person; hence, it can encourage the collaborative process. Furthermore, according to Widianingsih and Morell (2007), Indonesia's policymaking has followed complex development stages, with elite and bureaucratic domination from national to sub-village (kelurahan) levels. The central government played the role of initiator, planner, financer and executor of policies, while local governments were positioned merely as facilitators of programs designed by the central government that cause dependency on central planning and

discouraged local creativity and innovation (Soetrisno, 1995, p. 84). The policy represented only the central government's interest, and the lack of transparent public policy formulation resulted in a high degree of social and political distrust.

According to the thinking of Widianingsih and Morell (2007), an important development path to cope with the above situations would be to have a strong leader emphasising the collaborative and adaptive policy process that will solve the cultural situation. This development path is in line with Popper and Mayseless (2003), who argue that the *interplay* of collectivistic and high-power distance cultures enhances the transformational leadership styles. Leaders encourage, inspire and motivate employees at lower levels to innovate and create change that helps the growth and the future success. Such a situation could grow in policymaking on innovation (NIS) and firms' management of innovation.

6.3.4 Step: Implementation

Hittmár, Varmus, & Lendel (2014) propose a model for implementation of innovation strategy consisting of four basic sequential phases (Figure 6.4): ensure the information base, focus on the realisation of organisational changes, move to lateral thinking and move to management of innovation processes. The first phase of the model highlights the need to ensure the information base that will underpin the management of innovation activities in policymaking (business suggest company level). If sufficient information and evidence have been used, the process can move smoothly into the second phase, with the primary goal of designing the necessary organisational change. Further, lateral thinking is solving problems using an indirect and creative approach, typically through viewing the issue in a new and unusual light (perspective). The most important part of the management of innovation processes is to check whether all the required processes of innovation in business are present. Only a thorough analysis can detect missing or unrelated procedures that, in the future, could cause a failure not only in implementation but also in the functioning of the innovation strategy.

In the implementation step, it is very important to incorporate the Indonesian culture for the success of the change strategy, as previously addressed in ‘policy transfer’. In collectivism culture, successful innovation implementation is an effort of multiple actors (Klein and Sorra, 1996); therefore, innovation implementation may well benefit from a collectivistic culture point of view (Nakata and Sivakumar, 1996). As indicated in section 6.3.3, high collectivism fosters the

collaboration and teamwork needed to address the challenges, resistance and efforts required for successful innovation implementation. The implementation preferably combines the requirements of collaborative policymaking at national and regional levels, as shown in Table 6.3. The table shows preliminary proposals of change strategy, concerning the core matter discussed in this chapter: Entrepreneurship Development, ICT Infrastructure and Curriculum, and Collaborative Policymaking. The level of firms is excluded in the table due to differentiation between micro-firms, small and medium-sized firms and large firms.

Table 6.1 Indicative Table of Strategic Search and Implementation

Strategic Implementation	**Entrepreneurship Development**	**ICT Infrastructure & Curriculum**	**Collaborative Policymaking**
National Level	Increase domestic industry competitiveness Promote R&D initiatives from the private sector Respect and benefit from particular facets of Indonesian culture	Transform the ICT education system to address the skills gap Stimulate education practices that facilitate innovation culture Build better infrastructures especially outside Java	Create conditions for collaborative policymaking in all regions
Regional level	Create a conducive environment for investment, incl. FDI	Facilitate the bridging of the infrastructure & ICT skill gaps	Allow and enable optimum consensus between stakeholders Synchronise the central, regional and local government policy Promote collaborative governance in innovation, incl. practical guidelines for implementation Differentiate policies between core and peripheral region

With regard to the ***national*** level, it is argued that industry competitiveness is one of the biggest challenges, along with increased R&D activities and an improved education system. Derived from literature study, a set of change requirements and practical solutions are proposed that appear to be realistic. These are important, yet together they cannot provide a complete picture.

General economic/innovation conditions

Aswicahyono and Rafitrandi (2018) argue that if Indonesia's investment grows faster, Indonesia will naturally shift to higher value-added industry that will increase domestic industry competitiveness including in the ICT sector. However, practical translation and implementation into better education and infrastructure remain a challenge. In addition, innovation without formal R&D tends to be dominant in Indonesia. The R&D sector's role, made up of private laboratories, universities and government R&D institutions, remains less important. To improve the links between the government and private sectors, some institutional programs, such as incubation centres (national/regionally owned), science and technology parks (STP) and technology parks (TP), are promoted. Currently, the programs' results are still not significant due to budget limitations and uncoordinated actions, but some improvements could feasibly be implemented successfully both in the short run and long run. In a similar vein, to prepare the human resources in R&D activities, especially in the ICT sector, Indonesia needs to encourage an open, curious, exploring and questioning education system to adapt to the digital era. Inserting some basic ICT knowledge will also be helpful to boost the digital mindset. In this way, schools are breeding a new generation of ICT leaders and innovators for a new change in Indonesia. However, those types of schools currently only exist in big cities, especially on Java, meaning that their establishment needs to be enhanced in other regions of the country. These actions can be undertaken by the national government and regional governments.

Transform the ICT education system to address the skills gap

Indonesia has implemented different curricula of ICT education. Curricula 2004 and 2006 included ICT as a compulsory subject at secondary school. The surprising thing is the elimination of ICT at school in curriculum 2013 due to obstacles at schools in rural areas and the lack of qualified, skilled ICT teachers. Meanwhile, for the Higher Education Institutes of Indonesia, the burden may be lighter than at the lower education levels. The latest technology, such as Virtual Reality, Augmented Reality or Mixed Reality, started to be used quite recently in learning at technical

universities especially those on Java (Nur, 2020). These technologies are currently implemented in other high level international studies all over the country but education at low level schools remains behind. In Chapter 4, this study found some business skills gaps especially regarding management and marketing skills related to innovativeness in ICT. To tackle these shortcomings, a set of training programs on ICT management and marketing skills needs to be developed, for instance, concerning digital marketing, digital analytics for marketing, artificial intelligence and cloud computing.

Characteristics of policymaking process

With regard to characteristics of policymaking, based on Chapters 4 and 5 and major parts of the current chapter, some challenges need to be solved, including Indonesian culture, namely, the *deliberation* and creation of consensus between stakeholders, and practical guidelines for policy implementation. Related to Indonesian culture, one question arises: Is it feasible to perform innovation while respecting the genuine culture of Indonesia? In this sense, Sonderman and Rosenstiel (2015) argue that innovation is a product of culture and relatively small changes to an organisation's processes and structure can have magnified effects on its culture, which in turn can enable vital innovation in new organisations. Consider, for example, an ICT application called Malaria Observation System and Endemic Surveillance (MOSES) that is a telemedicine application to identify and diagnose malaria based on Indonesian culture and behaviour, which indicates that innovation can respect culture in Indonesia.

Next, related to optimum consensus between stakeholders, Jakarta Post (2018) reported that the government of Indonesia is aware that the application of science, technology and innovation for society's well-being has yet to reach an optimum level. Reaching a higher level is very important, especially for supporting the economy and for specific industry sectors to advance. Still, the application is currently unable to provide a better contribution to the advancement of the economy and society. Therefore, the government is now working on its national research master plan (RIRN), seeking to synergise interests and create consensus between different stakeholders in the science and applied research fields to produce optimum innovation.

Currently, there is ‘hearsay’ that Indonesia has only a few clear, practical guidelines for implementing ICT policy. However, the central government introduced Government Regulation number 80/2019 in November 2019 to provide legal guidelines for the country's e-commerce

industry and clear guidelines and compliance by November 2021. This development illustrates that the guidelines can be created if there is the political will from the government. And finally, with regard to policymaking implementation, more attention is needed for consultation of stakeholders and deliberation between them and for evaluation. Evaluation of policies can be done along the way (monitoring) and at the end during or after implementation. Consultation and evaluation appear to be weakly developed in Indonesian governance, as indicated by The Policy Lab, University of Melbourne and The Indonesian Centre for Law and Policy Studies, (Blomkamp et al., 2018*).* The main actor concerned is the national government.

With regard to the ***regional level,*** as taken from Chapter 5 and from some literature, several challenges were found, such as achieving stakeholder agreement, policy synchronisation and collaboration, a better-balanced development in ICT infrastructure and providing detailed guidelines. In line with this, the study proposes the following requirements addressing the challenges at regional level, which can be assumed to be feasible to implement as follows:

Synchronise and collaborate on policy in regional innovation ecosystems

According to the latest World Bank annual ratings (year 2019), Indonesia is ranked 73 among 190 countries in the ease of doing business, indicating a low synchronisation policy between the central, regional and local governments. In an effort to address this problem, the central government has implemented changes and introduced a program called the Online Single Submission system (OSS) (July 2018). However, there are major barriers to the success of these changes (online submission of new investment application) including a lack of information for businesses, inadequate IT infrastructure and failure to synchronise the central and local governments under the OSS. As a result, policy changes and the OSS have not been working as intended (Freddy and Saputri, 2018). To tackle the challenge, regular consultation meetings between stakeholders can be considered in order to align with each other.

Another important requirement to implement innovation processes is collaboration within localised networks that improve innovation capabilities and performance (Imanto et al., 2019). A relevant question is how the collaborative model between stakeholders can build an innovation ecosystem that runs effectively and improves innovation capabilities (Stam, 2015). In fact, some of the creative city communities in Indonesia, for instance, the Bandung Creative City Forum, the Solo Creative City Network, the Malang Creative City, and many others, try to establish

collaboration between regional governments, universities and private sectors mostly including SMEs. The result of these initiatives is currently not clearly visible, but by continuous improvement, these initiatives may open other opportunities for innovation. At the other end of the urban spectrum, in *remote rural areas*, capital investment such as 'micro-credit' may be an efficient way for improving connectivity and increasing ICT innovation activity. Programs of 'micro-credit' institutions, including monitoring how they work, have been established but need to be improved, i.e. through a decrease in interest rates that are charged.

Bridging of ICT infrastructure and skills gaps (differentiate for city-size and region type)

Indonesia has already decided to substantially improve the ICT infrastructure. In late 2019, through the Ministry of Communication and Information, the government announced the Palapa Ring project to provide access to 4G internet services to more than 500 regencies across the country (Kominfo, 2019). Reducing the infrastructure gap will, in turn, reduce the ICT skills gap because the people in remote areas can learn various new ICT skills by utilising the ICT infrastructure. The activities may not only increase connectivity (infrastructure) on a local scale, but also improve maintenance and protect infrastructure against the impact of natural disasters (which can be done by regional governments). However, 'infrastructure is only half of the story'. Increasing ICT skills, providing (use of) mobile devices in poor regions, organising community learning sessions for parents and children, and also showcasing the challenges of starting an ICT-based firm and the required entrepreneurial skills, could be equally relevant. This preferably goes along with regional (local) programs to support enhancing ICT skills and broader education.

Aside from the previous strategies, a policy to decrease the disparities between regions in Indonesia can be developed. In fact, a policy to address the differences in urban and regional development, most notably, developing urban growth centres in eastern Indonesia, was designed in the late 2000s. In particular, the government introduced an official national spatial development plan (Rencana Tata Ruang Nasional) at the time to promote balanced urban development. However, according to The Jakarta Post (2018), this policy has not been effective enough in guiding urban development because it has never been consistently integrated with investment and infrastructure plans. The policy nevertheless shows differentiation between core (metropolitan) and peripheral regions and, if sufficiently integrated with other plans, it is assumed to be successful.

Aside from policy differentiation between distinct regions, policy differentiation between SMEs and LFs needs to be considered, given the empirical results in Chapter 3, 4 and 5. In this regard, the Indonesian government has implemented many policies to deal with program differentiation between firms according to their size. However, it turned out not to adequately improve the capacity and productivity of micro, small and medium enterprises (MSME). In the meantime, SMEs encountered some obstacles, such as the fact that an existing business cannot be used as a guarantee for obtaining funds, difficulties in partnering and business licensing, and legal problems. The subsequent program of solutions outlined in the new law in 2021 encompasses ease of financing facilities and fiscal incentives, additional arrangements related to partnerships, training and assistance in the use of bookkeeping systems and applications, certification of halal product guarantees for SMEs, legal aid and assistance services, and ease of single business licensing via online single submission. Such a program also holds true for SME firms in the ICT sector, illustrating realistic policy differentiation between small and large firms.

6.3.5 Step: Monitoring (evaluation), eventual adaption

In general, monitoring refers to the organised set of activities encompassing the iterative collection and elaboration of information on the direction and evolution of socio-economic phenomena and policy measures delivery. The use of monitoring aims to identify to what extent decisions in policymaking can be realised and whether there is a need for adjusting the course of policy actions (Kleibrink, Gianelle, and Doussineau, 2016). In fact, Figure 6.5 indicates that each step in collaborative policymaking is concerned with repetitive actions and connected with policy implementation. For instance, co-designing public policy based on the available information is implemented adaptively to make changes in the organisation.

Specifically, understanding important dimensions of uncertainty in the policy process helps identify, articulate and prioritise unintended critical developments. In other words, an adequate understanding and treatment of uncertainty in decision support endeavours is an essential part of dealing with complex, inherently uncertain policy issues (Walker et al., 2003). Furthermore, monitoring strategies have two main functions in policymaking and implementation of innovation and development goals: an *analytical* function which is primarily internal to the strategy designing and managing, and an *advocacy* function which concerns the relationship between the strategy and the broader economy and society and can thus be regarded as mostly external to the strategy

development process (Rip, 1997; Romer, 1993; Saltelli, 2007). Both the analytical function and advocacy function are required in the design and implementation of the change strategy.

6.4 Evaluation of the Change Strategy

6.4.1 Evaluation of design criteria

After the design of a policy, evaluation of the design criteria is needed to explore whether the policies can match them. The design criteria in this regard refer to three related criteria mentioned in section 6.1 as consistency, coherence and congruence. In terms of consistency, the policies should reinforce each other; in this case, regional-based policy would reinforce national policy, and vice-versa, or ICT education policy reinforces economic development impacts of access to ICT infrastructure. Having a non-consistent ICT innovation policy can be a significant setback to the ICT innovation development progress. In terms of coherence, the policies need to coexist with each other and with other instrument norms. For example, the coexistence of the regulation of incubators at regional level and national level due to different characteristics. Another example could be to provide financial support to small ICT firms, which would work well if the small business can also serve as security in financial transactions, such as buying real estate serving the business. Searching for coherence means that ICT policies or programs need to be seen as embedded in larger systems/networks, e.g., taxation, transactions, trade regulation, etc. It may be stated that coherence of ICT programs in Indonesia as mentioned at several places in the previous text can clearly be improved. And regarding the third criterium, congruence, the policy may work together in a uni-directional or mutually supportive fashion. In this regard, national policy works together with regional policy in a uni-directional way to achieve the goal of improvement of ICT curricula all over the country. Another example could be support to large ICT firms, which also enhances small ICT firms' development through fair subcontracting, thus improving the sector at large. And regarding firms' innovativeness, upgrading the level of innovativeness needs to be coupled with trade regulation, such that Indonesia can better develop export. Overall, it can be stated that determining whether the three criteria have been/can be satisfied is a difficult and comprehensive task. Much depends on the how policy aims have been designed (how broad) and which different policy areas are involved. In addition, a lot of data and deeper understandings of causal relations and contexts are needed than currently available.

Further, with regard to *policy transfer*, the idea was developed that collaborative policymaking – as originated and developed in European culture - would provide solutions to

implementation issues and other policy challenges in Indonesia. In response to the situation in Indonesia, firstly, it was suggested that collaborative policymaking is preferably introduced in an incremental and trustful way to enable stakeholders at all levels to feel comfortable and to learn from each other. Secondly, it was suggested that the policy itself could take advantage of two different dimensions of Indonesian culture: introduction of collaborative policymaking through the 'top-down' model and practical elaboration through using the 'collectivist' dimension. The latter would support collaboration and deliberation between the stakeholders (at all levels) involved.

In a preliminary way, it can be proposed that certain domestic values, including loyalty to family and friends, and to local community, 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, altogether also known as *community value creation* (e.g., Yunus, 2017). Community value 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, it recognises that local people are the best to come up with solutions to their own local problems. In more detail, a community-led approach seeks to ensure that innovative new solutions are produced that are contextually appropriate and locally owned, making them more likely to be sustainable and impactful. Such bottom-up approach is cross-cultural, and also in line with Indonesian traditional culture, *gotong royong*, which reflects mutual assistance and cohesiveness in community living to achieve the goals of the community or society. Additionally, Indonesia's diverse cultural heritage can provide a rich source of inspiration for creative ideas and solutions.

It is however slightly 'premature' to advice such approach to be adopted. This is because its practise still needs to become more entrepreneurial, pro-active and marketing-minded (new opportunities) (Widjojo et al., 2019). Furthermore, while it can be understood how such approach would work in ICT activity in smaller cities and rural areas, it is more difficult to imagine how it would work (or calls for an alternative interpretation) in larger cities with universities and more complex (hierarchical) networks. At this point, the 'Smart City' concept can briefly be addressed.

The core of 'Smart Cities' concept, in which citizens collaborate in analysing and problem design of urban solutions, includes solutions that are ICT-based or facilitated, like in traffic management and routing to vacant parking places, in safety and security in public places and in detecting dangers, like air-pollution, radiation, seismic activity and pandemic. Having smart city policies in implementation in Indonesia, it appears that it takes longer than expected and that benefits cannot yet be fully enjoyed, like in the case of Bandung (its masterplan) (Mayangsari and Novani, 2015). It can be imagined that implementing dialogue in open en evidence-based approaches, in which the stakeholders act as equal partners to each other, requires experimentation and change in small steps.

6.4.2 Limitations

Given the Indonesian policy and culture context of high-power distance, it is preferred that a new change strategy, such as Collaborative Policymaking, is introduced in an incremental way, eventually including small-scale experimentation, thereby avoiding radical steps and sources of distrust. However, what could support the introduction of collaborative policymaking is the collectivistic dimension in the national culture. Furthermore, given the intention to improve matching with Indonesian culture and the preference for incremental change, the analysis suggests viewing collaborative policymaking in a broader frame and examining what can be learned from other literature and practical experience for the following reasons:

- find better conceptualisations of collaboration and experimentation concerning collaborative policymaking
- design a more comprehensive vision of antecedents, processes and outcomes from collaboration
- make better connections with practice such as design of collaborative structures; and
- make new (broader) connections with other disciplines to extend theoretical underpinning.

The above list indicates that more study is needed to make the proposed collaborative policymaking more robust.

6.5 Summary and Conclusion

In order to summarise the chapter's results, a return to the research question on policy design is needed: *What would the content and processes (steps) be in a change strategy*? *How*

should the change strategy be designed and implemented and what are the implications for the design of the policies?

The chapter starts with proposing a change strategy that would enable better design and implementation of policies as a result of collaboration between top-down and bottom-up stakeholders. In the context of promoting and sustaining ICT innovation in Indonesia, the best 'merging' theory is Entrepreneurial Ecosystems (includes firms, knowledge spillovers, networks and interaction firm-networks/cluster, and institutional circumstances). By understanding the various components of the entrepreneurial ecosystem and how they interact, businesses can better position themselves for success and growth.

Accordingly, five steps in Collaborative Policymaking are proposed, applied to content matter in Entrepreneurship Development and ICT Infrastructure and ICT Curriculum, which is new for Indonesia. The basic difference with conventional ways of policymaking is that all stakeholders (actors) are involved in a collaborative way of policymaking, drawing on consensus building, consultation and deliberation (OECD, 2020). With regard to content, the set of steps encompasses problem formulation, actor and network analysis, strategic search for a solution (direction), implementation and monitoring (eventual adaption). The steps may partially overlap, while monitoring may be used in the entire process. Monitoring typically deals with unpredictability and uncertainty, which in some situations may call for adaption of problem formulation and policy aims. Further, the change strategy is preferably designed in a collaborative way between stakeholders (top-down and bottom-up), leading to changes taking place in an incremental way, including small-scale experimentation, to enable learning and trust building, and adapted to Indonesia's culture and values.

In addition, analysis of the content matter of policymaking has revealed several situations affecting ICT firms that call for improvement (partially already undertaken by the government): a business culture that lacks ambition (risk-taking) in which innovation is steered top-down, while specifically smaller ICT firms lack R&D and management and market(ing) skills. Though ICT infrastructure has considerably improved (Palapa Ring) with the better connection of regions in the country and keeping pace with the improvement of ICT curricula, more remote rural areas tend to suffer from low connectivity and ICT education that lags behind.

This chapter has presented the final stage of the research on innovativeness in ICT firms in the context of Indonesia and on ways to improve it. What is new to the study of innovation in

Indonesia can be summarised as follows. Firstly, the study provides a set of directions of solutions following empirical analysis at the firm level in the ICT sector for the entire country and for two different regions. Secondly, the elaboration of collaborative policymaking to improve policy design and implementation in Indonesia's ICT sector is new and could be adopted by all stakeholders involved in the ICT sector to work with policies that better respond to challenges of increasing innovation activity in practice. However, the reflection also suggested that such policymaking requires an incremental introduction, and overall, being a first attempt, it needs better conceptualisation, deeper understanding of causal relations and context, and better connections with practical structures and alternative disciplines.

Chapter 7 Discussion and Conclusion

7.1 Introduction

Considering the large domestic market to be served, improving innovativeness of ICT firms has increasingly become more pressing as ICT is a promising sector for Indonesia's economic growth (BPS, 2016). As in other developing countries, ICT firms in Indonesia are facing many challenges in firm-internal conditions to reach higher levels of innovativeness (Hameed et al., 2018), specifically in firms' management capabilities. In general, firms use internal resources and capabilities as well as external resources, through their networks, to access valuable and rare resources. They use these resources to develop their learning capacities for their innovative activities, to orient and compete in their target markets (Gulati et al., 2000; McEvily and Marcus, 2005, Xia and Liu, 2021) since the target markets are usually uncertain and involve different levels of competition (Mohr et al., 2010).

Furthermore, influencing conditions in the entrepreneurial ecosystem also call for several improvements before ICT firms can grow faster and contribute to the national economy. Such improvements – which can be seen as a 'transition' towards higher levels of innovativeness of domestic firms – encompass the availability of several resources and the policy to make them available. This is particularly relevant as Indonesia has the type of economic growth that is primarily driven by natural resources and trade rather than by science and innovation (Damuri, Aswicahyono, & Christian, 2018). However, the supporting programs in such an economy remain problematic. Many programs initiated by the central government resulted in relatively little impact on innovation improvement.

In literature, different government approaches to realise the aims of increasing innovativeness of domestic firms, reducing dependency from imports from other countries and narrowing the digital divide, especially in the ICT industry and in the small firm's segment, have received more and more attention in recent years (Tambunan, 2007; Azali, 2017; Purbo, 2017; Hartono & Kusumawardhani, 2019). However, the existing knowledge transfer mechanisms among universities, research institutions, industries and the government do not seem to act sufficiently effectively. These circumstances have created barriers in R&D collaboration in Indonesia (Indarti & Wahid, 2013) and in the education system, which prevent achieving an international ICT skills level. The insufficient knowledge transfer mechanism and education are

also apparent from the modest capability of firm management (Aryanto, Fontana and Afiff, 2015) and firms' absorptive capacity of technology transfer from foreign investment (Budiharto, Suyanto and Aloisius, 2017). To sum up, the modest capability of firm management limits domestic firms in undertaking innovations at high level (Helfat and Raubitschek, 2018; Hartono and Kusumawardhani, 2019). The above-mentioned situations indicated in literature, are empirically confirmed in this PhD study.

With the intention of understanding and improving the ICT industry's innovative performance in Indonesia, this PhD study uses two primary approaches: (1) firms' internal capabilities and skills, and (2) external contexts, namely national and regional entrepreneurial ecosystems. Accordingly, the study explores the underlying firm internal and external factors and their impacts on firm innovative performance and proposes key recommendations to improve the situation. This chapter proceeds with a discussion of the research design in section 7.2. In section 7.3, the study provides the answers to the research questions posed in this PhD thesis and the findings concerning the hypotheses. Finally, the study's main conclusions, scientific and empirical implications, and contributions to strategy and policymaking are discussed in section 7.4.

7.2 Research approach and methods of analysis

As a recap of this PhD research, Chapter 2 started with reviewing relevant theories and existing studies on which the hypotheses were based. In a knowledge-based approach, the resource-based view of firms and organisational learning theory, combined with the related theory of dynamic capabilities, were used to analyse the internal and external conditions related to firm innovation. As a result, potentially influencing factors have been identified and several hypotheses on the performance of firm innovation in national and regional contexts were formulated in Chapter 2. Special attention was paid to the problematic situation of the ICT sector in Indonesia (Chapter 3), by addressing the following themes: how Indonesia deals with challenges in the ICT sector, such as digital divide, innovation mindset/culture and education. Furthermore, Chapter 4 and Chapter 5, provided descriptive analysis of firm level innovation, and quantitative models on firm level innovation were specified and explored using empirical data through multivariate analysis, including both linear and non-linear regression models. The focus of this analysis was on firms at the country level (Chapter 4) and on firms at the regional level (Chapter 5). Chapter 6 subsequently builds on the previous chapters; given the challenges regarding increasing

innovation, it discusses what kind of strategies or policies would qualify to change the situation. The application of multi-actor theory, notions of participatory policymaking, and transferability of policy solutions and strategic guidelines were used in Chapter 6 to propose specific policies.

Survey Database

A dataset was built to enable empirical analysis of the ICT firm's innovation performance in Indonesia. Using three main sources, namely, Indonesia Yellow Pages, Chamber of Commerce and BPS (Sensus Ekonomi, 2016), during November 2016-June 2017, the study sent around 2,000 questionnaires to ICT-based firms in all regions in Indonesia covering five islands (Sumatra, Java, Bali, Kalimantan and Sulawesi) and 15 cities (Medan, Batam, Padang, Palembang, Lampung, Jakarta, Bandung, Semarang, Yogyakarta, Surabaya, Denpasar, Balikpapan, Palangkaraya, Makasar and Manado). As a final outcome, the survey collected 260 valid responses. The questionnaire consists of two parts: (1) questions related to the firms' internal conditions enabling innovation activities (amongst others, firm size and R&D organisation); and (2) questions related to the firms' perception of selected external conditions (urban character of location, strength of networks in clusters, share of foreign direct investment in firms and hindrance of regulation). The data collected from the questionnaires were used to test the formulated hypotheses at the country level (Chapter 4) and at the regional level (Chapter 5).

Database Derived from Interviews

In addition to the above survey database, an in-depth qualitative database was derived from six semi-structured interviews that were conducted in the period of 2017-2018, of which four with managers of ICT firms (small and larger firms) and two with industry experts from a university and government. The experts all have a different expertise and are ICT practitioners in Balikpapan (representing Kalimantan Island), Solo (representing Central Java area), Bandung (representing West Java area) and Palembang (representing Sumatra). The aim of the interviews has been to obtain in-depth insights into obstacles and challenges faced by the firms in increasing innovativeness, which could not be collected via a mail survey. These insights enable the subsequent qualitative analysis that was essential for deriving strategy and policy recommendations in Chapter 6.

7.3 Discussion of results related to research questions

This section discusses the primary results as answers to the research questions of this study regarding innovation activities and strategy guidelines for change. The hypotheses formulated in Chapter 2 and empirically examined in Chapters 4 through 5, are also discussed in this section.

7.3.1 Innovativeness

First and foremost, the problem of innovation in the ICT sector in Indonesia has been revealed and characterised by investigating the sector's situation (Chapter 3).

RQ1: What at the sector level are the problematic situations and influencing conditions that contribute to the lagging behind of the ICT innovativeness in Indonesia?

The question has been answered at different levels, national and regional (as a sector) and individual firms. Main challenges in the ICT sector at the country level refer to: (1) the digital divide as disparities in access to ICT infrastructure, ICT education and in workforce quality; (2) a trade deficit of the country's sector; and (3) culture and mind-set in innovation. The three challenges and their relationships are discussed in more detail below.

The digital divide is concerned with gaps between different population density, education level and ICT infrastructure (providing access to modern information and communications versus no access at all or restricted access) and causes *regional* disparities in ICT workforce readiness to be involved in ICT innovation. Indonesia faces numerous hurdles in its ICT sector, such as its inability to cultivate and grow a strong domestic ICT talent base due to limitation in education and workforce quality. Digital literacy and skills demand such data science, and artificial intelligence is only expected to rise with the growth of ICT sector. There is also a distinct divide between segments of large firms and smaller firms. Larger firms have more access to financial institutions and FDI, which makes it easier to provide funding on R&D and innovation. The larger firms typically have more privileges with business permits.

Regarding trade deficit, the industry structure indicates that most firms are active in the service sector and a smaller part in manufacturing (BPS, 2016). The size of trade deficit for the ICT sector reaches USD 5 billion. The major cause of such deficit is because many ICT firms in Indonesia use hardware and software mostly imported from foreign countries. This trade deficit indicates that innovativeness in the ICT sector in the country is relatively low and depends on innovation from other countries. The low level of innovation is also indicated by the patents in the

ICT sector, in which patents registered from non-residents are often higher than the patents registered by residents (Figure 3.5). Indonesia shows a positive trend in the aggregate ICT sector patents in which patent applications in the ICT sector have grown to one third of all patent applications. However, due to limitations in developing mass production, the problem of ICT diffusion remains and innovation in the domestic industry continues to lag behind. Other challenges come from the activity for business activities. Although obtaining basic permits and licences (e.g., to establish a company) has become relatively easy, it remains complicated and time-consuming to obtain other business permits as these permits need approval from various government departments. In general, it has become easier for the country's micro, small and medium-sized entrepreneurs to obtain basic permits. However, this is not the case in all regions across the country.

Finally, culture mindset and workforce readiness refer to preparation to enter the labour market with the required knowledge, skills, abilities, ambitions and other attributes to engage in challenges in ICT occupations which also remain behind. The lack of workforce readiness tends to prevent the ICT industries in Indonesia from catching up with other Asian countries in innovativeness and growth, which further causes the ICT sectors in Indonesia to depend heavily on import of ICT products from abroad. In more detail, culture and mindset challenges are hampering the development of ICT innovativeness in firms. At the firm level, the hierarchy model tends to make innovation originating on the work floor difficult to be realised. In addition, the hierarchy model at the region or ecosystem level (governance) may also slow down the change process of improving innovativeness. To respond to the challenges, the central government needs, among other things, to tighten collaboration with local and regional governments and private sectors and gradually change entrepreneurship culture through education.

With regard to *RQ 2: What is the level of innovativeness among ICT firms in Indonesia?* The study concludes that most of the ICT firms in Indonesia as represented in the survey have a low to medium level of innovativeness as shown in a set of indicators (Table 4.1). The study observed relatively large shares of the sample being engaged in low or modest innovativeness, namely, one-third spending less than 10 per cent of sales on R&D and almost 40 per cent involved in a very low level of their newness products/services. The situation is related to constraints on innovation activity as indicated in Chapter 4.

Chapter 4 presents results on firms' innovativeness in the country to get a picture of the severity of the low level and to explore background factors. Two indicators are used to measure the level of innovativeness: Newness of Innovation and R&D Intensity.

RQ3: In which ways and to what extent do firms' capabilities and entrepreneurial ecosystem influence firms' innovativeness?

Using multiple regression modelling in Chapter 4, the study found that several firm internal indicators (including firm size, R&D Intensity, manager's ICT skills, manager's experience and market-related skills) and firm external conditions (including level of urbanisation, cluster strength, FDI and regulation) have a positive relationship with firm innovativeness. The results indicate that the higher the value of each variable, the higher the probability of strong innovative performance. For instance, a larger firm tends to be more innovative than a smaller one. In addition, the study provides empirical evidence that the level of R&D organisation, in the sense of professionalisation, has a positive effect on innovativeness. Additionally, the relationships in learning processes and capabilities' conditions are often not linear. Accordingly, the findings are that firm size, R&D intensity, manager ICT skills and FDI have a positive quadratic relationship with innovativeness, which means that some higher values have to be reached before innovativeness starts to grow at a faster (exponential) rate. In contrast, manager's experience has a pattern that shows no significant relationship (Newness of Innovation as dependent variable) and negative quadratic relationship (R&D investment as dependent variable) which means that at a particular point of increased manager's experience, a negative influence tends to emerge, most probably due to lock-in effects. In addition, market-related skills tend to be strongly significant in a positive pattern. With regard to entrepreneurial ecosystem conditions, the results are mixed, in that they failed to confirm the influence of urban environment but indicated some positive influence of intra-cluster relationships. The most important difference in results between the two innovation indicators is the strength of relationships with innovativeness; for overall conditions, R&D intensity has a stronger relationship with innovativeness than indicator Newness of Innovation.

The empirical results of hypotheses related to research question RQ2 are summarised in Table 7.1 and explained in detail in the following texts:

A. Firm Internal (size and R&D organisation)

Hypothesis 1.1: Firm size is positively associated with innovativeness (linear).
Hypothesis 1.2: Firm size is positively associated with innovativeness (quadratic).

The first two hypotheses suggest that larger firms tend to be more innovative than smaller firms. This argument is in line with Resource Based View (RBV) because a firm needs more resources (knowledge) to produce new, more advanced products (Barney, 2001; Kim et al., 2015; Teece, 2018). Nevertheless, this PhD study found that the relationship between firm size and innovativeness is not always linear, i.e., there is also a positive quadratic relationship. Such a positive quadratic relationship only applies for the indicator Newness of Innovations and is not supported for the R&D intensity indicator. A positive quadratic relation means that at the beginning, firm size does not seem to have any positive relationship with Newness of Innovations. However, after reaching a certain size, the relationship becomes significant and gets stronger.

Hypothesis 2: A higher level of R&D organisation is positively associated with innovativeness

In investigating this hypothesis, four ranked categories are used to measure R&D organisation (Appendix 5, question 4 of the questionnaire). The underlying assumption is that firms at a higher rank of R&D organisation, i.e., employing R&D collaboration and having an own R&D department will have better innovative performance than those at lower ranks. The study found that the hypothesis is confirmed for R&D intensity but not confirmed for the indicator Newness of Innovations. This result may imply that firms with a higher rank of R&D organisation invest more heavily on R&D compared to those with a lower rank of R&D organisation, but the Newness of Innovations for these firms appears to be still below the expectation.

B. Firm-internal conditions concerning management

Hypothesis 3.1: Manager's ICT skills are positively associated with innovativeness (linear)
Hypothesis 3.2: Manager's ICT skills are positively associated with innovativeness (quadratic).

These hypotheses are supported. In particular, the results indicate that higher manager's ICT skills will increase firm innovativeness in both dependent variables (Newness of Innovation and R&D intensity). This seems to be a logical finding since ICT is a high technology industry that needs particular sets of skills to work with. In this case, higher skills levels are required to accelerate and foster innovation. Insufficient ICT skills, such as those concerning programming and data mining, will hamper the innovation process. The results of the quadratic relationship also

indicate that it is necessary to establish manager's ICT skills to the required level of skills to boost innovativeness.

Hypothesis 4.1: Years of manager's experience is positively associated with innovativeness (linear)
Hypothesis 4.2: Years of manager's experience is positively associated with innovativeness (quadratic)

The results indicate that experience matters for supporting R&D intensity; however, it does not affect the Newness of Innovations. The quadratic results also show a trend that longer experience hampers innovation, most probably due to the lock-in situations. Accumulated years of experience may, after a positive development of innovation, increase self-confidence in such a way that lack of openness for new innovation emerges.

Hypothesis 5.1: Manager's cognitive capability is positively associated with innovativeness (linear)
Hypothesis 5.2: Manager's cognitive capability is positively associated with innovativeness (quadratic)

There is a common consensus that a manager's cognitive capability supports innovation practices in a firm. The results show that this hypothesis can be confirmed for R&D intensity but not for Newness of Innovations. The partial model (model 2, management related) demonstrates a positive quadratic relationship between innovativeness and manager's cognitive capability. Like manager's experience, cognitive capability is needed proportionally to boost firm innovativeness, and this may mean that it is essential that manager's capability is used together with new knowledge and experience from outside the firm.

Hypothesis 6: Stronger market-related skills are positively associated with innovativeness.

Market-related skills are important capabilities in business organisations. The results confirm the hypothesis for the two dependent variables on innovation (R&D intensity and Newness of Innovation), but only in linear association (non-linear association could not be explored due to non-ratio scale of measurement).

C. Firm external conditions (entrepreneurial ecosystem)

With regard to entrepreneurial ecosystem conditions included in the study, all of the associations are at the lowest level of significance. To be clear, however, our results are mixed in that they confirm the positive influence of urban environment and indicated some positive influence of intra-cluster relationships.

Hypothesis 7: Level of urbanisation is positively associated with firm innovativeness.

Urbanisation has already taken place for years in the region of Jakarta and Surabaya. Urbanisation benefits the region because it brings higher levels of supporting services, better infrastructure, a better developed labour market, knowledge spillovers, etc. The results confirm that such benefits (also called agglomeration advantages) exist in Indonesian cities with regard to the two dependent variables (i.e., Newness of Innovation and R&D Intensity).

Hypothesis 8: Strong intra-cluster networks are positively associated with innovativeness

The formation (growth) of clusters is considered to be an enabling condition for improving firm innovativeness, particularly through collaborative relationships within clusters. There is a difference in strength regarding intra-cluster network and the two dependent variables of innovativeness. Strong intra-cluster networks tend to have a significant association with innovation for the R&D intensity indicator but not for Newness of Innovation. A potential explanation for this situation is that the firms may spend more on R&D intensity if they are located in a cluster with a common strategy of strong R&D intensity but still face difficulty in transforming R&D activity and results into actual new innovations.

Hypothesis 9.1: FDI share is positively associated with innovativeness (linear)
Hypothesis 9.2: FDI share is positively associated with innovativeness (quadratic)
In general, studies on FDI's impact on innovativeness have provided contradictory results. Some research shows that FDI positively influences innovativeness while other studies disentangle a negative influence or absence of any influence. The results reveal that FDI is positively associated with innovativeness after a certain level. This means that the FDI share below a certain level (threshold) does not affect innovativeness, while above the threshold it will drastically improve innovativeness. Such an association of FDI is significant for the indicators R&D intensity and

Newness of Innovation. This situation indicates that FDI helps firms acquire some new knowledges to produce higher newness in innovation.

Hypothesis 10: Better (perceived) quality of regulation is positively associated with innovativeness
Like FDI, regulations can have a positive or negative influence on innovation activities. In this sense, this PhD study argues that better-perceived quality of regulation may positively impact innovation, and the results reveal that Hypothesis 10 is supported for our two dependent variables of innovativeness.

In addition, the study explores two potential interaction effects regarding manager's capabilities and cluster network partners with innovativeness:
11.1: *Interaction between manager's cognitive capability and intra-cluster network strength is positively related to innovativeness.*
11.2: *Interaction between level of marketing skills and intra-cluster network strength is positively related to innovativeness*.

Regarding hypotheses 11.1 and 11.2, the results indicate that manager's cognitive capability and market-related skills significantly moderate the relationship between intra-cluster network strength and innovativeness. Still, the moderating role of the manager's capability tends to be stronger than that of market-related skills, a reason for this may be the broader skills level that is required to meet the sometimes competing strategic and current operational objectives of a firm, which does not always seem possible.

Table 7.1 Summary of testing of hypotheses
(See: Subchapter 4.4.2)

Innovation conceived as	**R&D intensity**		**Newness of Innovation**	
Hypothesis	**Confirmed/Not**	**Note**	**Confirmed/Not**	**Note**
1a) Firm size is positively associated with innovativeness (linear)	Not Confirmed		Confirmed	
1b) Firm size is positively associated with innovativeness (quadratic)	Confirmed		Confirmed	
2) A higher level of R&D organisation is positively associated with innovativeness	Confirmed		Confirmed	
3a) Manager's ICT skills are positively associated with innovativeness (linear)	Confirmed		Confirmed	
3b) Manager's ICT skills are positively associated with innovativeness (quadratic)	Confirmed		Confirmed	
4a) Years of manager's experience is positively associated with innovativeness (linear)	Confirmed		Not Confirmed	Confirmed in partial model 2
4b) Years of manager's experience is positively associated with innovativeness (quadratic)	Confirmed		Not Confirmed	Confirmed in partial model 2
5a) Manager's cognitive capability is positively associated with innovativeness (linear)	Not Confirmed	Confirmed in partial model 2	Not Confirmed	Confirmed in partial model 2
5b) Manager's cognitive capability is positively associated with innovativeness (quadratic)	Confirmed		Not Confirmed	Confirmed in partial model 2
6) Stronger market-related skills are positively associated with innovativeness	Confirmed		Confirmed	
7) Level of urbanisation is positively associated with firm innovativeness	Confirmed		Not Confirmed	Confirmed in partial model 3
8) Strong intra-cluster networks are positively associated with innovativeness	Not Confirmed	Confirmed in partial model 3	Confirmed	
9a) FDI-share is positively associated with innovativeness (linear)	Not Confirmed		Not Confirmed	
9b)FDI-share is positively associated with innovativeness (quadratic)	Confirmed		Confirmed	
10) Better (perceived) quality of regulation is positively associated with innovativeness	Not Confirmed	Confirmed in partial model 3	Confirmed	
11a) Interaction between the manager's cognitive capability and intra-cluster network strength is positively related to innovativeness.	Confirmed		Confirmed	
11b) Interaction between market-related skills and intra-cluster network strength is positively related with innovativeness	Confirmed		Confirmed	

RQ 4: In what respect is the entrepreneurial culture in Indonesia different from those assumed in common innovation theory and what could be the implication of such differences?

Derived from literature and interviews, the argument is that Indonesian entrepreneurial culture faces a 'strong power distance' or hierarchy, lack of strong ambitions and a risk-avoiding attitude that may hinder innovation. On the plus side, positive values in Indonesian entrepreneurial culture such as the collectivism culture, creativity and loyalty to friends and family may support an innovative entrepreneurial environment.

Concerning regional differences in innovativeness (Chapter 5), the following research questions have been addressed:

RQ5: To what extent and how do the influence of internal, management and external conditions on firm innovativeness differ between various regions of Indonesia?

Regional differences were explored by broadly dividing Indonesia into two regions: Jakarta (defined as core region) and outside Jakarta (non-core) regions. The hypotheses and the findings for regional level are previously shown in Table 5.5 and will be concisely summarised as follows:

HR1: ICT firms in the core region are more innovative than those in non-core regions

The study found that for most conditions, ICT firms in the core region are more innovative than those in the non-core regions due to better circumstances (better ICT infrastructure, availability of good ICT education institutions, availability of many financial institutions and investment) and agglomeration advantages, but not for all conditions. Table 5.2 shows that the firm-specific conditions of R&D organisation, manager cognitive capability, level of marketing skills and cluster network strength between the core region and non-core regions in the country are statistically not different (almost similar).

HR2: The relationship between firm-internal conditions and innovativeness in the core-region is stronger than that in non-core regions

The study can confirm HR2 in that the relationship between internal conditions and firm innovativeness is stronger in the core region than the relationship in non-core regions in all conditions (firm size, R&D intensity, R&D organisations).

HR3: The relationship between management conditions and innovativeness in the core region is stronger than that in non-core regions

With regard to HR3 (on management conditions), the study also confirms that the relationship between management conditions and innovativeness is stronger in the core-region compared with non-core regions.

HR4: The relationship between firms' entrepreneurial ecosystems regulation conditions and innovativeness in the core-region is stronger than that in non-core regions

However, for entrepreneurial ecosystems (HR4), the study cannot confirm that the relationship between external conditions and innovativeness in the core region is stronger compared with non-core regions.

HR5:The moderation of cognitive capability to cluster network in its association with firm innovativeness is stronger in the core region than that in non-core regions

The study confirms HR5 in that the moderation of manager's cognitive capability to cluster network strength on innovativeness is stronger in the core region compared with non-core regions.

HR6: The moderation of marketing skills to cluster network in its association with firm innovativeness is stronger in the core region than that in non-core regions

HR6 cannot be confirmed by the study, thus implying that the moderation of level of marketing skills to cluster network strength on innovativeness is not stronger (can be similar or weaker) in the core region compared with non-core regions.

All-in-all, the conclusion is that the conditions influencing firm innovativeness that are significantly different between the core-region and non-core regions, are primarily internal and management conditions.

7.3.2 Policy guidelines

Innovation change strategy at the country level is considered by the researcher as the strategy to change the innovation mindset of Indonesian people by respecting Indonesia's multifaceted culture and empowering all the actors involved in the National Innovation System (NIS). The interpretation by the central and regional governments and Indonesia's firms is generally aligned with current international views[5] (Guellec and Paunov, 2018).

[5] Innovation policies need to address data access issues; become more agile; promote open science, data sharing and co-operation among innovators; and review competition for innovation and intellectual property policy framework.

However, due to the digital divide in Indonesia, the study found a slightly different understanding between central government and regional governments. In this regard, innovation change strategy should be dominated by regional innovation strategy to enable the eastern region catching up with the western part of Indonesia. For example, the regional level is important for participatory policymaking and negotiation (national and regional) which makes implementation easier.

RQ6: What would the content and processes(steps) be in a change strategy? *How should the change strategy be designed and implemented and what are the implications for the design of the policies?*

The RQ address the design process, implementation and the implications of the policies. The study suggests culture-oriented and multi-actor approaches to deal with the innovativeness challenge in Indonesia. The cultural approach is essential because culture may determine personal (power) relationships, risk-taking behaviour ambitions within firms and, accordingly, innovation behaviour, while a multi-actor approach with dialogue and negotiation may facilitate adjustment in each actor's role to arrive at a certain consensus on decisions and responsibilities. The adjustment of each actor's role can happen due to participatory policymaking in such a way that having a say in decisions and responsibility in implementation will be distributed to all actors instead of a single actor.

The study also suggests short-term and long-term programs (Appendix 17)**.** Short-term programs may act as clear milestones in the journey to reach the long-term goal of all programs. In short-term programs, for instance, the study recommends a designed training for ICT firms' managers to increase their skills and knowledge in ICT that will improve the capacity to innovate, to prevent lock-in and to refresh the experience. In addition, the regulation on FDI should be enhanced to increase foreign participation while protecting the local small industries that cannot compete with global competitors. This regulation should be combined with a strategy to further increase benefits for domestic firms from knowledge spillovers from FDI.

To respond to the challenge of increasing professional levels in local ICT firms, it is essential to provide strong incentives to talented ICT employees in both short-term and long-term programs, i.e., to provide them with continuous professional training if they intend to innovate and remain competitive in the market. Providing incentives to ICT professionals is important for motivating young talent to sharpen their ICT skills while being retained in local ICT firms and to

prevent brain drain (the migration of skilled professionals to Jakarta or even abroad)**.** In addition, the study suggests key strategies to improve ICT firms' innovativeness in Indonesia, for small and large firms in managerial aspects, such as training for managers in ICT knowledge, training in dealing with risks in innovation and learning to co-create with customers in specialised segments (for small firms).

7.4 Suggestions to make the study results transferable in practice

Considering previous discussions, several suggestions will be given in this section to make the study transferable in practice. Though there are no studies available on transferability in an Indonesian context, there are several clues for practical transferability. Following Gaarder and Jimenez (2021), facilitating dialogues among researchers, decision-makers and other actors can help increase impacts from the results of the study. In the case of Indonesia, the innovation ecosystem is not yet well developed and has not yet influenced many organisations. Therefore, the process of dialogues may need to include many parties. This process may require a coordinator to deal with different viewpoints. Maintaining ongoing dialogues improves the chances of generating findings that help address relevant and urgent policies and implementation challenges. It also helps to provide evidence to the users at the time that they need it and in a format that is actionable and understandable. The remaining section is devoted in more detail to two related approaches, a transdisciplinary approach including three design principles and the so-called Design-Thinking to make results and recommendations more impactful in practice.

Koskinen (2017) suggests a *transdisciplinary research* approach aimed at providing transformational knowledge through active interactions and collaborations among scientists and stakeholders in innovation practices. Transdisciplinary research according to Aboelela et al. (2007) is defined as research efforts conducted by researchers from different disciplines jointly working to create new conceptual, theoretical, methodological and translational innovations that integrate and move beyond discipline-specific approaches to address a common problem. Hence, while this approach has been originally developed to enhance sustainability, here the study applies the transdisciplinary research approach in the context of improving innovation levels. Subsequently, the use of Design Thinking (DT) is suggested by various researchers (e.g., Gonera & Pabst, 2019; Carlgren et al., 2016) to make a study more impactful. DT is described as a human-centred approach to problem-solving, creativity and innovation combining what is technologically feasible

with what is desirable and economically viable (Brown & Katz, 2011; Carlgren et al., 2016). It is important to note that there are two levels of co-creation in this study: 1) between research and policymaking and 2) on firm-level, in R&D between firms and customers/users. Therefore, some advantages in applying DT into the current study on innovation can be summarised as follows: it helps to create the right environment for a deeper and much broader understanding of the voice of the user of research results and policy advice. It helps to move beyond the monologue of research (especially between research and policymaking) and, if incorporating prototyping and testing, begin an ongoing process of dialogue with current/potential users of research and policy recommendations. An enabling factor in using DT for this study is the creation of spaces for mutual learning and experimentation, such as niches that are protected (from market forces) and living labs that are user-centred and develop co-creation with stakeholders in real-life environments (Brown & Katz, 2011; Carlgren et al., 2016; Van Geenhuizen, 2018; Gonera & Pabst, 2019).

Table 7.2 provides the details on the proposed suggestions for improving transferability and impact of research results, with reasons why improvements are absent or poorly developed, and notes on needs in supporting change strategy.

Table 7.2 Suggestions for improving transferability and impact of research results

Suggestion for strategy to make more impact	**Reason why (almost) absents in practice**	**Notes on needs in supporting change strategy**
Dialogue with all parties (stakeholders)	Dialogue is limited due to 'silos' or boundaries between parties	- Need for a solid stakeholder analysis to identify interests and power, but also common ground for the dialogue
Using new methods like DT preventing 'monologue of research', and increasing creativity in solutions	Still using old methods due to unfamiliarity with and potential resistance to new methods	- Need for experimentation in collaboration between research and policymaking
Research co-creation Co-creation between firms and users (customers)	Co-creation in research is unfamiliar practice, as are tools like niche innovation and living labs (firms)	- Need for an integrator - Results of experimentation and demonstration need to be convincing to enable broader use
Trans-disciplinary research	Current research is mostly a single discipline, due to difficulties in boundary spanning between disciplines	- Need for an integrator - Results of experimentation and demonstration of boundary spanning need to be convincing to enable a broader use

7.5 Conclusion, Implications and Contribution to Strategy and Policymaking

7.5.1 Contribution to Empirical Study

This section discusses the conclusion, implications and contribution to strategy and policymaking. With regard to the country level, the *first* conclusion is that small firms in Indonesia have to put extra effort into learning to increase innovativeness. This situation calls for the improvement of their management capabilities, in particular ICT skills and market-related skills. The overall picture is one of low professionalisation of R&D, according to standards of developed economies, and lack of funding preventing small firms to catch-up (Long & Dong, 2017; World Bank, 2015). This situation complies with the result that innovativeness according to intentions (R&D intensity) is somewhat different compared with innovativeness as realised innovations (Newness of Innovations), where the latter is subject to more complexity and risk. In turn, this is also in line with entrepreneurial values, such as hierarchy within firms, relatively strong risk-avoidance, a modest ambition level and weak individualism, that are hampering innovation. However, values such as collectivism, creativity and high valuation of friendship and family relationships tend to drive and stimulate innovation, which calls for enhancing such values.

The *second* finding is a relatively weak positive influence of the urban environment and somewhat stronger positive influence of clusters. Accordingly, the study could not fully support theoretical ideas of agglomeration advantages, among others benefits from knowledge spillovers particularly in metropolitan areas. Further, our results on clusters did not support previous works (Bathelt et al., 2004; Gunawan et al., 2016) which relate to a potential 'dark' side of knowledge transfer. This situation can be understood as follows. In developed countries, where institutional support, infrastructure, and human capital tend to be stronger, firms may be better able to mitigate the disadvantages of tight networks in the cluster. They may be able to more effectively manage collaborations or tap into global networks to access diverse knowledge, for example. In developing countries like Indonesia, on the other hand, tight networks may be more crucial to overcome institutional weaknesses but could also reinforce local routines and hinder learning from more advanced economies. Parts of developing economies may have relatively young ICT clusters where the 'good side' has not yet been fully substantiated and 'dark sides' have not yet emerged, further emphasising that clusters are an important source of novel knowledge (Aslesen and Harirchi, 2016). However, it appears that potentials of cluster advantages can be better used, which calls for more attention.

The *third* conclusion refers to FDI and innovativeness. Innovativeness tends to increase in a positive non-linear (u-shaped) way with firm-level FDI, suggesting increasing returns (benefits), which is in line with Tambunan (2007) and Zhang et al. (2010) emphasising FDI as an important source of novel learning and knowledge transfer. However, also in this respect, opportunities tend not to be fully used.

Next, the study found that core region and non-core regions in Indonesia differ in most firm-internal conditions, including management and entrepreneurial ecosystem conditions. The differences between the core region and non-core regions are in the relationships between innovativeness and firm capabilities, and between innovativeness and entrepreneurial ecosystem. In the core-region, the relationships of innovativeness with management capabilities are much stronger than those with external conditions (entrepreneurial ecosystem). Meanwhile, in the non-core regions, the relationships with the two conditions tend to be weaker.

7.5.2 Theoretical Contributions

With regard to theory, the study contributes by extending general innovation theories with a vastly populated developing country, characterised by low technological level and low innovativeness mainly among small firms. More specifically, the empirical investigation of firm-internal factors and entrepreneurial ecosystem conditions, including non-linear patterns of influence, is also an important contribution. In addition, the analyses concerning regional-economic disparities in innovativeness between the core region and non-core regions are another novel contribution.

This study has utilized quite a number of different theories, particularly for understanding empirical practice of innovation in Indonesia. Which one is to be preferred and for what reasons? Though only partially operationalized and measured in the current study, preference would go to Entrepreneurial Ecosystems theory. The reason is that this theory merges several other theories. It not only includes the firm level resources and capabilities (addressing influence of e.g., firm size and skills, and interaction mechanisms with the environment) but also knowledge spillovers (agglomeration theory), the networks concerned (cluster theory) and institutional factors, the last one in particular needed to understand potential change strategies.

7.5.3 Policy Contributions

The study suggested a new (policy) approach to respond to the many challenges in Indonesia, namely, in improving policymaking concerning conditions for innovation. Accordingly, the suggestion is to move to collaborative policymaking (co-creation of research and recommendation between stakeholders) to enhance policy implementation. The related approach, on the firm level, refers to the introduction of 'co-creation of inventions with customers', which is a relatively new innovation practice in Indonesia.

7.5.4 Conclusion

The chapter has provided conclusions regarding the major challenges in Indonesia, conditions influencing innovativeness in Indonesia, differences between regions of Indonesia and change strategies to deal with the challenges. As a conclusion, the study found that an important underlying problem in Indonesia's ICT sector is the digital divide, which causes disparities in ICT access, education and workforce readiness. Meanwhile, a second important underlying problem is the Indonesian entrepreneurial culture that faces a 'strong power distance' or hierarchy eventually blocking innovation. In particular, the last calls for transformational change, for which several suggestions are provided in the study, particularly collaborative policymaking.

Chapter 8. Reflection on Limitations and Future Research

This chapter provides a critical reflection of empirical and design chapters in the study (Chapters 4, 5 and 6): it discusses the limitations of the research and provides suggestions for future research. The study itself exemplifies a new research line on innovation in the business sector, at the national and regional level, and in search of differentiation in innovativeness and underlying factors (Edwards-Schachter, 2018). Moreover, studies of innovation in the context of Indonesia are still limited and the studies that are there differ in emphasis and depth, which makes it difficult for researchers to pinpoint the various enhancing and constraining conditions influencing the innovation process in the business sector, the policy design, and the decision-making of policymaking institutes (central and local governments). Therefore, there is not a perfect study, and the limitations should be followed up by several future research (lines). The chapter is structured as follows. First, the limitations of the research will be elaborated chapter by chapter (Chapters 4, 5 and 6), and this will be followed by several suggestions for future research.

8.1 Limitations of the research

This section discusses the limitations of the research, mainly for the 'core' empirical Chapters 4 and 5, and for the design of a change strategy in Chapter 6. In Chapter 4, investigating the level of innovation and influential conditions in innovativeness, the limitations are the following. *First*, some small ICT firms refused to act as respondents in the survey, potentially causing some bias in the results. This may have happened because the method of the survey was an online survey. The online survey aimed to reach sufficient numbers of respondents from all over Indonesia, which would be very costly and time consuming if conducted with an on-site survey (Wright, 2005) considering the relatively large size of the country. On-line surveys, however, can be easily neglected by potential respondents. Other reasons for the non-response of small firms may be due to performance issues (financial or growth issues) as mentioned by Wolf et al. (2016). The firms may feel 'uncomfortable' with exposing their actual performance. At the same time, the study employed stratification methods to compensate for overrepresentation of large firms, but this could not fully reduce the influence of larger firms on the overall pattern in which most firms are SMEs (BPS, 2019), like in many other countries (WTO, 2016). Also, to

support interpretation, the situation of small ICT firms was addressed in expert interviews; however, this could only partially compensate for non-response in statistical analysis.

Secondly, a deeper understanding of low knowledge absorptive capacity and delay in learning (such as low professionalisation of the firms' R&D organisation and slow learning processes), as touched upon in Chapter 4 and Chapter 5, is missing and would be in place in follow-up surveys and modelling, for example, by directly connecting to specific knowledge types and learning processes that are not covered in the survey, except for marketing skills.

Thirdly, the study used rather straightforward measurement to characterise innovation behaviour of the firms, namely number of innovations at a particular point in time and Newness of Innovation (which is subject to geographic region for which the innovation is new) as an output-indicator of the innovation process. To compensate for that issue, the study also took firms' R&D investment into account, as an indicator on the input side of innovation activity. Apart from this, the survey could not make the measurement more robust as it was designed to be as simple as possible to encourage the respondents to complete the survey without reducing the core of the study (Wolf et al., 2016). However, the simplifications may have resulted in some significant aspects not being captured, such as hidden motivation and barriers to innovate.

Fourthly, the statistical analysis in Chapters 4 and 5 (multiple regression analysis) has been somewhat limited, with more complicated relations remaining under the radar. However, time and resources were not sufficient to extend the statistical modelling. In Chapter 5, the regional study, an additional limitation has been introduced with the geographical division of Indonesia into core region and non-core regions, which may not fully represent Indonesia's actual regional differentiation in innovation (or presence of agglomeration advantages). However, it is not possible to precisely represent the actual and much more differentiated situations due to low availability of official statistical data, such as private R&D expenditure and number of innovations in each region (World Bank, 2017). The wider and more differentiated gaps (in economy and advancement) between regions in Indonesia would have been very interesting to investigate, but it would have required much more time and resources.

In addition, Chapter 6 is a first attempt to design a change strategy. This situation means that underlying conceptualisation and experimentation are limited concerning collaborative and

adaptive policymaking (design). Also, making connections with practice such as design of collaborative structures (organisational) has remained behind. This also holds true for connections with other disciplines to extend theoretical underpinning of collaboration. Further, the chapter is faced with limitations in knowledge on challenges of transferability of solutions to increase innovation levels. This situation exists because there are few success stories of transferability in Indonesia due to a shortage in experience in dealing with transferability (Afifudin, 2010). The case of the World Bank and IMF's failure to cope with economic crises in countries like Indonesia (and Thailand) has often been cited as an example of how changes could not be sufficiently transferable and did not work effectively (Rodrik, 2007). More importantly, studies on transferability of solutions to low innovation - both at firm-level management of innovation and in policy-making - developed in other geographic contexts facing different local cultures and policy-relations compared to Indonesia, have not yet been undertaken or are just starting. This situation means that results on testing transferability are missing, and generalised questions like "would collaborative policymaking work well, eventually with some adjustment to align with the Indonesian situation, and - as a new innovation model for small ICT firms - could co-creation work to prevent risks of failure in the market?" have remained unanswered.

8.2 Suggestions for future research

In line with the previous discussion, suggestions for future research will be discussed for each chapter separately. This is followed by a discussion of several additional lines that all refer to empirical chapters. For Chapter 4, suggestions for future research could include: *firstly,* application of a more advanced technique of causal modelling, i.e., structural equation modelling (SEM) (Hoyle, 1995), to investigate the innovation model factors' many interrelationships. To be able to fully use opportunities of applying SEM, the study needs to collect more data on firms' innovation preferences and experienced barriers. And *secondly*, there is a need to rigorously test the relationships revealed in this study (for instance between the innovativeness and marketing skills, ICT skills, and networks within clusters) and the non-linear character of some of these relations. *Thirdly*, there is a need to design a longitudinal approach that may better open ways to understanding causality and to improve interpretation of the non-linear relations observed in the current study. The sheer size and fast growth of the domestic market in Indonesia justify such further investigation.

For Chapter 5, suggestions for future research can be made concerning a more detailed differentiation in innovativeness (gaps) between large metropolitan areas and small cities beyond such areas; such a study could also focus on comparison of ICT innovativeness with similar countries in (Southeast) Asia which can deepen understandings, e.g., on influence of culture on management and risk-taking in innovation activity. In addition, non-response among small and micro-firms can be overcome by using a professional surveyor.

In future research regarding Chapter 6, a better conceptualisation of key processes (like collaboration and deliberation) and a better connection with additional disciplines could be undertaken, alongside designing of organisational structures enabling the new collaborative (and eventually the adaptive) approach in practice. Accordingly, other methods to design the change strategy could be considered, such as the cascading strategy regarding conditions of innovativeness in the ICT sector in Indonesia (CMOE, 2019). Cascading strategy, as a strategy at both firm level and sector level, is the process of disseminating the firms' overarching strategy throughout the organisation and the entire value chain of the firm's activities to ensure that implementation occurs (CMOE, 2019). In addition, testing based on views by different experts, like in innovation, culture and business values and in policy analysis, would be helpful in making a change strategy more realistic.

On the whole, there are some additional lines for future research connected to all empirical chapters in the study and Chapter 6: involve a larger number of small companies as respondents by hiring professional surveyors, organise more discussion with stakeholders and integrate novel perspectives from other professional angles in the current design of a change strategy, and among small firms to establish collaboration with customers and researchers to benefit from co-creation research. To summarise, the chapter contains the reflection of the study, involves the limitation, suggestions for future research and suggestions to make the study more impactful as shown in Table 8.1.

Table 8.1Main limitations and suggestion for future research

Limitation	**Reason why almost absent in current study**	**Notes on future study**
Refusal by some SMEs to act as respondent	Respondents feel 'embarrassed' to reveal the real conditions	Extend survey and supplement with other data collection techniques (professional surveyor)
Missing some aspects of innovative behaviour	Keep the questionnaire simple to respond to	Introduce in-depth survey and complement with interviews
Using simple modelling of innovativeness	Aimed to do 'groundwork' for designing a change strategy	Use advanced model assessment techniques (like SEM)
Division of country into regions, without including agglomeration factor	Official data are limited; missing indicator for agglomeration	Approach real situations more sophisticated, e.g., accounting for large and small cities over the whole country (use of agglomeration index)
Design of a change strategy is missing a comprehensive approach in conceptualisation, theoretical context (disciplines) and practical structure	Experience with such design is (very) limited	Adopt a more comprehensive approach in the design and consultation with stakeholders and experts
The suggested method for policy design has not been tested	Experience on transferability is (very) limited in Indonesia, including expertise (expert vision)	Gain outcomes through alternative methods, like cascading strategy (firm level) using value chains and activity chains. Use visions from experts in similar countries with more experience.

Finally, the research is one of the first attempts to fill the gap in innovation studies in Indonesia. However, there are several more recent studies in the context of Indonesia in different areas and sectors, using a different approach and characterisation. Appendix 18 provides a list of these studies published in the past 10 years. The selection is made in such a way that only innovation studies *conducted at the firm level* are included in the list. The current study is unique because of its coverage of a single and very dynamic sector, ICT, including a specific modelling approach to analysis of firm-level innovativeness and specific design of a change strategy to increase innovativeness.

Appendices

Appendix 1. Construct Measurement, Internal and External Validity (Chapter 1 and Chapter 4)

Firm Innovativeness
The construct 'Firm innovativeness' is measured not only through self-perception of the firms, but also from outside the firms - its entrepreneurial ecosystem and networks. Therefore, the survey in this study encompassed not only self-measured innovativeness, but also how managers perceive their external environment (ecosystem) and their relationships in such environment. The survey also posed the question how the managers perceive the influence of external and network relationships on firm innovation capability. In this regard, a valid innovativeness scale provides the study with a systematic method for evaluating the connection between innovativeness and firm internal, external and network attributes. See also Chapter 4 (section 4.3.2).
Internal (Firm-centered) construct
Firm-centered construct is most important when it comes to firm innovativeness. In this study, the size, the existence of R&D organization, and the managerial capability is taken into account to define the innovativeness level. To ensure the validity of the internal construct, some previous studies are followed (e.g. Qian & Acs, 2013; Helvat & Peteraf, 2015; Hendrayati & Gafar, 2016). The studies are also confirmed with data from Statistics of Indonesia and interviews with experts.
External environment (entrepreneurial ecosystem) construct
The external/environment construct is defined as an inclusive concept that involves main outside influences to which a business responds or reacts in order to maintain its flow of operations and strategy on innovativeness. In detail, it is limited in this study to indicators of entrepreneurial ecosystems with regard to knowledge spillovers (large cities), multi-faceted partnering in clusters (strength), key investment relations (FDI) and regulation. The validity of this construct is derived from use of previous studies (like Stam, 2015; Audretsch and Belitsky, 2017; Stam and Van der Ven, 2021), and also secondary data from BPS and other official institutions.
Network construct
Network construct consists in trust relationships between firms and their partners, sharing knowledge that contributes to extend business out of region or international more easily, or collaborate in innovation. The construct is validated by use of previous studies (e.g. Eisingerich & Bell, 2010; Gunawan, Jacob & Duysters, 2016)

Internal and external validity (Stock and Watson, 2018)
Internal validity refers to whether the analysis is valid for the population and sample being studied. Derived from the testing and model estimations involved, it seems that this validity is relatively strong. Due to using a few indicators only in measuring external environment/entrepreneurial ecosystem, this part's internal validity tends to be somewhat weak.

External validity refers to whether the results can be generalized to other populations in Indonesia (representativeness of the sample). This validity tends to be at reasonable level, as the sample was made as representative as possible in post-stratification procedure (urbanization level and firm-size).

Appendix 2 Interview (Chapter 2)

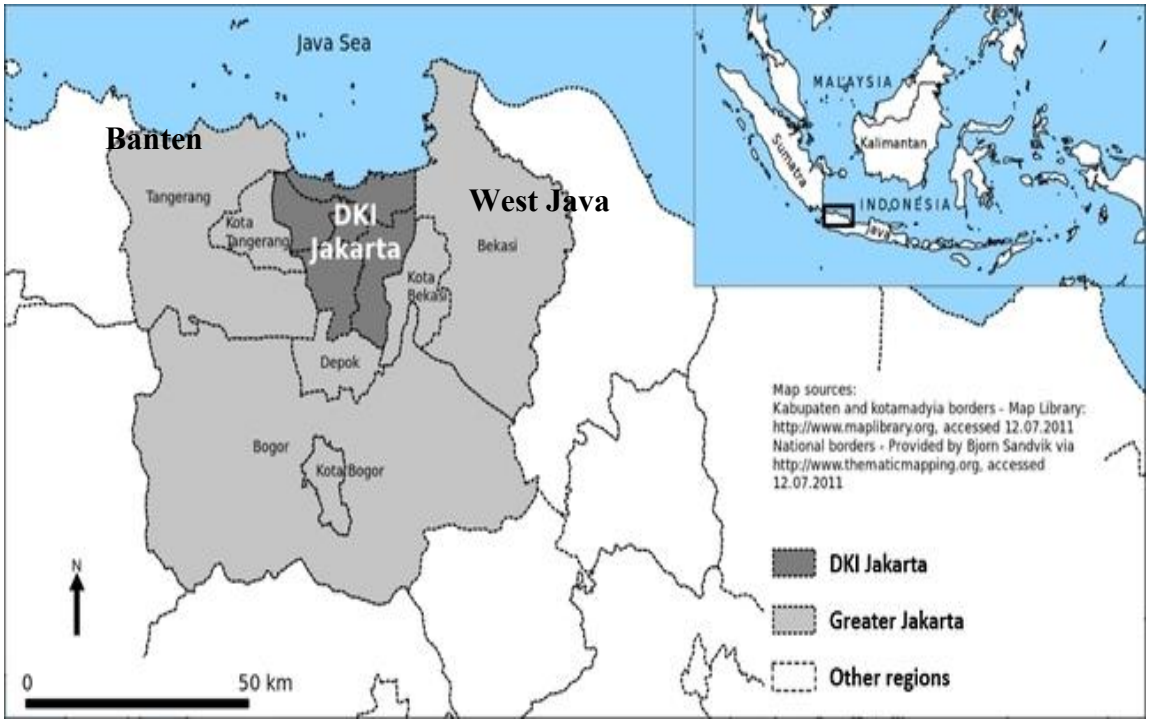
Role	Institution/Location	Questions
Central Government	BKPM (Indonesia Investment Coordinating Board)	*a. Institutional level* With regard to innovation, - What is the strength of your institution? - What obstacles have you experienced in innovation activities (related to your institution)? - How your institution deals with that? - What opportunity do you expect? - What strategy do you suggest tackling the challenges? - How can it be done? *b. National level* In your opinion, - What is the main challenge in developing national ICT innovativeness (related to your institution's function)? - How is the current situation? - What have you already done in your institution to address the challenge? - What opportunity do you expect? - What strategy do you suggest tackling the challenges? - How can it be done?
	Ministry of Industry	
	Ministry of Research & Technology	
Regional Government	Regional Investment Agency	
	Bandung Regional Government	
Financial Institution	Micro Banking (operate nationwide)	
	1 angel investor Jakarta	
Universities	1 private university in Bandung	
	1 public university in Depok	
	1 public university in Solo	
Incubators	1 incubator in Bandung	
	1 incubator in Palembang	
Community	1 ICT Professional association	
Firms Consultancy	3 Large Firms in Jakarta Foreign Expert in Knowledge-based Economic Development and implementation	

Appendix 3 The use of ICT equipment and education in schools **(Chapter 3)**

Item	*Percentage/Ratio*
Use Radio in a learning activity	19.08%
School has a telephone facility	46.01%
Use TV in a learning activity	21.32%
Have internet access	76.25
Ratio student use computer	1:15
Students access the internet in school	71.65%
The teacher qualifies teaching ICT	10.10%

Source: BPS (2016)

Appendix 4. Map of Greater Jakarta (Chapter 3)



Source : http://www.maplibrary.org & http://www.thematicmapping.org (accessed on 12.07.2011)

Appendix 5 Questionnaire (Chapter 4)

Firm Innovativeness in ICT Clusters of Indonesia

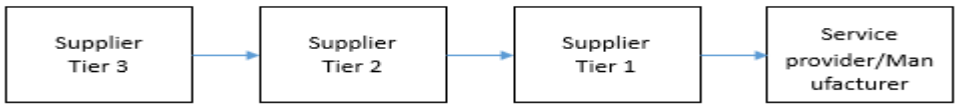
The questionnaire is designed to analyze firm innovativeness of ICT-based firms in ICT cluster of Indonesia and contribute to a recommendation for policy improvement. The questionnaire is fully confidential and no disclosure of individual/organizational information. The questionnaire consists of four sections: internal factor, innovativeness, external, and network factors.

Section 1 of 4

1. Your Year(s) of experience in the firm: _____
2. Year of establishment of your firm: _____
3. a. The number of full-time employees of your firm:

   b. The number of part time employees of your firm:
4. What type of R&D activities in your firm? *Mark only one circle*
   - o The study have an R&D unit
   - o The study do R&D activities but has no unit
   - o The study collaborate R&D activities with other institutions
   - o The study do not have any R&D activities
5. The percentage of R&D spending on sales of your firm (approximately): _____%
6. The highest level of education of your firm manager: *Mark only one circle*
   o SMA/High School o D3 o Sarjana/Bachelor o S2/Master or higher
7. Cultural background of your firm top manager: *Mark only one circle:* o Jawa/Sunda o Melayu o Batak o Dayak o Batak o Bugis o Bali o Madura o Others _____

Position in the value chain



8. Your firm position in the supply chain (see the above figure: *Mark only one circle*
   o Supplier tier 3 o Supplier tier 2 o Supplier tier 1 o Service provider/manufacture

Section 2 of 4

Firm Innovativeness

9. What types of innovation that your firm undertakes and how many times it was taken in the last two years? (can be more than 1 answer)]: *Check all that apply & fill in the blanks*

☐ Product/Service Innovation [Changes in design, components, architecture products, ways to service customers, new products or services], _____times

☐ Process Innovation [Adaptation of existing product lines, implementation of new (process) technologies], _____ times

☐ Marketing innovation [Changes in the product design, product promotion and the price, include exploitation of new territorial market, penetration of new market segments], _____times

☐ Other types of innovation, mention _____ (type and times)

10. Rate the newness of your firm innovation based on the coverage of the newness. *Mark only one circle*
    - o New to the firm o New to the industry in certain region in Indonesia o New to the industry in Indonesia
      o New to the world

Section 3 of 4

External Factors (EES)

11. What is your opinion about the influence of the institutional conditions (such as taxation) on your firm innovativeness? *Circle only one number*

    Negatively influence 1 2 3 4 5 6 7 8 9 10 Positively influence

12. What is your opinion about the influence of the position of your firm in the value chain (question number 8) on your firm innovativeness? *Circle only one number*

    Negatively influence 1 2 3 4 5 6 7 8 9 10 Positively influence

13. Is a foreign firm investing in your firm?

    o No o Yes ..... % (of share)

14. In your opinion, how is the relation between foreign investment with your firm innovativeness? *Circle only one number*

    Negatively Influence 1 2 3 4 5 6 7 8 9 Positively influence

15. What are your main suggestions to strengthen FDI role, regulation institutional and position in the value chain in improving your firm innovativeness?

    _____

    _____

    _____

Section 4 of 4

Network Factors

Cluster is a geographic concentration of firms and other supporting actors in the same sector and region. For instance: Bandung ICT cluster consists of ICT-based firms, local government and/or universities/other research organizations of Bandung.

The degree of relationship among cluster members/ non cluster members can be indicated by the extent of mutual trust, the meeting intensity and the idea/resources exchange frequency. It also applies for a firm relationship with non-cluster members].

Firm openness can be indicated by its willingness to cooperate with other parties, accept other party idea/ values and sharing knowledge/resources to improve firm innovativeness.

16. Organizations that often interact with your firm from your cluster and the degree of relationship (could be more than 1)? 1: very weak 10: very strong *Check all that apply and circle only one number*

Organization	*Degree of relationship*
☐ Local/Regional Government institution	1 2 3 4 5 6 7 8 9 10
☐ Large companies	1 2 3 4 5 6 7 8 9 10
☐ SMEs	1 2 3 4 5 6 7 8 9 10
☐ Universities or other research organizations	1 2 3 4 5 6 7 8 9 10
☐ Others _____	1 2 3 4 5 6 7 8 9 10

17. Organizations that often interact with your firm from **outside** cluster and the degree of relationship (could be more than 1)? 1: very weak 10: very strong *Check all that apply and circle only one number*

Organization	*Degree of relationship*

☐ Local/Regional Government institution	1	2	3	4	5	6	7	8	9	10
☐ Large companies	1	2	3	4	5	6	7	8	9	10
☐ SMEs	1	2	3	4	5	6	7	8	9	10
☐ Universities or other research organizations	1	2	3	4	5	6	7	8	9	10
☐ Others _____	1	2	3	4	5	6	7	8	9	10

18. What is your opinion about your firm openness to innovate (see the explanation of network factors above)?] *Circle only one number*

Very Weak 1 2 3 4 5 6 7 8 9 Very Strong

19. What are your main suggestions to improve the network strength and openness of your firm to increase the firm innovativeness?]

_____

_____

_____

Appendix 6. Post Stratification for Urbanization Level and Firm Size (Chapter 4)

Distribution and weighting concerning Urbanization Level (Region)

Urbanization Level (Region)	ICT Firm Population (a)	Sampe size (b)	%population (c)	%sample (d)	Weighting Region (Wr) (c/d)
Jakarta	199344	130	46	50	0.92
Big cities in Java	191182	101	44	39	1.14
Big cities outside Java	40752	29	9	11	0.86

Distribution and weighting concerning Firm Size

Firm Size	ICT Firm Population (a)	Sample size (b)	%population (c)	%sample (d)	Weighting Size (Ws) (c/d)
Small and Medium Firm	625772	202	98.7	75	1.32
Large Firm	8133	70	1.3	25	0.05

Source: BPS, 2018a

Appendix 7 Linear Regression Diagnostics (a) **(Chapter 4)**

Diagnostic	Type of test/method	Number of Innovations	Newness of Innovation
Detecting unusual and influential cases	Applying different methods, the studyasses' outliers; residuals; scatter plots; leverage; Cook's D	Deleted 12 outliers due to inconsistency and/or extreme values	Deleted 12 outliers due to inconsistency and/or extreme values
Reliability and Validity	Cronbach's Alpha Coefficient; Pearson Product Moment correlation	α= 0.73[>0.6] Corrected item total-correlation > r table	α= 0.74[>0.6] Corrected item total-correlation > r table
Test for normality of residuals	Kolmogorov – Smirnov Test	Monte Carlo sig: 0.87 [>0.05] p value = 0.03 [<0.05]	Monte Carlo sig: 0.66 [>0.05] p value = 0.049 [<0.05]
Test for 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
Test for multicollinearity	Variance inflation factor (VIF)	Mean VIF = 4.19[<10]	Mean VIF = 4.25[<10]
Test for model specification error	Ovtest	F: 0.48 [<10] p-value: 0.07 [>0.05]	F: 2.47 [<10] p-value: 0.07[>0.05]

(a) […] tolerance value.

Non-Response bias using Independent t-test

Indicator	Response (due date)	N	Mean	Leven Test		Assumption	t-test		Summary
				F	Sig		t	Sig(2-tailed)	
R&D intensity	On time	108	21.67	0.48	0.56	*equal variances*			No significant different
	Late	152	19.55			*assumed*	-1.38	0.66	
Newness of Innovation	On time	108	9.93	0.45	0.62	*equal variances*			No significant different
	Late	152	8.44			*assumed*	-0.80	0,53	

Harman Common Methods to test common method bias

Componen t	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulativ e %	Total	% of Variance	Cumulativ e %
1	2.99	18.74	18.74	2.99	18.74	18.74
2	2.30	14.34	33.08			
3	1.25	7.81	50.19			
4	1.08	6.75	64.63			
5	.88	5.48	76.28			
6	.84	5.27	81.55			
7	.76	4.72	86.27			
8	.70	4.38	90.66			
9	.15	.93	99.45			
10	.09	.55	100			

Extraction Method: Principal Component Analysis.

Interpretation: There is no common method bias because total % of variance is less than 50% (50% is the threshold).

Appendix 8. Compound Variables (Chapter 4)

a. Level of marketing skills

This is a compound variable derived from innovation spending, perception of cluster relationships and perception of openness. It is calculated using three types of factor analysis of which the results are consistent and robust.

Methods	*Principle factor*			*Principle-component factor*			*Maximum-likehood factor*		
Variables	*Number of items*	*Retained Factors*	*Factor loading*	*Number of items*	*Retained Factors*	*Factor loading*	*Number of items*	*Retained Factors*	*Factor loading*
Innovation spending	3	1	*0.66*	3	1	*0,64*	3	1	*0,58*
Perception of cluster relationships			0.63			0.60			0.61
Perception of Openness			0.59			0.68			0.65

b. Managerial Cognitive Capability (CC)

Manager cognitive capability is a broader indicator of learning and diversity herein, derived from manager's specific expertise, perception of institution arrangements and perception of external relationships (collaboration). It is calculated using three types of factor analysis of which the results are consistent and robust.

Methods	*Principle factor*			*Principle-component factor*			*Maximum-likehood factor*		
Variables	*Number of items*	*Retained Factors*	*Factor loading*	*Number of items*	*Retained Factors*	*Factor loading*	*Number of items*	*Retained Factors*	*Factor loading*
Manager Expertise	3	1	*0.56*	3	1	*0,60*	3	1	*0,55*
Perception of institution arrangement			0.66			0.64			0.63
Perception of external relationship			0.61			0.74			0.67

c. ICT Skills

ICT skills is derived from a broad regional ICT skill level and managers' education level, in a simplified way. An example below illustrates the calculation.

Respondent A owns an undergraduate degree and leads a firm in Aceh Province. This situation gives a score for her/him of 0.5425 (score ICT skills at regional level) x 3 (score of undergraduate) = **1.6275.**

The reason to use such simplified compound indicator, is to avoid bias from self-estimation in a situation in which skill levels are not yet (fully) standardized, and personal interpretation may play a role.

Province	**% adults skilled in ICT (2020)**
ACEH	54.25
SUMATERA UTARA	58.60
SUMATERA BARAT	58.67
RIAU	62.67
JAMBI	56.87
SUMATERA SELATAN	54.52
BENGKULU	53.42
LAMPUNG	55.57
KEP. BANGKA BELITUNG	60.37
KEP. RIAU	81.73
DKI JAKARTA	88.08
JAWA BARAT	71.09
JAWA TENGAH	65.78
DI YOGYAKARTA	81.36
JAWA TIMUR	63.91
BANTEN	69.35
BALI	72.56
NUSA TENGGARA BARAT	52.72
NUSA TENGGARA TIMUR	42.89
KALIMANTAN BARAT	54.10
KALIMANTAN TENGAH	59.66
KALIMANTAN SELATAN	62.88
KALIMANTAN TIMUR	75.33
KALIMANTAN UTARA	71.99
SULAWESI UTARA	63.03
SULAWESI TENGAH	51.68
SULAWESI SELATAN	60.50
SULAWESI TENGGARA	60.35
GORONTALO	55.68
SULAWESI BARAT	47.66
MALUKU	49.96
MALUKU UTARA	45.22
PAPUA BARAT	59.45
PAPUA	30.93
INDONESIA	**64.26**

Manager Education	**Score**
High School	1
D3	2
Undergraduate	3
Graduate	4

d. Cluster Network Strength

This variable indicates whether the intra-cluster networks are stronger as compared with external cluster networks (including four different partners).
Cluster Network Strength classified as follows: if NsI> 1, then 1 (strong), otherwise 0 (*Ns*) is calculated as:

Network Strength Inside Cluster (*NsI*) is calculated as:

Where:
NsIg denotes Network Strength with Government inside cluster.
NsIf denotes Network Strength with Large Firms inside cluster.
NsIs denotes Network Strength with SMEs inside cluster.
NsIr denotes Network Strength with universities/research institutes inside cluster.
Network Strength *Outside* Cluster (*NsO*) is calculated similar to *NsI* (replacing Internal with External cluster).

Source : BPS https://www.bps.go.id/indicator/28/1447/1/proporsi-remaja-dan-dewasa-usia-15-59-tahun-dengan-keterampilan-teknologi-informasi-dan-komputer-tik-menurut-provinsi.html (on 4 July 2020)

Appendix 9. Correlation matrix (Chapter 4)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Newness	1											
2. R&D intensity	.09	1										
3.Size	.13*	-.08	1									
4.R&D organization	-.01	.21**	.22**	1								
5.ICT skill	.05	.14*	.01	-.15*	1							
6.Experience	.07	.15*	-.01	-.23**	.10	1						
7.Cog.Capability	.01	.06	.07	.03	.10	.05	1					
8.Level of marketing skills	.16*	.06	.24**	.41**	.01	-.01	.07	1				
9.Urbanization	.06	.14*	.06	-.11	.51**	.14*	.06	-.01	1			
10.Netw.Strength	-.06	-.02	-.10	-.12	.06	.02	.05	-.09	.04	1		
11.FDI	.08	.11	.09	.03	.10	.03	.44**	.16**	.09	.01	1	
12.Regulation	.04	.12	.10	.09	.02	-.05	.22**	.10	.01	.19**	.08	1

*. Correlation is significant at the .05 level (2-tailed).

**. Correlation is significant at the .01 level (2-tailed).

Appendix 10 Tests Used and Variables Checking (Chapter 4)

The variables on ratio and interval level are preferably be tested using *Independent T-test* (McKnight & Najab, 2010). This test assumes that the variables involved follow a normal distribution and the variance is homogeneous. The results of the test (see appendix 1) show that the variance of the variables is homogeneous, however, the distribution is not normal (using *Saphiro-Wilk test*). Therefore, the use of the *Mann–Whitney U* test is suggested.

Mann–Whitney U test (McKnight & Najab, 2010) can be used to compare for interval and ratio data. It is a nonparametric test of the null hypothesis that it is equally likely that a randomly selected value from one sample will be less than or greater than a randomly selected value from a second sample. Additionally, even though *Mann–Whitney U* test is a non-parametric test, preferable the variance is homogeneous, therefore the studycheck it is using *Levene's test*. The variables that can be tested accordingly include Number of innovations, Newness of Innovations, Firm size, R&D intensity, manager's experience, managerial cognitive capability and FDI share in ownerships (in interval/ratio measurement level). For

variables in rank measurement level, the studyemployed the *Spearman rank correlation test* (Gauthier, 2001). This test applied for three variables: R&D organization, manager's education and level of marketing skills.

In addition, for categorical data, the studywere interested in comparing the proportions of a certain category in the two regions, using *Z-test for two proportions* (Park, 2015). Unlike the Mann-Whitney U test, this type of test is a basic statistical calculation and can be done using Microsoft Excell. The studyalso used the *Chi-square test of independence* (McHugh, 2013) to determine if there is a significant relationship between two categorical variables, namely cluster network strength, and regions (core and non-core); and regulation and regions. This statistic pertains to the expected cell count assumption so that this assumption should be met. Both Z-test and Chi-square test are non-parametric tests. These tests were applied with regard to variables cluster network strength and regulation (see Appendix 11).

The assumptions of the Mann Whitney U test are:

a) all the observations from both groups are independent of each other.

b) the responses are ordinal.

c) under the null hypothesis H_0, the distributions of both groups are equal, and d) alternative hypothesis H_1 is that the distributions are not equal.

Normality and Homogeneity test

Variables	Normality* *(Shapiro Wilk Test)*		Homogeneity** (*Levene's test)*
	Region 1	Region 2	based on mean
Number of Innovations	0.00	0.00	0.17
Newness of Innovations	0.00	0.00	0.42
Firm Size	0.00	0.00	0.08
R&D intensity	0.00	0.00	0.25
Manager's Experience	0.00	0.00	0.10
Manager's Cognitive capability	0.00	0.00	0.55
FDI-share on ownerships	0.00	0.00	0.18

*Normal if $p \geq 0.05$ ** homogeneous if $p \geq 0.05$

*** *All variables do not have a normal distribution, but their variances are homogeneous*

Triangulation Methods

No	Step	Note
1	Identify the research question	RQ of the study
2	Determine the different sources of data that are relevant	Interview, survey, documents, observation, news
3	Collect data from each source	Online & offline
4	Analyze the data from each source separately, using appropriate qualitative or quantitative methods.	Statistic tools, Nvivo
5	Compare the results from each source to identify similarities and differences, as well as any contradictions or inconsistencies.	Chapter 4-5
6	Use the insights gained from the triangulation process to develop a more comprehensive understanding of the research question or problem.	Chapter 6-8

Appendix 11. Cross Tabulation for Cluster Network Strength and Regulation
(Chapter 4)

Cross Tabulation of Cluster Network

Cluster Strength	Region		Total
	1	2	
Strong	104	68	172
Otherwise	38	50	88
Total	142	118	260

*0 cells (0.0%) have expected count less than 5.
**The minimum expected count is 57.49

Cross Tabulation of Regulation

Regulation	Region		Total
	1	2	
Positive	67	58	125
Otherwise	75	60	135
Total	142	118	260

*0 cells (0.0%) have expected count less than 5.
**The minimum expected count is 47.91

Appendix 12. Linear Regression Diagnostics - Region
(Chapter 5)
Linear Regression Diagnostics - Jakarta

Diagnostic	Type of test/method	R&D intensity	Newness of Innovation
Detecting unusual and influential cases	Applying different methods, the studyasses' outliers; residuals; scatter plots; leverage; Cook's D	Deleted 10 outliers due to inconsistency and/or extreme values	Deleted 10 outliers due to inconsistency and/or extreme values
Reliability and Validity	Cronbach's Alpha Coefficient; Pearson Product Moment correlation	α= 0.71[>0.6] Corrected item total-correlation > r table	α= 0.61[>0.6] Corrected item total-correlation > r table
Test for normality of residuals	Kolmogorov - Smirnov Test	Monte Carlo sig: 0.65 [>0.05] p value = 0.03 [<0.05]	Monte Carlo sig: 0.36 [>0.05] p value = 0.03 [<0.05]
Test for 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
Test for multicollinearity	Variance inflation factor (VIF)	Mean VIF = 3.32[<10]	Mean VIF = 3.25[<10]
Test for model specification error	Ovtest	F: 3.45 [<10] p-value: 0.56[>0.05]	F: 3.47 [<10] p-value: 0.09[>0.05]

(b) […] is the tolerance value.

Linear Regression Diagnostics- Outside Jakarta

Diagnostic	Type of test/method	R&D intensity	Newness of Innovation
Detecting unusual and influential cases	Applying different methods, the studyasses' outliers; residuals; scatter plots; leverage; Cook's D	Deleted 2 outliers due to inconsistency and/or extreme values	Deleted 2 outliers due to inconsistency and/or extreme values
Reliability and Validity	Cronbach's Alpha Coefficient; Pearson Product Moment correlation	α= 0.69[>0.6] Corrected item total-correlation > r table	α= 0.66[>0.6] Corrected item total-correlation > r table
Test for normality of residuals	Kolmogorov - Smirnov Test	Monte Carlo sig: 0.39[>0.05] p value = 0.02 [<0.05]	Monte Carlo sig: 0.27 [>0.05] p value = 0.048 [<0.05]
Test for 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
Test for multicollinearity	Variance inflation factor (VIF)	Mean VIF = 2.18[<10]	Mean VIF = 4.15[<10]
Test for model specification error	Ovtest	F: 0.78 [<10] p-value: 0.75[>0.05]	F: 2.58 [<10] p-value: 0.06[>0.05]

(a) […] is the tolerance value.

Appendix 13 Correlation – Region

(Chapter 5)

Jakarta

	1	2	3	4	5	6	7	8	9	10	11
1. Newness of innovation	1										
2. Firm R&D intensity	.18*										
3. Firm Innovation projects	.57**	.23**									
4. Firm Size	.13	.07	.07								
5.Firm R&D organisation	.08	.17*	.07	.25**							
6.ICT Skill	.15	.62**	.52	.03	.23**						
7.Experience	.00	.30**	-.08	.15	.04	.20**					
8. Cognitive Capability	-.04	.00	.12	.04	.05	.03	-.02				
9. Marketing Skills	.29**	.30**	.26**	.09	.26**	.32**	-.01	.05			
10. Cluster Netw. Strength	-.05	-.12	-.08	.00	.00	-.06	.05	.07	-.04		
11.%FDI	.03	.03	.07	.09	.08	-.01	.00	.65**	.10	.09	
12 Regulation	.07	.07	.13	.16*	.11	.15	-.06	.19*	.14	.16	.07

Outside Jakarta (Chapter 5)

	1	2	3	4	5	6	7	8	9	10	11
1.Newness of Innovation	1										
2. Firm R&D intensity	.05	1									
3. Firm Innovation projects	.49**	.19*	1								
4. Firm Size	.16	-.06	.15	1							
5. Firm R&D organisation	-.14	.27**	.11	.22*	1						
6.ICT Skills	.00	.15	-.06	.194*	.26**	1					
7.Experience	.15	-.13	.01	.16	-.07	-.01	1				
8. Cognitive Capability	.13	.09	.14	.11	.10	.21*	.15	1			
9. Marketing Skills	.02	.53**	.20*	-.03	.21*	.42**	-.01	.09	1		
10. Cluster Netw. Strength	-.08	-.11	-.15	-.15	-.24	.02	-.03	.01	-.15	1	
11.% FDI	.17	.07	.16	.20*	.10	.16	.05	.60**	.25**	-.11	1
12. Regulation	.09	.11	.16	-.05	.08	.09	-.04	.26**	.06	.23*	.09
13. Urban	-.03	.08	-.02	.00	.01	-.07	.25**	-.10	-.03	.03	-.10

*. Correlation is significant at the 0.05 level (2-tailed); **. Correlation is significant at the 0.01 level (2-tailed).

Appendix 14. Results of Ordinary Least Squared (OLS) Regression (Chapter 5)
Dependent Variable: *R&D Intensity-Region 1*

	Model 1(Internal)		**Model 2 (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	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	.03(.00)						.03(.01)	.03(.00)	.03(.00)	
Firm Size sq.		.10(.00)								.05(.00)
Firm R&D organization	.15(.04)†						.10(.04)**	.09(.04)**	.12(.05)**	
Specific: Management										
Manager's ICT-skills			.17(.01)*				.14(..01)*	.14(.01)*	.14(.02)*	
Manager's ICT-skills sq.				.15(.00)*						.18(.00)*
Manager's Experience			.28(.05)†				.27(.01) †	.26(.01)†	.21(.01)†	
Manager's Exp. Sq.				-.20(.01)†						-.19(.02)***
Manager's CC			.02(.00)				.02(.00)	.03(.00)	.03(.01)	
Manager's CC sq.				.03(.00)						.04(.00)
Level of marketing skills							.32(.05) †	.32(.05)†	.33(.03)†	.34(.02)†
External (EES)										
Cluster Network Strength					.15(.01)*	.19(.01)*	.15(.09)*	.16(.08)*	.14(.05)*	
FDI Share					.08(.00)*		.03(.00)*	.04(.00)*	.02(.00*)	
FDI Share sq.						.01(.00)*				.08(.00)*
Regulation					.09(.01)*		.09(.02)*	.09(.02)*	.09(.05)*	.09(.02)*
Interaction Effects										
Cognitive capability*Cluster Network Strength								.04(.01)*		
Level of marketing skills*Cluster Network Strength									.16(.04)**	
N	144	144	144	144	144	144	144	144	144	144
F	6.65†	6.78†	9.77†	10.221†	2.84**	2.75**	5.17†	4.73†	5.62†	7.84†
R^2	.26	.25	.42	.44	.19	.19	.49	.49	.48	.47

*p<0.1; ** p<0.05; ***p<0.01; †p<0.005

Appendix 15. Results of Ordinary Least Squared (OLS) Regression (Chapter 5)
Dependent Variable: *R&D Intensity-Region 2*

	Model 1(Internal)		**Model 2 (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	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	.19(.00)***						.18(.00)***	.17(.00)***	.17(.00)***	
Firm Size sq.		.18(.00)***								.20(.00)***
Firm R&D organization	.03(.00)						.02(.03)	.03(.03)	.02(.05)	
Specific: Management										
Manager's ICT-skills			.09(.06)*				.32(.02)**	.31(.03)**	.31(.02)**	
Manager's ICT-skills sq.				.07(.00)*						.22(.00)**
Manager's Experience			.09(.03)*				.22(.06)†	.21(.02)***	.21(.09)***	
Manager's Exp. Sq.				-.07(.02)*						-.21(.01)***
Manager's CC			.06(.01)*				06(.01)*	.08(.01)*	.08(.01)*	
Manager's CC sq.				.08(.00)*						.90(.00)*
Level of marketing skills			.15(.06)**				.37(.06)†	.37(.05)†	.40(.03)†	
External (EES)										
Cluster Network Strength					.12(.05)*		.08(.02)*	.07(.00)*	.11(.01)*	.06(.02)
FDI Share					.10(.03)**		.07(.02)**	.08(.01)**	.04(.00)**	
FDI Share sq.						19(.00)*				.30(.04)*
Regulation					.15(.03)**		.08(01)**	.10(.00)**	.09(.01)**	
Interaction Effects										
Cognitive capability*Cluster Network Strength								.08(.01)*		
Level of marketing skills*Cluster Network Strength									.06(.04)*	
N	116	116	116	116	116	116	116	116	116	116
F	5.92**	4.51**	7.44†	805†	2.97**	4.20	8.05†	6.42†	4.54†	5.46†
R^2	.26	.27	.25	.27	.25	.23	.51	.52	.48	.50

*p<0.1; ** p<0.05; ***p<0.01; †p<0.005

Appendix 16 Contribution of theories/approaches (elaboration by the author) (chapter 6)

Theory/approach	Culture theory	System (NIS)	Multi actors	Policy Transfer	Co-Creation model) (As example of innovation in production)
Focus adopted in the analysis	Functionalist perspective	Multi-Level Power structure Resistance to change	Network practices Power/resources and collaboration	Importing foreign policy (on innovation)	A novel way for innovation design and development
Contribution to the understanding of innovation and system change	Culture as a determinant of innovation	Change as a socio-technical transition and a multi-dimensional shift (feedback loops)	Collaborative and iterative nature of system change	Policy learning, a process in which bad and good lessons are drawn and elaborated	Mutual interaction among customers and producers (providers)
Contribution to the implementation of change strategy	Adopt change in matching with different culture	Need of process to tackle the rigidity of economic, social, cultural institutions and regulative norms	Adopt a collaborative process (incl. consultation and deliberation) and continuous reflection on actors' role in decision on innovation	Create awareness about matching of domestic (culture) context with foreign solutions of change	Creation of new user values from the interaction of customer & provider

Appendix 17. Actor analysis (tadapted from Enserink et al, 2010) (Chapter 6)

Level	Actors	Area	Objective	Existing/expected situation & gap	Important resources	Potential tension
National	Central Government (CG)	Entrepreneurship Development	Increasing domestic players to boost economic	The market in Indonesia is enormous, and most players are from abroad	Authority to support establishment of domestic players	RG will only focus in its teritory while CG may only focus on the potential area
		Policy making	Effective coordination between ministries and government level	Lack of coordination between ministries and government level, make it challenging to comply the between law	Authority to manage & coordinate ministries and multiple government level	
Regional	Regional Government (RG)		Effective coordination between local government	Lack of coordination the local government level	Authority to manage & coordinate local government level	
National	Central Government	ICT infrastructure	Similar access in all over the nation	The eastern part enjoys less access to ICT than the western regions.	Authority for ICT infrastructure development in national level	CG tend to proritise easier area while RG will focus to its area despite the dificulties
Regional	Regional Government		similar access with another region		Authority for ICT infrastructure development in regional level Proposal for infrastructure development in the region	

Level	Actors	Area	Objective	Existing/expected situation & gap	Important resources	Potential tension
National	Central Government	Entrepreneurship Development	Applying local content regulation	Local content regulation exists but not well applied	Authority to develop the regulation	The resistence of foreign vendors
National	Central Government	Policy making	Attract more foreign investment	Revision of Negative Investment list to attract more investment	Authority to create and revise negative investment list	The resistence of local business
National	Central Government	Entrepreneurship Development	Coordinated entrepreneurial ecosystem	Each entrepreneurial ecosystem component is working without coordination	Authority to coordinate the ecosystem	The resistence of each component
National	Central Government	Policy making	Preventing economic crisis	Economic crisis	Authority for economic contingency plan	
National	Central government	Entrepreneurship Development	Establishing & coordinating more incubators at the national level	Many incubators are established but not coordinated	Authority to regulate incubators in national level	Incubators and RG will focus on their teritory while CG may only focus on the potential ones
Regional	Regional Government		Establishing& coordinating more incubators at the regional level		Authority to regulate incubators in regional level	
	Incubators		Creating and supporting new ventures	Not many ventures are created, many fail	Financial, information, knowledge	

Level	Actors	Area	Objective	Existing/expected situation & gap	Important resources	Potential tension
National Regional	Financial Institutions	Entrepreneurship Development	Make use its financial resource and create benefit from it	Angel investors from domestic and abroad are interested to invest in Indonesia	Financial	Angel investor will pay attention to the most valuable, while CG wants to spread the investment
National Regional	Universities/ Research institutions	Entrepreneurship Development	Collaboration with industry for better research utilization	Small collaboration between industries and research institutions	Knowledge, manpower, information	Industries may have different interest with universities
National Regional	Higher and lower Education institution	ICT-curriculum	Developing creative manner and curiosity for student	Adjusting education system	Knowledge, manpower, information	Industries choose the best manpower and do not want to invest more on human resource
	Firm		Developing creative manner and curiosity for the employee	Some of ICT managers do not aware of innovation, they only do routine jobs	Organization, financial, network, manpower	
National Regional	NGO/ Community	Entrepreneurship Development	Create more creative industries	Growth of creative industries from domestic and abroad	Manpower, initiative	
Firm	Firms	ICT-curriculum	Obtain qualified engineering talents	Advanced engineering talent is lacking in Indonesia	Organization, financial, network, manpower	Industries choose the best manpower and do not want to invest more on human resource, meanwhile CG have limited resource for education

Level	Actors	Area	Objective	Existing/expected situation & gap	Important resources	Potential tension
National	Central Government	ICT-curriculum	Increase national higher human quality index	ICT curriculums need to be adjusted	Authority to implement adjusting ICT curriculum	Industries choose the best manpower and do not want to invest more on human resource, meanwhile CG have limited resource for education
	Higher Education		Provide industries with high quality talents		Knowledge, manpower, information	
National	Central Government	Policy making	Effective governance	Most of policies are top down	Authority in policy making	Different interest between CG and community
	Community		More democratic governance		Public initiative	
	Central Government	Policy making	Clear practical guideline for policy	No practical guidelines on issuing a policy	Authority for issuing practical guidelines	
	Central Government	Entrepreneurship Development	More collaboration offers from international players	A few collaborations offer from international players	Organization, financial, network, manpower	

Source: Interview & Author elaboration

Appendix 18. Requirements and Program (Chapter 6)

Level	Requirements	Strategy	Actors	Program	
				Short Term	**Long Term**
National	Increasing domestic industry competitiveness	Strengthen domestic industry	Central Government	Provide an incentive for new development of component industry (foreign & domestic)	Regulation on investment in the component industry
		Addressing the need for domestic market	Central Government		Industrial zone for the component industry
		Partnering local industry with foreign players	Central Government	Apply local content regulation based on the importance	Periodic review on local content regulation
		Regulating the product's standard	Central Government	Apply ICT standard based on industry readiness	Periodic review on ICT standard
	Promoting R&D initiative from the private sector	Establish a policy to stimulate R&D in ICT in the private sector and partnership with universities and public institutions	Central Government	An incentive to local research institutions	Promote local research institutions Regulation on firm collaboration to avoid dispute
	Transforming the ICT education system to address the skill's gap	Adjustment on ICT Curriculum	Central Government	An incentive for ICT professional	Long term incentive for ICT professional
		Develop collaboration between the ICT industry and ICT educational institutions through training and R&D collaboration;	Central Government	Provide ICT training especially for small firms	Periodic review on ICT certification
		Strengthen the firm network for skill and capacity development	Central &Regional Government, NGO, Community, Firms	Empower professional organization and NGO	Regulation on firm collaboration in human resource
	Education practices that facilitate innovation culture	Adjustment of the education system which supporting creative thinking and innovation	Central Government, Universities	Training for the teacher Introduces critical thinking	Strengthen critical thinking

Level	Requirements	Strategy	Actors	Program	
				Short Term	**Long Term**
National	Respecting particular facets of Indonesian culture	Creating a domestic product that fits with Indonesian culture	Government, Education institution	Ease patent registration	Establish an independent body
	Clear practical guidelines for the implementation of the policy	Establish practical guidelines after issuing a policy	Government	Guidelines for central government policy	Guidelines for all level government policy
	Sufficient consensus between the stakeholders that are affected	Orchestrating all entrepreneurial ecosystem component	Government	Conducting regular meetings with all stakeholders	Establish independent body that can work across ministries and government
Regional	Synchronize the central, regional, and local government policy	Orchestrating all entrepreneurial ecosystem component Strengthening Regional innovation System	Government	Conducting regular meetings with all stakeholders Training for local civil servants	Establish independent body that can work across ministries and government
	Promoting collaborative governance in innovation	Promoting Collaborative governance (middle-through approach)	Government	Starting collaborative governance of non-significant aspect	Colaborative governance on most aspect
	Bridging the infrastructure & ICT skill gaps in Indonesia	Continuous Development of ICT infrastructure especially in eastern part	National & Regional government	ICT infrastructure development especially for lagged areas	ICT infrastructure development for all areas

Level	Requirements	Strategy	Actors	Program	
				Short Term	Long Term
Regional	Policy differentiation between urban and peripheral region	Bridging the differences between urban and rural area	Government	Revise policy for rural area	Revise policy for urban area
	Creating conducive environment for investment	Coordinating the incubators	Government, incubators	Facilitate LFs to build ICT incubation, develop public incubation	Support ICT incubations with mentors, funding and incentive for private incubation
		Reduce significant restrictions to foreign investors, which limit investment and competition harming the competitiveness of the protected sectors	Government		Standard procedure of incubations
		Focusing on domestic industry and market	Economic crisis	Empowering SMEs	Empowering SMEs and LFs
Firm	Policy differentiation between SMEs and LFs	Encouraging and deregulating private and public financing for SMEs	Angel investors from domestic and abroad are interested to invest in Indonesia (SMEs)	Ease financial scheme for SMEs through local financial institutions	Regulation for SMEs to have easy access to financial institutions

Appendix 19. Recent Publication (Chapter 8)

No	Author	Sample size (firms)	Region and sector	Focal issue of analysis	Modelling approach	
1	Gunawan & Pawitan, 2012	95	Bandung (West Java) SMEs (Shoe making)	Product, process, marketing innovation	Quantitative (survey & interview)	Only product innovation included, mostly the ones that connect to internet, due to weak network connection hence no knowledge sharing in the cluster
2	Etriya et al.,2012	2	West Java Agriculture (Vegetable farm)	Innovation adoption & generation (product & process innovation)	Case study on Entrepreneurial orientation (Risk Taking & Proactiveness)	Risk taking and proactiveness affect innovativeness
3	Dhewanto et al.,2015	12	Bandung (West Java) ICT	Cluster competitiveness	Qualitative (Triple Helix)	cluster fosters innovation by establishing an active collaboration between various parties such as industry, government, and academia in an R&D unit.
4	Aryanto et al., 2015	42	Indonesia, ICT	Innovation & Strategic human resource management	Quantitative (SEM-PLS)	strategic human resource management significantly affects innovation capability and furthermore the innovation capability also significantly affects innovation performance
5	Hendrayati & Gaffar, 2016	116	Indonesia, Fashion Industry	Marketing performance	Path analysis	There is a positive influence between innovation and marketing performance
6	Nurliza et al.,2021	198	Indonesia, SMEs (Food & beverages)	innovation marketing process	SEM (TOE framework & marketing mix)	proved that each technological, environmental, organizational, and characteristics are positively related to each of the people and processes. The management team roles in innovative solutions and contingencies of a complex environment gave the highest positive effects to technology and environment.

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Liza Mahavianti Syamsuri was born in Blora, Central Java, Indonesia. She earned her Master's degree in Electrical Engineering from the Faculty of Engineering, University of Indonesia, Jakarta, and her Bachelor's degree in Telecommunication Engineering from Telkom University, Bandung, Indonesia.

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She has research interests in innovation, ICT, spatial economic & agglomeration, and regional development. She joined Delft University of Technology (TU Delft) in the Section of Economic & Technology Innovation (ETI), Faculty of Technology, Policy, and Management to pursue her doctoral degree in September 2015 with the Indonesia Endowment Fund for Education (LPDP) - Ministry of Economics of Indonesia sponsorship. Despite the global COVID-19 pandemic that caused a delay of 3-4 months in completing her PhD thesis, she managed to finish her PhD thesis on ICT innovativeness in Indonesia in <date to be decided>.

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