SaaS Adoption Factors among SMEs in Indonesian Manufacturing Industry

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Master Thesis
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SaaS Adoption Factors among SMEs in Indonesian Manufacturing Industry

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Acknowledgement

Starting the thesis journey with my own idea on Indonesia's telecommunication topic was somehow gave me passion to complete the research. However, I never thought that doing a field research in Indonesia would not be that easy. Although I realized in the beginning that there would be some challenges waiting, however the real challenges were far beyond my expectation. In addition, the data found from the research was also far from expectation. Hence analyzing the data was also posing great challenges. Yet, writing a good thesis report is not an easy one. Therefore, I would like to thank to people who contributed to this work.

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Executive Summary

Small Medium-sized Enterprises (SMEs) are always associated with the health and dynamic of economy as well as inventions and innovations rate of a country. In Indonesia, SMEs are the backbone of the economy. They have proven their crucial role to the economy during the Asian crisis in 1997-1998 and the global crisis in 2008-2009. Recent evidence suggests that cloud brings substantial contribution to the economic growth of a country. Having cloud well adopted by SMEs would create greater impact to the economy.

Benefits of cloud computing to small-medium SMEs seem obvious: financial savings (e.g. infrastructure savings, maintenance savings, etc.) and resource management advantage (e.g. skilled IT labor and equipment, resource flexibility, etc.). Software as a Service (SaaS) is one of cloud service model that has been acknowledged as the most plausible cloud service for SMEs. With regard to SMEs, Indonesia has enormous market size consisting of around 650.000 units. Despite its market size, according to Indonesian Cloud Forum (ICF), SMEs adoption to cloud computing including SaaS is only 3%. Yet, little is known about why the adoption of such technology is very low for SMEs in Indonesia. A requirement to SaaS adoption is the ICT adoption, notably the availability of basic IT infrastructure such as Internet and computer, which can also be seen as the basic requirement for SaaS adoption. However it is also unclear how many SMEs have adopted this basic IT infrastructure.

Various factors may facilitate or inhibit SaaS adoption, yet very little is known about these factors. Meanwhile to be widely adopted by SMEs, it is important to understand their adoption behavior towards SaaS. In this regard, this study seeks to investigate the factors that influence SMEs in Indonesia to adopt SaaS by focusing on manufacturing industry. Previous study suggests that manufacturing is the relevant industry for economic competition impact due to cloud. It suggests that the largest impact of cloud will occur in manufacturing sector. In Indonesian context, manufacturing industry found to adopt IT in a relatively higher level compared to other industries.

The knowledge on the adoption factors can provide input to the government as well as the SaaS providers in formulating a strategy for a better penetration of SaaS in SMEs market. Hence, such issue becomes the challenge of this study that needs further investigation. This leads to the problem statement of the study: *What are the factors that influence the adoption of SaaS of SMEs in Indonesian manufacturing industry?*

Based on the above problem statement, this study is intended to investigate the factors that may facilitate or inhibit SMEs towards the adoption of SaaS, also to provide input to the government and the SaaS providers in formulating strategy for a better penetration of SaaS in SMEs market in general. In order to achieve these aims, this study seeks to answer the following research questions:

1. *What is the level of ICT and SaaS adoption in particular among the SMEs in Indonesian manufacturing industry?*
2. *What factors have strong influence to the ICT adoption among the SMEs in Indonesia, and how does that affect the adoption?*
3. *What factors have strong influence to the SaaS adoption among the SMEs in Indonesia, and how does that affect the adoption?*
4. *How to resolve the impeding factors in order to increase the SaaS adoption?*

Ordinal logistic regression and rough set analysis were applied to test the hypotheses in investigating the ICT and SaaS adoption factors. The study found a low level of ICT adoption among the SMEs. About 49% of SMEs do not have Internet connection and 29.8% do not even have a computer. This could be the main problem on why the cloud adoption, especially SaaS, is still low among the SMEs in Indonesia. Realizing that the study found in big cities, it can be imagined that there are even higher percentage of SMEs in Indonesia without computer and/or Internet connection. With regard to SaaS adoption, from the total respondents, there are only 12.5% of SMEs that have heard about SaaS, 4.8% are in the process of evaluating SaaS, and only 2% that have adopted SaaS. Moreover, the findings of the study suggest that firm size, education of middle to top management, and industry sector positively influence the ICT adoption among SMEs. In addition, the findings concerning SaaS adoption indicate that relative advantage, complexity, and compatibility as the strongest factors that tend to influence SaaS adoption level.

These findings provide a better understanding on how SaaS is adopted by SMEs in Indonesia. It is still long way to go for SaaS to be adopted widely by SMEs; much effort is needed to boost such adoption. The low level of ICT adoption among SMEs should be addressed prior to or in parallel with SaaS adoption. Other factors from this study that expected to influence the ICT adoption are necessary to be investigated in this issue.

Further, this study contributes to the knowledge on the adoption factors of information technology among SMEs in general. In terms of practical relevance, it gives recommendations to the national government as well as SaaS providers in formulating strategies for a better penetration of SaaS in the SMEs market. SMEs characterized by large size, higher complexity in the production process and/or higher export market share, are suggested to be the potential ICT and SaaS adopter in particular. Marketing efforts that emphasize on market education is necessary to increase the perceived relative advantage and reduce the perceived complexity of SaaS. Regulation on how to provide affordable and understandable basic IT infrastructure for SMEs is needed. Finally, cloud business ecosystem is also necessary so that factors that specifically aimed for the adoption acceleration can be identified.

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Chapter 1. Introduction

Cloud computing has become the global trend in computing industry in the last few years. It is considered as a disruptive technology (Etro, 2010,Belmans & Lambratte, 2012) towards the entire industry and the channel (Frost&Sullivan, 2011). Further, it shifts the way we use Information Technology (IT) today (Frost&Sullivan, 2011). Russ Daniels, a CTO of Cloud Services in Hewlett-Packard (HP), mentioned that cloud computing will extend IT into vast new markets and change the structure of the IT industry (Pyke, 2009).

Cloud computing (hereinafter: cloud) has become a major strategic issue among business practitioners, governments, as well as researchers. Cloud is predicted to affect the core segments of $2.4 Trillion (T) worldwide spend by businesses and governments on Information and Communication Technology (ICT) products and services (Stefan Ried et al., 2010). In terms of driving the economic growth, study by International Data Corporation (IDC) in March 2012 found that "spending on public and private IT cloud services will generate nearly 14 Million (M) jobs worldwide from 2011 to 2015." (Gatz et al., 2012). Moreover, they also found that "IT innovation created by cloud would produce $1.1 T/year in new business revenues".

What is cloud exactly? Although the buzzword of cloud has just emerged in the last few years, the term of cloud computing itself at least was already mentioned in 1997 (Mei et al., 2008). Moreover, the concept of cloud has been widely used for sometimes: Flickr, YouTube, Webmail, etc. Cloud is still evolving, therefore the risks and benefits entail in the underlying technology may change in the course of time (Mell & Grance, 2009). As the consequence, it allows various definitions of cloud computing in the literature. In its simple word, cloud solution is "an information technology service model where computing services (both hardware and software) are delivered on-demand to customers over a network in a self-service fashion, independent of device and location" (Marston et al., 2011). It is not necessary anymore for people or companies to have his or her own IT infrastructures that (usually) spend high upfront investment and maintenance cost. Cloud allows them to rent these IT infrastructures from the third party, and pay per use. Cloud shifts IT products (software and hardware) to services that can be rented and accessed via internet (Lin & Chen, 2012). Hence the availability of Internet plays an important role in cloud business.

Given higher business competition nowadays, companies need to push down their business capital, operational cost, human resources cost, and production costs; particularly for Small Medium-sized Enterprises (SMEs), which predominantly have limitation in financial resources. They better start giving more attention to revenue growth and business expansion. Many scholars and business practitioners claim that the benefits of cloud is an "eminent sense" for SMEs (Miller, 2008,Grossman, 2009,Kshetri, 2010a,Marston, et al., 2011,Sultan, 2011,Lin & Chen, 2012). The concept of on-demand and self-service enables cloud to offer advantages to businesses especially SMEs such as: financial savings, business flexibility and scalability (Harris & Alter, 2010,Lin & Chen, 2012), business agility, and IT resource enhancement. Financial savings is made from buying (or investing), running, and maintaining IT infrastructure (Miller, 2008,Harris & Alter, 2010). Additionally, "it can provide almost an immediate access to IT resources without (or small) upfront capital investments" (Marston, et al., 2011) and hence leads to a faster time-to-market. Further, it dramatically lowers the cost of entry for small firms trying to get IT infrastructure that they may not have been able to afford in the past (Grossman, 2009,Kshetri, 2010a). Therefore, increasing the adoption of cloud for SMEs is a positive step towards enhancing SMEs competitiveness.

1.1 Research problem

SMEs are always associated with the health and dynamic of economy as well as inventions and innovations rate of a country (Al-Qirim, 2005). In Indonesia, SMEs are the backbone of the economy. Data from Ministry of Cooperative and Small Medium Enterprise (MCSME) shows that they contribute for about 56.23% of the total national Gross Domestic Product (GDP) in 2007 (MCSME, 2009). In addition, they provide 97.04% employment in 2008. They have proven their crucial role to the economy during the Asian crisis in 1997-1998 and the global crisis in 2008-2009 (Tambunan & Hakim, 2010).

Compared to other countries in Asia or even in the world, Indonesia is considered as the top five countries with the "highest formal Micro, Small and Medium Enterprises (MSME) density" (Kushnir et al., 2010). Although this study included the micro enterprises in the number, it indicates that the potential market for SME segment in Indonesia is larger compared to most countries in the world. There are at least 650,000 SMEs at the small and medium scale. This number may attract local and international cloud providers to market their product in Indonesia. Moreover, with the large market potential, it allows providers to gain more benefits from the economies of scale. In addition, Indonesia is predicted by International Monetary Fund (IMF) to be one out of six countries that dominate the world economy in 2030 (MCIT, 2012). Research by World Bank concluded that 10% of broadband penetration would increase the GDP of developing countries by 1.38% (MCIT, 2012). McKinsey Global Institute also mentioned that internet contributes 2.9% of the GDP of a country (MCIT, 2012). Thus, investigating IT adoption, especially associated with internet-based applications among SMEs in Indonesia is an interesting topic.

Recent evidence suggests that cloud brings substantial contribution to the economic growth of a country. Such contribution is about to create millions of new jobs particularly in small medium-sized businesses (Etro, 2009,Gatz, et al., 2012), develop new products and services, extend the market reach for SMEs (Kshetri, 2010b) and eventually increase the economy. Having cloud well adopted by SMEs would create greater impact to the economy. Thus, knowing factors that influence the cloud adoption among the SMEs will give insight on how to increase the economy of the country through the adoption of such technology.

According to Etro (2009), manufacturing is the relevant industry for economic competition impact due to cloud. He suggests that the largest impact of cloud will occur in manufacturing sector. In Indonesian context, manufacturing industry includes sectors such as automotive component, textile and textile products, and high tech equipment that have more complex production processes and management systems, which often need advanced IT. In addition, it also includes sectors such as craft industry that has higher export market share (Rianto, 2008) which also often needs IT to connect or communicate with their customers. These characteristics of businesses motivate SMEs in manufacturing industry to adopt IT in a higher level compared to SMEs in other industries. Moreover, among the types of industry, manufacturing industry contributes the highest GDP to the country, 24.3% in 2011 (BPS, 2012). Thus, it can be argued that manufacturing industry is the potential market for cloud technology. Therefore, this study focuses itself in manufacturing industry.

Cloud was introduced at least since 2006 by PT. Telekomunikasi Indonesia (PT. Telkom) through its subsidiary TelkomSigma (Mangula et al., 2012). Other service providers followed in the subsequent year such as: IBM Indonesia (2007), VMWare (2008), and other IT companies. The development of cloud got more support with the establishment of Indonesian Cloud Forum (ICF) in 2011. ICF is a community forum of practitioners, users, and providers focusing on cloud issues in Indonesia. This indicates how cloud started to evolve in Indonesia.

The trend of cloud adoption in Indonesia keeps increasing from year to year. Research by IDC found that Indonesia's cloud adoption value in 2012 has reached $75.7 M and is predicted to grow by 37.1% in 2016 (Putri, 2012). Moreover, according to research by ICF in March 2012, cloud penetration in Indonesia has reached 20% (Putri, 2012). The penetration of cloud is predicted to increase 41% and 70% in 2012 and 2013 respectively (Putri, 2012). However, it is unclear in the numbers how many large enterprises and SMEs that have adopted cloud.

Among the types of cloud service model, SaaS is the most plausible service to be implemented in SMEs. Generally, SMEs are characterized with poor IT expertise. Using SaaS, which is easier to install, maintain and update, would help them solving this problem (Kshetri, 2010b). Global research on cloud computing by KPMG (2011) found that SaaS is a typical cloud implementation that has been widely adopted. For Indonesian context, data shows that 65% of cloud adoption in 2011 consists of SaaS (Frost&Sullivan, 2011). It is expected that SaaS is becoming more familiar to SMEs in Indonesia,

in order to improve their business performance. Applications development is one of IT requirements in SMEs manufacturing industry to do their daily businesses. Characterized with lack of financial services (in general), SMEs in manufacturing industry could significantly lower their spending in regard to applications by adopting SaaS. The adoption of SaaS, is a viable way for manufacturing industry to simplify software management, improve service levels, and reduce capital costs (Gatz, et al., 2012). In this regard, SaaS may facilitate greater contribution to SMEs in manufacturing industry to the economic growth. Knowing factors that may influence SaaS adoption among the SMEs, particularly in manufacturing industry, helps better understanding on how to achieve this objective. In this regard, the study will focus itself to SaaS.

Despite its market size and eminent sense of SaaS benefits to SMEs, the adoption of cloud (including SaaS) in SMEs is still very low. Only 3% of SMEs in Indonesia have adopted cloud (Putri, 2012). Meanwhile, most of cloud (including SaaS) providers in Indonesia have introduced their product to medium enterprises and some of them already included small enterprises (Mangula, et al., 2012). Yet, little is known about why the adoption of such technology is still low for SMEs in Indonesia. A prerequisite to SaaS adoption is the ICT adoption notably the availability of basic IT infrastructure such as computer and Internet (hereinafter, the ICT adoption definition in this study includes mainly the computer and Internet adoption). ICT adoption can also be seen as the basic requirement for SaaS adoption. A study by Access Markets International (AMI) Partners in 2006, found that there were only 20% SMEs in Indonesia that have computer (Wicak, 2006). However, a study in 2007, Indonesian manufacturing industry is found to have a higher level of ICT adoption: 98% of SMEs had computer and 62% had Internet connection (Rianto, 2008). It seems this number is quite high for a developing country. According to International Telecommunication Union (ITU), for Asia Pacific (APAC) region, there were only 21.9% Internet users in 2010 (ITU, 2010). Yet, if it is analyzed further, the respondents of the study came from textile and textile product, automotive component, and craft industry sector. These sectors may have higher level of ICT adoption compared to other sectors within the industry. Although this number gives insights to the adoption level of ICT within the manufacturing industry, yet it should be cautiously generalized. Moreover, to the author's knowledge, no recent researches have been performed that investigate the level of ICT adoption, particularly computer and Internet, among SMEs in Indonesia. Meanwhile ITU found that the number of Internet users have been six times higher between 2003-2013 for APAC region (ITU, 2013). Thus, investigating the ICT adoption among the SMEs in Indonesia for the current state is necessary in this study.

As found in the literature, various factors can limit and influence the adoption of IT (Iacovou et al., 1995,Thong & Yap, 1995,Premkumar & Roberts, 1999). Moreover, in the case of cloud, research by Accenture (2010) found that "the perceived benefits and risks from cloud vary more by country than industry" (Harris & Alter, 2010). Factors such as environmental and organizational characteristics of companies may play a role. Hence, adoption factors may also differ across countries. Previous studies on international diffusion patterns also found that the process of innovation adoption significantly

differ by country (Frambach & Schillewaert, 2002). This is also the case for Indonesia where very little is known about the adoption factors of SaaS. While there has been a research on the provider perspective of cloud in Indonesia for adopting particular business model (Mangula, et al., 2012), this research does not shed light on the factors that influence the adoption of such technology, particularly in SMEs market. Meanwhile to be widely adopted by SMEs, it is important to understand their adoption behavior towards SaaS. The knowledge on the adoption factors can provide input to the government as well as the SaaS providers in formulating a strategy for a better penetration of SaaS in SMEs market. Hence, these issues become the challenge of this study that needs further investigation. This leads to the problem statement of the study:

What are the factors that influence the SaaS adoption of SMEs in Indonesian manufacturing industry?

1.2 Aims and research questions

Based on the problem statement specified in the previous section, this research is intended to investigate the factors that may facilitate or inhibit SMEs towards the adoption of SaaS. It is also aimed to provide input to the government and the SaaS providers in formulating strategy for a better penetration of SaaS in SMEs market in general. In order to achieve these aims, this study seeks to answer the following research questions:

1. *What is the level of ICT and SaaS adoption in particular among the SMEs in Indonesian manufacturing industry?*
2. *What factors have strong influence to the ICT adoption among the SMEs in Indonesia, and how does that affect the adoption?*
3. *What factors have strong influence to the SaaS adoption among the SMEs in Indonesia, and how does that affect the adoption?*
4. *How to resolve the impeding factors in order to increase the SaaS adoption?*

1.3 Research scope

Taking into consideration the time available and budget constraints, this study limits itself to some respects:

1. Types of industry: manufacturing industry

The title of the study reflects the industry type boundary of this study: manufacturing industry. As previously described that SMEs in manufacturing industry is a relatively high potential market for cloud technology.

2. Regional boundary scope: West Java

In terms of regional boundary scope, this study focuses itself to manufacturing industry in West Java. The main reason for this selection is that West Java has the largest number of business entities distribution, including SME (BPS, 2007). Therefore, taking West Java as the study case would give better representation of SMEs in Indonesia.

1.4 Research originality

Study on cloud in Indonesia has received substantial attention from academics and business practitioners. There have been some researches on this emerging technology, ranging from the technology perspective to business perspective. However, previous studies on cloud in Indonesia mostly focus on technical approach of cloud (Galih, 2011,Pardamean & Rumanda, 2011,Sarinanto, 2011), some discuss the business perspective of cloud have also been descriptive and qualitative in nature (LPPMI, 2011,Rahadi & Farid, 2011,Lim & Suparman, 2012,Mangula, et al., 2012,Surendro & Fardani, 2012). To the author's knowledge, these studies have not treated the adoption factors of cloud, especially SaaS, for SMEs segment in much detail.

Further, although extensive researches have been globally carried out on cloud, most of these researches focus on the concept and state of development of cloud (Buyya et al., 2009,Kshetri, 2010b,Sultan, 2011), risks and benefits as well as challenges and opportunities provided by cloud (Dubey & Wagle, 2007,Kshetri, 2010a,Benlian & Hess, 2011,Thomson, 2011,Belmans & Lambratte, 2012), global level adoption (Weber & Kauffman, 2011), individual level adoption (Wu, 2011a, 2011b,Ratten, 2012), and micro level of organization (e.g. successful strategy for cloud adoption within a firm) (Caldeira & Ward, 2001). There is yet research, except by Low et al. (2011) that addresses cloud adoption at firm level in much detail, especially for SMEs segment.

In regard to ICT adoption, except a study by AMI partners (Wicak, 2006) and (Wahid & Iswari, 2007,Rianto, 2008), there were not many researches, especially the recent ones, that unveiled the level of ICT adoption among SMEs in Indonesia. Meanwhile, the growth of computer and Internet adoption especially for APAC region has been six times greater from 2003-2013 (ITU, 2013). Hence, taking previous studies as the reference is not preferable. Moreover, although there have been some empirical researches on factors influencing the adoption of ICT (computer and internet) among SMEs such as (Thong & Yap, 1995,Premkumar & Roberts, 1999,Sentosa et al., 2011), yet there is few empirical research for this issue for Indonesian context, except a study by Rianto (2008). Most of researches in ICT adoption for Indonesian context, have only been carried out in a small number of areas such as by Susanty et al. (2012); descriptive or explorative in nature such as by Wahid and Iswari (2007),Rianto (2008); or directly jump to investigate the more advance IT adoption such as ecommerce by Govindaraju and Chandra (2011), RFID by Adhiarna et al. (2013), etc. These previous researches have not treated the basic IT infrastructure adoption in much detail, whereas it is the fundamental for the more advanced IT adoption.

Thus, with regard to Indonesian context, this study is the first that provides comprehensive knowledge or insights on the adoption factor of ICT and SaaS, particularly for SMEs market. Meanwhile with regard to the global context, this study tries to cover the lack of knowledge on the adoption factors of cloud at the firm level, especially for SMEs segment.

1.5 Scientific and managerial relevance

This study focuses on factors that may facilitate or inhibit the SaaS adoption among the SMEs. It is not only theoretically interesting but also practically. The knowledge and results gained in the study are expected to provide:

1. Enrichment of the existing knowledge on adoption factors in the organization context (scientific relevant);
2. Filling the knowledge gap on the adoption factors of cloud, especially SaaS, for organization context (scientific relevant);
3. Understanding the factor that influence SMEs in adopting basic IT infrastructure and SaaS can shed light into the adoption phenomenon. It is expected to provide inputs for government as well as SaaS providers in formulating strategy for a better penetration of SaaS in SMEs market (practical relevant).

1.6 Research approach

This study is an empirical research. The research problem is approached with cross-sectional field survey (observation of representative subset at a specific point in time). The logical steps to answer the research questions are poured in the research approach (see **Figure 1**).

Several interrelated steps are involved in the approach. The study begins with extensive literature review on relevant theory and context of this study, such as Diffusion of Innovation (DOI) theory, Technology Organization and Environment (TOE) model and other relevant theories on innovation adoption. After that, a theoretical framework of the study and hypotheses are formulated and served as the basis for the analysis. Next, the hypotheses are tested to the empirical data that are collected through survey. Subsequently, a series of analysis is conducted by using statistical method to answer the research questions. Finally conclusions and recommendations are drawn based on the research findings.

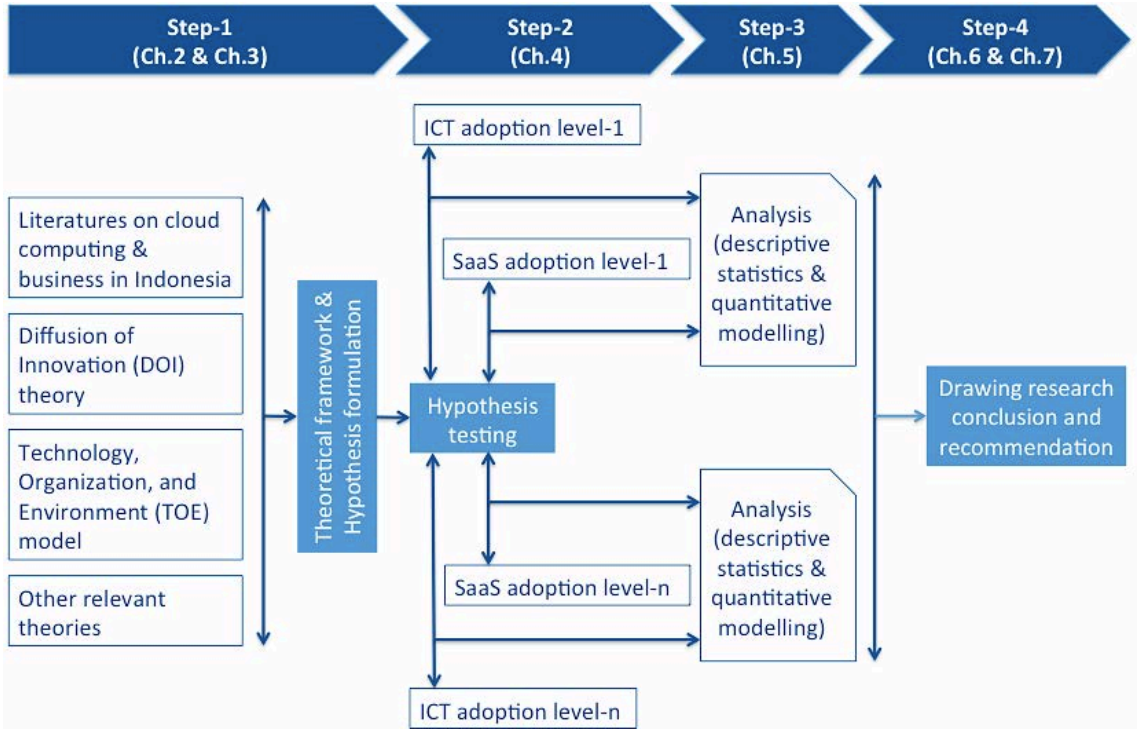


Figure 1. Research approach

1.7 Report outline

The thesis report consists of seven chapters; the outline arranged in accordance to the research approach illustrated in **Figure 1**. In Chapter 2, the definition, concept, service and deployment models of cloud computing are first described. Further, the concept and current state of the SaaS development in general and in Indonesian context are elaborated. In Chapter 3, the definition of adoption as well as ICT and SaaS adoption level are defined. In addition, the research adoption focus and unit analysis of adopter are determined in this chapter. Further, the relevant theories, concepts and models to information technology adoption are explored by which the hypotheses are formulated. Chapter 4 discusses the research methodology used in the study. The unit of analysis, the SMEs, is defined in this chapter. Moreover, research data collection, research sampling, questionnaire design and development are elaborated. In Chapter 5, data analysis on the data gathered is performed. Further, the findings from the analysis are elaborated in Chapter 6. Finally, conclusion and recommendation are drawn in Chapter 7.

Chapter 2. Software as a Service

This chapter presents the literature review on Software as a Service (SaaS). The discussion of cloud and SaaS is mainly addressed in this chapter. It provides information of the state of the art and current state of development of the technology. Section 2.1 starts with an explanation of cloud definition. After that section 2.2 describes various types of existing cloud services and deployment models. Further section 2.3 explains the current state of SaaS development. In this section SaaS development path and its benefits and risks are provided. Finally in section 2.4 the current state of SaaS development in Indonesia together with the readiness index of Indonesia towards SaaS adoption is addressed.

2.1 Cloud definition

There have been some formal definitions of cloud computing proposed by academics and business practitioners. However, definition provided by U.S NIST (National Institute of Standards and Technology) appears to be the widely used in cloud community (Stefan Ried, et al., 2010). They define cloud computing as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell & Grance, 2009). Moreover, they define five essential characteristics of cloud:

a. On-demand self-service – consumer can unilaterally determine the computing capability as needed without interaction with service provider.
b. Broad network access – capabilities are available over the network and accessible through various device platforms (e.g. mobile phone, laptop, and PDA).
c. Resource pooling – the provider's computing resources are pooled to serve multiple consumers using a multi-tenant model.
d. Rapid elasticity - capabilities can be rapidly and elastically provisioned.
e. Measured service – resource usage can be monitored, controlled, and reported to the consumer as transparency for both stakes: provider and consumer.

2.2 Cloud services and deployment models

Meanwhile, in terms of service model, NIST distinguishes cloud into three categories, namely (Mell & Grance, 2009):

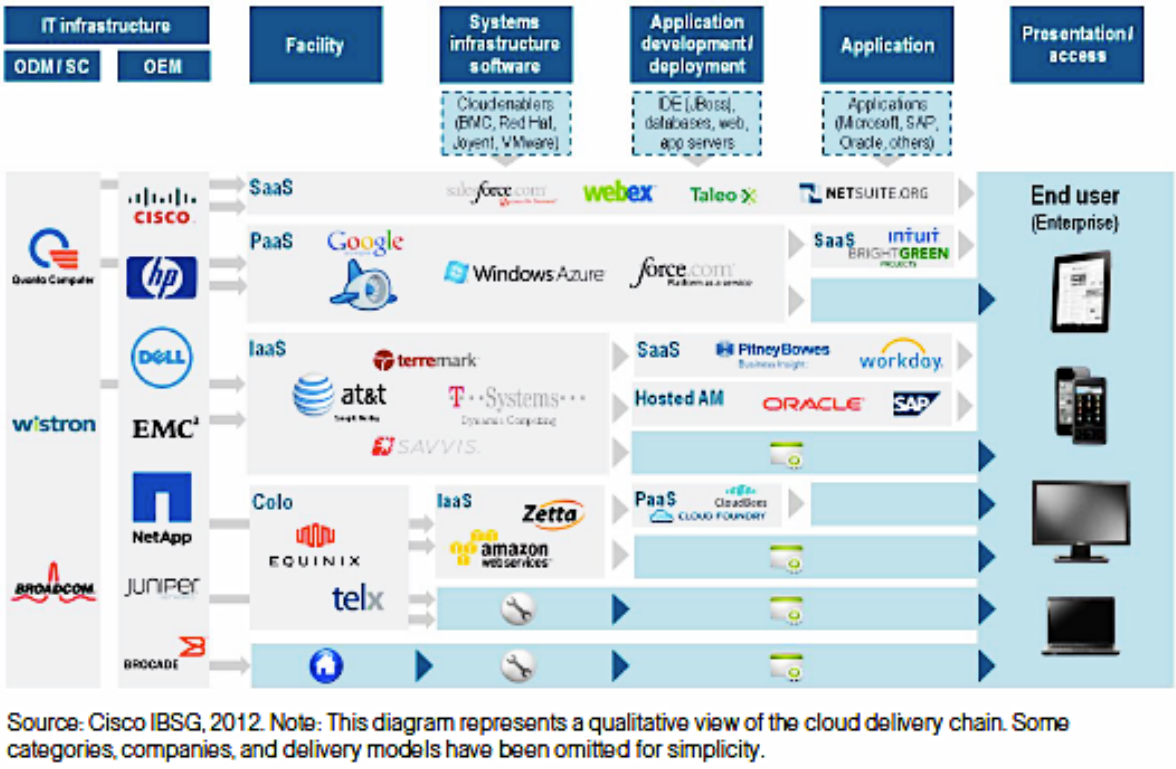
1. *Software as a Service (SaaS)*, it is an application that can run on a cloud infrastructure, provided by service providers. It is accessible trough a thin client interface (e.g. web browser). The user does not need to manage or control the underlying cloud infrastructure.
2. *Platform as a Service (PaaS)*, it is consumer-created or acquired applications created by the provider that are deployed onto the cloud infrastructure. The user does not need to manage or control the underlying cloud infrastructure but has control over the deployed applications.
3. *Infrastructure as a Service (IaaS)*, it is capability of provision processing, storage, networks, and other fundamental computing resources that are provided by service providers. The consumer does not need to manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications and may have limited control of selecting the networking components.

Furthermore, according to NIST, there are 4 types of deployment model of cloud computing (Mell & Grance, 2009):

1. *Private Cloud*, it is when "the cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise".
2. *Community Cloud*, it is when "the cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns. It may be managed by the organizations or a third party and may exist on premise or off premise".
3. *Public Cloud*, it is when "the cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services".
4. *Hybrid Cloud*, it is a combination of two or more type of cloud computing as mentioned before.

2.3 Software as a Service (SaaS)

In simple word, SaaS is defined as "on-demand applications provided through an internet browser, eliminating the need to install, run and maintain programs on internal systems" (KPMG, 2011). As mentioned earlier, SaaS is one of cloud service models. Previous researches found that SaaS has been the most widely adopted among the cloud service models (Cateddu & Hogben, 2009a,Frost&Sullivan, 2011,KPMG, 2011). Moreover, in the context of SMEs, SaaS is the most plausible to be implemented. Among the cloud service models, only SaaS that covers the entire aspect of IT delivery chain, from IT infrastructure, facility, system infrastructure software, application development, to application provision for end-user (see **Figure 2**). Characterized with poor IT expertise and lack of financial resource, SMEs found SaaS able to fulfill all aspect of their IT needs. It covers the IT infrastructure to application provision for SMEs with less effort and resources.



Source: Cisco IBSG, 2012. Note: This diagram represents a qualitative view of the cloud delivery chain. Some categories, companies, and delivery models have been omitted for simplicity.

Figure 2. Cloud computing value chain
Source: (Belmans & Lambratte, 2012)

2.3.1 SaaS competitors

Before SaaS appears as the new software delivery model, there was licensed package software (product-based) delivery model. In this model, customers received physical software (usually in a form of CD) to be installed in computer. Product-based delivery model is characterized with relatively significant upfront licensing costs, lengthy implementation, relatively high maintenance and upgrade costs (often multiples of initial upfront costs), computer-based computing (on-premise software), and product-based delivery service (SIIA, 2005,JU et al., 2010). As the consequences, this model is inflexible in switching vendors, limited in the number of computing devices, and requires more time and cost for maintenance management.

Application Service Provider (ASP) came to cover some limitations of this traditional software delivery model. It was first emerged in 1998-2000s (SIIA, 2005). In this model, the provider serves as broker of the legacy software from major enterprise software vendors (e.g. SAP, Microsoft, Siebel, etc.) for businesses that did not want to own or manage the software by themselves with a license basis (SIIA, 2005,JU, et al., 2010). In this model, the applications were hosted in several data centers owned by the ASP. The provider is responsible to buy the software from vendors, maintain and make it available to customers through internet-based access (JU, et al., 2010). The provider sometimes also customized the application based on the customers' requirement (Infotech, 2008). Customers pay the application service with rental model – pay per use. This model allows customers to reduce

the infrastructure (e.g. server) and personal costs (maintenance). It is accessible anytime and anywhere by Internet.

However, ASP model soon failed. After the ASP began to proliferate, they found that the cost and challenge of customizing and maintaining efficiently the modified version applications became more difficult, time consuming and expensive even compared to on-premise software (JU, et al., 2010). Moreover, the provider lacked of the domain knowledge to customize the applications. The ASP's performance issues made most of ASP companies exited the businesses. In addition, the economic lethargy, reduced IT spending due to the shake out in the dot.com business had also influenced the failure. ASP was then known as the first generation of hosted application (SIIA, 2005).

SaaS emerged in the early 2000s (SIIA, 2005). It is known as the second generation of hosted application. It is the improved version of previous generation (ASP) in terms of the performance and business model. In general, SaaS is similar to ASP. It is characterized as pay per use, internet-based computing, and internet-based delivery service relationship (SIIA, 2005). However to some extent, SaaS is different from ASP. In terms of business model, ASPs were focusing themselves in "providing an organization with the ability to move certain application processing duties to third-party managed server" (JU, et al., 2010). They concerned on providing a single-tenant application through application modification. Yet, they lacked of required domain knowledge of the software they were running. On the other hand, SaaS providers focus on a multi-tenant (multiple-customers) application. Therefore, SaaS significantly reduce the software and service costs through economies of scale. In addition, SaaS providers at the same time own the application and hence they mastery the required knowledge regarding the applications. SaaS is more attractive than ASP because it emerged when the supporting technology: web-based programming and Internet capacity, had a lot improved. ASPs were less prepared and tend to rush their offerings before they could solve the performance, security, customization and integration issues. At the same time many organizations were not ready to adopt ASP model at that time (JU, et al., 2010). Thus, SaaS fundamentally shift the assumptions, relationships and partnerships, as well as the value propositions between software vendors, clients and users, as well as third-party service providers (SIIA, 2005). **Table 1** summarizes the differences between ASP and SaaS.

Table 1. Differences between ASP and SaaS

	ASP	SaaS
Application deployment	**Borrowed.** ASPs deployed commercial applications from other companies.	**Built.** Software is developed by the SaaS vendor it self.
Implementation time	**Long.** Lenghty cycle to install and customize the application that originally built by other companies.	**Immediate.** Directly available for on-demand within specific time limits.
Upgrades and enhancements	**Infrequent.** Asps depend a lot on the commercial applications providers. Usually it happens once a year.	**Often.** The SaaS vendors own the data center and they can directly upgrade the software and make it available to the customers.
Integration	**Expensive and time consuming.**	**Inexpensive.**
IT support	**Exclusive.** It depends on the degree of customization and integration.	**Inclusive.**
Multi-tenant scalability	**No.**	**Yes.**
Market-timing	**Ahead of its time.**	**On-time.** The supporting technologies are already available.

Source: (Infotech, 2008,JU, et al., 2010)

Salesforce.com was the first company that launched SaaS. The company was first established in 1999 and launched its first product in 2000 (SIIA, 2005). They focused on Customer Relationship Management (CRM) application that was delivered with SaaS principles. Subsequently in 2006, initiatives to create similar services began to appear from giant companies such as Microsoft with Live online service, Oracle with Oracle Siebel, etc.

2.3.2 SaaS benefits and risks

The concept of cloud: on-demand and self-service, theoretically enables cloud to offer advantages. However, as a new emerging technology, cloud also entangles risks. Researches have theoretically reveal some potential benefits and risks of cloud (Miller, 2008,Cisco, 2009b,Marston, et al., 2011). Nevertheless, empirical researches to enterprise customers towards the perceived benefits and risks of cloud showed that the priority order of cloud's benefits and risks are varied across countries (Harris & Alter, 2010,KPMG, 2011). SaaS, as part of cloud, shares similar characteristics with cloud. Therefore, benefits and risks of cloud are also valid for SaaS. There have yet literatures that discuss the benefits and risks of SaaS in specific.

Compared to large enterprises, SMEs put different priority towards the benefits and risks of SaaS. **Appendix A** describes a complete literature review on cloud and SaaS benefits and risks from previous empirical researches. The top five benefits and risks of SaaS were then extracted from the literature review (see **Table 2**).

Table 2. Top five benefits and risks of SaaS

No	Benefit	Risk
1	Avoid capital expenditure (hardware, software, IT support, and information security by outsourcing)	Data security/privacy/ confidentiality issues
2	Reduce operating costs (e.g. maintanance, human resource, etc.)	Reliability/uptime/business continuity issues
3	Increase flexibility and scalability of IT resources	Dependence on external providers
4	Improve business performance	Difficulty integrating with existing system
5	Improve business agility (e.g. improve decision making process, mobility advantage, reduce time to market, expanding market)	Other potential high costs (e.g subscription)

2.4 Cloud computing and SaaS in Indonesia

Cloud has become a new trend in Indonesian IT industry. IT companies are vying in offering cloud services varied from IaaS, PaaS, and of course SaaS. In addition, there are an increasing number of scientific researches published on this issue in Indonesian context. Recently, Gartner also mentioned that Indonesia and India are the two countries in Asia Pacific (APAC) region with the highest growth rates in terms of all new spending of cloud services (Gartner, 2013).

Cloud computing in Indonesia is not so new. It has started since 2006 provided by Telkom Sigma (Mangula, et al., 2012). Subsequently, other cloud providers emerged. Until today, there are already more than 10 SaaS providers in Indonesia. **Appendix B** provides complete overview SaaS providers in Indonesia.

With relatively many SaaS providers in Indonesia, yet the adoption of SaaS is still considered low, particularly in SME market. Asia Cloud Computing Association (ACCA), a non-profit cloud organization in APAC region, developed a Cloud Readiness Index (CRI) to measure the level of readiness of a country readiness for implementing cloud. To date, ACCA can be considered as the one and only organization that actively involved in making cloud well penetrated in APAC region by focusing on the opportunities and issues of cloud (ACCA, 2013).

According to this index, in 2012 Indonesia was at the 11th on the list out of 14 countries in APAC region. It occupied the same position in 2011 (see **Figure 3**). For Indonesia, score for the all the indicators are lower than the average of all countries and five indicators are lower than the average of ASEAN countries (exclude Singapore). Specific comparisons between the ASEAN countries (Indonesia, Malaysia, Philipines, Thailand, and Vietnam) are showed, to see Indonesia readiness compared to its closest neighbors. As the one and only developed country in ASEAN, Singapore is not taken into the average or comparison (for ASEAN countries) due to different characteristics with the other countries, which are developing countries. Further explanations on these five indicators are given in the subsequent paragraph.

	Data Privacy	International Connectivity	Data Sovereignty	Broadband Quality	Government Online Service and ICT Prioritization	Power Grid and Green Policy	Intellectual Property Protection	Business Sophistication	Data Center Risk	Freedom of Information Access	Cloud Readiness Index	Rank (2012)
Japan	9.0	10.0	5.6	7.6	7.9	7.8	7.6	8.4	6.0	8.9	7.9	1
Korea	9.0	8.0	6.2	9.0	9.1	7.1	5.9	6.9	7.4	7.7	7.6	2
Hong Kong	7.5	7.4	7.6	7.6	8.4	5.7	7.9	7.1	8.0	8.7	7.6	3
Singapore	4.5	9.2	8.1	6.3	9.5	5.7	8.7	7.3	6.4	7.1	7.3	4
Taiwan	7.0	7.5	5.9	6.1	8.8	7.1	7.1	7.5	6.5	8.9	7.2	5
New Zealand	9.0	1.3	8.1	5.4	7.8	8.3	8.3	6.6	7.1	8.9	7.1	6
Australia	7.5	2.7	7.3	6.0	8.2	7.5	7.6	6.7	5.6	8.6	6.8	7
Malaysia	7.5	4.6	5.6	3.7	8.2	6.2	7.0	7.1	6.2	6.9	6.3	8
India	6.0	8.4	4.7	2.4	6.3	3.3	5.0	6.1	3.1	7.6	5.3	9
China	4.0	5.0	3.5	3.5	6.6	4.5	5.7	6.2	5.1	7.1	5.1	10
Indonesia	**6.0**	**4.8**	**2.1**	**2.2**	**5.7**	**4.9**	**5.1**	**6.0**	**3.1**	**7.2**	**4.7**	**11**
Philipines	2.5	4.6	4.3	2.3	5.5	5.8	4.0	5.9	3.6	7.5	4.6	12
Thailand	3.0	2.8	1.5	5.9	5.5	4.8	4.4	6.0	3.6	7.4	4.5	13
Vietnam	5.0	3.2	3.9	2.2	5.9	3.8	3.6	5.3	5.4	6.6	4.5	13
Average (all)	**6.3**	**5.7**	**5.3**	**5.0**	**7.4**	**5.9**	**6.3**	**6.7**	**5.5**	**7.8**	**6.2**	
Average (ASEAN excl.Singapore)	**4.8**	**4.0**	**3.5**	**3.3**	**6.2**	**5.1**	**4.8**	**6.1**	**4.4**	**7.1**	**4.9**	

Figure 3. Cloud Readiness Index
Source: (ACCA, 2012)

Data sovereignty indicator is assessed by seven criteria: quality of law, predictability, smart applicability, quality of enforcement, clear scope of protected data, cloud-friendly storage requirements, and efficient-cross border data flows. The top score is 8.1 for Singapore and New Zealand, whereas the total average score is 5.3 and the ASEAN average is 3.5. Compared to its neighbors, except Thailand, Indonesia score regarding data sovereignty is far below its neighbor.

In terms of regulation, to date Indonesia is still poor for regulations governing cloud-related technology and business. In 2012, Indonesian government has just legitimized regulation on Electronic System and Transaction Implementation (Law no. 82/2012). There are 7 points that are managed in the regulation: electronic system implementation, electronic agent actors, electronic transaction implementation, electronic signature, electronic certification implementation, reliability certification institution, and domain name organization. Cloud is part of the electronic system and transaction implementation. Therefore, this regulation indirectly regulates cloud-related technology and business. However, the regulation is still general. Meanwhile, to have cloud better developed where various stakeholders are involved, specific regulation is required. The government has identified this need and has committed to make another 10 regulations that specifically manage the cloud-related technology and businesses. In addition to that, according to ACCA, the legal framework for cloud services in Indonesia is still unclear (ACCA, 2012). There is one article in the regulation that invites the contradiction between several global electronic agent actors: regulation on the obligation for every electronic system actor to put their data and disaster recovery center in Indonesia. As the

consequence for this issue, Indonesia is considered poor for its law enforcement, clear scope of protected data, cloud-friendly storage requirements, and efficient-cross border data flows.

Broadband quality is assessed by the average broadband speed to a nearby server and percentage of users that have at least 2 Mbps access. These criteria reflect the actual broadband coverage of a country. The top score is 9.0 for Korea, whereas the total average score is 5.0 and the ASEAN average is 3.3, whereas Indonesia holds score 2.2. Broadband Quality Score (BQS), which is issued by Cisco, indicates the broadband speed of a country. In 2009, Indonesia held rank of 63, the lowest among its closest neighbors (see **Table 3**). Moreover, Head of Human Resource Development of MCIT, Cahyana Ahmadjayadi, confirmed that the Internet bandwidth in Indonesia is still limited (Fauzi, 2010). This condition may hinder the growth of cloud in Indonesia. Suryo Suwignjo, CEO of IBM Indonesia, mentioned that bandwidth in Indonesia is still a problem. However, he mentioned that improvement has been made in recent years (Chandrataruna & Wibowo, 2013).

Table 3. Broadband quality score (BQS)

Country	Indonesia	Vietnam	Thailand	Philipine	Malaysia
Rank BQS (2009)	63	58	57	57	48

Source: (Cisco, 2009a)

Government online services and ICT prioritization indicator emphasizes on the government's commitment to cloud, level of government support, government application of cloud for its IT services, and ICT promotion across the economy (ACCA, 2012). The top score for this indicator is 9.5 for Singapore, the total average is 7.4, and the ASEAN average is 6.2, whereas Indonesia scores 5.7. Among its neighbors, only Malaysia that has significantly higher score (8.2), while the rest of the ASEAN countries are below the ASEAN average.

Power grid and green policy indicator focuses on how power in the country can be sustained in the long run, what countries are doing to ensure renewable energy usage, whether multiple power sources are tapped and whether the grid has redundancy built-in (ACCA, 2012). The top score is 8.3 for New Zealand, the total average is 5.9, and the ASEAN average is 5.1, whereas Indonesia scores 4.9. Only Malaysia and Philipine that surpass the ASEAN average score. In terms of energy access and security, Malaysia has an excellent energy infrastructure compared the other ASEAN countries (WEF, 2012). On the other hand, Indonesia not only lacks in a well-distributed energy grid, but also lacks of policy that could ensure the sustainable power consumption.

Finally, *Data center risk* indicator emphasizes on data center-related costs, political stability, natural disasters, water availability and energy security. The top score is 8.0 for Hong Kong, the total average is 5.5, and the ASEAN average is 4.4, whereas Indonesia scores 3.1. Only Malaysia and Vietnam, which score exceed the ASEAN average. The main reason Indonesia holds such low score is that the natural

disaster factor. As one of the countries that positioned on the “ring of fire” path, the possibility of Indonesia to have natural disaster is relatively higher compared to other countries.

These all indicators made by Asia Cloud are indeed important from macro perspective. Meanwhile this study focuses on the micro level aspects of SaaS adoption. There may be a relationship between macro level and micro level aspects. Understanding the micro level aspects could help to understand the macro level aspects.

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Chapter 3. Theoretical Background

This chapter reviews the literatures on the established theories of technology adoption. This study borrows the relevant theories to the research context. When borrowing theories, it is important to make sure that the theories fit with the context of the study. Section 3.1 starts with defining the term adoption. Next, section 3.2 provides the definition of ICT and SaaS adoption. After that the research adoption focus and the unit analysis of adopter are described in section 3.3 and 3.4 accordingly. Further the theoretical framework is developed in section 3.5. Finally, the hypotheses are formulated in section 3.6.

3.1 Defining adoption

A considerable amount of literature has been published on innovation adoption and diffusion such as (Tornatzky & Klein, 1982,Tornatzky & Fleischer, 1990,Venkatesh & Davis, 1996). All these researches eventually estuary on classical adoption theory by Rogers (1983). Classical theory of adoption suggested by Rogers (1983) has provided basic concepts, terminology and scope of the field in innovation adoption (Fichman, 2000). This theory defines adoption as "physical acquisition or purchase of the innovation" (Rogers, 1983). Innovation in areas such as information technology, biotechnology, consumer electronics are considered as the domains of high-tech innovation (Mohr et al., 2010). High-tech marketing literature suggests that there are at least 6 issues involved in assessing high-tech customer behavior (see **Figure 4**). Understanding the steps in the purchasing process is necessary to understand the process of adoption and diffusion.

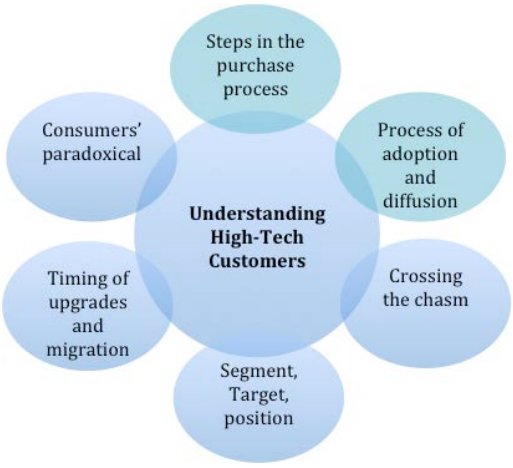

Figure 4. Issues in understanding high tech customers
Source: (Mohr, et al., 2010)

Although it seems similar, yet there is an obvious difference between the adoption process for individual and organization. Individual adoption process is typically a binary event (adopt or not), whereas organization adoption is a complex process that unfolds overtime (Fichman, 1992). Some researchers have suggested adoption (or purchasing) process model for individual such as (Mohr, et al., 2010). Meanwhile for organization adoption, particularly adoption towards IT, Cooper&Zmud (1990) suggest that adoption is part of the implementation stages which undertaken in several stages (see **Figure 5**):

- **Initiation**: a process (active or passive) of scanning organization's problems (or opportunities) offered by the IT solution. Initiation stage ends when a match between organization's problems and IT solutions offered is found.
- **Adoption**: is the negotiation process (rational and/or political) in order to get the organization's support for the implementation of the IT solution. It is indicated when a decision is reached to invest some resources to facilitate the implementation effort.
- **Adaptation**: is the process of developing, installing, and maintaining the IT solution. During this stage, the organization's members may also be trained for the new procedures and the application of the IT solution. This stage ends when the IT solution is available or ready to use by the organization.
- **Acceptance:** is the process of inducing members to commit using the IT application. It ends when the IT application has been employed in the organizational work.
- **Routinization**: is the stage when the IT application is used routinely as normal activity. It is indicated when the IT solution has no longer perceived as "unfamiliar" thing.
- **Infusion**: is the stage when the IT solution has been used to its fullest potential and eventually has an important role in organizational effectiveness.

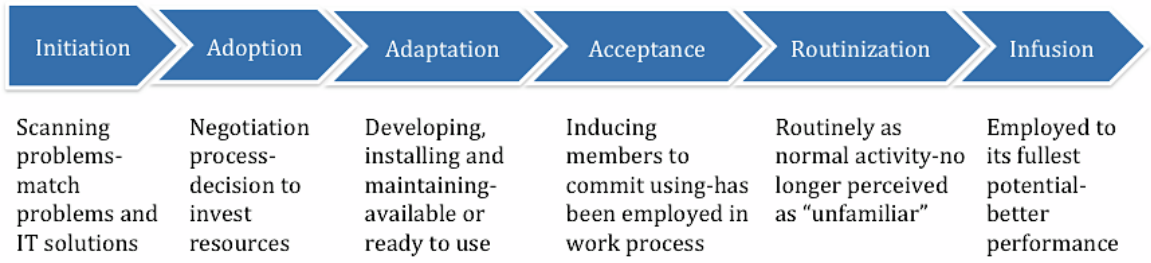

Figure 5. IT Implementation stages in organization
Source: (Cooper & Zmud, 1990)

This study focuses on the initiation and adoption stage that have been suggested by Cooper&Zmud (1990). Hence, their definition of adoption is adopted in this study. Adoption is defined as the investment of some resources to acquire or purchase of IT solutions decided by an organization. Some researches may also call this stage as "initial adoption" (Moore & Benbasat, 1991,Molla & Licker, 2005).

3.2 Defining ICT and SaaS adoption level

This study aims to unfold factors that influence the adoption of ICT and SaaS among SMEs in Indonesia. ICT adoption in this study focuses on the adoption of basic IT infrastructure namely computer and Internet. ICT adoption level is a requirement to SaaS adoption. Therefore, 3 technologies are incorporated in the ICT adoption formulation, and 5 levels of ICT adoption are proposed in this study, namely:

1. Worst: no computer at all
2. Bad: has computer but no Internet
3. Common: has computer and internet, but never heard of SaaS
4. Good: Have heard SaaS or planning to evaluate SaaS
5. Best: In the process of evaluating SaaS or have adopted SaaS

The ICT adoption levels imply that SaaS adopters are included within the ICT adopters in general. Hence the relationship between ICT adopters and SaaS adopters can be illustrated in **Figure 6** below.

Figure 6. Relationship between ICT and SaaS adopters

In this study, SaaS adopters are further investigated specifically for their behavior. Different from the ICT adoption level that focuses on physical adoption of the technology, SaaS adoption focuses further on the types of the adopter. Understanding the behavior of various types of adopter could help to increase the diffusion of SaaS. Rogers (1983) suggests that there are 5 types of adopter, namely innovators, early adopter, early majority, late majority, and laggards. These types of adopter could be found in the later stage of the diffusion. Meanwhile, SaaS in Indonesia is still in its early stage of diffusion. In this early stage, we could only find at least 3 levels of adoption: not yet adopted, in the process of evaluating, and have adopted the technology. Therefore, 3 levels of SaaS adoption are proposed in this study, namely:

1. Non-adopter of SaaS
2. In the process of evaluating SaaS
3. Adopter of SaaS

As illustrated in Figure 6, SaaS adopters are part of the ICT adopters. It implies that the "non-adopter of SaaS" level in SaaS adoption equals to "good" level in ICT adoption, whereas the "in the process of evaluating SaaS" level and "adopter of SaaS" level in SaaS adoption equal to "best" level in ICT adoption. In SaaS adoption level, the "best" level is distinguished into two different levels.

3.3 Research adoption focus

In most diffusion literatures, there are two types of research: adopter studies and macro diffusion studies (Attewell, 1992). Adopter studies focuses on "the differences in adopter innovativeness" (Fichman, 2000). The data captured in this particular issue includes: characteristics of the adopter and their adoption context, and the timing of the adoption (Fichman, 2000). Meanwhile, the macro diffusion studies focus in "characterizing the rate and pattern of adoption of a technology across community of the potential adopter" (Fichman, 1992) within which usually involve mathematical model. Macro diffusion studies can be found for technology that has diffused in the later stage of diffusion. Since SaaS in Indonesia is still in its infant stage (Mangula, et al., 2012), this study focuses on adopter studies that discusses issues related to adopter innovativeness.

Further, the adoption research itself is distinguished into two types of approach (Mohr, 1978,Rogers, 1983,Benbasat, 1984,Cooper & Zmud, 1990): factor approach and process approach. Factor approach concerns with identifying static forces that lead to the successful adoption. On the contrary, the process approach concerns with the dynamics behavior of stakeholders overtime during the adoption. Again, since SaaS in Indonesia is still in its infant stage, this study focuses on factor approach.

3.4 Unit analysis of adopter

Previous researches subtly suggested that there are 3 (three) types of adopter as the unit analysis in adoption studies: individual level (independent/autonomous choice), individual within an organization, and organization level (see **Figure 7**). These types are distinguished based on the context of the research (organization or individual) and level of the adopter (organization or individual).

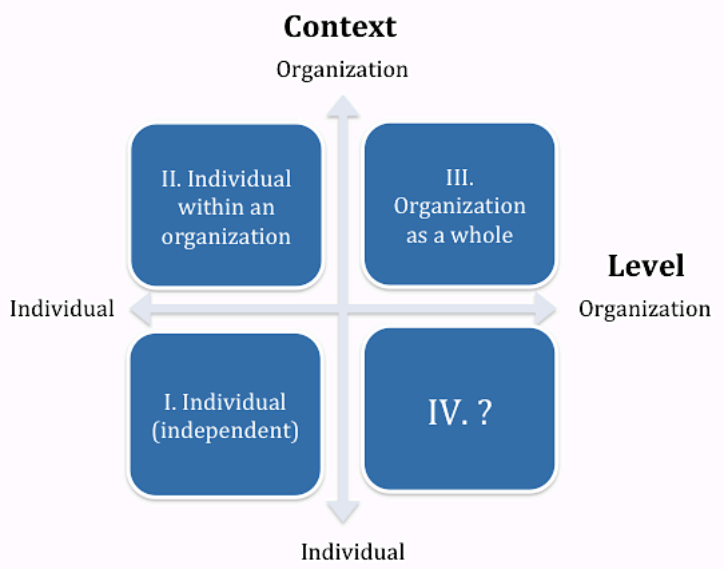

Figure 7. Distinction of adopter types

Distinction in regard to context of the research is clear: organization and individual. However, distinction on the level of adopter within organization context, sometimes implicitly defined (Frambach & Schillewaert, 2002). Given the dimension of adopter contexts and adopter levels, resulted in 3 types of adopter: individual (independent choice), individual within an organization, organization as a whole. Meanwhile the forth quadrant (organization level within individual context) does not make sense.

First type of adopter namely individual context for individual level usually called as individual adoption. It is characterized with autonomous choice as well as simpler process in the decision making of the adoption. It usually involves "personal-use" innovations which do not require special knowledge prior to adoption (Fichman, 1992). On the contrary, adopter within the organizational context (type 2 and 3) entangles more complex decision-making process towards the adoption and hence involves more complex variables. Innovations that associated in the organizational context of adopters are "work-place" innovations.

Second type of adopter namely Individual adoption within organization, is more relevant to implementation stage (Moore & Benbasat, 1991). On the other hand, the third type of adopter, namely organization as a whole is relevant to adoption stage. Although adoption is necessary for implementation to occur, factors influencing the adoption in both stage may have different effects (Cooper & Zmud, 1990). Hence, a mistake in defining the unit of analysis of adopter may result in using inappropriate theory. Eventually it leads to inappropriate factors explaining the phenomena of adoption. Some researchers have recognized these differences (Fichman, 1992,Frambach & Schillewaert, 2002). They differentiate factors that may influence the adoption within each level of the organizational context: individual within organization and organization as a whole. This study focuses on the adoption of organization as a whole (type 3), in this sense SMEs, as the unit analysis of the adopter. As aforementioned, SMEs play an important role to the economy of a country. Having SaaS being adopted by SMEs is predicted to create greater impact to the economy of a country. Thus, it is interesting to see the phenomenon of SaaS adoption among the SMEs.

3.5 Theoretical framework development

A set of factors that influence the adoption of technology within an organization has been identified by previous literatures in different disciplines. This section elaborates in detail the relevant literatures in the same context with the study as previously described, upon which a refined theoretical framework on adoption factors towards IT for organization level is proposed.

3.5.1 Diffusion of Innovation (DOI) theory

Classical theory of adoption or also known as Diffusion of Innovation (DOI) theory suggested by Rogers (1983, 1995) has provided basic concepts, terminology and scope of the field in innovation adoption (Fichman, 2000). It has been a popular reference theory in examining information

technology adoption within and by organizations (Fichman, 1992, 2000,Tan et al., 2009,Wang et al., 2010). It identifies factors that facilitate or inhibit technology adoption such as technology characteristics, adopter's characteristics, and means by which adopters learn about the technology (Rogers, 1983). Key concepts introduced by this theory that are associated with adoption are provided in **Table 4** below.

Table 4. Key concepts of diffusion of innovation theory

Component	Definitions or generalizations
Innovation characteristics	Innovation possess certain characteristics (relative advantage, complexity, compatibility, trialability, and observability) which as perceived by adopters determine the ultimate rate and pattern of adoption.
Adopter characteristics	Some potential adopters are more prone to innovate than others and can be identified as such by their personal characteristics (education, age, job tenure, etc.). Adopters are categorized into 5 (five) types based on their timing to adopt (innovator, early adopter, early majority, late majority, and laggards).
Adoption decision stages	The adoption decision unfolds as a series of stages, flowing from knowledge of the innovation through persuasion, decision, implementation, and confirmation. Adopters are predisposed towards different kinds of influence (e.g. mass market communication versus word-of-mouth) at different stages.
Opinion leaders and change agents	The actions of certain individuals (opinion leaders and change agents) can accelerate diffusion, especially when potential adopters view such individuals as being similar to themselves.

Source: (Fichman, 2000)

It can be inferred that DOI theory generally assumes the context of adoption and innovation. It assumes that the technology is simple innovation (mostly personal-use innovation) that is being adopted autonomously by individual (Fichman, 1992, 2000). On the contrary, adoption at organization level involves various innovations, and information technology is often considered as a complex technology. In addition, the adoption process at organization level is a complex process that may involve a number of individuals with different roles. As the consequence, factors incorporated in the adoption study of IT at organization level are more complex. In this sense, DOI theory suggested by Rogers (1983, 1995) should be cautiously applied. Nevertheless, many adoption literatures have proven that DOI theory that emphasizing the influence of innovation characteristics to adoption, has a "solid theoretical foundation and consistent empirical support" (Zhu, Dong, et al., 2006).

Although some points in DOI theory are relevant to adoption process at organization level, yet it needs extension and modifications, due to reasons (Fichman, 1992): a) Some of its variables do not match with organizational context, b) organization adoption is not a binary event, it is one stage in a process than unfolds over time, c) it involves interactions between stakeholders. Other researches have also suggested the same: to use DOI theory in combination with other models (Tan, et al., 2009).

Nevertheless, in his book "Diffusion of Innovation" (1995), Rogers provides a summary of early research on organizational diffusion (Oliveira & Martins, 2011). He mentions that the potential

relevant factors to organizational adoption or diffusion are: leader characteristics, organizational factors, and external characteristics. The framework of organizational diffusion and specified factors mentioned by Rogers (1995) is illustrated in **Figure 8** below.

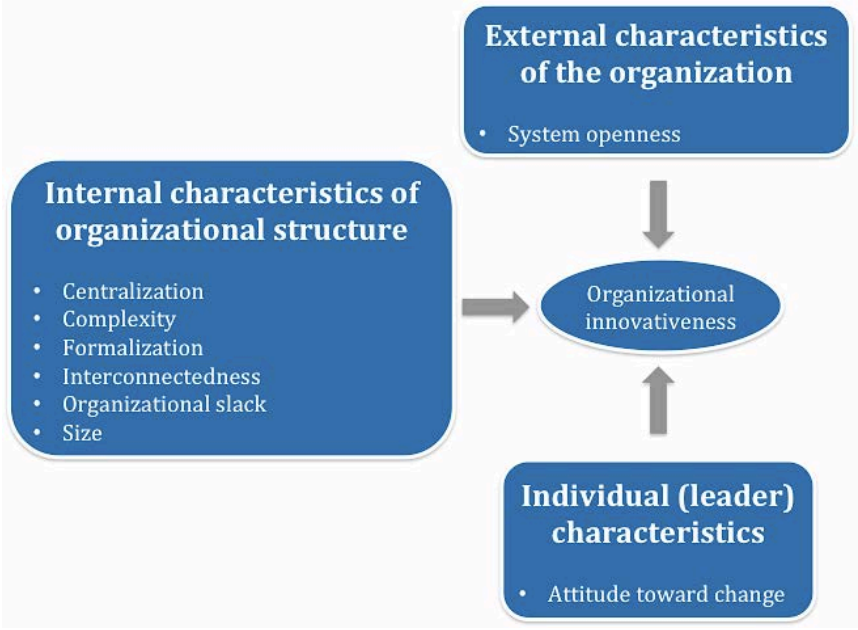

Figure 8. Diffusion of Innovations
Source: (Rogers, 1995)

3.5.2 Technology-Organization-Environment (TOE) model

Realizing the weaknesses of DOI theory by Rogers (1983), researchers started to develop models that incorporate more rigorous elements of adoption such as the technology, type of adopters, etc. There are at least two basic theories that were developed for different adoption context: Technology Acceptance Model (TAM) and Technology Organization and Environment (TOE) model.

TAM was introduced by Davis (1986), which was similar to DOI model. He suggests that the acceptance of information technology is influenced by perceived usefulness (PU) and perceived ease of use (PEOU). PU refers to the degree, which a person believes that using a technology would increase his productivity, performance, as well as affectivity, whereas PEOU refers to the degree to which a person believes that using a technology would be effortless. Definitions of PU and PEOU are similar to definitions of relative advantage and complexity by Rogers (1983) respectively. According to Rogers, relative advantage is "the degree to which the innovation is perceived to be better than what it supersedes", whereas complexity is defined as "the degree to which innovation is perceived as relatively difficult to understand and use" (Rogers, 1983). Therefore, it can be argued that PU and PEOU are interchangeable with relative advantage and complexity respectively. Davis developed this model based on psychological theory: Theory of Reasoned Action (TRA) (Ajzen&Fishbein, 1975).

TAM has experienced some modifications and expansions: First modification (Venkatesh & Davis, 1996), TAM2 (Venkatesh & Davis, 2000), Unified Theory of Acceptance and Use of Technology

(UTAUT) (Venkatesh et al., 2003), and TAM3 (Venkatesh & Bala, 2008). These expansions incorporate variables such as social influence, facilitating conditions, performance expectancy, and effort expectancy, which are moderated by age, gender, experience, and voluntariness of use.

TAM is applicable for research context of individual level: either for individual context (individual independent choice) or organizational context (individual within organization). TAM has been a widely used model in these contexts in information technology field (Szajna, 1996,Yang, 2005,Wu, 2011a). Moreover, it has been proven to be a robust model across countries (Weber & Kauffman, 2011), and types of IT innovation (Yang, 2005) in explaining adoption for individual level .

At this point there had been a research gap on comprehensive framework in analyzing the factor adoption by organizations. In 1990, Tornatzky&Fleischer proposed a model for analyzing IT adoption and implementation by organizations as so called TOE (Technology, Organization, and Environment) framework (Tornatzky & Fleischer, 1990). As reflected by the name, this framework suggests that there are 3 aspects, which influence the adoption of IT by firms: Technology, Organization, and Environment aspect.

Technology aspect includes the internal and external technologies relevant to the firm (existing technologies and skills available in the firm (Zhu, et al., 2006,Oliveira & Martins, 2011) and available technologies in the market (Oliveira & Martins, 2011)). Organizational aspect includes characteristics and processes of the organization (firm size and scope, centralization, formalization, complexity of managerial structure, amount of slack resources, and quality of human resources). Environment aspect includes competitors, trading partners, industry and market structure, and regulatory environment (Zhu, et al., 2006,Oliveira & Martins, 2011). **Figure 9** below illustrates TOE framework as suggested by Tornatzky & Fleischer (1990).

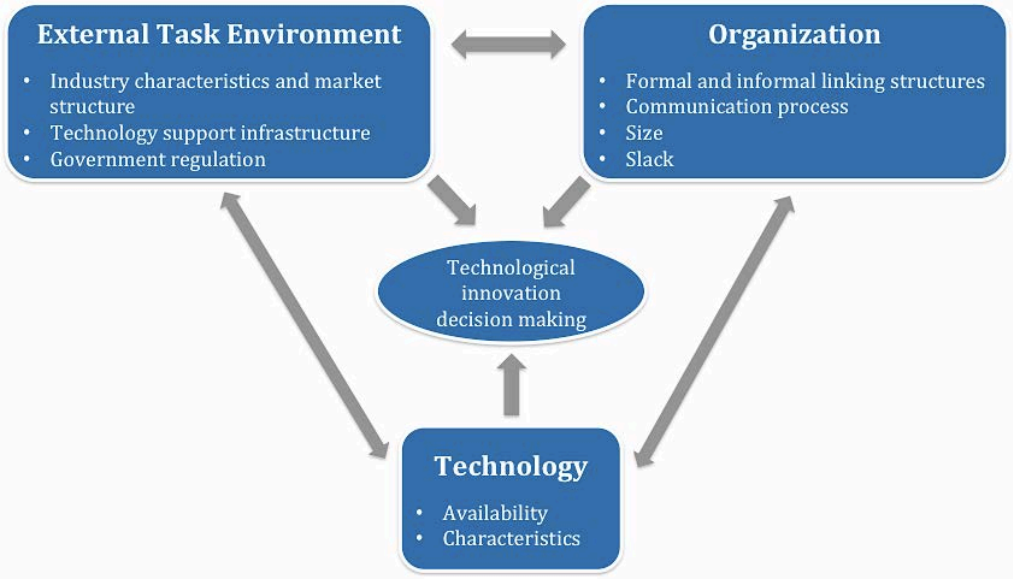

Figure 9. TOE framework
Source: (Tornatzky & Fleischer, 1990)

TOE framework is consistent with DOI theory by Rogers (1995) (Zhu et al., 2003,Zhu, Kraemer, et al., 2006,Wang, et al., 2010) within which also includes technology characteristics, internal and external characteristics of organization. Nevertheless, specific factors identified within each aspect in TOE vary across studies (Zhu, et al., 2003). As the author knowledge, there is no study that applies TOE framework, also maintains the specific factors within each aspect that initially suggested by Tornatzky & Fleischer (1990).

Despite its limitation, TOE framework has been widely used in analyzing the adoption of IT by firms (Chau & Tam, 1997,Thong, 1999,Kuan & Chau, 2001,Zhu, et al., 2003,Low, et al., 2011). It has been empirically tested across countries, different types of IT, and different types of firm (see the work of Oliveira & Martins (2011) on more lists of research applying TOE framework). It has been found useful in understanding the adoption of IT by firms (Chau & Tam, 1997,Kuan & Chau, 2001,Wang, et al., 2010). In addition, it has a solid theoretical basis and consistent empirical support (Chau & Tam, 1997,Zhu, et al., 2003,Oliveira & Martins, 2011). Other available frameworks on firm adoption towards IT, such as "perceived e-readiness factors" by (Molla & Licker, 2005) has also already been facilitated in TOE model.

Thus, it can be argued that the combination of DOI and TOE model is a strong combination to understand the IT adoption phenomenon at organization level. Moreover, a study by Oliveira & Martins (2011) which investigated various studies on technology adoption at organization level, found that combination of DOI and TOE framework is the most widely used framework in the studies. **Figure 10** illustrates the summary of applicability of each theory for different contexts of unit analysis of adopter that has been discussed before.

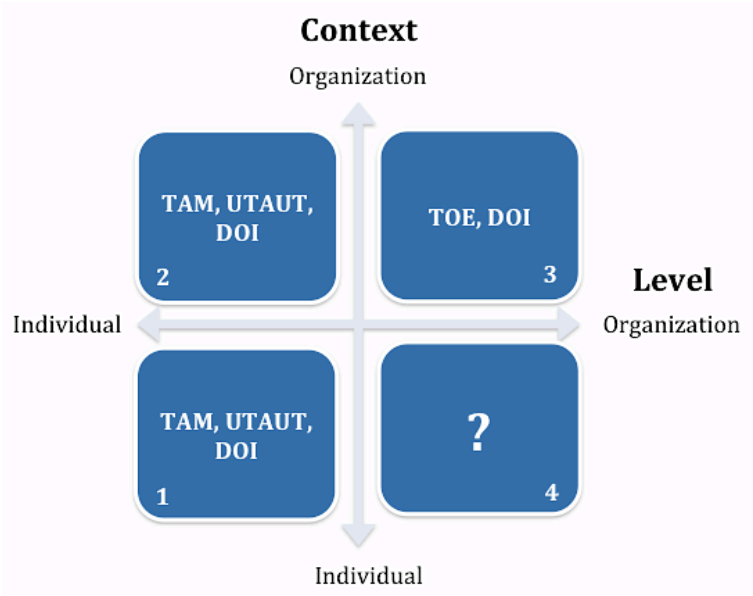

Figure 10. Matrix of adopter contexts and theories applied

3.5.3 Research Framework

SaaS is considered as a new disruptive technology, it involves more complex adoption factors compared to mass-item products. Hence investigating SaaS adoption factors merely using DOI framework or TOE framework separately, leads to neglection of other important factors that may involve.

Relevant theories in explaining the adoption of IT at organization level have been elaborated in the previous chapter. It is argued that the combination of DOI and TOE framework is a strong combination to help better understanding the adoption process of firm towards IT. It also provides a more holistic adoption model rather than applies them separately. Therefore, in this study the combination of DOI and TOE framework is used. Moreover, as described before, although TOE framework is the most widely used in the study of IT adoption of organization level (Oliveira & Martins, 2011), yet there is no study that maintains specific factors within each aspect that initially suggested by Tornatzky & Fleischer (1990). Therefore, the combination of factors within each aspect from DOI and TOE that deemed important are adopted in this study. **Figure 11** illustrates the research framework of this study.

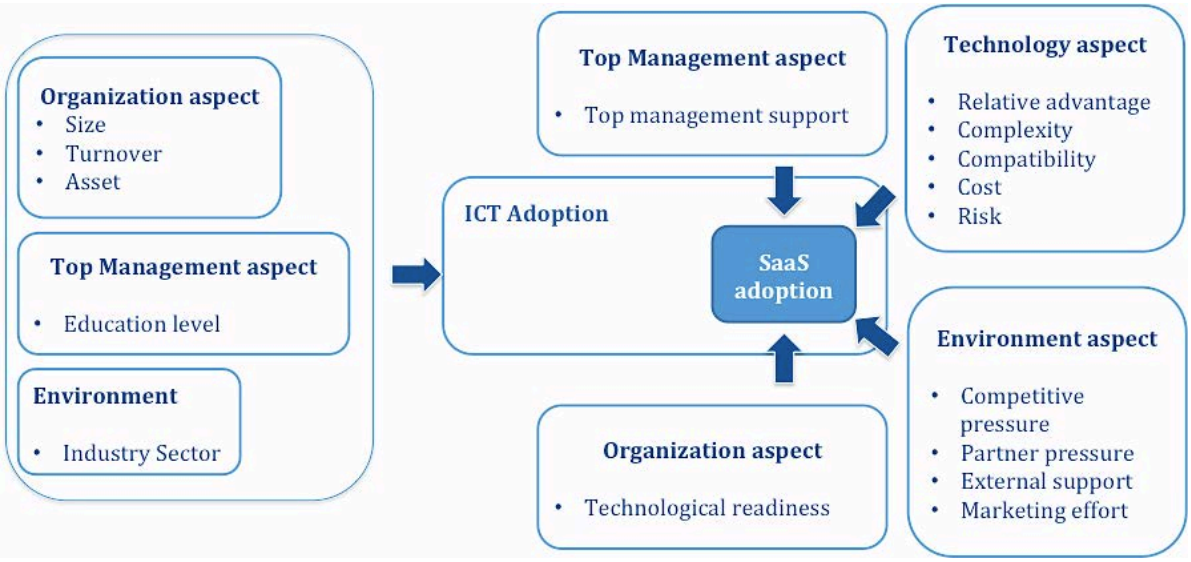

Figure 11. Research framework

Four aspects are proposed in this study: technology, organization, environment, and top management. This framework is in line with a model proposed by (Thong, 1999) on information systems adoption model in small businesses. The last aspect, top management, is separated from the organization aspect. Incorporating top management aspect within the organization aspect may reduce the importance of this aspect in the adoption of IT. In fact, top management in SMEs plays an important role.

ICT adoption is predicted for factors that comprises of primary characteristics of firms, which are objective in nature. There are only three aspects included in ICT adoption. Technology aspect is left out because within the ICT adoption, there are various technologies involved. On the other hand, the SaaS adoption level is predicted by factors that comprises of secondary characteristics of the firm: perception-based characteristics, which are subjective in nature.

As explained before, that within the ICT adoption includes the SaaS adoption at the "best" level. Therefore, the combination of these primary and secondary characteristics from ICT and SaaS adoption level, directly predicts SaaS adoption by both types of characteristics, yet in different group of hypotheses. Distinction between the two characteristics: subjective and objective, in the adoption study is important as it leads to inconsistency in the findings (Downs & Mohr, 1976,Kuan & Chau, 2001). Hence in this study both characteristics of factors are separately investigated.

All factors investigated in this study are selected based on the relevance to the objective of the study, especially that associated with managerial relevance objective. The significant difference in the number of factors within each context does not alter the role of each factor in influencing SaaS and ICT adoption. Each factor is investigated independently from the context.

The primary relationship between dependent and independent variables are investigated in this study. Hence a one-stage model relationship is used. SaaS is still considered as a new emergence technology in Indonesia. As far as the author knowledge, especially in Indonesia, there has yet been any study on the cloud or SaaS adoption factors at organization level. Therefore, studying direct relationship between dependent and independent variables is important as the prior knowledge to further investigation on the interaction between the dependent variables (process-based approach).

3.6 Hypotheses formulation

Three aspects of factors on ICT adoption at organization level are proposed in this study: organization, environment, and top management aspect. Each aspect incorporates several factors. Meanwhile, four aspects are proposed for SaaS adoption: technology, organization, environment, and top management aspect. Each aspect comprises of several factors. The expected role of each factor to the ICT and SaaS adoption is illustrated in **Figure 12**.

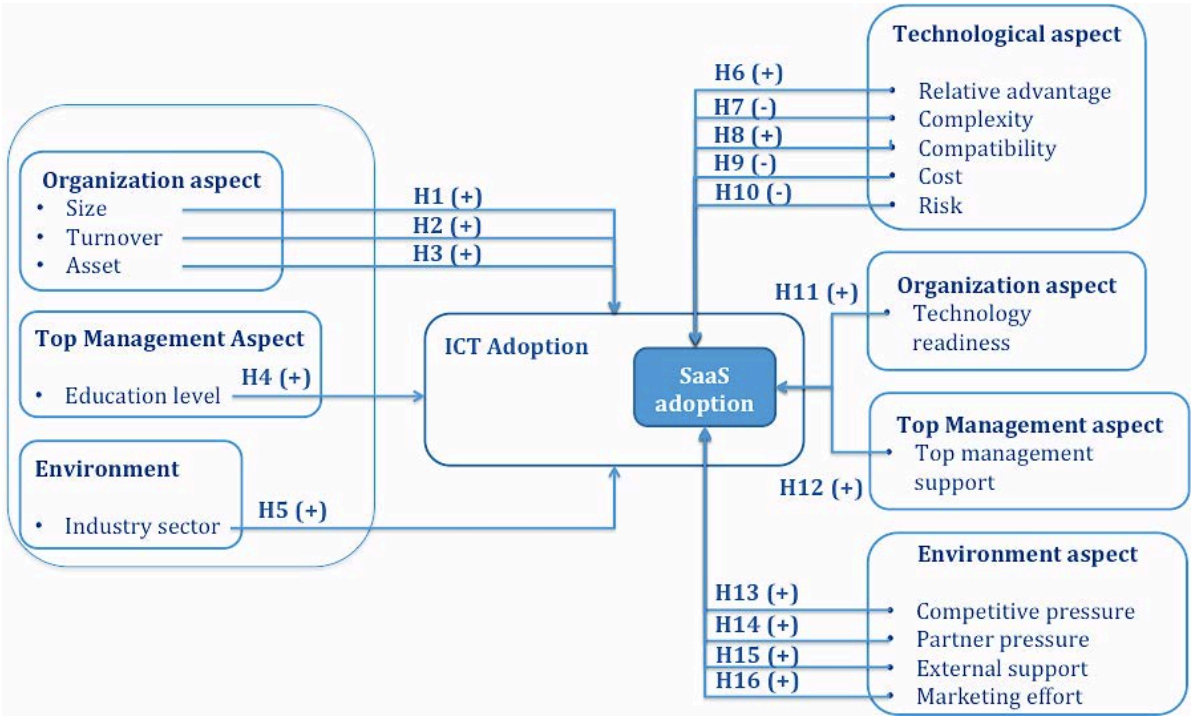

Figure 12. Research hypotheses

3.6.1 ICT adoption

3.6.1.1 Organization aspect

Organization aspect in ICT adoption incorporates the primary characteristics of company: Size, Turnover, and Asset.

Size

Firm size is found to be an important factor that determine strategy selection in small businesses (Dholakia et al., 1991,Dholakia & Kshetri, 2004). It also has been found significantly influence the adoption of IT (Thong & Yap, 1995,Premkumar & Roberts, 1999,Zhu, et al., 2003). Firms with larger size have more flexibility in managing their resources either in the adoption or implementation of new IT. Hence they are more likely to take risks when adopting new IT (Premkumar & Roberts, 1999). On the other hand, smaller firms have limited resources, which restrict their ability to take risk of adopting new IT. Thus:

H1: SMEs with larger size are more likely to adopt ICT

Turnover and Asset

Except a study by (Molla & Licker, 2005), there are not many literatures investigated the influence of turnover and asset towards the adoption of IT. However, from the perspective of objective characteristic of the company, turnover and asset are strongly associated with the perceived cost of a technology, a factor that have been investigated in many IT adoption literature (Cragg & King,

1993,Kuan & Chau, 2001). Therefore, these factors are worth to be investigated from the objective perspective. A company that has higher turnover and asset has more affordability to adopt IT. Thus,
H2: SMEs with higher turnover are more likely to adopt ICT
H3: SMEs with higher asset are more likely to adopt ICT

3.6.1.2 Top management aspect

Primary characteristic from the top management aspect of SMEs that investigated in this study is the education level of the decision maker in SMEs who is mostly at the middle to top management of the SMEs. Although the primary characteristic of top management was rarely investigated in the previous studies in IT adoption, however the top management capability (e.g. IT knowledge, innovativeness) have been investigated (Thong & Yap, 1995,Thong, 1999). Education level of top management is strongly associated with these factors. Thus,
H4: SMEs that has top management with higher education level are more likely to adopt ICT.

3.6.1.3 Environment aspect

Primary characteristic from the environment aspect of SMEs that investigated in this study is the industry sector. Different industry sector where a firm operates may influence its IT adoption differently. Previous studies in Indonesian context, found that due to their unique characteristics, high technology orientation and creative industry sectors have higher level of IT adoption compared to other sectors in manufacturing industry (Rianto, 2008). High technology orientation sector is characterized with more complex production process compared other sectors. Meanwhile, creative industry sector is characterized with more export market share. Thus,
H5: SMEs that are characterized with more complex production process and/or export market share are more likely to adopt ICT

3.6.2 SaaS adoption

3.6.2.1 Technology aspect

Innovations with favorable characteristics are more attractive and easier to adopt (Rogers, 1995,Fichman, 2000). Therefore, adopter's perception towards the IT characteristics is the primary determinants in adopting an IT (Thong, 1999). A meta-analysis study of Tornatzky & Klein (1982) on innovation adoption studies, found that compatibility, relative advantage, complexity, and cost are the first four innovation characteristics that are most frequently addressed in the articles he reviewed concerning the innovation characteristics and its adoption. In addition, these characteristics were found consistently significant in innovation adoption studies across various settings (Premkumar & Roberts, 1999,Grandon & Pearson, 2004,Tan, et al., 2009).

Relative advantage

Relative advantage is defined as "the degree to which the innovation is perceived to be better than what it supersedes" (Rogers, 1995). Relative advantage has been consistently identified as significant factor that motivate organization to adopt new IT innovation (Premkumar & Roberts, 1999,Thong,

1999,To & Ngai, 2006,Zhu, et al., 2006,Tan, et al., 2009,Low, et al., 2011). Evaluating the advantages of the new technology is part of rational decision making in purchasing process of an organization (Premkumar & Roberts, 1999). Therefore, the benefits offered encourages firms to adopt new technology (Fink, 1998,Lee & Kim, 2007).

According to ENISA (European Network and Information Security Agency) on their empirical research towards SMEs' perspective on cloud computing, found that most possible reasons behind SMEs engagement to cloud are (Cateddu & Hogben, 2009b): avoiding capital expenditure, increase flexibility and scalability of IT resources, improve business agility and performance . This is in line with some other empirical research on SMEs perspective (Sahandi et al., 2012) or large enterprises' perspective (Harris & Alter, 2010,KPMG, 2011) although there is a difference in the priority. Therefore, SMEs with higher perceived relative advantage towards SaaS are more likely to adopt SaaS. Thus:

H6: SMEs with higher perceived relative advantage towards SaaS are more likely to adopt SaaS

Complexity

Complexity is defined as "the degree to which the innovation is perceived as relatively difficult to understand and use" (Rogers, 1995). Complexity creates higher uncertainty for successful implementation and hence it increases the risk in the adoption decision (Premkumar & Roberts, 1999). Therefore, complexity serves as a barrier in the adoption of IT innovation.

Previous researches have confirmed that complexity is the barrier in the adoption of IT innovation (Thong, 1999,Grandon & Pearson, 2004,Tan, et al., 2009,Wang, et al., 2010). SaaS is relatively new technology. Although some principles of SaaS may similar to the traditional software, yet in the beginning user may still be unconfident using this new technology. It takes time for user to understand and get used to the new system of SaaS. Thus:

H7: SMEs with lower perceived complexity towards SaaS are more likely to adopt SaaS

Compatibility

Compatibility is defined as "the degree to which the innovation is perceived as being consistent with existing values, past experiences, and needs of the company" (Rogers, 1995). It has been consistently identified as the important facilitator to innovation adoption for SMEs (Thong, 1999,Grandon & Pearson, 2004,Al-Qirim, 2005,Tan, et al., 2009,Wang, et al., 2010).

Resistance to change may inhibit firms to adopt a new IT innovation, especially SMEs which have less resources to deal with the changes. Therefore, it is important for firms, especially SMEs that the changes are compatible with their values and beliefs, past experiences, and needs of the firm because then it requires less adjustments and hence they can minimize the changes (Premkumar & Roberts, 1999,Lee & Kim, 2007,Low, et al., 2011).

Adopting SaaS may bring changes to the work practices and/or procedures within SMEs. SaaS simplifies the software management. Firms do not need to hire employee with special skill for software management to manage their software by themselves. SaaS also enables company to have access towards the software anytime, anywhere and anyhow. There are many other impacts of SaaS to firms. If these changes are not compatible with company's values and beliefs, past experiences, and need, they may have less propensity of adopting SaaS. Thus:

H8: SMEs with higher perceived compatibility towards SaaS are more likely to adopt SaaS

Cost

Cost refers to the perceived cost to pay adoption and implementation of the technology (technology-installation, implementation, maintenance, etc.) (Kuan & Chau, 2001). It has been found to be one of the most important factors that hamper the growth of IT in small organizations (Cragg & King, 1993,Kuan & Chau, 2001). In addition, Moore & Benbasat (1991) suggest that cost is very relevant to be investigated in organizational adoption level especially at the initial adoption stage. SMEs are generally characterized with lack of financial resources. Hence they tend to adopt IT with less expensive price (Tornatzky & Klein, 1982,Thong, 1999). Although some literatures mention that SaaS enables firms to avoid upfront capital investments (e.g. software license, data center facilities rental, etc.) and reduce the operational costs (e.g. maintenance cost), the on-demand payment model of SaaS provides uncertainty on other potential high costs following the adoption of SaaS (IDC, 2009). Thus:

H9: SMEs with lower perceived cost towards SaaS are more likely to adopt SaaS

Risk

There are not many adoption literatures discuss risk as one of the influential factors to adoption. However, in any cloud literatures, risks entail in the adoption of cloud have been identified as the major factor hampering its adoption (IDC, 2009,Harris & Alter, 2010,Benlian & Hess, 2011,KPMG, 2011,Asprey, 2012). Hence risk deserves special attention for cloud context. In addition to benefit, risk has also been involved in the rational adoption decision making in an organization. Empirical research by Benlian & Hess (2011) has found that perceived risk on SaaS adoption significantly hamper the firms' intention to adopt.

Definition of risk is very broad; hence in this study risk is defined as the uncertainty regarding the negative consequences (other than cost) of adopting SaaS, which includes: confidentiality issues, business continuity issues, and dependency issues. SaaS works in an open environment. Customer trusted their data, computing operation, and other operations associated with software management to third party. Therefore, firm that adopt SaaS relies heavily their business to third party. They may loose control towards their data and computing reliability. Hence companies adopting (or consider to adopt) SaaS may have greater concerns on unauthorized access to their data and leads to security and privacy jeopardize. Thus:

H10: SMEs with lower perceived risk towards SaaS are more likely to adopt SaaS

3.6.2.2 Organization aspect

Technology readiness

Technological readiness is sometimes called as technological competence (Wang, et al., 2010). It is defined as the availability of technological capability (IT infrastructure and human resources) within the firm (Kuan & Chau, 2001,To & Ngai, 2006,Wang, et al., 2010,Low, et al., 2011).

In general, IT infrastructure refers to "installed network technologies and enterprise systems, which provide a platform on which the technology applications can be built (Low, et al., 2011). For SaaS in SMEs context, the main IT infrastructure includes computer and Internet connection. Meanwhile, IT human resource refers to the availability of relevant knowledge and skills to implement the technology related applications (Wang, et al., 2010,Low, et al., 2011).

SaaS is considered a new emergence technology. Implementing SaaS would require new IT skills and knowledge. The availability of IT professionals or experts within an SME would reduce the uncertainty facing by the firm during the implementation of the technology. In fact, SMEs are characterized with lack of specialized IT knowledge and technical skills (Thong, 1999). Many businesses, including SMEs, tend to postpone their adoption of an innovation until they have sufficient internal expertise (Thong, 1999). Empirical studies have found that technological readiness is one of the important facilitator in adopting new IT innovation (Thong, 1999,Kuan & Chau, 2001,To & Ngai, 2006). Further, the availability of supporting technology in implementing SaaS also motivates a firm to adopt SaaS. Thus,

H11: SMEs with higher perceived technology readiness towards SaaS are more likely to adopt SaaS

3.6.2.3 Top management aspect

Top management support

SME tends to have highly centralized structure where top management makes most decisions in the company. They make nearly all decisions, from strategic to daily operations (Bruque & Moyano, 2007,Nguyen, 2009). Therefore, they directly affect the adoption of IT innovation in the company and hence their support is an important requirement. Top management support includes: creating a supportive climate and providing adequate resources for adoption of SaaS (Premkumar & Roberts, 1999,Low, et al., 2011).

Previous researches on IT adoption have shown that top management support is one of the important facilitator in IT adoption (Al-Qirim, 2005,Wang, et al., 2010). Moreover, study on cloud computing adoption in Taiwan among the high tech industry also found top management support as one of the requirement for firm's cloud adoption (Low, et al., 2011). Thus:

H12: SMEs with higher perceived top management support towards SaaS are more likely to adopt SaaS

3.6.2.4 Environment aspect

Competitive pressure

Competitive pressure is defined as level of pressure felt by the firm from competitors within the industry (Thong, 1999,Grandon & Pearson, 2004,Low, et al., 2011). Several studies have identified competitive pressure as an important factor for adoption of new IT innovation (Thong & Yap, 1995,Grandon & Pearson, 2004,To & Ngai, 2006,Wang, et al., 2010,Low, et al., 2011). The more intense the competition within the industry, the more likely firms seek to innovations to leverage its competitive advantage (Thong, 1999,Wang, et al., 2010). Empirical studies have shown that there is positive relation between intense competition and adoption rates (Robertson & Gatignon, 1986,Thong, 1999). IT in this sense helps businesses to compete in 3 ways (Porter & Millar, 1985): changing the industry structure and in doing so alters the rules of competition, creating competitive advantage by giving companies new ways to out perform their rivals, and spawning whole new businesses, often from within a company's existing operations.

Usually, SMEs lack of financial resources and vulnerable to short-term planning in response to their highly competitive environment. Hence they prone to adopt a low-cost IT innovation which may inadequate for their purpose (Thong, 1999). Adopting SaaS enables SMEs to have an advance IT infrastructure without upfront investment. Further, by adopting SaaS, SMEs do not need to bother the software management (e.g. maintenance), because it has been handled by third party. Therefore, adopting SaaS allows SMEs to focus on their core business and hence able to deliver competitive advantage (Feuerlicht et al., 2011). Therefore, SMEs that have higher perceived competition are more likely to adopt SaaS.

H13: SMEs with higher perceived competitive pressure are more likely to adopt SaaS

Partner pressure

Partner pressure is defined as level of pressure felt by the firm from trading partners (suppliers & buyers) (Al-Qirim, 2005,Low, et al., 2011).Partner pressure has been identified as the facilitator to IT adoption (Iacovou, et al., 1995,Premkumar & Roberts, 1999,Wang, et al., 2010,Low, et al., 2011). SMEs rely on their trading partners, suppliers and buyers, to survive. When their suppliers or buyers require them to use SaaS, there is hardly any reason for them to refuse the requirement. Thus:

H14: SMEs with higher perceived partner pressure towards SaaS are more likely to adopt SaaS

External support

External support is defined as "the availability of support for implementing and using an information system" (Premkumar & Roberts, 1999). While not many previous adoption literatures discussed this factor, yet it is relevant to be discussed in the context of SMEs. The main reason is SMEs bear inadequate IT expertise. As a result, they suffer from lacking of IS knowledge and technical skills and in turn raise the barrier to IT adoption (Thong, 1999). Therefore, SMEs rely heavily their IT issues on external support (e.g. vendors, communities, and other agencies) (Cragg & King, 1993,Fink, 1998).

The availability of external support may reduce the uncertainty of adoption and hence increase the likelihood of adoption. Thus:

H15: SMEs with higher perceived external support towards SaaS are more likely to adopt SaaS

Marketing effort

Innovation adoption researches to a large extent have neglected the role of supplier activities (Robertson & Gatignon, 1986,Frambach & Schillewaert, 2002). Most existing researches tend to explain the innovation adoption from the adopter side. However, other studies have found marketing effort has significant effect on adoption decision (Robertson & Gatignon, 1986,Frambach & Schillewaert, 2002). To answer the challenge from Frambach & Schillewaert (2002) to have more research on the role of supplier activities to the adoption decision, this study proposes a hypothesis on marketing effort issue. In addition, this factor is relevant to the objective of the study. Marketing effort is defined as efforts done by service provider in promoting their SaaS products. It includes: promotion, promotional incentive, and accessibility of the service (distribution). Thus:

H16: SMEs with higher perceived marketing intensity from vendors towards SaaS are more likely to adopt SaaS

Chapter 4. Research Methodology

This chapter elaborates the object of the study focus. The respondents, research design, sampling technique, questionnaire design, and questionnaire development are discussed in detail in this chapter. Section 4.1 describes SMEs as the unit analysis in detail. Section 4.2 provides information on how the data is collected. Next, section 4.3 explains the research sampling determination. Finally, the questionnaire development and questionnaire design are described in section 4.4 and 4.5 accordingly.

4.1 Unit of analysis: SMEs

There are various definitions of SMEs across countries and institutions. According to World Bank, there are three types of SMEs: Medium, Small, and Micro Enterprise. Characteristic for each type of SMEs is provided in **Table 5**.

Table 5. Criteria of SMEs according to World Bank

Types of Enterprise	Number of Employee	Turnover	Liquid Asset
Micro	≤ 10 employees	≤ $100 K	≤ $100 K
Small	> 10 - 50 employees	> $100 K - $3 M	> $100 K - $3 M
Medium	> 50 - 300 employees	> $3 M - $15 M	> $3 M - $15 M

Source: (Rudjito, 2003)

In Indonesia itself, various definitions of SMEs across institutions are available. Indonesia Central Board of Statistic (BPS) and Ministry of Cooperative and Small Medium Enterprise (MCSME) prominently define such definition. MCSME defines SMEs based on Law no.20/2008 about micro, small, and medium enterprises. As reflected in the title, there are 3 types of SMEs according to the law namely: Micro, Small, and Medium Enterprise. They distinguish each category based on the annual revenue and total asset. **Table 6** gives detail characteristics of each type of SMEs according to MCSME.

Table 6. Criteria of SMEs according to MCSME

Types of enterprise	Asset	Turnover
Micro	max Rp.50 M	max Rp.300 M
Small	>Rp. 50 M - Rp. 500 M	>Rp.300 M - Rp.2.5 B
Medium	>Rp.500 M - Rp.10 B	>Rp.2.5 M - Rp.50 B

Source: Law no.20/2008

Meanwhile, BPS divides SMEs into 2 types: Small and Medium Enterprise. Small enterprise is a business entity that has 5 to 19 employees, whereas Medium enterprise is a business entity that has 20 to 99 employees. This study refers the definition of SMEs based on BPS. The main reason is that in practice, the available data that includes firm's annual revenue and total asset is very limited and not easy to access considering the time limitation of the research.

4.2 Research data collection

This study focuses on factor approach in adoption as previously explained. In order to capture the static forces that lead to adoption, cross sectional study is chosen. It is an observation of representative subset at a specific point in time (Verschuren & Doorewaard, 2010). It enables doing cross-study comparison for different point in time and place.

Combination of survey with mail questionnaire and personally administered questionnaire were used in this study. Both methods were used to complement each other's drawbacks. Mail questionnaire method was applied to reach areas far away from main cities where the author was located. These areas were mostly rural areas. Mail survey enables us to reach wide geographic regions with relatively low costs (Sekaran & Bougie, 2009). Respondents could also have flexible time in filling out the questionnaire. Moreover, it gives high anonymity. However, this method always has low response rate. For Indonesia context, mail survey response rate is very low, less than 30%. As to give an illustration, response rate in a research to large manufacturing companies in Central Java within more than one month is 22.78% (Kasidi, 2007). Therefore, it can be predicted the response rate for SMEs in rural areas may far lower than that number. The accessibility of the area and the usuality of respondents in receiving similar questionnaires may play role. Therefore, to increase the response rate mail questionnaire was combined with personally administered questionnaire. Moreover, an attractive reward (gift voucher) was also offered for those who send back the filled in questionnaire. Calls were also made to the mail respondents one week after the dissemination of questionnaires to encourage participation.

Personally administered questionnaire was specifically applied to respondents located near from the author's location (Bandung, Bekasi, and Bogor). Moreover these cities cover almost 50% of the sample distribution (see **Appendix C**). This method provides higher response rate compared to mail

questionnaire although more effort and costs are needed. Yet the uncertainty in getting the response is reduced. However, prior contact to sample is still necessary, as it may increase the response rate and prevent rejection from respondents. Through the first phone contact, the respondents were explained the nature of the study and their participation were then sought. Based on their approval, they were visited at their location to directly fill in the questionnaire.

4.3 Research sampling

Survey research methodology posses some strengths as described in the previous section. However, these benefits only valid when the population is correctly targeted (Sekaran & Bougie, 2009). Sampling is the process of selecting the right objects for the research. It is impossible to collect data from all the population, although possible, it is obstructed by time, costs, and other human resources limitation (Sekaran & Bougie, 2009). Sampling is also likely to produce more reliable results as fatigue is reduced and fewer errors are produced (Sekaran & Bougie, 2009). Some procedures are involved in determining the sample. Steps in determining sample are elaborated further.

4.3.1 Population and sample frame

Firstly, the population is defined as SMEs in manufacturing industry in West Java. After that, sample frame was sought. The most complete sample that the author was able to find, that incorporates lists of SMEs in manufacturing industry in West Java, was from the directory of manufacturing SMEs in 2009 in West Java industrial area (ITB, 2009). This directory was developed in cooperation between the provincial government of West Java and Bandung Institute of Technology. The directory provides complete information about the company: name of the company, products, address, phone number, fax number, number of employees, contact person, and job title of the contact person.

In total, there are 6520 enterprises that consist of small, medium and large companies. The only identity that can be used to indicate types of enterprise is number of employees. Unfortunately, the company list consists of enterprises with number of employees greater than 20. Total of enterprises that have employees between 20-99 are 4532 enterprises (see **Appendix C**).

4.3.2 Sample design and size

A proportionate stratified random sampling is applied in the study. This method satisfies the aim of the study: results generalization. Moreover, it provides advantage as the most efficient sample method and possible to have comparisons among groups (Sekaran & Bougie, 2009). A proportionate sampling is given to the city and the sectors within the manufacturing industry. It is then followed by a random selection of each subject from each stratum.

Determining sample size in research is critical. It determines the level of generalizability of the result and eventually determines the quality of the result. Therefore it should be properly undertaken.

Sample size is a function of variability in the population, precision, confidence level desired, and type of sampling used. Calculating sample size for one variable is very straightforward. However, it is not easy to determine sample size when there are several variables of interest. Krejcie & Morgan (1970) have simplified the sample size for given population size (Sekaran & Bougie, 2009). Nevertheless, not only statistical significance that should be taken into account but also practical significance is important for the result. Hence, Roscoe (1975) suggests that for multivariate research (e.g. logistic regression), "the sample size should be several times (preferably ten times or more) as large as the number of variables in the study (Sekaran & Bougie, 2009). In total, this research will analyze 5 independent variables for ICT adoption level and 11 variables for SaaS adoption level. Since the respondents for SaaS adoption investigation are already included in ICT adoption level, the highest number of variables (11 variables) was taken as the reference to determine the number of sample. With the respond rate of approximately 20%, sample size of 650 is taken for this research.

4.4 Questionnaire design

In order to address the research objectives, the questionnaire were developed with four parts: ICT adoption (part-1), specific questions on SaaS adoption (part-2), questions on respondent's demography (part-3), and company's demography (part-4). Prior to questionnaire, a cover letter explaining the objective of the research, brief explanation on cloud and SaaS, and explanation on the questionnaire itself were described.

Questions in part-1 were aimed to identify the level of ICT adoption and at the same time served as filter to respondents that were appropriate to fill in the part-2 of the questionnaire. Part-2 of the questionnaire, about perceptions towards SaaS, can only fill in by respondents with sufficient knowledge on SaaS and/or cloud.

Questions in part-2 were also divided into 3 sub-parts: environment, technology, and organization aspect. The top management aspect was merged into organization aspect in the questionnaire to avoid too many headlines. Moreover, it was intended to give small incentive to respondents that they have completed part of the questionnaire when they finish one part and hence may motivate them to complete the questionnaire. The name of the sub-part was also to indicate the general direction of the question. Further, the questions were structured from general and easy questions of environment aspect of the company. It was then followed by relatively difficult question in technology aspect, and ended with easy questions again in organization aspect. This structure was intended to avoid fatigue bias. Finally, questions in part-3 consist of basic respondents' and firms' demography data. Basic information about the respondent and firms were asked.

In terms of wording, it is one of the important elements in designing questionnaire. It can minimize information distortion obtained from respondents. Several principles in question (and option) wording are applied in the questionnaire (Oppenheim, 1976):

1. Keep it as short as possible
2. Use familiar word yet not vague
3. Avoid leading questions and loaded word; instead use as neutral word as possible.
4. Avoid prestige bias by providing: options more than two (for yes/no answer), and statement in the instruction that "there is no right or wrong answer".
5. Produce positive feeling of the respondent towards the questionnaire by providing the cover letter with: initial explanation of the survey and the study, statement that guarantee anonymity of respondents, statement how their participation is important although they do not understand about cloud or SaaS. Moreover, the open-ended question is provided with minimum space.

4.5 Questionnaire development

Part 1 and part 3 of the questionnaire are intended to obtain information from the respondent, which is objective in nature. Particularly for part 3 of the questionnaire, the demography data of the respondents and firms consist of their physical attributes. Therefore, a direct question that addresses the desired answer can be post.

On the other hand, part 2 of the questionnaire is intended to investigate the respondent's perceptions towards SaaS adoption, which are abstract and subjective in nature. Hence, operationalization of the variables is needed. Operationalization is a technique of reducing the abstract concepts into more observable behavior or characteristics (Sekaran & Bougie, 2009). Several steps are involved in operationalizing a concept: defining of the construct that wants to be measured, determining content of the measure and response format. Each step is elaborated further in subsequent section. It discusses mainly the development of questions or measure items of part 2 of the questionnaire.

4.5.1 Definition and contents of constructs

The constructs that were going to be measured are the variables mentioned in the hypotheses, which serve as independent variables. Definition and explanation on each variable has been elaborated in depth in chapter 3. Most of the definition of the constructs was adapted from previous studies on adoption factors at organization level. For the operationalization of constructs that were not available or have never been investigated before, a self-developed definition was made. **Appendix D** gives the summary of the definition of each construct and the source of the literatures.

In terms of contents of constructs or usually called measures, Tornatzky & Kleins (1982) suggests that in studying innovation characteristics, ideally it utilizes replicable and potentially reliable measures. Hence, it allows comparability across studies. One way to achieve this is to use the measures from previous studies on technology adoption factors. Measures from previous studies have been well tested and meticulously assessed for the validity and reliability. Some modifications were performed to adjust the measures to the context of this research. Self-developed measures were

made for measures that were not available from existing literatures. Especially for relative advantage and risk, the measurements were adopted from empirical research to SMEs on benefits and risks of cloud (Cateddu & Hogben, 2009b,Feuerlicht, et al., 2011,Sahandi, et al., 2012), see further in **Table 2**. **Appendix E** provides detail information on source of literatures that were adopted in developing the content of constructs.

4.5.2 Response format

Likert scale options were provided to answers the questions in part 2, which were the result from operationalization of the constructs. Likert scale is designed to examine the (dis) approval on a statement, from strongly disagree to strongly agree. Although there is still a debate whether likert scale is an ordinal or interval, generally it is treated as an interval scale (Sekaran & Bougie, 2009). In this study, the likert scale is also treated as interval. Therefore it is possible to do arithmetic operation (summation and average). Thus, it is possible to identify differences between different types of SaaS adoption level. Moreover, likert scale is suitable for self-administered questionnaire due to its practicality for the completion (Brace, 2004).

However, when using likert scale, pattern answer and central tendency answer should be paid attention. In order to avoid these issues, combination of positive and negative statements are required (Brace, 2004). In the questionnaire designed, negative statements are applied for complexity, cost, and risks variables. The rest variables use positive statements.

Likert scale is usually expressed in a 5-point scale. It is one of types of itemized scale, which usually expressed in 5 or 7-point scale with various anchors. Although it allows for various point scale (4,5, 7,9, or whatever), "research indicates that from five to seven or nine points on a rating scale does not improve the reliability of the ratings" (Elmore & Beggs, 1975- salience of concepts and commitment to extreme judgments in response pattern of teachers) (Sekaran & Bougie, 2009). Therefore, this study adopted the 5-point likert scale to make the options as simple as possible and hence easier for respondents to choose. In addition to 5-point likert scale, a "do not know" option was also provided in the questionnaire to facilitate respondent's expression in answering the questions. It is intended to prevent lukewarm response, which usually at the mid point response (neutral).

Meanwhile, for part 1 of the questionnaire, multiple choice of answers were given based on the possible options available. An "others, please specify" answer was also provided to facilitate answer other than the options given. For part 3, the demography part, except the ""Job title", "Turnover", "Asset", and "Sector" within the industry, open-ended question was given. It was intended to get the real information instead of in a form of scale or category. However, specifically for "Turnover" and "Asset" multiple choices in a form of categories were provided. It was due to sensitivity that associated with financial information of the firms. In Indonesia, especially SMEs, they often hesitate to give the exact number of data that associated with their financial condition. It is proven by the rarely availability of SMEs directory that includes the financial condition of the firm. Therefore,

categorical options were given for “Turnover” and “Asset”. The categorical options were based on the SMEs criteria according to MCSME. For “Job title” and “Sector”, multiple choices were given based on the possible options available, and an “others, please specify” option was also provided.

4.5.3 Pilot survey

Before the questionnaire was disseminated to the respondents, pilot survey was carried out. Pilot work serves as validity checking of the questionnaire designed: wording, item selection, structure, etc. (Oppenheim, 1976).

In this study, informal pilot survey was carried out. It is in the form of interview to colleagues and representative of samples (Brace, 2004). One Phd candidate and one SME in Indonesia were asked as the respondents for the pilot survey. They were asked to fill in the questionnaire as if they were the targeted respondents. Several questions are asked to get feedback from them, such as (Fink, 2003): how much time did you need to complete the questionnaire, are the instructions clear, are the questions easy to understand, are the choices provided facilitate sufficiently respondent’s expression for answering the questions, is the privacy of the respondents respected and protected, are there any other suggestion regarding the questionnaire, etc. Based on the pilot survey, small improvements were made to the questionnaire. The final cover letter and questionnaire can be seen in **Appendix F** and **Appendix G** respectively.

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Chapter 5. Data Analysis and Results

This chapter discusses the data analysis applied to the data gathered from the survey. The investigation to ICT and SaaS adoption by using the data analysis are explained in this chapter. Descriptive statistics and quantitative modeling are applied in the data analysis. Section 5.1 starts with the presentation of sample characteristics. After that, in section 5.2 the investigation with regard to ICT adoption is described by applying descriptive statistics and Ordinal Logistic Regression (OLR) model. Finally, section 5.3 describes the SaaS adoption investigation by applying descriptive statistics and Rough Set Analysis (RSA).

5.1 Sample characteristics

About 650 questionnaires were sent, and 165 responses were received. Sixty-one firms were excluded due to incomplete information (28 firms) and inappropriate sample characteristics of SME (33 firms). The valid questionnaires were mostly came from big cities: Bandung, Bekasi, and Bogor. The effective response rate was 17.66% (104/589). It seemed sufficient compared to previous research (Thong & Yap, 1995,Dholakia & Kshetri, 2004,Grandon & Pearson, 2004,Low, et al., 2011). The questionnaires were then coded and keyed and the information from the questionnaire was extracted. The demography characteristics of the respondents are provided in **Table 7.**

This study uses the definition of SMEs according to BPS, which determines the type of the firm based on their size (FTE). This study found that 60.6% of SMEs comprise of small enterprises, and 39.4% are medium enterprises. This composition is much higher than the reality where there are only 9.65% of medium enterprises in manufacturing industry in Indonesia in 2007 (BPS, 2008). This might be because of the questionnaires that were sent back, mostly come from big cities: Bandung, Bekasi, and Bogor. In Big cities, the composition of medium enterprises to small enterprises is larger than in rural cities.

With regard to sector, as previously predicted most of the SMEs in manufacturing industry operate in the wearing apparel, food & beverage, and textile businesses. This finding confirms data from BPS in 2010, that these sectors are the top 5 sectors in manufacturing industry in terms of number of businesses (BPS, 2011). Hence, this implies the representativeness of the data obtained from the survey.

Table 7. Demography characteristics of respondents

Characteristics	Sample composition
Type of SME	
Small (5-19 FTE)	60.6%
Medium (20-99 FTE)	39.4%
Firm's Age (years)	
≤ 5	16.3%
6 - 10	20.2%
11 - 15	35.6%
> 15	27.9%
Turnover	
< Rp. 300 M/year	70.9%
Rp.300 M - Rp.2.5 B/year	23.3%
Rp. 2.5 B - Rp. 50 B/year	5.8%
Asset	
< Rp.50 M	49.1%
Rp.50 M - Rp.500 M	39.4%
Rp.500 M - Rp.10 B	11.5%

Characteristics	Sample composition
Sector within Manufacturing Industry	
Chemicals&chemical product	1.0%
Fabricated metal products	8.7%
Food&beverage	19.2%
Furniture	5.8%
Leather and shoes	4.8%
Machinery & equipment	1.0%
Other manufacturing	6.7%
Paper & paper products	2.9%
Printing	5.8%
Rubber&plastic products	3.8%
Textile	11.5%
Wearing apparel	21.2%
Woods&products of wood/rattan/bamboo	7.7%

The representativeness of the data towards the larger population was also checked by a non-response bias test. Non-response bias arises when the respondents differ from non-respondents in regard to the observable characteristics: the demography or attitudinal variables (Sax et al., 2003). Non-response bias is one of the potential source of bias in a survey studies, therefore it needs to be properly investigated (Fowler, 1993,Grandon & Pearson, 2004). Previous studies, particularly in adoption studies, most researchers equate the individuals who respond later in terms of administration period with non-respondents, and then compare with the early respondents (Thong & Yap, 1995,Kuan & Chau, 2001,Al-Qirim, 2005,Low, et al., 2011). They compare the early and late respondents with the characteristics in continuous scale: number of employees, assets, and turnover. However, in this study, the characteristics of the firm "Age" and "Size" were used, since both were the only variables that were measured in continuous scale.

This study defines the early respondents as those who completed or sent back the questionnaire within 3 weeks after the questionnaire distribution, whereas the late respondents are defined as those who sent back the questionnaire after three weeks of the questionnaire distribution. Around 49% of the responses were from early respondents. A normal distribution of the data was first checked. It was found that the data of "Age" and Size" was not normally distributed although data transformation has been applied. Therefore Mann-Whitney U test was used as the non-parametric alternative to independent-samples t-test. Using the significant level of 5% and confidence interval of 95%, the test was employed. The results showed that the distribution of both variables is the same

across categories of timing (early/late). **Table 8** provides the result from Mann-Whitney U test. Thus, it can be concluded that there is no difference between the respondents and the non-respondents.

Table 8. Non-response bias test a)

Variables	Median		Mann Whitney Z test	Asymptotic Signifcance (two-tailed)	Interpretation
	Early Respondents	Late Respondents			
Age	11.00	13.00	-1.810	0.07	Retain null hypothesis
Size	16.00	10.00	0.469	0.639	Retain null hypothesis

p<0.05
H0: The distribution of variable is the same across categories of timing (early/late)
a) Mann-Whitney U test

Further, one statistical model and one data mining approach were used to investigate two main issues in the research question: ICT adoption and SaaS adoption. The following sections elaborate the data analysis for each issue.

5.2. ICT adoption

5.2.1 Descriptive statistics

The data extracted from the questionnaires provides information on the adoption of computer, Internet, and SaaS at the same time within each company. The ICT adoption levels of SMEs are provided in **Table 9** below.

Table 9. ICT adoption level

ICT Adoption Level		%
1	**Worst**: no computer at all	29.8%
2	**Bad:** has computer but no internet	19.2%
3	**Common:** has computer and internet, but never heard of SaaS	38.5%
4	**Good**: Have heard SaaS or planning to evaluate SaaS	5.8%
5	**Best**: In the process of evaluating SaaS or have adopted SaaS	6.7%

It is surprising to find out that 29.8% of the SMEs, especially in manufacturing industry, do not have a computer. In addition, in total there are 49% companies without Internet connection (19.2% of them already have computer). The rests of the companies, from 51% respondents that have already computer and Internet, only 12.5% have heard about SaaS, and there are 2.9% that have heard only about cloud.

The finding suggests that most of SMEs in Indonesia lack of basic IT infrastructures (computer and internet). This could be the main problem on why the cloud adoption, especially SaaS, is low among the SMEs in Indonesia. What is more, the study was found among the SMEs that mostly are located in big cities. It can be imagine that there are even higher percentage of SMEs lack of these basic IT infrastructures. The national government should pay attention on this issue to have cloud, especially SaaS, better diffused among the SMEs market.

Further, for the purpose of the statistical analysis, this 5-level ICT adoption served as the dependent variable whereas the firm size (Size), firm turnover (Turnover), firm asset (Asset), middle to top management education (Education), and firm sector (Sector) served as the independent variables. Initially, turnover variable was provided in 3 categories (see **Table 7**), yet due to empty cells issue between the categorical data, it was reduced into 2 categories. Empty cell is the number of cells with zero cases. Empty cells between the categorical data of dependent and independent variables could result in the unreliable goodness of fit statistics, especially for logistic regression model (ESRC, 2013). Aggregation of one or more categories into another category to avoid empty cell, also applied for Education. In this study, the initial 6 categories of education were aggregated into 2 meaningful categories: lower than senior high school graduated and higher than diploma degree graduated. In this sense, the author argues that there is no important information omitted. The aggregation was defined based on a borderline where the differences exist between these two categories. People that hold at least a diploma degree in general have more knowledge and information access compared to high school graduated people or lower than that.

In terms of the sector, two categories were defined: traditional industry and high technology orientation as well as creative industry. There is a significant borderline both types of industry. As previously described, high technology orientation sector is characterized with higher complexity on production process and complicated management systems compared to other sectors within the manufacturing industry (Rianto, 2008). Meanwhile, creative industry is characterized with higher export market share compared to other sector within the manufacturing industry (Rianto, 2008). Due to these characteristics, high technology orientation and creative industry have a higher level of IT adoption among other sectors within the manufacturing industry. High technology orientation and creative industry sectors include the chemicals & chemicals products, fabricated metal products, machinery & equipment, rubber & plastic products, furniture, textile, wearing apparel, and wood & products of wood/rattan/bamboo sectors. Meanwhile, the traditional industry includes the food & beverage, leather & shoes, paper & paper products, printing, and other manufacturing. Descriptive statistics of each variable is provided in **Table 10** below.

Table 10. Descriptive statistics of ICT adoption level

Variables	Description	Descriptive Statistics
Dependent Variable		
ICT Adoption Level		
Level 1	**Worst**: no computer at all	Freq: 29.8%
Level 2	**Bad:** has computer but no internet	Freq: 19.2%
Level 3	**Common:** has computer and internet, but never heard of SaaS	Freq: 38.5%
Level 4	**Good**: Have heard SaaS or planning to evaluate SaaS	Freq: 5.8%
Level 5	**Best**: In the process of evaluating SaaS or have adopted SaaS	Freq: 6.7%
Independent Variable		
Size	Employee (FTE)	Mean: 14.35 Std.dev: 11.66 Min: 1 ; Max: 77
Turnover (2-level; ordinal)		
1	< Rp.300 M/year	Freq: 70.9%
2	≥ Rp.300 M - Rp.50 B / year	Freq: 29.1%
Asset (3-level; ordinal)		
1	<Rp.50 M	Freq: 49.1%
2	Rp.50 M - Rp.500 M	Freq: 39.4%
3	> Rp.500 M - Rp.10 B	Freq: 11.5%
Education of Respondent (2-level; ordinal)		
1	≤ senior high school graduated	Freq: 51.9%
2	≥ diploma degree graduated	Freq: 48.1%
Sector (2-category; nominal)		
1	Traditional industry	Freq: 39.4%
2	High technology orientation and creative industry	Freq: 60.6%

5.2.2 Statistical analysis: Ordinal Logistic Regression

Five independent variables and one dependent variable were used to explore factors that facilitate or inhibit the ICT adoption (see variables used in **Table 10**). Ordinal Logistic Regression (OLR) model was applied. This model allows the dependent variable be measured on ordinal scale and independent variables with various scales. Applying this model, the information on ordinal nature of the dependent variable is kept and hence enriches the analysis and the findings. Similarly, this study has dependent variable, which is ordinal in nature and independent variables with various scales. Therefore, OLR model was applied in the study by using the SPSS (Statistical Package for Social Science). Some common checks and considerations were also performed before the OLR model was applied, namely multicollinearity and empty cell. Empty cell has been investigated and explained in the previous paragraph. It resulted in aggregating turnover from 3 levels into 2 levels and education from 6 levels into 2 levels. Meanwhile, for other assumptions that hold in liner regression model such as normality distribution and homoscedasticity are not required in OLR model (ESRC, 2013). This is also one of the advantages of OLR model compared to linear regression model.

Multicollinearity

Multicollinearity is the "extent to which a variable can be explained by other variables in the analysis" (Hair et al., 1995). It is an issue that a model could have. A model that consists of independent variables which are not correlated each other provides a better model.

Multicollinearity can be investigated with different ways. Since the dependent variable and independent variables have different measurement scales, spearman's correlation was applied to investigate correlation between these variables. **Appendix H** provides the result of the spearman's correlation test. The strongest single correlations were between turnover and asset (0.678). Initially, variable asset was chosen for further analysis, due to its stronger correlation with the dependent variable (0.301). However, when it was included in the model, it made the model did not fit with the assumption of parallel lines (see explanation on this assumption in subsequent paragraph). Thus, variable asset was replaced by turnover, which was finally included for further analysis. The remaining correlations between independent variables did not indicate serious concern for multicollinearity, as the correlations were below 0.5 (Hair, et al., 1995).

Ordinal Logistic Regression (OLR) analysis

Ordinal logistic regression was applied to investigate factors that facilitate or inhibit the ICT adoption. One dependent variable and four independent variables were eventually used, as asset was dropped from the model due to strong correlation with turnover. With confidence interval of 95%, four models for each individual variable and one model of simultaneous variables in relation to ICT adoption were investigated. The result of OLR model of ICT adoption is provided in **Table 11**.

Table 11. Ordinal logistic regression analysis of ICT adoption

Variables	Model 1	Model 2	Model 3	Model 4	Full Model
	β coef. (s.e)	β coef. (s.e)	β coef. (s.e)	β coef. (s.e)	β coef. (s.e)
Size	**0.04 (0.011)*** **				**0.03 (0.01)** **
Turnover (High level=1)		**1.02 (0.41)** **			0.45 (0.44)
Education (High level=1)			**1.36 (0.38)*** **		**1.2 (0.41)*** **
Sector (High level=1)				**0.88 (0.38)** **	**1.15 (0.39)*** **
N	104	104	104	104	104
LR Chi square	**15.33*** **	**6.43** **	**13.65*** **	**5.62** **	**32.12*** **
Pseudo R2	0.15	0.06	0.13	0.06	0.28
Log Likelihood	156.35	28.77	28.36	28.95	215.89
Test of parallel lines (sig.)	0.30	0.57	0.66	0.641	0.92

*p<0.1, **p<0.05, ***p<0.01

The table shows that, for individual model, all the coefficients of the independent variables: size, turnover, education, and sector are statistically significant in influencing the ICT adoption. However, in the full model, turnover did not show a significant coefficient. This raises the question why turnover became insignificant when tested simultaneously with other variables. This could be explained that turnover might be less significant when simultaneously compared to other factors such as sector, size, and education. The role of financial aspect of a firm might be not that important as initially predicted.

In the full model, the pseudo R^2 was significantly higher than the individual model, hence the full model explains better the phenomenon of ICT adoption compared to the individual models. The relatively low pseudo R^2 (0.28) does not refuse the fact that the influence of independent variables that are found significant. Pseudo R^2 in OLR model is different from R^2 in linear regression (ESRC, 2013). In linear regression R^2 suggests the proportion of variance in the outcome that can be explained by the independent variables. It is not possible to compute the same R^2 as in linear regression. In OLR model, "a good R^2 depends upon the nature of the outcome and the explanatory variables" (ESRC, 2013). Nevertheless, the coefficient of pseudo R^2 of 0.28 indicates that a model containing variables of size, education, and sector is likely to be relatively poor predictor of the outcome. This suggests that there might be other factors that are important in predicting the ICT adoption level but did not included in the model. Factors associated with technology aspect were not included in the model, whereas these factors have been found important in influencing IT adoption by the previous studies.

Positive sign of coefficient size complies with the theory that the larger the firm size, the more likely it will adopt ICT. Meanwhile education and sector also show a positive sign. It means that SMEs with higher education of the middle to top management and characterized with higher complexity on production process and/or higher export market share are more likely to adopt ICT compared to SMEs with lower education of the middle to top management, and from traditional industry respectively. Moreover, the test of parallel lines resulted in not significant for all the models resulted. It means that all the models meet the important assumption required by OLR model (ESRC, 2013) that the slope coefficients are the same across the response categories, in this case the ICT adoption. Thus, based on the samples tested, the result from the OLR model suggests that H1 (Size), H4 (Education), and H5 (Sector) are supported.

5.3 SaaS adoption

5.3.1 Descriptive statistics

In this section, SaaS adoption was specifically examined. SaaS adoption is part of the ICT adoption, as previously defined. Therefore, the samples for SaaS adoption level were also part of the larger sample in the ICT adoption (n=104). However, in SaaS adoption, the samples that were included in the

investigation were only those who have heard about SaaS or cloud. Because only these people whose answers were valid for the part 2 of the questionnaire (perceptions towards factors that influence the SaaS adoption). They already have the basic idea of what is SaaS all about. It was interesting to find that only 15.4 % from the total respondents (n=104) that have heard about SaaS (12.5%) or cloud (2.9%). Therefore, in total there are 16 respondents that were valid for further analysis of SaaS adoption level. **Table 12** shows the SaaS adoption level among SMEs that have heard about SaaS or cloud. The profile of the respondents in SaaS adoption investigation is presented in **Table 13**.

Table 12. SaaS adoption level

	SaaS adoption level	Cases	%
1	Non-adopter of SaaS	9	56.2%
2	In the process of evaluating SaaS	5	31.3%
3	Adopter of SaaS	2	12.5%
	TOTAL	16	

Table 13. Profile of respondents in SaaS adoption investigation

Education category	
≤ Senior high school graduated	5
≥ Holds diploma degree	11
Total	16

Turnover category	
< Rp.300 M/year	8
≥ Rp.300 M - Rp.50 B / year	8
Total	16

Size	
< 20 FTE	6
≥ 20 FTE	10
Total	16

For the purpose of the statistical analysis, the 3-level of SaaS adoption served as the dependent variable whereas the perceptions on factors that previously defined: relative advantage, complexity, compatibility, cost, risk, technology readiness, top management support, competitive pressure, partner pressure, external support, and marketing effort, served as the independent variables. Descriptive statistics of each variable is provided in **Table 14**. The descriptive statistics suggests that most of respondents at least "agree" on items in relative advantage, compatibility, and competitive pressure (min score ±3.00 and mean score ≥ 3.5).

Table 14. Descriptive statistics of SaaS adoption level

Variables	Measurement type	Descriptive Statistics
Dependent Variable		
SaaS Adoption	Ordinal	Non adopter of SaaS: 9 (56.2%) In the process: 5 (31.3%) Adopter of SaaS: 2 (12.5%)
Independent Variables (hypothesis)		
1. Relative Advantage (H6, positive)	Interval (5-point likert scale)	Mean: 3.61; Std. Dev: 0.52 Min: 2.8 ; Max: 4.40
2. Complexity (H7; negative)		Mean: 2.92; Std. Dev: 0.82 Min: 1.00 ; Max: 4.67
3. Compatibility (H8; positive)		Mean: 3.47 ; Std. Dev: 0.54 Min: 3.00 ; Max: 5.00
4. Cost (H9; positive)		Mean: 3.05; Std. Dev: 0.65 Min: 2.00 ; Max: 4.50
5. Risk (H10; negative)		Mean: 2.94; Std. Dev: 0.50 Min: 2.00 ; Max: 3.75
6. Technology Readiness (H11; positive)		Mean: 3.12; Std. Dev: 0.76 Min: 2.00 ; Max: 5.00
7. Top Management Support (H12; positive)		Mean: 3.34; Std. Dev: 1.01 Min: 1.00 ; Max: 5.00
8. Competitive Pressure (H13; positive)		Mean: 3.73; Std. Dev: 0.40 Min: 3.00 ; Max: 4.25
9. Partner Pressure (H14; positive)		Mean: 2.94; Std. Dev: 0.77 Min: 1.00 ; Max: 4.00
10. External Support (H15; positive)		Mean: 3.21; Std. Dev: 0.77 Min: 1.00 ; Max: 5.00
11. Marketing Effort (H16; positive)		Mean: 2.81; Std. Dev: 0.80 Min: 1.33 ; Max: 4.00

In addition to response from the "have heard" of SaaS or cloud, responses from the "never heard" of SaaS or cloud were also extracted. Possible reasons on why they have never heard SaaS or cloud were extracted and provided in **Table 15**. A statistical analysis was applied to this result to investigate whether the proportion between responses are statistically different and not by chance. A chi-square analysis was applied. The result shows that the proportions on possible reasons on why "never heard" about SaaS or cloud; not interested, do not have the capability on IT issues, and never been offered by the service provider, are statistically different.

Table 15. Possible reasons on why "never heard" about SaaS or cloud

Reason why never heard or does not know about cloud or SaaS	Number of Responses	%
Not interested	21	18.92%
Do not have the capability on IT issues	55	49.55%
Never been offered by the service provider	35	31.53%
Total	**111**	**100%**

Note: n=88, multiple responses are given by respondents; result of chi square test (chi-square=15.78; sig=0.000)

The finding on possible reasons on why "never heard" about SaaS or cloud is unexpected, that most of respondents admit that they do not have the capability on IT issues and that they have never been offered by SaaS providers. In terms of the earlier factor, it is interesting to see the profile of the SME that have never heard about SaaS particularly the education background of its middle to top management. There are 56.8% (n=88) of SMEs for which the education background of the middle to top management is lower or equal to senior high school graduated. Although there may not be a direct relationship between education background and the capability on IT issues, yet education background may play role in someone's capability on IT. A person who holds a diploma degree in general has more knowledge and information access, particularly on IT issues, compared to a person that is only high school graduated. As also indicated by the OLR model, that education background of middle to top management is significant in influencing ICT adoption. Another remark from the finding is that the SaaS providers have not promoted SaaS intensively among the SMEs market. There were almost 32% of the "never heard" respondents that never been offered by the SaaS providers. This aspect should be noted, particularly by SaaS providers that increasing the SaaS promotion to SMEs market can increase the awareness of SaaS among SMEs and eventually may increase the SaaS adoption.

Moreover, possible factors that may influence the "never heard" respondents (on SaaS or cloud) in adopting new technology such as SaaS were also extracted and provided in **Table 16**. It is found that five variables are given the highest scores: relative advantage (22.47%), compatibility (21.35%), marketing effort (13.48%), cost (12.36%), and complexity (9%). A remark on this finding is that both relative advantage and compatibility are factors that were given relatively high scores both by the "have heard" respondents (see **Table 13**) and the "never heard" respondents (see **Table 15**). It implies that both type of respondents show their approval that relative advantage and compatibility tend to influence them in adopting SaaS.

Table 16. Factors influence the "never heard" respondents in adopting new technology

Factors influencing "Never-heard" respondent in adopting new technology	Number of Responses	%
Relative advantage	40	22.47%
Complexity of the technology	16	8.99%
Compatibility of the technology to the company	38	21.35%
Cost implication	22	12.36%
Risk implication	5	2.81%
Firm's technological readiness	12	6.74%
Support from top management	6	3.37%
Firm's competitive pressure	7	3.93%
Firm's Partner pressure	3	1.69%
External Support towards the technology	5	2.81%
Marketing effort from provider	24	13.48%
Total	**178**	**100%**

Note: n=88, multiple responses are given by respondents

5.3.2 Data analysis: Rough Set Analysis

Eleven independent variables and one dependent variable were used to predict factors that facilitate or inhibit the SaaS adoption, by using 16 cases available. Using the guideline from Hosmer & Lemeshow (2005), the minimum number of cases required for applying statistical inference is 10 cases per independent variable (Utexas, 2013). With 16 cases, it is possible to test the individual hypothesis. Yet, it is not possible to test all the hypotheses simultaneously. Thus, statistical inference is not preferable for this study.

Rough Set Analysis (RSA) is a data mining technique, which is useful "to solve qualitative problems such as clustering, association, classification, dimension reduction, and forecasting" (Wu, 2011b). RSA was introduced by Pawlak (1982). It is a valuable tool to deal with vague, inexact, and uncertain datasets (Mahapatra et al., 2010,Wu, 2011b). RSA has been applied in various fields such as company behavior, marketing, banking, engineering, medical science, etc. RSA has several advantages compared to traditional statistical inference (Geenhuizen & Nijkamp, 2011,Wu, 2011b): 1) it requires no assumption either associated with the probability distribution of the variables or the independence of the variables, 2) it can be applied to small size datasets and/or with low level of measurement (e.g. categorical), 3) it fits with fuzzy characteristics of the data.

The information that consists of condition attributes (also known as independent variables in statistic) and the decision attribute (also known as dependent variable in statistic) is analyzed by RSA and the hidden knowledge is discovered and expressed in a form of decision rules (Wu, 2011b). Researches with RSA suggest steps in the implementation (Wu, 2011b). Firstly, calculate the

approximation. After that finding reducts of the attributes and core of the attributes. Finally, create decision rules with the covering index (CI). These steps are discussed in detail in the subsequent paragraphs. However, data preparation is first discussed.

Data preparation

RSA provides better results when the attributes with continuous scale are in the finite sets of low cardinality (McKee, 2000). Since the attributes used in the SaaS investigation are in continuous scale, they were first recode into qualitative terms such as 'low, medium, and high' with the corresponding numeric of '1,2,3'. The mean score of the total items within each construct was first calculated. The result was then normalized by subtracting the mean score of the construct for each object with the total mean score of the construct, and then divide it with the standard deviation. Finally, the data was transformed into classes '1,2,3'. Mahapatra et.al. (2010) suggests to transform data with normalized value <0.3 into low (1), normalized value 0.3-0.7 into medium (2), and normalized value >0.7 into high (3). Particularly for attributes complexity, risk, and cost, the opposite threshold of low and high applies. The normalized and transformed data is provided in **Appendix I** and **Appendix J**.

Data analysis

Data analysis was applied using the software called ROSE (Rough Sets Data Explorer) that implements the RSA approach. The results are summarized as follows:

1. The total quality of classification and the accuracy of classification for each class achieved a rate of 1.00. It suggests that "all the objects have been completely classified and identified" (Wu, 2011b).
2. The core reducts resulted that all the eleven condition attributes belong to the core with the maximum quality classification of the core 1.00. It means that all these attributes contribute to the explanation of SaaS adoption and no variable contains redundant information.
3. Finally, using the basic minimal covering, 5 decision rules were obtained. Basic minimal covering is a method to obtain the minimal number of possibly shortest rules covering all the cases (ProSoft, 1999). Coverage Index (CI) shows the strength of the rules. CI of 40% means that there are 4 out of 10 cases that fit with the rule. In general, a better decision rule is shorter and with higher CI (Wu, 2011b). The decision rules obtained from the data mining are presented in **Table 17**.

Table 17. Rough Set Analysis of SaaS adoption

Rule (CI)	Number of cases	Condition attributes ==> decision attribute
Rule 1 (89%)	**8**	(Complexity =3) & (Compatibility=1) ==> (Adopt SaaS=1)
Rule 3 (60%)	3	(Relative advantage=2) & (Marketing Effort=1) ==> (Adopt SaaS=2)
Rule 4 (40%)	2	(Risk=1) ==> (Adopt SaaS=2)
Rule 5 (100%)	**2**	(Relative Advantage=3) & (Compatibility=3) ==> (Adopt SaaS=3)

Note: Rule 2 is not presented in the table as it has very weak coverage index (11%)

The analysis reached maximum CI of 100% (rule 5), followed by rule 1 (CI=88.89%), rule 3 (CI=60%), and rule 4 (CI=40%). The results indicate that:

a. Respondents who have not adopted or in the process of evaluating SaaS (Adopt SaaS=1), show a high level of perceived complexity and low level of perceived compatibility (rule 1);
b. Respondents who are in the process of evaluating SaaS (Adopt SaaS=2) show a medium level of perceived relative advantage and low level of perceived marketing effort (rule 3). Moreover, they also show a low level of perceived risk (rule 4);
c. Most importantly, respondents who have adopted SaaS (Adopt SaaS=3) show a high level of perceived relative advantage and compatibility (rule 5).

The finding suggests that the borderline for factors influencing SaaS adoption lies in rule 1 and 5. Therefore, relative advantage, compatibility, and complexity are stronger factors in influencing SaaS adoption. It suggests that SaaS adoption is driven by a positive perception of the relative advantage and compatibility. On the contrary, SaaS adoption tends to be inhibited by a negative perception of complexity. Hence, the result suggests that relative advantage, compatibility, and complexity fully comply with the hypotheses. Meanwhile, risk and marketing effort are suggested to influence the thinking about SaaS (rule 3 and rule 4), but these factors do not directly influence the SaaS adoption. Hence, the result suggests that risk and marketing effort partially comply with the hypotheses. The result also suggests that the rest of the factors do not comply with the hypotheses. The compliance of the hypotheses with the RSA result is provided in **Table 18**.

Table 18. Compliance of the hypotheses with RSA result

Hypothesis (relation)	Variable	Result
H6 (+)	Relative advantage	Fully comply
H7 (-)	Complexity	Fully comply
H8 (+)	Compatibility	Fully comply
H9 (-)	Cost	Does not comply
H10 (-)	Risk	Partially comply
H11 (+)	Technology readiness	Does not comply
H12 (+)	Top management support	Does not comply
H13 (+)	Competitive pressure	Does not comply
H14 (+)	Partner pressure	Does not comply
H15 (+)	External support	Does not comply
H16 (+)	Marketing effort	Partially comply

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Chapter 6. Interpretation of Results

The objective of this study was to gain a better understanding towards ICT and SaaS adoption among the SMEs in Indonesia. SMEs in manufacturing industry in West Java were used as the sample in the research. The data analysis has produced some interesting facts. The result suggests that the ICT adoption is influenced by firm size, education background of the middle to top management, and sector in which the SME operates. With regard to SaaS adoption, the result suggests that relative advantage and compatibility as driving factors and complexity as the inhibiting factor. The following section discusses the findings in detail.

6.1 ICT adoption factors

The study found that the ICT adoption level among the SMEs in Indonesia is on a low level. About 49% of the SMEs in the sample do not have an Internet connection, whereas 29.8% of the SMEs do not have a computer. The result is become more interesting that SMEs in the sample are located in big cities. Thus, it can be imagined that there are even higher percentage of SMEs in Indonesia without computer and/or Internet connection. A previous study in 2007 in the Indonesian context for SMEs in manufacturing industry found higher levels of ICT adoption, 98% had computer and 62% had Internet connection (Rianto, 2008). However, the study was conducted only to 3 sectors within the manufacturing industry: automotive component, textile and textile product, and creative industry sectors. Without this basic IT infrastructure, it may take long time for SaaS to be widely adopted by SMEs in Indonesia.

This finding raises the question whether there is a well-distributed electricity and telecommunication infrastructure that allows the utilization of computer and Internet. Previous studies on ICT adoption in developing countries indicate that one of factors that influence the adoption of ICT is the availability of system infrastructure, including the electric power supplies and Internet access connection (Kapurubandara & Lawson, 2006,Lal, 2007,Apulu, 2012). In this sense, almost 80% of the area in Java has already ben covered by electricity infrastructure (Bramantyo, 2013). The rests of 20% are for those who live in mountains and places that are geographically difficult to access. In terms of internet access, data in 2008 shows that more than 70% of households in Java have internet access connection (MCIT, 2010). Therefore, the lack of availability of electricity and Internet access infrastructure may not be the case for SMEs in this study. It means that there are other factors that

influence the low adoption of ICT among SMEs, especially in West Java. Previous studies in developing countries, such as Sri Lanka and Nigeria, have indicated that characteristics of firm, owner/manager, and industry sector contribute to the adoption and exploitation of ICT among the SMEs especially in developing countries (Shiels et al., 2003,Kapurubandara & Lawson, 2006,Apulu, 2012).

This study investigated the influence of firms' characteristics: size, turnover, asset, education background of middle to top management, and firm sector towards the ICT adoption. However, since asset and turnover are collinear, variable asset was then dropped from further analysis. The results of the analysis suggest firm size, middle to top management education, and sector within which the SME operates are statistically significant in influencing SMEs to adopt ICT. It gives indication that SMEs that are larger in size (FTE), have middle to top management with higher education, and operate in sector characterized with higher complexity on production process and/or higher export market share are more likely to adopt ICT.

The relatively low pseudo R2 (0.28) of the full model indicates that the model containing variables of size, education, and sector is likely to be relatively poor predictor of the outcome. This suggests that there might be other factors that are important in predicting the ICT adoption level but did not included in the model, such as factors associated with technology aspect was not included in the model. However, the relatively low pseudo R2 (0.28) does not refuse the fact that the influence of independent variables that are found significant.

In terms of firm size, the study confirms previous research in IT adoption that firms with larger number of employees are more likely to adopt IT (Thong & Yap, 1995,Premkumar & Roberts, 1999,Zhu, et al., 2003). This finding gives insight for SaaS providers that SMEs with large number of employees are potential market to adopt ICT. The study found turnover insignificant in influencing the ICT adoption. Meanwhile it was found significant when tested individually. This could be explained that turnover might be less significant when compared to other factors such as sector, size, and education. The role of financial aspect of a firm might be not that important as initially predicted.

The middle to top management education background was found to be significant. This confirms the previous research by (MacGregor, 2004) and (Xu & Quaddus, 2005) indicating the significant influence of CEO's educational level towards the technology adoption. Middle to top management within SMEs plays an important role as decision maker. SMEs tend to have highly centralized structure, where these people make most of decisions in the firm. They make nearly all decisions from strategic to daily operations (Bruque & Moyano, 2007,Nguyen, 2009). Generally, people with higher education background have more insights, information and knowledge. They have more access to information. Thus, education background of the middle to top management in SMEs plays an important role in the decision making process of adopting ICT.

The sector was also found to be significant in influencing ICT adoption. Industry sectors that are characterized with higher complexity on production process and/or higher export market share are more likely to adopt ICT. This finding gives insight to SaaS providers that firms with these characteristics are potential market to adopt ICT.

6.2 SaaS adoption factors

Using the RSA technique, three factors were indicated to have strongest influence towards SaaS adoption, namely relative advantage, complexity, and compatibility. The SaaS adopter can be identified by relative advantage and compatibility. SMEs that show a high level of perceived relative advantage and compatibility are more likely to adopt SaaS. On the other hand, the SaaS non-adopter can be identified by complexity and compatibility. SMEs that show a high level of perceived complexity and low level of perceived compatibility are not likely to adopt SaaS. In addition to that, two factors also found to influence the thinking of SaaS, the factors are namely risk and marketing effort. SMEs that are in the process of evaluating SaaS can be identified by a low perceived risk, low perceived marketing effort and medium perceived relative advantage.

Due to the small sample, the generalization of these findings should be treated cautiously. However, the findings do give insights into which factors related to the needs and concerns about the SaaS among SMEs, particularly manufacturing industry.

6.2.1 Technological aspect

Relative advantage has been consistently identified as the significant factor that motivate organization to adopt new IT innovation (Premkumar & Roberts, 1999). In this study, relative advantage was indicated to be one of the strongest factors in driving SaaS adoption. SaaS adopters have shown a high level of perceived relative advantage of SaaS. Meanwhile, the SMEs that are in the process of evaluating SaaS, have shown a medium level of perceived relative advantage of SaaS.

In general, SMEs are not as well informed as large enterprises, particularly on technology. Therefore, generally, SMEs have lower awareness towards new technology compared to large enterprises. As a consequence, it is important for SaaS providers to actively communicate the benefits of SaaS to the market. This could increase their awareness about SaaS and hence promote the adoption of SaaS among the SMEs market. As already identified in marketing literature, awareness is the first step in the purchasing or adoption process of a product (Mohr, et al., 2010).

Complexity was also indicated as one of the strongest factors in inhibiting SaaS adoption. The SaaS non-adopters have shown a high level of perceived complexity. The SaaS non-adopter perceived SaaS to be difficult to learn, inflexible to interact with, and difficult to use. This confirms the previous studies on IT adoption in Malaysia that complexity found to be significantly inhibit the IT adoption

(Tan, et al., 2009). This study gives insight to SaaS providers that they should reduce the complexity perception of SaaS, particularly among the SaaS non-adopter. Market education is key to reduce the complexity. Less "high-tech sound" communication and trainings to SMEs are the samples of necessary market education.

This study also suggests that compatibility was one of the strongest factors in driving SaaS adoption. SaaS adopters are characterized with positive perception of SaaS compatibility with their firm's existing culture and values, preferred work practices, and past experiences regarding IT appliances. On the other hand, the SaaS non-adopters are characterized with negative perception of SaaS compatibility with their firm. This finding is consistent with previous studies in IT adoption studies, including in developing country such as Malaysia (Premkumar & Roberts, 1999,Thong, 1999,To & Ngai, 2006,Zhu, et al., 2006,Tan, et al., 2009,Low, et al., 2011).

With regard to the findings in the ICT adoption, 49% of SMEs do not have Internet connection and what is worse, 29.8% of SMEs do not even have a computer. The main reason is not due to lack of electricity supply or Internet access connection, instead due to other reasons such as compatibility. Most SMEs still use the traditional way by doing most of their work manually either for the administration, marketing, transaction, or even the manufacturing work itself. It can be argued that SaaS is not yet compatible to most of SMEs in Indonesia. Therefore, it is recommended to increase the familiarity of SMEs towards IT, particularly computer and Internet, in order to increase the level of perception towards compatibility of SaaS.

Realizing the important role of Internet and information technology in general to the economy of a country, so far Ministry of Communication and Information Technology (MCIT) of Republic of Indonesia has included the broadband infrastructure as one of national development target in a program called National Broadband Network (NBN) from 2010-2015 (MCIT, 2012). Although the realization of the program is not yet known, in this program the government has targeted to have 75% fixed broadband and 100% mobile broadband distribution access coverage by 2015. By the end of 2017, both fixed and mobile broadband are targeted to cover 100% of the distribution access (MCIT, 2012). However, the utilization of computer and Internet has yet been regulated for its quality service (MCIT, 2012). In this sense, national government should pay attention to the availability of this regulation and on how to provide affordable and understandable basic IT infrastructure especially for SMEs.

Further, the study also indicates risk as less important factors in identifying SaaS adoption. In addition, cost was found insignificant factor that influences SaaS adoption. The finding suggests that both the SaaS adopters and SaaS non-adopters have similar perceptions towards risk and cost of SaaS. This is not consistent with previous studies on IT adoption (Premkumar & Roberts, 1999,Kuan & Chau, 2001). The data shows that (see **Appendix J**), most of the SMEs have high perception towards risk and cost of SaaS. This could be explained by two folds; Firstly, SaaS is considered as new

technology. The risk and cost implications entail to the technology have not been exposed completely. SMEs are still hesitant to adopt SaaS due to this uncertainty. Both the SaaS adopter and non-adopter still have insufficient knowledge on these issues. A clear upfront agreement particularly associated with risk and cost implication between the SaaS providers and SMEs is necessary to reduce the high-perceived risk and cost of SaaS by the SMEs.

6.2.2 Organizational aspect

It is surprising to have technology readiness to be not important factor to identify the adopter or non-adopter of SaaS in this study. This finding does not confirm the previous studies in IT adoption that found technology readiness as factor that significantly influence the IT adoption (Thong, 1999,Kuan & Chau, 2001,To & Ngai, 2006). However, the data shows that (see **Appendix J**), most of the non-adopter and those in the process of evaluating SaaS have low perception towards their firm's technology readiness. This suggests that most of SMEs are generally lack of technology readiness: relevance knowledge and skill and technology infrastructure to support the implementation of SaaS. Somehow, technology readiness is also related to the compatibility factor; how SaaS compatible with the firm's past experiences in using the same application or technology. Increasing the SMEs familiarity to IT, particularly computer and Internet, is the basic step to increase the compatibility and at the same time the technology readiness of SMEs. Therefore, to the extent that the SMEs can be lowered their knowledge gap in regard to IT and increased their IT infrastructure capability, may promote the path to adoption of SaaS.

6.2.3 Top management aspect

It is also surprising to have top management to be less important in influencing the SaaS adoption. This finding does not confirm previous studies on IT adoption (Al-Qirim, 2005,Wang, et al., 2010). However the data shows that most of SMEs have low perception towards top management support (see **Appendix J**). This may be due to the fact that SaaS is still in its infancy stage, uncertainties entail in the adoption. Thus, most of top management of SMEs tend to "wait and see" how well this technology develop and give necessary benefits to their firms. Research by (Wang, et al., 2010) confirms that top management support is insignificant during the early stage of the technology development.

6.2.4 Environmental aspect

In the environmental aspect, only marketing effort wasfound as one of important factors that identify the SMEs that are in the process of evaluating SaaS. They are characterized with a low level of perceived marketing effort from the providers. However, marketing effort was not found as the influencing factors in the SaaS adoption. Both SaaS adopters and SaaS non-adopters have similar perceptions towards marketing effort from providers. The data (see **Appendix J**) shows that most of the adopters and non-adopters scores medium to high for marketing effort. Nevertheless, with regard

to the finding on reasons why "never heard" about SaaS or cloud (see **Table 15**), most of the respondents that have never heard about SaaS or cloud admitted that they have never been offered by the providers. Thus, an important remark here is that marketing effort is important to increase the awareness of SMEs about SaaS, yet it is less important in influencing the adoption of SaaS.

Unexpectedly, the study found that the competitive pressure, partner pressure, and external support are not the influencing factors in the SaaS adoption. In terms of competitive pressure, from the data (see **Appendix J**), it was found that there were various levels of perception within each SaaS adoption level towards competitive pressure. It suggests that competitive pressure does not play significant role at this early stage of SaaS adoption. Thong (1999) has indicated that the competitiveness of the environment does not have a direct influence to SMEs in adopting IT.

Partner pressure is also not found as factor that influences the SaaS adoption. This finding does not confirm the previous studies on IT adoption that have found partner pressure to be significantly influence the IT adoption (Iacovou, et al., 1995,Premkumar & Roberts, 1999,Wang, et al., 2010,Low, et al., 2011). However, the data (see **Appendix J**) shows that most of SMEs have low perception towards partner pressure. Firstly, it could be explained that because there is only one item explaining the partner pressure in the questionnaire, hence it was not really elaborated. Secondly, it could be that most of SMEs do not have vertical linkages with bigger companies. Therefore partner pressure may not be the case for most of SMEs in this study.

Finally, the study suggests that external support to be not important in influencing the SaaS adoption. External support in this study focuses on the availability of technical supports and trainings on how to effectively using SaaS. However, from the data (see **Appendix J**), most of the non-adopters have low perception and the adopters have high perception towards external support. This may also imply that external support may also have role in identifying the adopters or non-adopters. SMEs bear inadequate IT expertise; the availability of external support on the relevant technology would increase the likelihood of SMEs adopting SaaS. In this sense, Government and SaaS providers could have collaboration to address this issue.

In Indonesian ICT white paper (2010), MCIT has identified that to have cloud better developed, sufficient infrastructure should be available. One step to achieve this, cloud infrastructure ecosystem should be developed. The government plays an important role in this ecosystem (MCIT, 2012):

1. Standardization to guarantee the interoperability and the quality service
2. Trade system and incentive scheme to guarantee the Return On Investment (ROI) from the stakeholders within the ecosystem
3. A consistent technology roadmap

MCIT also identified the importance of collaboration between all aspects within the ecosystem to have cloud better developed (MCIT, 2012): interoperability between cloud provider, sharing assets,

joint development and joint market education. However, apart from the infrastructure ecosystem, it is also important to develop cloud business ecosystem. Although some aspects of cloud business have been included in the infrastructure ecosystem, it is important to specifically create business ecosystem and identify factors that are specifically aimed for the adoption acceleration such as the compatibility of the technology to the business function in SMEs as well as affordable and understandable technology are suggested to be emphasized both by the national government and cloud particularly SaaS providers.

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Chapter 7. Concluding Remarks

This chapter presents and discusses mainly on the summary findings of the study. Section 7.1 presents and discusses the summary of the main conclusion. Section 7.2 the limitations of the study are described and recommendations for future research are drawn. Finally, section 7.3 provides self-reflection of this study.

7.1 Summary of the main conclusion

SaaS is believed to have an eminent sense to SMEs. Potential benefits of SaaS are expected to provide better overall performance of SMEs. However, the SaaS adoption among the SMEs in Indonesia is still low. Very little is known on what factors are influencing the adoption of SaaS. In this study, SMEs in manufacturing industry in West Java were used as the study case. A prerequisite to SaaS adoption is the ICT adoption notably the availability of basic IT infrastructure such as computer and Internet. Computer and Internet can be seen as the basic requirement for SaaS adoption. However, it is unclear what is the level of ICT adoption so far among the SMEs. Therefore, aside from SaaS adoption investigation, ICT adoption level among the SMEs was investigated. Within the ICT adoption level, the SaaS adoption was defined as the highest level. Thus, factors influencing the ICT adoption, also directly influence the SaaS adoption. Four factors were investigated to identify their influence on the ICT adoption: firm size, turnover, education background of the middle to top management, and firm sector. A number of 104 samples were analyzed using the Ordinal Logistic Regression (OLR) model. Individual model for each factors were explored. The result suggests that all factors (individually) significantly influence the ICT adoption. A full model that comprises of all factors was also explored. The result suggests that only firm size, education background of the middle to top management, and industry sector that significantly influence the ICT adoption.

In a next step, the SaaS adoption was investigated specifically among respondents that have heard about SaaS and/or cloud. It was found there were not many SMEs that have heard and adopted this technology. A number of 16 samples were analyzed using the Rough Set Analysis (RSA) approach that is appropriate for small sample. Various perceptions on circumstances (technological, organizational, top management, and environmental aspect) influencing SaaS adoption were investigated. The result suggests that relative advantage, complexity, and compatibility are the strongest factors influencing the SaaS adoption. In addition, risk and marketing effort were suggested as important factors in

identifying the SMEs that are in the process of evaluating SaaS. However, these factors were not found as the strong factors in influencing the SaaS adoption.

Overall, the study suggests that lack of the availability of electricity and Internet access infrastructures are not the case in influencing ICT and SaaS adoption for the SMEs in the study. In addition, lack of financial aspect (turnover and cost) is also suggested as not important in influencing the ICT and SaaS adoption in particular. This remark is important to be realized both by the national government and SaaS providers that apparently other factors are more important in influencing ICT and SaaS adoption. Characteristics associated with the top management and environment aspect are suggested to have a role in ICT adoption. Meanwhile factors associated with technology aspect are suggested to have a major role in SaaS adoption. The answers to the research questions of this study are summarized below:

1. *What is the level of ICT and SaaS adoption in particular among the SMEs in Indonesian manufacturing industry?*

With regard to the ICT adoption, the study found that, the ICT adoption level among the SMEs is low. About 49% of SMEs do not have Internet connection, where 29.8% do not have a computer. Based on a predefined ICT adoption level in the study, the result for each level is as follows:

1. Worst: no computer at all = 29.8%
2. Bad: has computer but no internet = 19.2%
3. Common: never heard of SaaS or cloud, has computer and internet = 38.5%
4. Good: have heard about SaaS or cloud or plan to evaluate = 5.8%
5. Best: In the process of evaluating or have adopted = 6.7%

With regard to the SaaS adoption, the study found that the SaaS adoption level among the SMEs is also low. Only 12.5% of SMEs that have heard about SaaS or cloud have adopted SaaS. Based on a predefined SaaS adoption level in the study, the result for each level is as follows:

1. Non-adopter of SaaS = 56.2%
2. In the process of evaluating SaaS = 31.3%
3. Adopter of SaaS = 12.5%

2. *What factors have strong influence to the ICT adoption among SMEs in Indonesia, and how does it affect the adoption?*

Using Ordinal Logistic Regression (OLR) model, four factors were investigated. Except for turnover, the study suggests all other factors positively influence the ICT adoption among the SMEs, namely firm size, education background of middle to top management, and industry sector. All these factors showed a positive relationship to ICT adoption. SMEs characterized with larger size, higher education

of the middle to top management and higher complexity on production process and/or higher export market share are more likely to adopt ICT.

3. *What factors have strong influence to the SaaS adoption among the SMEs in Indonesia, and how does that affect the adoption?*

With regard to SaaS adoption, due to the small sample, RSA technique was used to explore the role of each factor to SaaS adoption. The study indicates that relative advantage, complexity, and compatibility are the strongest factors in influencing SaaS adoption. SaaS adopters can be identified with a high level of perceived relative advantage and compatibility. Meanwhile the SaaS non-adopters can be identified with a high level of perceived complexity and low level of perceived compatibility.

4. *How to resolve the impeding factors in order to increase the SaaS adoption?*

Findings of the study, both concerning the ICT and SaaS adoption, suggest necessary actions to be undertaken, particularly by the national government and providers to promote the adoption of SaaS. Some recommendations are made in this sense:

1. SMEs characterized by large size, higher complexity in the production process and/or higher export market share, are suggested to be the potential ICT and SaaS adopter in particular.
2. The low level of ICT adoption among SMEs should be addressed prior to or in parallel with SaaS adoption.
3. Marketing effort such as active promotion and incentive offering is necessary to increase the awareness of SMEs about SaaS. Yet it is less important in direct influence to SaaS adoption. On the contrary, marketing efforts that emphasize on market education are more important. Active communication particularly on the relative advantage of the technology may increase the SaaS adoption. Moreover, Practical training is necessary to reduce the perceived complexity of the technology. Less "high tech sound" terminologies and communications may be needed in the communication and training. Trial ability and demonstration of the technology may also help reducing the level of complexity among SMEs.
4. In order to increase the perceived compatibility, the regulation on quality service of computer and Internet in particular is necessary. It helps increasing the utilization of these basic IT infrastructures and is expected to give familiarity of SMEs to IT. Regulation on how to provide affordable and understandable basic IT infrastructure for SMEs is also necessary.
5. Apart from the cloud infrastructure ecosystem that has been identified, cloud business ecosystem is also necessary to be created so that factors that specifically aimed for the adoption acceleration can be identified. Factors such as the compatibility of the technology to the business function in SMEs as well as affordable and understandable technology are suggested to be emphasized both by the national government and cloud providers in particular the SaaS providers.

7.2 Limitation and recommendation for future research

The limitations found in the study and recommendations made for future research are as follows:

1. The study only covers the initial adoption. While for long-term success of the SaaS adoption, the acceptance stage should also receive attention.
2. The study uses cross-sectional research; results that may have a time component must be cautiously taken.
3. Both study on the ICT adoption and SaaS adoption only focus on the main relationship between independent and dependent variable. Therefore the interrelationship between variables cannot be identified. Partial Least Square (PLS) path modeling is recommended to do such research. PLS has been found powerful to analyze the causal model comprises of multiple constructs.
4. This study focuses itself to SMEs in manufacturing industry. This study suggests that different characteristic of sectors do play a role in the ICT adoption. Therefore, it is imperative for future studies to consider SMEs from different industries.
5. The low level of ICT adoption among SMEs should be addressed prior to or in parallel with SaaS adoption. Other factors from this study that expected to influence the ICT adoption are necessary to be investigated in the future.
6. With regard to SaaS adoption investigation, one factor tends to inhibit SaaS adoption: a negative perception of complexity among the SaaS non-adopter. Future research should give attention on how to overcome this factor; whether training, product demonstration, or trial ability of the product does help reducing the high level of perceived complexity.
7. Compatibility deserves more attention in future research as it tends to facilitate the SaaS adoption. It is recommended to do future research on how to match between the SaaS and the business functions of SMEs.
8. Particularly for SaaS adoption investigation, due to the small sample, generalization of the results should be cautiously taken.
9. Despite its advantages, RSA also lacks to some respects. 1) Since it produces better result for attributes with low cardinality, some information in attributes with continuous scale may be omitted. 2) Some technical problems still appear in the software, such as incompatibility between ROSE and Microsoft Excel, less user friendly for some features, etc. Hence it poses challenges especially during the data input process. If ROSE can be improved to these respects, it is possible for RSA to be more widely used particularly in data mining.
10. This study applies for SaaS in general. Mobile cloud was not specifically discussed in the study. The main difference is that mobile cloud specifically defined for access by mobile devices. In terms of the technology, cloud allows access anytime, anywhere and anyhow. However, for SMEs in Indonesia, the utilization of mobile devices except laptop (such as smart phone, tablet, etc.) for business purposes is not widely applied.
11. Researches found that the penetration of mobile Internet access in Indonesia is higher than fixed Internet access. This fact should receive more attention on how it can contribute to the economy of Indonesia through cloud or SaaS adoption in particular.

7.3 Self-reflection

Finally, with regard to the reflection of the overall study, three activities are identified as important in which some challenges were posed. Therefore recommendations to do similar activities in the future are given, namely:

1. Information search

   A thorough information search particularly on the supporting information to the relevant context, in this sense Indonesia, is necessary. However, in Indonesian context, this information is somehow not easily accessible in an open environment. It took a considerable amount of time and effort to do this information search. Therefore, allocating some more time in the research plan for the information search is required in this sense.

2. Data collection

   Conducting a survey research in Indonesia is quite challenging. Conventional mail survey is not recommended since it gives a very low response rate (±3%). Therefore it is recommended to conduct electronic survey (e.g. via email, online questionnaire) for specific target respondents that are familiar with this technology. In addition, a personal interview usually gives better result, yet expensive.

3. Dealing with the results

   Sometimes, the results that were expected from the data collection go beyond expectation. This applies in this research, which results were a bit out of expectation. The ability to see things differently and intensive discussions with supervisor help a lot in dealing with such issue.

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Appendix

Appendix A: Cloud providers in Indonesia

NO	Providers	Company type	Cloud Services Offered	Year of offering cloud	Target Market	Source Information
1	Telkom Sigma	Local	IaaS, SaaS	2006	Medium to large enterprise	Mangula et al. (2010)
2	IBM Indonesia	Local	IaaS	2007	Medium to large enterprise	Mangula et al. (2010)
3	Net Solution	Local	IaaS, SaaS	2008	Medium to large enterprise	Mangula et al. (2010)
4	Codephile	Local	SaaS	2008	Small to medium enterprise	Mangula et al. (2010)
5	Infinys	Local	IaaS, PaaS, SaaS	2009	Medium to large enterprise	Mangula et al. (2010)
6	Lintas Media Danawa	Local	IaaS, SaaS	2009	Medium to large enterprise	Mangula et al. (2010)
7	Walden Global Solutio	Local	SaaS	2009	Medium to large enterprise	Mangula et al. (2010)
8	Dimension data	Multinational	IaaS, SaaS	2010	Medium to large enterprise	Mangula et al. (2010)
9	Telkom	Local	IaaS, SaaS	2010	Small, Medium, large enterprise	Mangula et al. (2010)
10	Biznet	Local	IaaS	2011	Medium to large enterprise	Mangula et al. (2010)
11	LintasArta	Local	IaaS	2011	Medium to large enterprise	Mangula et al. (2010)
12	Indosat	Local	IaaS, SaaS	2012	Medium to large enterprise	Mangula et al. (2010)
13	Microsoft	Multinational	SaaS	2012	Small, Medium, large enterprise	Purwadhika (2012)

Appendix B: Complete literature review on benefits and risks of SaaS

Source	Survey target	Top Benefits	Top Risks
IDC (2009)	Perceived benefits and risks Enterprises, not mentioned in detail	Top 5 perceived benefits of customers to cloud: - Pay for what only you use (77.9%) - Require less in-house IT staff costs (67%) - Always offers latest functionality (64.6%) - Simpler in sharing systems with partners (63.9&) - Seems like the way of the future (54%)	Top 5 Perceived risks of cloud: - Security (87.5%) - Availability (83.3%) - Performance (82.9%) - On demand payment model may cost more (81%) - Lack of interoperability standard (80.2%)
ENISA (2009)	Perceived benefits and risks **SMEs, Europe**	Top 5 possible motivations: - Avoiding capital expenditure in hardware, software, it support, and information security by outsourcing (68.1%) - Flexibility and scalability of IT resources (63.9%) - Business continuity and disaster recovery capabilities (52.8%) - Increasing computing capacity and business performance (36.1%) - Remove economic/expertise barriers impeding to modernize business process by the introduction of IT (30.6%)	Top 5 possible barriers: - Confidentiality of corporate data (67.2%) - Privacy (47%) - Integrity of services and data (42.2%) - Availability of services or data (39.4%) - Lack of liability of providers in case of security incidents (31.7%)
KPMG (2010)	Perceived benefits and risks **Large enterprises, Worldwide**	Top 5 perceived benefits of cloud to business (in general): - Reduce cost (50%) - Accelerate time to market (35%) - Change interaction with customers and suppliers (32%) - Fundamentally change business model (32%) - Provides management transparency on transactions (32%) Top 5 perceived benefits of cloud to business (in **ASPC countries**): - Reduce cost (57%) - Change interaction with customers and suppliers (49%) - Accelerate time to market (44%) - Fundamentally change business model (43%) - Provides management transparency on transactions (37%)	Top 5 concerns/risks of cloud: - Security is in the top list (44%) - Performance (29%) - Difficulty integrating with existing system (20%) - IT governance (18%) - Loss of control over data customers (16%)

Source	Survey target	Top Benefits	Top Risks
Accenture (2010)	Perceived benefits and risks **Large enterprises, Worldwide**	Top 5 perceived benefits of cloud: - Reducing up front IT costs/capital expenditure (35%) - Reduce/avoid cost of maintaining own IT infrastructure (36%) - Provide platforms for standardized, efficient business process (29%) - Provide IT services where IT infrastructure, resources or labour is limited (28%) - Provides new ways to engage and interact with customers (27%) Top 5 perceived long-term benefits of cloud: - Enable speed, flexibility, and responsiveness (60%) - Permanently and significantly lower operating costs (54%) - Enable new, innovative processes (46%) - Support product/service innovation (40%) - Improve decision making (33%) Top 5 perceived benefits of cloud (in Brazil): - Expand operations to new markets (around 57%) - Support product/service innovation (around 57%) - Permanenetly and significantly lower operating costs (20%)	Top 5 perceived risks of public cloud: - Data security/privacy/ confidentiality issues (44%) - Reliability/uptime/business continuity issues (30%) - Complienace with legal, regulatory, and auditing requirements (29%) - Integration with existing systems (25%) - Legal or regulatory ambiguity (24%)
Sahandi et al. (2012)	Perceived benefits and risks **SMEs, UK**	Top 5 perceived benefits of cloud: - Cost reduction (45.5%) - Mobility and convenience in accessing applications (44.9%) - Flexibility and scalability of IT resources (38.9%) - Increasing computing capacity (32.9%) - Providing greater IT efficiency and agility (31.7%)	Perceived risks of cloud: - Privacy - Confidentiality of private data.
Feuerlicht et al. (2011)	Possible motivations and barriers **SMEs, Czech Republik**	Top 5 possible motivations: - Cost reduction (26%) - Rapid deployment (20%) - Improve scalability (19%) - Improve flexibility (17%) - Improve ability to support business objective of organization (13%) **SaaS adoption motivation:** - Cost reduction - Rapid implementation	Top 3 possible barriers: - Increased dependence on external providers (17%) - Increase costs (subscription) (15%) - Security (14%) Top 3 SaaS barriers to adoption: - Dependence on external providers - Loss of control on data - Security Concerns of adopter: - Security - High cost (subscription) Concerns of non adopter: - Increase dependence on external providers - Lack of scalability - Security

Appendix C: Sample frame demography

Business category	Total	%
Large	1988	30.49%
SME	4532	69.51%
Total	**6,520**	**100.00%**

City	Employee (20-99)	%
Bandung	1282	28.3%
Bekasi	473	10.4%
Cirebon	463	10.2%
Bogor	460	10.2%
Majalengka	451	10.0%
Sukabumi	214	4.7%
Tasikmalaya	155	3.4%
Bandung Barat	135	3.0%
Karawang	121	2.7%
Garut	117	2.6%
Ciamis	105	2.3%
Purwakarta	102	2.3%
Indramayu	100	2.2%
Cimahi	84	1.9%
Cianjur	80	1.8%
Sumedang	67	1.5%
Depok	54	1.2%
Kuningan	39	0.9%
Banjar	15	0.3%
Subang	15	0.3%
Total	**4,532**	**100%**

Appendix D: Definition of constructs

Variables	Definitions	Source
Relative advantage	The degree to which the innovation is perceived to be better than what it supercedes/precursors	Rogers (1995, p.213); Qirim (2005); Premkumar & Roberts (1999); Grandon & Pearson (2004)
Risks	The uncertainty regarding the negative consequences (other than cost) of adopting SaaS which includes: confidentiality issues, business continuity issues, and dependency issues	Self-developed
Complexity	The degree to which the innovation is perceived as relatively difficult to understand and use	Rogers (1995, p.230); Premkumar & Roberts (1999)
Compatibility	The degree to which the innovation is perceived as being consistent with existing values, past experiences, and needs of the company	Rogers (1995, p.223); Qirim (2005); Premkumar & Roberts (1999); Grandon & Pearson (2004)
Cost	The expenses in the adoption and implementation of the technology (technology-installation, implementation, maintance, etc.)	Kuan & Chau (2001); Moore & Benbasat (1991); Qirim (2005)
Technological readiness	The availability of technological capability in a company (infrastructure and IT human resources)	Low et al. (2011); Kuan & Chau (2001); Wang et al. (2010); To & Ngai (2006)
Top management support	Top management support to the extent of creating a supportive climate and providing adequate resources for the adoption of new technology	Low et al.(2011); Premkumar & Roberts (1999)
Competitive pressure	Level of pressure felt by the firm from competitors within the industry	Low et al. (2011); Grandon & Pearson (2004); Thong (1999)
Partner pressure	Level of pressure felt by the firm from trading partners (suppliers & buyers)	Low et al. (2011); Qirim (2005)
External support	The availability of support in implementing and using the technology	Premkumar & Roberts (1999);
Marketing effort	Efforts done by service provider in promoting their products (SaaS)	Self-developed

Appendix E: Source of literature for the content of constructs

Constructs	Source of literatures for the content of constructs
Relative advantage	ENISA (2009); Sahandi et al. (2010); Feuerlicht et al. (2011)
Risk	ENISA (2009); Sahandi et al. (2010); Feuerlicht et al. (2011)
Complexity	Grandon & Pearson (2004)
Compatibility	Grandon & Pearson (2004); Wang et al. (2010)
Costs	Premkumar & Roberts (1999); Zhu et al. (2006)
Technological readiness	To & Ngai (2006); Wang et al. (2010)
Top management support	Premkumar & Roberts (1999); Wang et al. (2010)
Competitive pressure	Thong & Yap (1995)
Partner pressure	Qirim (2005)
External support	Premkumar & Roberts (1999)
Marketing effort	Premkumar & Roberts (1999)

Appendix F: Questionnaire's cover letter

Dear Owner/CEO/IT Manager,

Firstly let me introduce myself, I am Rahmi Muliana, Master student Management of Technology at Delft University of Technology, The Netherlands. Currently, I am conducting a graduation project research titled "SaaS Adoption Factors for SMEs in Indonesian Manufacturing Industry", and I would like to invite you to participate in this research. The research is also endorsed by the Indonesian Ministry of Communication and Information Technology (MCIT). This research is intended to find the cloud computing, especially Software as a Service (SaaS) factors that influence adoption amongst the Small and Medium Enterprises (SMEs) in Indonesia. The result of this research could give good insights into services that match your needs.

Cloud computing enables users to access a flexible volume of services as needed via Internet. This research focuses on SaaS, cloud computing service applications that can be accessed by users at anytime, anywhere, and using various telecommunication devices without installing on the computer (e.g. Googledocs, Office365, GoogleApps, applications from Netsuite, Salesforce, SaaS from Telkom – M-Force, e-Mail, e-Accounting, e-Project, etc.). Some of these applications are free and some are not. In this research **we focus on the non-free SaaS**. If you do not know about cloud computing or SaaS, your cooperation to this research is also very valuable. I will be grateful if you are willing to participate in this survey although it is voluntary in nature. In return, I would like to provide you with a summary on how to implement SaaS in SMEs. Therefore, please provide your email address in the space provided on this page to further following up the reward.

The questionnaire would take approximately **10-15 minutes** to complete. Your responses will be kept anonymous: not be identified with you personally, nor will anyone be able to determine which company you work for. Please return the completed questionnaire by putting it in the stamped envelope that has been provided together in the package and send it back to the address attached in the envelope at least a week after you received it. If you have any question concerning the questionnaire you may contact me through email.

Sincerely yours,
Rahmi Muliana, ST
R.M.ERISMAN@student.tudelft.nl
(+6281510770235)

Supervisor: Prof. Dr. Marina van Geenhuizen
Professor of Innovation and Innovation Policy,
Delft University of Technology

Please specify your email address here: ……

Appendix G: Questionnaire

Please tick one of the available options or fill in the questions

① Before you answer the following questions, make sure you have read the information in the cover letter

1. General question: SaaS adoption

1. Does your company use any computer in running the business (e.g. administration, transaction, operation, manufacturing, marketing, etc.)?
   - ☐ Yes (plese specify the number of the computer (or laptop) that your company has: .....)
   - ☐ No
2. Does your company have internet connection?
   - ☐ Yes, privately-used ☐ Yes, shared used ☐ Not at all
3. If your company has a privately-used internet connection, please specify one of its connection type below:
   - ☐ Dial-Up ☐ ISDN (Internet Service Digital Network)
   - ☐ ADSL ☐ Leased line
   - ☐ TV Cable modem ☐ Others, please specify: .....
4. Have you ever heard about cloud computing?
   - ☐ Never heard
   - ☐ Heard, not yet considered adopting ☐ In the process of evaluating
   - ☐ Plan to evaluate in the near future ☐ Already adopted
5. Have you ever heard about Software as a Service (SaaS)?
   - ☐ Never heard
   - ☐ Heard, not yet considered adopting ☐ In the process of evaluating
   - ☐ Plan to evaluate in the near future ☐ Already adopted
6. If you have adopted SaaS, please mention the application services that you are using:
   - ■ Free SaaS: .....
   - ■ Non-free SaaS (if any):.....
7. If you never heard of both cloud computing and SaaS, what could be the reason behind it? (multiple responses are allowed)
   - ☐ Do not pay attention ☐ No service provider has been offering to us
   - ☐ Do not understand ☐ Others, please specify: .....
8. If you never heard of both cloud computing and SaaS, what would be the idea that mostly influence your company in adopting a new technology such as SaaS? (multiple responses are possible)
   - ☐ Relative advantage of the technology ☐ Competitive pressure
   - ☐ Compatibility of technology to company ☐ Partner pressure
   - ☐ The complexity of the technology ☐ External support
   - ☐ The risk of the technology ☐ Company's technological readiness
   - ☐ The cost implications of adopting ☐ Support from top management
   - ☐ Marketing effort from provider ☐ Others, please specify.....

If you have answered **"never heard"** on both question 4 and 5, you can deny the specific questions on Part-2 of the questionnaire. But please do not forget to **fill in Part 3 and 4** of the questionnaire which represent you and your company

2. Specific questions: SaaS adoption

The following questions ask you about your perceptions of adopting SaaS. Please indicate your agreement with the next set of statements by **circling** one of the 5-point scale boxes below or "n" if you think you don't know. There is no right or wrong answer, both answers (positive or negative) are equally important.

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Do not know
Environmental aspect							
1	Rivalry in our industry is intense	1	2	3	4	5	n
2	Many similar products are in the market (substitute)	1	2	3	4	5	n
3	It is easy for our customers to switch to other similar products	1	2	3	4	5	n
4	There are competitors using or soon to be using SaaS	1	2	3	4	5	n
5	Our partners (e.g suppliers, buyers, etc.) require/encourage us to adopt SaaS	1	2	3	4	5	n
6	Technical supports for effectively using SaaS are available in our environment	1	2	3	4	5	n
7	Trainings for using SaaS are available in our environment	1	2	3	4	5	n
8	Incentives for adoption SaaS are available in our environment	1	2	3	4	5	n
9	Service providers actively promote SaaS to our company	1	2	3	4	5	n
10	Service providers offer incentives (e.g. discount, gimmick, etc.) if we adopt SaaS	1	2	3	4	5	n
11	Service providers makes SaaS easily obtained from our site	1	2	3	4	5	n

Technological aspect							
12	Using SaaS enables our company avoid capital expenditure (e.g hardware, software, IT support, and information security by outsourcing)	1	2	3	4	5	n
13	Using SaaS enables our company to have more flexibility and scalability in IT resources	1	2	3	4	5	n
14	Using SaaS enables our company to improve its agility (e.g. decision making process, mobility advantage, reduce time to market, market expansion)	1	2	3	4	5	n
15	Using SaaS enables our company to improve its business performance	1	2	3	4	5	n
16	Overall, we find using SaaS is advantegous for our company	1	2	3	4	5	n
17	Adopting SaaS makes us concern about data security/privacy/confidentiality issues	1	2	3	4	5	n
18	Adopting SaaS makes us concern on the reliability/uptime/business continuity	1	2	3	4	5	n
19	Adopting SaaS makes us concern on being dependent on external providers	1	2	3	4	5	n
20	Overall, we consider the adoption of SaaS is risky for our company	1	2	3	4	5	n
21	Learning to operate SaaS is difficult for me and other employees	1	2	3	4	5	n
22	We find SaaS not flexible to interact with	1	2	3	4	5	n
23	Overall, we find SaaS is difficult to use	1	2	3	4	5	n
24	The costs for the subscription of SaaS is high for our company	1	2	3	4	5	n
25	The costs for the maintanance and support of SaaS is high for our company	1	2	3	4	5	n
26	The money and time invested in training employees to use SaaS are high	1	2	3	4	5	n
27	Overall, we find cost of adopting SaaS is high	1	2	3	4	5	n
28	SaaS is consistent with our company's existing culture and values	1	2	3	4	5	n
29	SaaS is consistent with the preferred work practices	1	2	3	4	5	n
30	SaaS is consistent with our past experiences of using similar apps	1	2	3	4	5	n
31	Overall, we find SaaS is compatible with our company	1	2	3	4	5	n

Organizational aspect							
32	We have the required technology infrastructure that support SaaS adoption	1	2	3	4	5	n
33	Our company has employee(s) that are capable in using SaaS	1	2	3	4	5	n
34	Top management enthusiasticaly pays attention the adoption of SaaS	1	2	3	4	5	n
35	Top management has allocated adequate resources (e.g. financial) to adopt SaaS	1	2	3	4	5	n

36. If there is a missing factor that may motivate or hinder your company in adopting SaaS, please describe:

Please tick one of the available options or fill in the questions according to the real condition

3. Demography of respondents

1. What is your last formal education?.....
2. When were you born (the year)? .....
3. Please specify your gender (F/M)?.....
4. What is your job title in the company? (multiple responses are allowed)

☐ The owner ☐ IT Manager ☐ Staff
☐ CEO ☐ IT Staff

4. Demography of the company, please mention:

1. The year when your company was **established**?.....
2. The year when your company **had its formal registration (if any)**?.....
3. The number of your **Full Time Equivalent (FTE)* employee** by the end of Dec 2012?.....
4. The city where your company operates:.....
5. Company's **turnover during** 2012:

☐ < Rp. 300 M/year ☐ Rp. 2.5 T - Rp. 50 B /year
☐ Rp. 300 M - Rp. 2.5 B / year ☐ > Rp. 50 B/year

6. Your company's **total asset** by the end of Dec 2012:

☐ <Rp. 50 M ☐ Rp. 500 M - Rp. 10 B
☐ Rp.50 M - Rp. 500 M ☐ > Rp. 10 B

7. Types of industry where your company operates:

☐ Chemical and chemical products ☐ Textiles ☐ Wearing apparel
☐ Furniture ☐ Tobacco ☐ Wood and products of wood
☐ Food & Beverages ☐ Others, please specify your product: .....

***FTE** or full time equivalent equals to the number of full-time employees plus the number of part time employees that have been converted to full-time basis. Example: If a person works full time, FTE= 1.0; If a person only works in the morning/afternoon, FTE=0.5; If a person only works for full time 3 days/week, FTE= 0.6, etc.

Appendix H: Correlation matrix (n=104) [a)]

	1	2	3	4	5	6
1. Size	1.000					
2. Turnover	0.331**	1.000				
3. Asset	0.351**	**0.678****	1.000			
4. Education	-0.381**	-0.130	-0.143	1.000		
5. Sector	-0.091	-0.077	-0.094	-0.067	1.000	
6. ICT Adoption	0.389**	0.242*	0.301**	-0.357**	-0.230*	1.000

*p<0.05 (two-tailed), **p<0.01 (two-tailed),
a) Using spearman's correlation coefficients.

Appendix I: Data normalization

ID	Adopt SaaS	Relative Advantage	Complexity	Compatibility	Cost	Risk	Tech. Readiness	Top.Mgmnt. Support	Competitive Pressure	Partner Pressure	External Support	Marketing Effort
1	2	0.6	0.2	0.5	-1.6	-0.4	-0.2	0.6	-0.6	0.1	-0.3	-1.6
2	2	-0.7	2.0	1.0	1.8	1.6	-0.2	0.6	1.3	0.1	0.3	0.8
3	1	1.0	0.2	-0.4	0.7	0.1	1.8	1.6	1.3	0.1	0.8	0.3
4	1	-1.1	0.2	-0.9	-0.1	0.1	-0.2	-0.3	-0.6	0.1	-0.3	0.3
5	1	-1.6	0.9	0.1	-0.1	-1.4	-1.5	-0.3	0.0	0.1	-1.4	-1.6
6	2	0.6	0.9	-0.4	-0.1	0.6	-0.8	0.2	-0.6	-2.5	-0.3	-0.6
7	1	0.6	-0.2	-0.9	-0.1	0.1	-0.2	-0.3	-0.6	0.1	-0.3	0.3
8	1	-0.3	0.2	0.1	-0.1	0.1	-0.2	-0.3	-1.8	0.1	-0.3	0.8
9	2	0.6	0.9	-0.4	0.3	1.6	-0.2	-0.3	0.7	1.4	0.3	0.3
10	3	1.4	-0.6	1.0	-0.5	0.1	0.5	0.6	-0.6	1.4	0.8	1.2
11	1	-1.1	0.2	-0.9	-0.1	0.1	-0.2	0.6	0.7	1.4	0.8	1.2
12	2	0.6	-0.2	0.5	-0.1	-1.9	-1.5	-1.3	0.7	-1.2	0.8	-0.6
13	1	-1.1	0.2	-0.9	-0.1	0.1	-0.2	-0.3	1.3	0.1	-0.3	1.2
14	1	0.6	-0.6	-0.9	2.2	0.6	-0.2	-0.3	-1.8	0.1	-0.3	0.3
15	1	-1.1	-2.0	-0.4	-0.8	0.1	0.5	-2.3	0.0	0.1	-2.5	-1.6
16	3	1.4	-2.0	2.8	-1.6	-1.9	2.5	1.6	0.7	-1.2	1.9	-0.6

Appendix J: Data transformation to ordinal scale

ID	Adopt SaaS	Relative Advantage	Complexity	Compatibility	Cost	Risk	Tech. Readiness	Top.Mgmnt. Support	Competitive Pressure	Partner Pressure	External Support	Marketing Effort
1	2	2	3	2	3	3	1	2	1	1	1	1
2	2	1	1	3	1	1	1	2	3	1	2	3
3	1	3	3	1	2	3	3	3	3	1	3	2
4	1	1	3	1	3	3	1	1	1	1	1	2
5	1	1	1	1	3	3	1	1	1	1	1	1
6	2	2	1	1	3	2	1	11	1	1	1	1
7	1	2	3	1	3	3	1	1	1	1	1	2
8	1	1	3	1	3	3	1	1	1	1	1	3
9	2	2	1	1	2	1	1	1	2	3	2	2
10	3	3	3	3	3	3	2	2	1	3	3	3
11	1	1	3	1	3	3	1	2	2	3	3	3
12	2	2	3	2	3	3	1	1	2	1	3	1
13	1	1	3	1	3	3	1	1	3	1	1	3
14	1	2	3	1	1	2	1	1	1	1	1	2
15	1	1	3	1	3	3	2	1	1	1	1	3
16	3	3	3	3	3	3	3	3	2	1	2	3