A Methodology for Assessing the Benefits of Software as a Service:

Perspectives and benefits when delivering Enterprise Resource Planning as service within Small and Medium Sized Enterprises

THESIS

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Abstract

Software as a Service (SaaS) has been utilized as a means to deliver an Enterprise Resource Planning (ERP) system since the last decade. This software delivery model enables Small Medium Sized Enterprises (SMEs) to outsource the system from vendors based on pay-per-use or pay-per-period without having to do prior investments. Yet, SaaS model is still immature in concept and the unforeseeable uncertainty is relatively high because of different application specificity and behavioral acceptance for adopting a SaaS-based application. In the field of ERP and SaaS, there is no literature, which discussed about what benefits can be achieved from adopting a SaaS ERP system. Moreover, differences in opinion about SaaS benefits have emerged from the perspectives of critical actors, e.g. an agreement toward cost-savings and time-savings among vendors and adopters.

This research explores the benefits of delivering SaaS ERP system within SMEs by considering three perspectives, which are the perspective of vendors as SaaS providers, the perspective of SMEs as SaaS adopters, and the perspective of lifecycle process of SaaS. In order to accommodate differences which might arise when conceptualizing these perspectives, each perspective is directed to a set of common goals and benefits, namely the benefits of Service Oriented Computing (SOC). For this reason, we developed a methodology for assessing benefits of SaaS that consists of three main steps, which are *understanding, conceptualizing,* and *estimating* the benefits of SaaS. Research data was collected from interviews and questionnaires to appreciate benefits from the three perspectives. Following this, the structures of SaaS benefits were conceptualized for each perspective. Then, we estimated the benefits of SaaS qualitatively by indicating such benefits whitin a case study, and quantitatively by applying Partial Least Squares (PLS) Path modeling method within which the structures of SaaS benefits were developed through SmartPLS software.

Our findings show that the proposed methodology can be used to realize the benefits of SaaS in more structured way through the models of SaaS benefits that accommodate the three perspectives. Although the models are weakly validated due to limited research data, rich descriptions of SaaS benefits pertaining to the delivery of SaaS ERP system within SMEs can be gained from the structures of SaaS benefits. Furthermore, a sound understanding to overcome differences in opinion about SaaS benefits can be expected through this comprehensive methodology since each perspective in realizing the benefits is directed to the achievement of the benefits of SOC. Yet, we suggest further research for the task of validating the models with more reliable research data. The comprehensive methodology can be improved by enhancing variables and factors that define the benefits and can be used as a best practice to improve readiness of adopting a SaaS-based application in general, and a SaaS ERP system in particular.

Keywords: *Enterprise Resource Planning (ERP), Software as a Service (SaaS), Service Oriented Architecture (SOA), Benefits of Service Oriented Computing (SOC), Small Medium Sized Enterprises (SMEs)*

Executive Summary

During the past ten years, Software as a Service (SaaS) has been introduced by vendors as a new way of software provisioning through which a network-based application is delivered as services to enterprises in order to streamline their business process while saving costs. This software delivery model fits best especially for Small Medium Sized Enterprises (SMEs) that have limited resources to manage their enterprise applications. Among these enterprise applications, Enterprise Resource Planning (ERP) system has been seen as a means for SMEs to experience growth of revenues in the same stage as large enterprises. For this reason, software vendors has been introducing a SaaS ERP system for SMEs which is potential to help increasing innovation by effectively optimizing enterprise resources while efficiently saving implementation time. However, many vendors cannot be able to deliver these promises inevitably without any difficulties among which lack of coordination and organizational acceptance from SMEs are likely result in undermining benefits of SaaS. These tensions might arise at different phases of SaaS lifecycle which includes three phases that are also referred to as 'processes'. They are *service discovery* process, *service selection and engagement* process, and *service enactment* process. During this SaaS lifecycle, vendors as SaaS providers and SMEs as SaaS adopters may have different opinions in realizing benefits of SaaS, e.g. disagreement toward type of benefits due to differences in opinion about what and how to measure the benefits quantitatively in terms of cost-saving.

In realizing substantial benefits of SaaS which might be undercut due to different conceptualization from many perspectives, our research focuses on developing a methodology which can be used to help in assessing the benefit of adopting a SaaS ERP system within SMEs by considering three perspectives. They are the perspective of critical actors, which are vendors as SaaS providers and clients as SaaS adopters, and the perspective of the lifecycle process of SaaS. In this research, we employ qualitative analysis by conducting a case study within which the benefits of SaaS are explored focusing on the perspective of SaaS providers who are important for the successful delivery of SaaS-based application, and furthermore we also perform quantitative analysis by applying statistical modeling to assess the benefits from each of the three perspectives.

Before these two analyses are performed, conceptual models of the structures of SaaS benefits are developed in order to understand the benefits from each perspective comprehensively. The perspective of SaaS providers are conceptualized by considering a list of benefits which is promised by vendors during the selection of SaaS ERP system, while the perspective of SaaS adopters are conceptualized by accommodating a list of benefits which is perceived by clients during the delivery of SaaS ERP system. Regarding the perspective of the lifecycle process of SaaS, we are particularly interested in seeing potential engagement between Service Oriented Architecture (SOA) approach and SaaS model as a means to successfully deliver SaaS ERP system as a service that fits the characteristic of an SME, including less complex requirements and relatively simpler business model. For this reason, we apply eight design principles of SOA during the whole process of SaaS lifecycle. These principles are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability, and service composability*.

SaaS contract not only incorporates Service Level Agreements (SLAs), but also standardizes services for multiple clients by which the *standardized service contract* principle is applied. Meanwhile, vendors should be able to accommodate business changes by promoting loose-coupled services which are agile and interoperable by which the *service loose coupling* is applied, and by accommodating reusable and

composable services by which the *service reusability* and *service composability* is applied. Information about services should also be abstracted in a way that this information is sufficient for service communication, and further is adequate to perform vendor diversification by which the principle of *service abstraction* is applied. Furthermore, this information should be easily located through a specific discovery mechanism by which the principle of *service discovery* is applied. Then, a service is only provided when it is necessary to support effective process and efficient resources, or otherwise it remains stateless by which the principle of *service stateless* is applied. Moreover, vendors should be able to provide less redundant services by providing autonomous services, which are robust to serve multiple clients by which the principle of *service autonomy* is applied.

Furthermore, to address different conceptualization of SaaS benefits, each perspective is associated with a list of benefits in software engineering, namely the strategic goals and benefits of Service Oriented Computing (SOC), or simply the benefits of SOC. Although this research does not emphasize on the application of SOC paradigm, we argue that this paradigm can drive the achievement of SaaS benefits through a set of common goals and benefits which has been established as a target state for an enterprise who aims at successfully adopting a service-oriented application. For this reason, the benefits of SOC are considered, which are *increased of inherent interoperability, increased of federation, increased of vendor diversification options, increased alignment of business and technology domains, increased of Return on Investment (ROI), increased of organizational agility,* and *reduced of Information Technology (IT) burden.* The ease-of-interoperability over services should be improved while also improving the capability of services to address business changes and therefore support alignment of business and technology domains. Increasing federation means harmonizing IT environment by standardizing services, while also providing possibilities to diversify vendors that can provide services. Furthermore, cost-effective solution is often represented in ROI-terms, while reducing IT burdens are amongst enterprises' goals.

In order to perform qualitative analysis within this research, we employ a case study to understand the benefits, which can be promised by vendors when delivering Exact Online that is financial management software that can help entrepreneurs, SMEs, accountants, and accounting firms to manage their financial issues. This application has been developed for further integrated applications that are similar to ERP systems, e.g. Exact Handel for trading companies, and Exact Time and Billing for warehouse companies. The research also accommodates the perspective of users of Gmail application in order to understand the benefits which can be perceived by users when subscribing to the application. Gmail is a SaaS-based email application that has been recently integrated with online ERP systems, e.g. myERP, and NetSuite ERP, since the year of 2010. By considering this real life practices, our study also aims at evaluating SaaS benefits through the adoption of SaaS ERP system within SMEs.

Meanwhile, we develop a methodology to assess benefits of SaaS in order to perform quantitative analysis within this research. The methodology considers conceptual model of SaaS benefit structures, while also performs qualitative analysis to understand SaaS benefits within a case study, and quantitative analysis to validate these structures by employing a statistical modeling method. For this reason, the methodology is comprehensive and is referred to as the comprehensive methodology, which includes three important steps, which are *understanding* benefits of adopting a SaaS-based application, *conceptualizing* the benefits, and *estimating* the achievement of the benefits. The first step is accommodated by gathering data through interviews, which are conducted within Exact Software Nederland who develops Exact Online application, and through questionnaires which are delivered to users of Gmail application. The second and the third step are accommodated by applying a statistical modeling, which is Partial Least Squares (PLS) method for Structure Equation Model (SEM) to structure and assess the benefits of SaaS.

From our conceptual model, we found three categorizations for the promised benefits that can conceptualize the benefits of SaaS which can be realized by considering the perspectives of SaaS

providers when promising benefits of a SaaS-based application. They are *technology-enabled business support benefits*, *interactive support benefits,* and *comprehensive support benefits*. The *technology-enabled business support benefits* represent efficient use of (enterprise) resources and effective management of business process through SaaS-based application; while the *interactive support benefits* represent available and reliable services, and high-secured access within SaaS-based application. The *comprehensive support benefits* represent integrated information to support business, and compliance to regulatory standards that are related to the delivery of SaaS-based application.

We also found six categorizations for the perceived benefits that can conceptualize the benefits of SaaS which can be perceived by SaaS adopters when adopting a SaaS-based application. They are *Level 0-Potential*, *Level 1-Prospective, Level 2-Promising*, *Level 3-Achieving*, *Level 4-Stabilizing*, and *Level 5-Optimizing* which can represent different levels of SaaS maturity model that shows what extent benefits of SaaS can be expected by SaaS adopters. The *Level 0-Potential* represents limited benefits, which can be expected by the adopters if they adopt SaaS-look-alike application, which actually fits best to a traditional-client server application that is delivered through application service provider (ASP) model. This level can be indicated by utility-based characteristic from pay-per-use or pay-per-period. The *Level 1-Prospective* represents benefits from adopting (manual) ASP-based application that is similarly provided for multiple clients. Therefore, this level can be indicated by SLA-driven characteristic within which vendors provide standardized services for multiple clients. The *Level 2-Promising* represents benefits from adopting (industrial) ASP-based application that can be configured for multiple clients. This level can be indicated by resource sharing characteristic within which enterprise resources can be efficiently used and business process can be effectively performed. The *Level 3-Achieving* represents benefits from adopting traditional SaaS-based application by which SaaS adopters may expect the benefits from reliable services and effective supports toward the application. The *Level 4-Stabilizing* represents benefits from adopting customizable SaaS-based application through which SaaS adopters may expect the benefits from continuous services and limited configuration options toward the application. The *Level 5-Optimizing* represents the benefits from adopting dynamic SaaS-based application by which SaaS adopters may expect the achievement of optimized SaaS benefits from stable but interoperable services.

From the perspective of the lifecycle process of SaaS, we found indicators that can help in understanding certain benefits of SaaS at different processes (phases) of SaaS lifecycle which employs the design principles of SOA. The standardized service contract, the service loose coupling, the service abstraction, and the service discoverability can be included within the early processes of SaaS lifecycle; while the service reusability, the service autonomy, the service statelessness, and the service composability can be included within the later processes of SaaS lifecycle. The design principle of standardized service contract can be indicated by *consistency of information about services*, and *description level of services*; whereas the design principle of service loose coupling can be indicated by *availability of configuration options*, and *granularity level of services*. The design principle of service abstraction can be indicated by *generality level of information about services*, and *the depth information about service implementations*; while the design principle of service reusability can be indicated by *multipurpose level of services*, and *frequency of reusable services*. The design principle of service autonomy can be indicated by *governance level of services* and *capability of autonomous services*; whereas the design principle of service stateless can be indicated by *availability level of services,* and *possibility of scaling application and data*. The design principle of service discoverability can be indicated by *accessibility level of services*, and *availability of mechanisms of discovering services*; while the design principle of service composability can be indicated by *custom option level of services,* and *flexibility of custom options for services*.

From our qualitative analysis, we found that the adoption of Exact Online can fulfill some of the promised benefits which are proposed in this research. Among these promised benefits, Exact Online application outperforms in achieving *interactive support benefits* because it offers a certified security standard that guarantees high security standard to protect client's data. Furthermore, these benefits are

also supported by the fact that this application gains popularity and trustworthy in successfully addressing financial issues through a SaaS model.

From our quantitative analysis, we developed three models of benefit structure which is based on the aforementioned SaaS benefits. The three models are the promised benefit model, the perceived benefit model, and the process benefit model. Although the promised benefit model cannot be validated due to very small sample size, the structures of the promised benefits can provide useful guidelines to understand SaaS benefits, which can be promised by SaaS providers when delivering a SaaS-based application. We found that the perceived benefit model is the most promising one amongst other models since SaaS benefits which can be expected by SaaS adopters when subscribing to a SaaS-based application, can be highly represented by the (proposed) structure of the perceived benefits. Furthermore, the process benefit model can be used as a reference to understand the structure of the process benefits, which can be realized during the lifecycle process of SaaS. However, due to limited number of sample sizes, we found that the process benefit model needs further studies to ensure that the (proposed) structure of the process benefits can be used to understand the benefits of SaaS during the whole process of SaaS lifecycle.

Our findings suggested that the comprehensive methodology can be used as a reference to structure the benefits of SaaS by which different opinions in realizing the benefits can be overcome. Moreover, since the benefits of adopting SaaS-based application, i.e. SaaS ERP system, can be appreciated during the whole lifecycle of SaaS, the benefits of SaaS can be ensured even at an earlier phase of SaaS lifecycle in order to successfully implement the application. Therefore, this methodology can help practitioners in scientific and business communities assessing benefits of SaaS comprehensively. Nevertheless, we should conclude our research by emphasizing that the result from case study shall not be seen as general conclusion toward benefits of SaaS which can be achieved from adopting a SaaS ERP system since the models of benefit structures in this research are not well validated due to limited research data and lack applicability of data gathering methods. For this reason, we suggested future research to employ more validation methods and to incorporate more variable constructs, which can define benefits of SaaS.

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Meanwhile, a Software as a Service (SaaS) model is leveraged for an ERP system which is offered to SMEs since they are able to outsource the system as a service and pay-per-use or pay-per-period while minimizing their total cost of ownership. From this point, I was inspired by the work of my first supervisor, Mr. Marijn Janssen, who studied about SaaS Business model in the public sector. I would like to thank him for his inspiring idea, abundant help, invaluable assistance, support and guidance. I am very lucky that he also introduced me to my second supervisor, Mr. Joseph Barjis, whom I would like to thank for his fruitful advises; and also my chairman, Professor Yao-Hua Tan, whom I would like to thank for encouraging me to be a good learner and researcher.

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List of Abbreviations

AHP	:	*Analytical Hierarchy Process*
ASP	:	*Application Service Provider*
COBIT	:	*Control Objective for Information and related Technology*
EAS	:	*Enterprise Application Software*
EML	:	*Enterprise Maturity Level*
ERP	:	*Enterprise Resource Planning*
FDs	:	*Functional Domains*
IT	:	*Information Technology*
LVs	:	*Latent Variables*
PLS	:	*Partial Least Squares*
ROI	:	*Return On Investment*
SaaS	:	*Software as a Service*
SEM	:	*Structure Equation Model*
SLAs	:	*Service Level Agreements*
SMEs	:	*Small Medium Sized Enterprises*
SMM	:	*Stage Maturity Model*
SOA	:	*Service Oriented Architecture*
SOC	:	*Service Oriented Computing*
SSO	:	*Single-Sign On*

Nomenclature

β (beta)	:	*path coefficient between latent endogenous variable*
δ (delta)	:	*measurement error for indicators of exogenous variable*
ε (epsilon)	:	*measurement error for indicators of endogenous variable*
η (eta)	:	*endogenous variable*
γ (gamma)	:	*path coefficient between exogenous variable and endogenous variable*
λ (lambda)	:	*path coefficient within measurement model (or between indicator and variable)*
ξ (xi)	:	*exogenous variable*
ζ (zeta)	:	*random disturbance term*
x	:	*operationalization of Latent Variables (for exogenous variable) through measurable indicator x*
y	:	*operationalization of Latent Variables (for endogenous variable) through measurable indicator y*

Preface

"Knowledge is of two kinds: that which is absorbed and that which is heard.
And that which is heard does not profit if it is not absorbed." [Abu Hassan Sayyidina Ali ibn Abi Talib]

Small and Medium Sized Enterprises (SMEs) are seeking for directions to achieve growth on revenue and profits. Since the last few decades, they have devoted to implementing Enterprise Resource Planning (ERP) that is believed as a means to save costs and improve business performance [Aberdeen Group, 2010]. ERP system offers functionalities, e.g. financial module that allows SMEs to standardize their business process while efficiently generating valuable financial reports. To achieve this goal, ERP system is delivered as a Software as a Service (SaaS) which enables SMEs to subscribe or pay on the basis of number of users or on the basis of period of time.

SaaS is a model of delivering software and providing services over software installation, control, and maintenance [Gonçalves & Ballon, 2011]. Meanwhile, the design of services related to SaaS applications can be designated by employing Service Oriented Architectures (SOA) approach, which introduces a concept of decomposing a system into services. In fact, SOA approach is considered as one of the enablers of SaaS model [Janssen & Joha, 2011]. The key drivers for employing this approach include alignment of business goals and Information Technology (IT) goals; rapid changing of business environment and rigid development of IT; and unclear results of business investment toward IT. Thus, SOA approach can be regarded as an agile business process concept, which can help to integrate applications and infrastructures in an organization. Furthermore, Service Oriented Computing (SOC) paradigm drives the SOA approach for service-oriented applications while SaaS represents business models for delivering software as a service. However, assessing the benefits of SaaS through the delivery of an ERP system is limited in practice since there is no specific methodology, which can be used to assess such benefits. Moreover, understanding benefits of SaaS can be conflicting if many perspectives of critical actors are considered. For instance, there is unlikely an agreement toward cost-saving benefits from adopting SaaS-based application due to differences in opinion by vendors and clients on what and how to measure the benefits.

In the light of this research problem, the research presented in this thesis aims at assessing benefits of utilizing ERP system, which is delivered by considering SaaS delivery model within SMEs. These benefits are conceptualized from three perspectives, which are the providers, the adopters, and the lifecycle process of SaaS. From the perspective of SaaS providers, the benefits of SaaS are conceptualized by considering the promised benefits, which are developed by vendors when defining Service Level Agreements (SLAs). From the perspective of SaaS adopters, the benefits of SaaS are perpetually abstracted and are not well appraised since there is limited information about SaaS application in the adopters' side due to lack of understanding toward SaaS model, which further may hinder the adopters to realize the benefits of SaaS. Therefore, the perspective of SaaS adopters is appreciated by assessing maturity level of SaaS, which defines a certain benefits of SaaS at different level of benefit achievements. Meanwhile, from the perspective of the lifecycle process of SaaS, the benefits of SaaS are conceptualized by considering the design principles of SOA, which are appreciated during the lifecycle of SaaS. These design principles are considered since they correspond to the agility characteristics of SMEs, which are likely to help delivering SaaS-based application

successfully within SMEs. Furthermore to address possibility of conflicting interest from different perspectives, we employ the strategic goals and benefits of Service Oriented Computing (SOC) by Erl [2007], which is referred to as the benefits of SOC. We argue that the benefits of SOC can drive the achievement of SaaS benefits from the adoption of SaaS-based application.

The assessment of SaaS benefits are incorporated within the comprehensive methodology, which is proposed within this thesis. The comprehensive methodology incorporates three main steps, which are to *understand, conceptualize*, and *estimate* the benefits of SaaS. **First**, data gathering methods are applied in order to understand the benefits of SaaS from three perspectives, which are SaaS providers, SaaS adopters, and the lifecycle process of SaaS. We apply interview-method in order to gather information about SaaS benefits, which are promised by vendors who offer SaaS-based applications and apply questionnaire-method in order to gather information about SaaS benefits, which are perceived by clients who subscribe to the applications. Both methods are also equipped with questions, which are related to understanding benefits of SaaS during the whole process of SaaS lifecycle by considering design principles of SOA in order to deliver these benefits. The results from both methods of data gathering serve input for path diagrams, which are used to structure the assessment of SaaS benefits.

Second, a statistical modeling is applied in order to conceptualize the structure of SaaS benefits according to Structure Equation Model (SEM). Each perspective in realizing SaaS benefits will be incorporated within a path diagram, which is comprised of indicators, variables, and measurement errors that can be used to estimate the achievement of the benefits of SOC. Therefore, there are three path diagrams each of which represents different conceptualization of SaaS benefits, which are from the perspective of SaaS providers, the perspective of SaaS adopters, and the perspective of lifecycle process of SaaS.

Third, causal relations between variables in each path diagram are estimated using the Partial Least Squares (PLS) Path modeling method for SEM, which is also referred to as 'PLS Path modeling'. By estimating these causal relations, we can know to what extent the benefits of SOC can be achieved by understanding benefits of SaaS from each perspective. A sound understanding toward the benefits of SaaS can be expected since difference opinion in realizing the benefits are accommodated by directing the achievement of SaaS benefits toward the achievement of the benefits of SOC.

This thesis is structured within seven consecutive chapters. In the first chapter, we will introduce the research problem, which drives the necessity of methodology to assess benefits of delivering ERP system by employing SaaS model within SMEs. Following this, the research questions and the research approach are also discussed within the first chapter. The next chapter, which addresses theoretical background discusses about foundations of the research that are considered when the research approach is conducted. The third chapter will present a discussion about how the benefits of SaaS are structured qualitatively from the three perspectives. Following this, the comprehensive methodology to structure these benefits following the PLS Path modeling will be presented in the fourth chapter. In order to validate the models of benefit structures, we present a case study in the fifth chapter while a quantitative analysis to help in validating the models will be presented in the sixth chapter. In the seventh chapter, we conclude the results from the research, which includes discussion for further research.

CHAPTER

1

INTRODUCTION

"It is part of the Sunna that a man should accompany his guest to the door of the house."
[Narrated Ibn Majah, Baihaqi]

Since the last ten years, there has been a growing discussion on how Small Medium Sized Enterprises (SMEs) can compete with large enterprises by utilizing an Enterprise Resource Planning (ERP) system [White, 1999; Everdingen et al., 2000; Greenemeier, 2001]. This adoption varies across different enterprise sizes and thus it results in different implications [Laukkanen et al., 2007]. A survey by Gable and Stewart [1999] discussed about this trend and how this adoption might contribute to improve revenue growth and margin growth of SMEs. Even though only few SMEs have implemented an ERP system within their business process, the result from this survey indicates that it is likely that SMEs adopt the system in order to boost their revenue growth and thus to compete in the same stage as larger enterprises. The result from this survey is in line with a former study by Buonanno et al. [2005] who argued that a decision upon ERP adoption within SMEs were more related to exogenous factors, e.g. *opportunity of the moment*, rather than business-related factors, e.g. *process integration and data redundancy*. The latter factors are commonly faced by larger enterprises. Therefore, this survey indicates that SMEs are willing to adopt an ERP system as one of Information Technology (IT) products regardless any structural peculiarities, which may be found to be a real obstacle when the system is implemented.

Meanwhile, many types of outsourcing model have been increasingly adopted by IT managers [Laplante et al., 2004]. This model has been regarded as a cost-saving effort to efficiently adopt IT products [Kremic et al., 2006; Holcomb & Hitt, 2007]. Among these types of outsourcing model, Software as a Service (SaaS) has been seen as a promising opportunity to improve enterprise's revenue by adopting IT products through SaaS delivery model [Pettey, 2006; Dubey & Wagle, 2007; Mertz et al., 2009]. The adoption of an ERP system through SaaS delivery model is often referred as a SaaS-based ERP system or SaaS ERP. This adoption has been studied by many researchers, particularly who work in the field of software engineering [Konstantinidis, 2011].

Furthermore, there have been a growing number of SaaS ERP adoptions in enterprises. This trend is driven by an increased attention toward service oriented applications within business sector [Pettey, 2006; Mertz et al., 2009]. The adoption of SaaS ERP system is due to its potential benefits for both critical actors, which are vendors who provide the system and enterprises who adopt the system. These benefits include reducing implementation time while saving costs and increased efficiency [Dippenaar, 2008]. The vendors as SaaS providers can ensure their service availability by delivering the ERP system according to service descriptions while effectively control the system through segregation of duties, which are formalized within a SaaS contract. On the other hand, enterprises as SaaS adopters can subscribe an ERP system, which is continually maintained by SaaS providers under which the period of the SaaS contract is still applied. Thus, this subscription can lower their risk factors and provide more stable security for the enterprises [Hoogvliet, 2008].

Regardless potential benefits of SaaS, the adoption of SaaS applications involves several uncertainty factors, e.g. technical and economic risks [Benlian, 2009], and psychosocial and strategic risks [Benlian & Hess, 2010]. These uncertainty factors show that SaaS adopters are highly dependent to providers to which the issue of managing the application and preserving data integrity [Kemp Little LLP, 2010] are escalated into severe problems of creating hidden costs, e.g. management costs [Gruman, 2007a]. Moreover, conflicting interests are due to happen because different opinions in realizing benefits of SaaS can occur at different process of SaaS lifecycle. For instance, cost-saving benefits, which are promised during service engagement can be perceived differently during service delivery since there is no agreement on what variables can determine cost-savings and how these variables can be measured.

In the research, which is presented in this thesis, a methodology to assess the benefits of SaaS is developed in order to understand the benefits from three perspectives, which are SaaS providers, SaaS adopters, and the lifecycle process of SaaS. By developing the methodology, which is comprehensive since it incorporates many perspectives, we aim at improving readiness of SaaS-based applications, particularly SaaS ERP system, within SMEs apart from challenges and risks, which might be faced during the implementation of SaaS model, which is relatively immature in concept. Moreover, best practices on how to improve the achievement of these benefits can be further studied to assist SMEs in adopting a SaaS-based application.

From the perspective of SaaS providers, we conceptualize SaaS benefits by considering the promised benefits, which can be delivered by operationalizing Service Level Agreements (SLAs) that are agreed during the early phases of SaaS lifecycle, including service discovery, and service selection and engagement. SLAs, which include description of services that are formalized in a SaaS contract are considered important in determining the likeliness of successful adoptions of a SaaS-based application within SMEs. Meanwhile from the perspective of SMEs as SaaS adopters, we conceptualize SaaS benefits by considering the delivery SaaS application during service enactment phase of SaaS lifecycle. For this reason, we develop a SaaS maturity model in order to realize the perceived benefits by SaaS adopters during the implementation of SaaS-based application. From the perspective of the lifecycle process of SaaS, we employ the design principles of Service Oriented Architecture (SOA) during the whole lifecycle of SaaS. By considering benefits of SaaS from many perspectives, we hope to have richer conceptualization and broader understanding toward the benefits of SaaS.

Since SaaS benefits can be conceptualized from many perspectives, the comprehensive methodology to assess SaaS benefits should be able to overcome conflicting interests between critical actors, i.e. vendors and clients. In the research presented in this thesis, SaaS benefits from the perspectives of SaaS providers and adopters are associated with a list of established benefits, namely the strategic goals and benefits of Service Oriented Computing (SOC). These benefits are often referred to as the benefits of SOC that was proposed by Erl [2007]. Whereas SaaS refers to the business model for delivering services, SOC refers to the architecture paradigm that drives SOA approach. We argue that the SOC paradigm can drive the achievement of SaaS benefits by considering the benefits of SOC when realizing the benefits from many perspectives through the adoption of a SaaS-based application. Therefore, the comprehensive methodology developed within the research structures how the promised benefits from the perspective of the providers and the perceived benefits from the perspective of the adopters can be directed to the achievement of the benefits of SOC.

We begin this chapter by presenting a research problem in Subchapter 1.1. This research problem outlines a research gap that drives the necessity of conducting the research presented in this thesis, which aims at developing a comprehensive methodology, which can be used to assess the benefits of SaaS. Following this research problem, a main research question and the related sub questions are posed in Subchapter 1.2. Subsequently, we briefly discuss about our research approach in Subchapter 1.3, which also outlines the structure of this thesis.

1.1 Research Problem

The locus of interest of adopting an ERP system is shown by both SMEs and ERP vendors who believe that this system can deliver significant benefits, such as simplified internal procedures and improved performance management [Federici, 2009]. However, these benefits are perpetually debated and conceptually abstracted from different perspectives of SMEs as adopter and ERP vendors as provider. From the perspective of SMEs, the challenge remains on how to deploy an ERP system without incurring their expenses within a limited time and budget, and their available resources [Pender, 2001]; whereas vendors are challenged to serve a suitable product for each SME, which has various business processes and by doing this, they can sustain a continual service and support over their products. To address these issues, outsourcing model has been regarded as suitable options to deliver Information Technology (IT) products comparing to a traditional on-premise software installation. This software delivery model is chosen because IT-delivered products are usually not within core business of an enterprise [Businessweek, 2006] and thus, many enterprises are hesitant about how these products can be directed to the achievement of enterprise business goals [Software-as-a-Service Executive Council, 2006].

Software as a Service (SaaS) is a software delivery model, which provides IT product as an outsourcing model. A SaaS provider delivers software, which is usually web-based and hosted centrally within its network through, which a customer can access the software via Internet, which depends on a recurring or usage basis. This SaaS subscription is different with traditional business process outsourcing (BPO), which requires management of the entire business process including human resource management and financial management when products or services are outsourced from providers. The maintenance, support and upgrades of IT products and the related infrastructures are specified within SaaS subscription agreement or usually referred as a SaaS contract, which also defines access to application functionalities per usage or per period. With regard of ERP system, which is an IT product that has been adopted within enterprises worldwide, this system can be delivered to SMEs as a SaaS-based application that allows an authorized access to enter the application, which is maintained by vendors who provides a seemingly service and technology support toward the system. Within SaaS delivery model, this ERP system is often referred as a SaaS-based ERP system or SaaS ERP.

Meanwhile, SaaS software delivery model has also been intensively studied by scientists within scientific communities. A number of literatures have been published pertaining to SaaS concept, SaaS model, and have reported several features and benefits of SaaS from the perspective of customers and vendors [Waters, 2005; Ma, 2007; Xin & Levina, 2008]. Some literatures presented how this software delivery model is implemented in business cases within which integration with architecture of an enterprise legacy system is made possible [Zhang et al., 2009; Rivero et al., 2010] while some other literatures argued about process, implications, and interaction between actors, which are involved during SaaS adoption [Sääksjärvi et al., 2005; Choudhary, 2007]. There are also discussions in scientific communities about lesson learned from implementing SaaS model [Greschler & Mangan, 2002; Chou & Chou, 2007] whereas comparison to other software delivery model, e.g. on-premise software, has also been discussed [Jakonen, 2011].

However, SaaS software delivery model is still considered limited in practice [Kwok et al., 2008] and deriving service quality upon this model is challenging [Benlian et al., 2010]. This situation can create organizational and managerial issues [Janssen & Tan, 2010] since ERP system will be managed locally but hosted centrally on SaaS providers. These issues could happen due to contracting problems, e.g. unclear rental and license agreement, unclear data storage agreement; risk on data confidentiality and data integrity, and risk on the event of a dispute over payment because of unclear actual deployment time [Sieper, 2007] and service availability [Tarzey, 2008]. If an ERP system is delivered through SaaS model, this system should be designed to support an integrated communication among multiple users

across different platforms and thus it should combine multiple user experiences, and standardized user interface and procedure [Hoogvliet, 2008; Giurata, 2008a; Giurata, 2008b]. This situation raises another challenge of managing complexity and interdependencies within multi-actor environment [Sun et al., 2009]. Therefore, political and technical consideration to adopt this integrated system should be also taken into account since SaaS adopters have limited information about SaaS concept [Software & Information Industry Association, 2000a] even though SaaS ERP system can be regarded as a core business application [Gruman, 2007b]; while SaaS providers have skillful expertise who are more capable to understand and implement SaaS concept.

Regardless these various challenges of delivering an ERP system through SaaS, both providers and SMEs would benefit from the adoption of an ERP system through SaaS delivery model. If an SME subscribes to a SaaS provider, which provides an ERP system, they would have more opportunities to focus on managing services, which are provided by the system since the maintenance, support, and upgrades of the system are managed more effectively by SaaS providers. Thus, SMEs would experience more direct profits by having less capital expenditure [Erlanger, 2005; Software-as-a-Service Executive Council, 2006] and would have more abilities to achieve their main business goals [Carraro & Chong, 2006b] within a shorter implementation time [Bleicher, 2006], which would also have impact on level of efficiency and risk [Zucco, 2006] during ERP project. In the other hand, SaaS providers can offer better online services and supports to customer since traditional business model has shifted to a more web-based service model [Software & Information Industry Association, 2001]. SaaS providers also would be able to reduce their substantial cost of application code delivery since the application is hosted centrally and thus they can offer faster application modifications to meet the demand of SMEs over an ERP system. Nevertheless, some critical actors, i.e. vendors and clients, can have different vision in conceptualizing the benefits of SaaS. For instance, variables to determine cost-saving benefits can be difficult to agree on what and how to measure the achievement of the benefits [Lacity & Willcocks, 2002]. Similar case is due to happen when ensuring that secured-access benefits can be achieved since high level of security is likely to result in higher costs.

In the light of addressing the possibility of having different perspectives when realizing benefits of SaaS, the research presented in this thesis underlines the importance of developing a comprehensive methodology that can be used to assess the benefits from adopting a SaaS-based application in general, and from adopting a SaaS ERP application in particular. The methodology should include important steps when realizing benefits of SaaS from the perspective of SaaS providers, SaaS adopters, and the lifecycle process of SaaS. It should incorporate activities to understand the benefits of SaaS from many perspectives, conceptualize these benefits, and assess to what extent these benefits can be achieved. The rest of this subchapter will discuss about the comprehensive methodology in general.

From the point of view of SaaS providers, SaaS model adoption raises a question on how to successfully deliver a SaaS-based application according to clients' expectation. To answer this question, we approach the likeliness of successful adoption of SaaS application by conceptualizing the promised benefits of SaaS, which are usually offered by providers. According to literatures and best practices in SaaS implementation [Dippenaar, 2008; Hoogvliet, 2008], these promised benefits are conceptualized by referring to commonly benefits, which can be promised by providers that offer SaaS applications to SaaS adopters. By referring to these benefits, a list of interview questions can be developed to confirm SaaS benefits from providers' perspective. For this reason, we define interview questions pertaining to SaaS benefits by considering the technique of semi-structured interviews in which the questions are open-ended whereby interviewees are free to express their views, which are firstly initiated by questions or probes from interviewers.

From the point of view of SaaS adopters, SaaS model adoption raises a question on how this adoption can be benefited for SMEs. To answer this question, we develop a maturity model that can be used to determine different level of SaaS benefits, which can be achieved by an enterprise when adopting

SaaS-based applications. A former study about a SaaS maturity model was studied by Limbăşan and Rusu [2011] who focus onto what extent the adoption of SaaS application within an enterprise while maturity models to assess the implementation of IT processes have been studied in many literatures [Sarno, 2009a; Sarno, 2009b]. In this research, we develop a maturity model of SaaS that is more on realizing benefits of SaaS within five levels. Each level of the model represents a description of benefits, which can be gained by an enterprise who subscribe to a SaaS application from SaaS providers. From these descriptions, a list of questionnaire questions is structured by referring to the description of benefits in each level in order to assess to what extent the benefits of SaaS can be perceived from client's perspective. In order to have a broader understanding about SaaS benefits from the perspective of SaaS adopters, we deliver these questionnaires to anonymous sampling by considering the technique of nonprobability accidental sampling within which anyone who participates to fulfill the questionnaire can be used as a sample if the person can be considered as relevant data source [Schillewaert et al., 1998].

Meanwhile, the perspective of SaaS providers might be conceptualized in contrast against the perspective of SaaS adopters. For instance, shorter implementation time, which is expected by SaaS adopters can also support SaaS providers' perspective in delivering SaaS application as quickly as possible. However, the benefits of having SaaS application implemented in time does not necessarily result in reducing investment costs since the need of SaaS application can be different for every business structures, and the existing dissemination of Information Technology (IT) within business process may be varied for different enterprises. Furthermore, an agreement toward cost-saving benefits can be difficult to achieve due to different opinions in what and how to measure variable of costs [Janssen & Joha, 2011]. To address this problem, we see the potential benefits of SaaS from the whole processes of delivering SaaS applications. These processes are incorporated within the lifecycle of SaaS, which represent three main processes of delivering SaaS application that are *discovery, selection and engagement,* and *enactment*. During this cycle, SaaS adopters and SaaS providers interact to discover services, engage and enact them while ensuring that services are delivered according to SaaS contract.

We consider the whole processes of SaaS lifecycle by seeing potential drivers of combining SaaS with Service Oriented Architecture (SOA) approach [Nassif & Capretz, 2010; Watson, 2010], and possibilities of enabling SaaS model through SOA concept [Janssen & Joha, 2011]. Therefore, we employ the design principles of Service Oriented Architecture (SOA), which was proposed by Erl, [2007], during the whole lifecycle. We consider these design principles by incorporating the principles within the design and implementation of services related to SaaS applications throughout the whole processes of SaaS lifecycle since a good service design is considerably crucial in determining the likeliness of successful adoptions of a SaaS ERP system. Therefore, we enhance interview questions and questionnaires by incorporating the design principles of SOA during the whole lifecycle of SaaS. The design principles of SOA are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability,* and *service composability*. Standardized service contract principle enables standardization of services for many clients; while service loose coupling, service reusability, and service composability accommodates business changes. Service abstraction incorporates sufficient information for a service while service discovery enables a mechanism to locate a service. Service statelessness promotes efficient use of services, whereas service autonomy promotes services, which are robust to many service requestors.

Furthermore, we employ the strategic goals and benefits of Service Oriented Computing (SOC) [Erl, 2007] in each perspective by directing SaaS benefits into these benefits of SOC. This mapping aims at accomplishing two purposes: to understand the significance of the benefits of SOC prior to applying a SaaS-based application, and to constantly view the benefits of SOC within a strategic context from the both perspectives of SaaS providers and adopters and within a principal context from the perspective of the lifecycle process of delivering a SaaS-based application. Aiming at accomplishing these purposes, the result of this research is beneficial to business communities by serving inputs for actors

who will be taking initiatives with regard to SaaS adoption in general and SaaS ERP adoption in particular. These actors include SaaS providers, which are interested in providing marketable IT products and improving service and support over these products; and SaaS adopters, which subscribe these services at lower costs and less implementation time. This research may also contribute to scientific communities since this research provides a preliminary study in constructing the benefits of SaaS adoption within SMEs sector from which further research can be proposed, i.e. by enhancing variables and factors, which define these benefits and by designing a best practice to adopt SaaS based application in any size of enterprises. By considering significant results, which can be gained from the research, we will emphasize our research goal in the next subsection.

1.2 Research Question

In Subchapter 1.1, main problems that underlie this research have been outlined. We conclude that an assessment toward Software as a Service (SaaS) adoption was not practically conducted while the benefits over this adoption are of limited in practice. Regardless the challenges to adopt this software delivery model, the benefits of SaaS from the point of views of providers and adopters are limited in concept. By considering massive adoptions of ERP system [Koch, 1996; Wallace and Kremzar, 2001], which can create competitive advantages for Small Medium Sized Enterprises [Koh and Simpson, 2005], and by realizing barriers of implementing SaaS ERP system, we outline our main research question as following.

> *"By adopting a SaaS model during the delivery of an ERP system within SMEs, what methodology can be used to assess benefits of SaaS from the perspective of SaaS providers, SaaS adopters and the lifecycle process of SaaS, and to what extent the achievement of SaaS benefits can be evaluated, in order to improve readiness toward SaaS adoption within enterprises?"*

Related to this main research question, we define the following sub-questions in order to gather detailed and scientific arguments for the research:

1) What is the current state of SaaS adoption within SMEs according to literatures, including what are the existing benefits and challenges of adopting a SaaS ERP system? [*explorative studies from literatures*]
2) How can the benefits of SaaS be understood from the point of view of vendors as SaaS providers? [*explorative studies from literatures and descriptive analysis by identifying characteristics of the promised benefits according to literatures*]
3) How can the benefits of SaaS be understood from the point of view of SMEs as SaaS adopters? [*explorative studies from literatures and descriptive analysis by identifying characteristics of the perceived benefits according to literatures and developing SaaS maturity model*]
4) How can the benefits of SaaS be understood from the point of view of the lifecycle process of SaaS? [*explorative studies from literatures and descriptive analysis by employing the design principles of SOA within the process of delivering SaaS application during SaaS lifecycle*]
5) What methodology can be used to structure the benefits of SaaS? [*descriptive analysis by developing a comprehensive methodology to assess SaaS benefits*]
6) How can the benefits of SaaS be assessed by employing the proposed methodology? [*explanatory analysis through a case study*]
7) To what extent, the achievement of the benefits of SaaS can be evaluated? [*explanatory analysis by an evaluation*]

In conjunction with the research problem, which is described in Subchapter 1.1, the first sub-question is structured in order to explore main benefits and challenges, which could be experienced if an SME adopts SaaS ERP system. The answer toward the first sub-question provides a general understanding of the related research in this area and positions the research proposed in this thesis in delivering contributions scientific and business communities. Next, the second, the third, and the fourth sub-

question aims at exploring the benefits of adopting SaaS ERP system, which can be conceptualized into different perspectives of SaaS providers, SaaS adopters, and the lifecycle process of SaaS during the delivery of SaaS applications. These questions inputs to identify the benefits of SaaS, which are structured to answer the fifth sub-question. A comprehensive methodology is constructed within which the benefits from different perspectives are structured and mediated by the strategic goals and benefits of Service Oriented Computing (SOC). In order to assess the achievement of SaaS benefits, a case study is needed to implement this comprehensive methodology. This case study answers the sixth sub-question in which the benefits of SaaS are assessed by employing the methodology. Then, an evaluation based on the case study is performed to improve the achievement of these benefits through which the seventh sub-question is answered. In the next subsection, we will discuss about the research approach, which is structured to answer the research question and the related sub-questions.

1.3 Research Approach

Research questions have been proposed in Subchapter 1.2. The research proposed in this thesis aims at finding what methodology can be used to structure the achievement of the benefits of Software as a Service (SaaS) and how to assess the achievement of these benefits within Small Medium Sized Enterprises (SMEs). This research can be categorized as exploratory, descriptive and explanatory research due to the following reasons. **First**, it explores the existing researches in the area of cloud computing in which SaaS delivery model, Service Oriented Architecture (SOA), and Enterprise Resource Planning (ERP) system is being discussed both by business and scholar communities. **Second**, the research structures the benefits of adopting a SaaS ERP system from the both point of views of SaaS providers and adopters. The latter perspective is structured by developing a SaaS maturity model that incorporates the perceived benefits by SaaS adopters while the former perspective is considered by operationalizing main characteristics of Service Level Agreements (SLAs) that are important in achieving the promised benefits by SaaS providers. **Third**, a comprehensive methodology is proposed, implemented in a case study, and evaluated in order to improve the readiness of adopting SaaS-based application, particularly SaaS ERP system within SMEs.

Before we present our research approach, Figure 1.1 shows the research area, which accommodates our research problem. There are four different areas within which the research focuses on a specific topic. The first topic, which is discussed in the research presented in this thesis is related to the adoption of SaaS ERP system in SMEs. This topic is shown in the bottom part of Figure 1.1 on which SMEs as SaaS adopters subscribe to SaaS application, i.e. ERP system, whereas SaaS providers deploy this application. Next, the discussion about the whole lifecycle of delivering SaaS application will be addressed in the second topic, which is shown as the box of SaaS lifecycle in Figure 1.1. In the third topic of discussion, SaaS concept will be addressed in detail by addressing the basic concept of SaaS contract, which includes Service Level Agreements (SLAs), the existing SaaS maturity model, and the design principles of SOA, which enable SaaS concept. Then, the fourth discussion, which is shown in the top part of Figure 1.1, will mainly focus on the benefits of SaaS, which are conceptualized from the promised benefits by providers, the perceived benefits by adopters, and the benefits of SOC according to literatures and best practices. This discussion is mainly a descriptive study (desk research) from related literatures on this topic.

In conjunction with this research area, we refer to the design principles of SOA, which are crucial in determining the likeliness of successful adoptions of a SaaS ERP system during SaaS lifecycle; they are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability,* and *service composability.* According to Erl [2007], these principles can be linked to seven strategic goals and benefits of Service Oriented Computing (SOC), which are *increased of inherent interoperability, increased of federation, increased of vendor diversification options, increased alignment of business and technology domains, increased of ROI, increased of organizational agility,* and *reduced of IT burden*. The strategic goals and benefits of SOC, which are often referred to as the benefits of SOC, represent a list

of established benefits in software engineering, into which the promised benefits and the perceived benefits will also be mapped.

To summarize, SaaS benefits, which are assessed within the research are addressed by accommodating both design and implementation perspective of SaaS providers and adopters, and considering the lifecycle process of SaaS during the delivery of SaaS applications. Therefore, we come to our main research topic, which is assessing benefits of SaaS as shown in the red-callout box in Figure 1.1.

In order to assess these benefits, we employ Partial Least Squares (PLS) Path Modeling, which is a methodology assessment that is appropriately used for relatively new concept, which is being developed. In realizing potential contributions, which can be derived from the research and a wide-range of research areas, we divide the research approach into four parts in which each part aims at answering the sub-research questions, which has been defined in Subchapter 1.2. The outline of the research is depicted in Figure 1.2. The dark-blue box-shapes represent chapters of the thesis while the light-blue box-shapes represent main topics, which are discussed within each chapter. The rounded-shape identifies, which sub-questions are answered within can be answered in each chapter.

According to Figure 1.2, there are six box-shapes, which represent six chapters within this thesis, after the first chapter of introduction. The first block represents Chapter 2, which will discuss about research foundations that underlie the research presented in this thesis. This chapter aims at answering the first sub-question (Q1) and discusses briefly about SaaS ERP model within SMEs, SaaS concept and benefits, and possible techniques to develop a comprehensive methodology. Following this discussion, the benefits of SaaS from three different perspectives will be explored further in Chapter 3. They are the perspective of SaaS providers, the perspective of SaaS adopters, and the perspective of the lifecycle process of SaaS. The characteristics of these benefits are identified in order to answer second sub-question to fourth sub-question (Q2, Q3, and Q4).

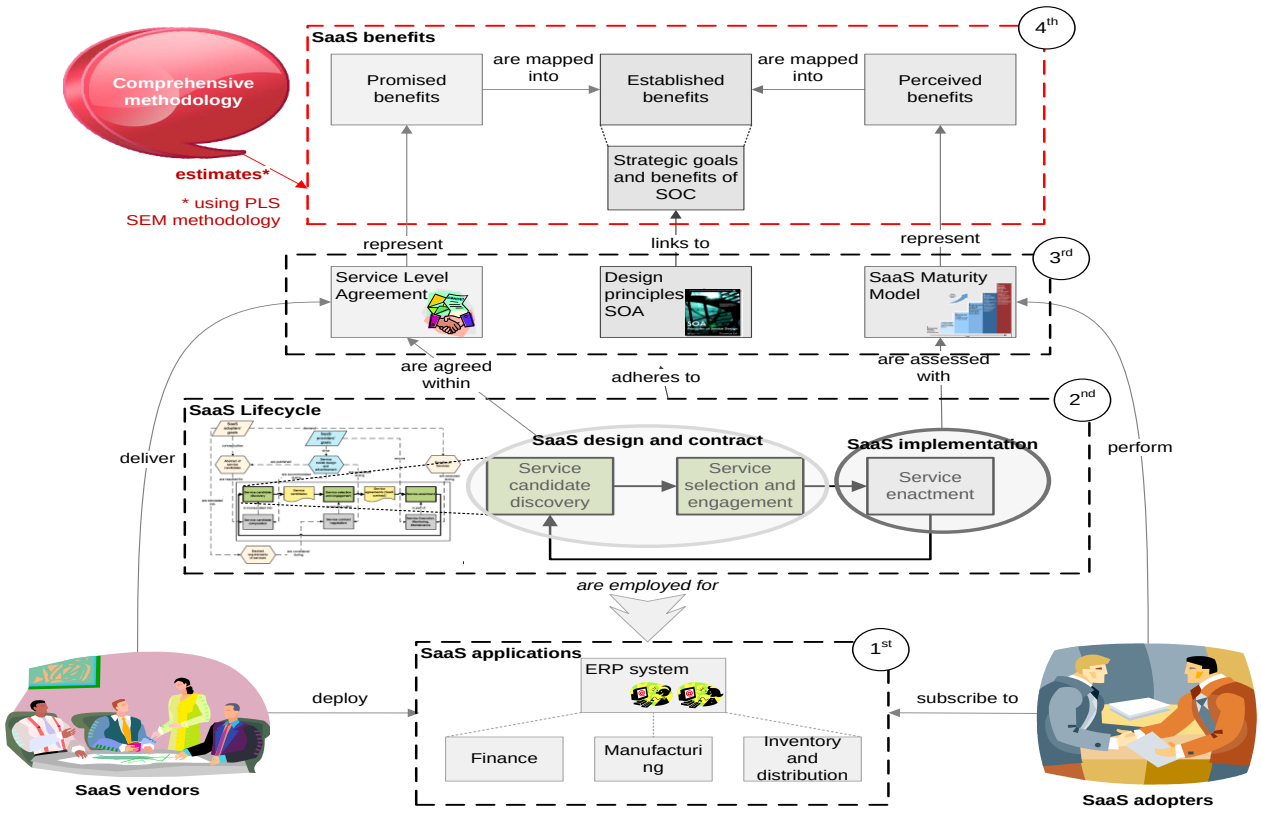


Figure 1.1 Four topics within our research area address specific research problem

According to the characteristics of benefits of SaaS, a list of interview questions are prepared in order to gather data about the achievement of SaaS benefits from the perspective of SaaS providers and SMEs as SaaS adopters. Then, these benefits are structured into three models each of which represents different perspectives in order to answer the fifth sub-question (Q5) that is discussed further in Chapter 4. Next, this comprehensive methodology is investigated by gathering data within both SaaS providers and adopters. This investigation aims at answering the fourth sub-question (Q6), which will be discussed further in Chapter 5. Then, this data is analyzed and the comprehensive methodology is evaluated in order to ensure that both of them can contribute to improving the readiness of adopting SaaS ERP system within an SME. This evaluation provides answer to the six sub-question (Q7) from which an analysis toward the comprehensive methodology is described within Chapter 6. From this analysis, we also provide a conclusion chapter within Chapter 7, which emphasizes the main outcomes from this research and contributions from the research and present discussion for further research.

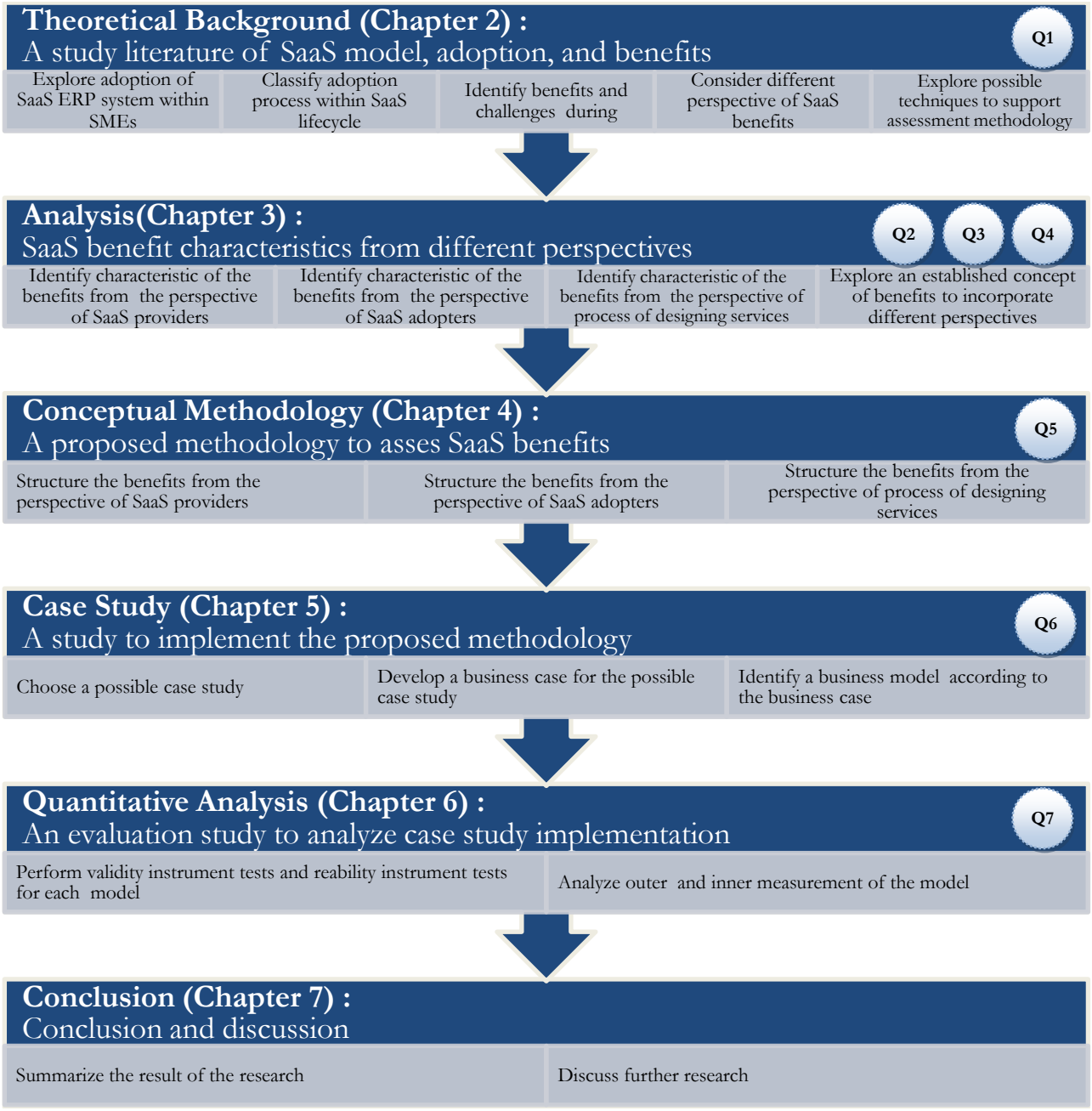


Figure 1.2 Outline of the thesis shows a general approach in delivering a comprehensive methodology to assess the benefits of SaaS

CHAPTER

2

THEORITICAL BACKGROUND

"He who goes out in search of knowledge is in God's path till he returns." [Narrated Tirmidhi, Darimi]

The research presented in this thesis aims at assessing benefits of Software as a Service (SaaS) from both perspectives of SaaS providers and SaaS adopters which are referred to as the promised benefits and the perceived benefits, respectively. The promised and the perceived benefits shall not conflict and thus both of them should be accommodated by referring to a list of established benefits in software engineering, which are referred to as the benefits of Service Oriented Computing (SOC), into which they are mapped. Furthermore, the benefits of SOC should also incorporate the whole processes of SaaS lifecycle pertaining to the delivery of SaaS applications, which determine the likeliness of successful adoption of the applications. We have presented briefly in Chapter 1 with regard to our motives in conducting the research in order to provide methodology for assessing the benefits of SaaS, including research problem, research question, and research approach.

In this chapter, we would like to explore more about our research foundations according to literatures that have a similar topic with the research. We categorize four main topics of discussion which follow our research approach as depicted in Figure 1.1 in Subchapter 1.3. **First**, we would like to discuss about the adoption of Enterprise Resource Planning (ERP) system within Small Medium Sized Enterprises (SMEs) which employ SaaS delivery model. **Second**, we would like to discuss briefly about SaaS lifecycle that incorporate perspective of SaaS providers and SaaS adopters in determining benefits of SaaS. **Third**, we outline how SaaS lifecycle can be regarded when defining SaaS benefits. This discussion covers challenges and benefits of SaaS which can be seen from different perspective of SaaS providers and SaaS adopters throughout SaaS lifecycle. The design principles of Service Oriented Architecture (SOA) that underlie SaaS lifecycle will also be incorporated within the third topic of discussion. **Fourth**, we would like to discuss about how SaaS benefits can accommodate both of the perspectives while referring to the strategic goals and benefits of SOC in order to have better understanding toward benefits of delivering SaaS application.

In conjunction with the four main topics of discussion, we aim at addressing the first sub-question presented in Subchapter 1.2, which is:

Q1) What is the current state of SaaS adoption within SMEs according to literatures, including what are the existing benefits and challenges of adopting a SaaS ERP system? [*explorative studies from literatures*]

In addition toward the main topics of discussion, we also would like to discuss about research methods which will be implemented during the research. The first method is about the methodology assessment that will be used as foundations to construct a comprehensive methodology to assess benefits of SaaS. The fifth topic of discussion will cover the methodology assessment which is Partial Least Square (PLS) Path modeling method for Structure Equation Modeling (SEM). The second method is about data gathering techniques which are applied within the research. The sixth topic of discussion will outline semi-structured interviews to gather data about SaaS benefits.

We outline the discussion topics in this chapter within Figure 2.1. This figure is adapted from the research approach which is presented in Figure 1.1 in Subchapter 1.3. The first topic will be discussed further in Subchapter 2.1 in conjunction with SaaS ERP adoption within SMEs. The next topic about SaaS lifecycle will be incorporated within Subchapter 2.2 while Subchapter 2.3 will focus more on the benefits and challenges to adopt SaaS-based application within this lifecycle. In the early phases of SaaS lifecycle, benefits of SaaS will be viewed from the perspective of SaaS providers which deploy the application and offer Service Level Agreements (SLAs) to SaaS adopters. When the application is delivered, benefits of SaaS will be seen from the perspective of SaaS adopters through SaaS maturity model. In order to realize the benefits of SaaS during the whole lifecycle of SaaS, we consider the design principles of SOA during the processes of the lifecycle. Therefore, we also discuss about these design principles in Subchapter 2.3. Considering that SaaS benefits can be seen from many perspectives, we present Subchapter 2.4 to discuss about how to accommodate different perspectives on defining SaaS benefits by referring to an established benefit in software engineering, i.e. strategic goals and benefits of SOC. Then, we briefly discuss PLS Path modeling method as a methodology to assess these benefits in Subchapter 2.5. Additional subchapter is given with regard to data collection method which is used within this research; this method will be addressed in Subchapter 2.6. We end this chapter by presenting a conclusion in Subchapter 2.7. The rest of this chapter will discuss further regarding these discussion topics.

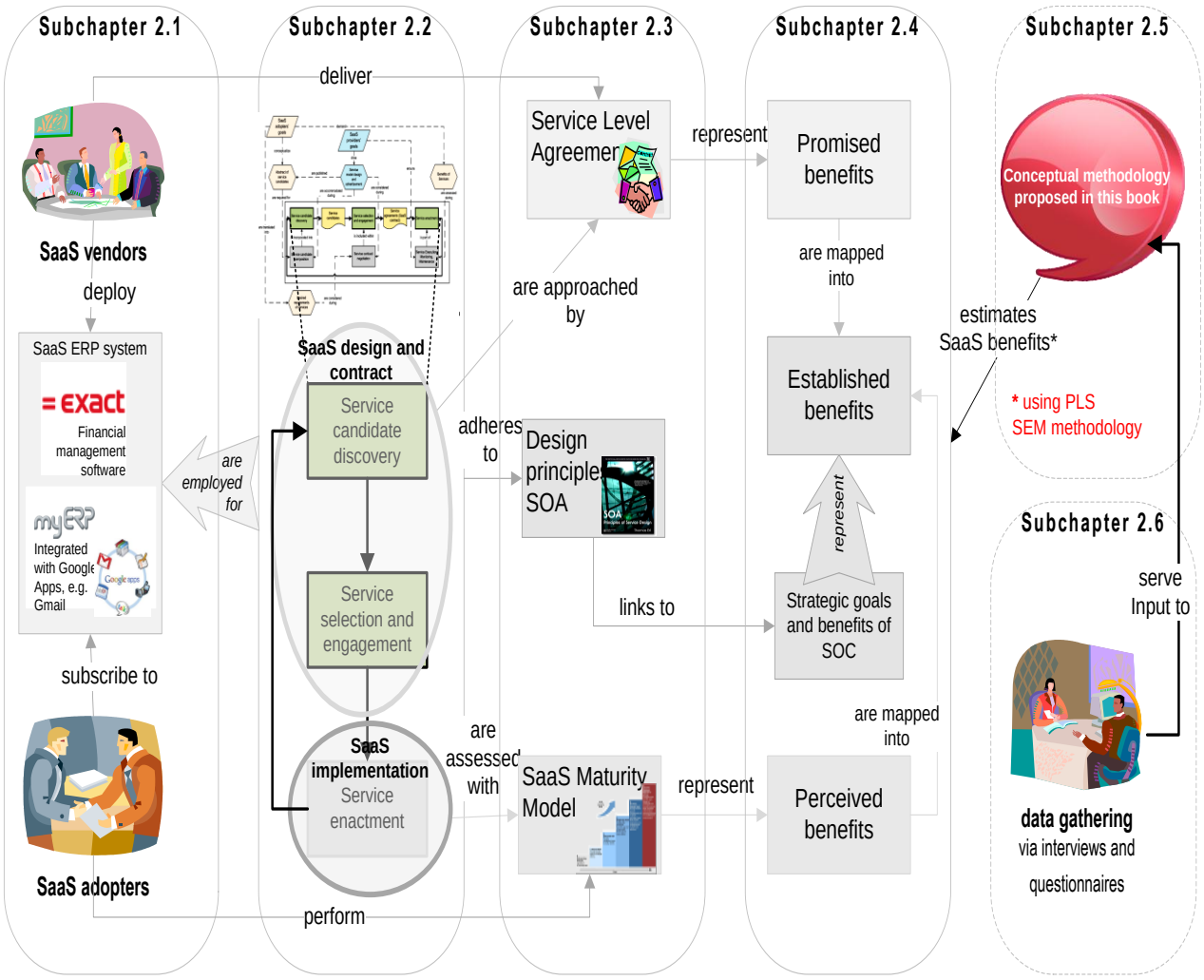


Figure 2.1 Outline of the thesis shows a general approach in delivering a comprehensive methodology to assess the benefits of SaaS

2.1 SMEs adopt SaaS ERP system

Enterprise Resource Planning (ERP) has been successfully adopted by many large enterprises worldwide [Sarno & Herdiyanti, 2010a]. This system offers rich functionalities that enable enterprises to standardize their business process [Ptak & Schragenheim, 2000; Chtioui, 2008]. ERP system has also been introduced by vendors to Small Medium Sized Enterprises (SMEs). Gable and Stewart [1999] discussed about a growing trend of ERP adoption in SMEs, and the related effects of ERP adoption in SMEs according to four dimensions of defining SMEs specificity. A tentative model of SMEs characteristic was defined with respect to SAP R/3 application software which is targeted for SMEs' market in Australasia. This model serves inputs for a continuous research which needs to use multiple-methods by incorporating many case studies and quantitative analysis. However, the adoption of ERP system has been in the domain of larger enterprises while the organizational capabilities and business vision in adopting the system are different within SMEs. A study by Huin [2004] suggested a set of organizational and operational factors which influence project management success in deploying an ERP system. He introduced an agent-based model which is able to reflect the management coordination of SMEs resources.

By taking the perspective from ERP vendors, Liang and Xue [2004] revealed three strategies on how to cope with contextual issues in the design and implementation of an ERP system. They are localization of ERP features to local management, customization at a variety of levels, and incremental adoption by continuously improving the system. While Raymond and Uwizeyemungu [2007] provided a profile of manufacturing SMEs by introducing a framework to better understand the nature, the state, and the antecedents of ERP implementation within SMEs. This framework can serve ERP vendors to better target their products/services to the SMEs which also can better position their firm before implement the system.

In the year of 2010, Aberdeen Group conducted an online survey of ERP implementation in 579 enterprises. The result was only 29% of the SMEs have adopted an ERP system in which reducing costs and improving customer services were the main drivers for an ERP adoption strategy. Few respondents (less than 20%) agreed that pressure to innovate and inoperability issues due to geographical location as factors driving ERP adoption. While SMEs focusing on revenue growth and margin growth, the fact that only few SMEs of which ERP system was implemented reflects hesitation toward benefits of ERP within their enterprises. The achievement of ERP implementation was measured in a former study by Sun et al. [2005] who proposed a structured framework to any SMEs which consider implementing an ERP system by incorporating a set of critical success factors (CSFs). These CSFs are converted into quantitative information which can reflect priority over CSFs to successfully implement the system.

Meanwhile, business practices see promising opportunities to adopt on-demand provisioning model [Pettey, 2006] which is expected to outperform the former on-premise model. Different software provisioning models have been offered by vendors, including *on-premise model, hosted model, Application Service Provider (ASP) model,* and *SaaS model* as depicted in Figure 2.2 which also shows main differences between these models. On-premise provisioning model allows enterprises to purchase standardized ERP licenses and to have their own IT infrastructures and resources which on the one hand facilitate ERP customization while on the other hand makes ERP systems tailored for large enterprises. In order to answer the growing demand of ERP system for SMEs [Aman et al., 2008], vendors offer this system through Software as a Service (SaaS) which adopts on-demand provisioning model in order to meet specific customer needs [Wu, 2011]. An example of on-demand SaaS ERP system for SMEs is SAP business ByDesign [Zhou, 2009] which accommodate customer specific needs, e.g. due to new customer market, and adjusting IT investment with little effort and costs [Konstantinidis, 2011]. However, SaaS ERP system is still among SaaS application with lower adoption rates since this system has higher levels of specificity and higher adoption uncertainty [Benlian et al., 2009].

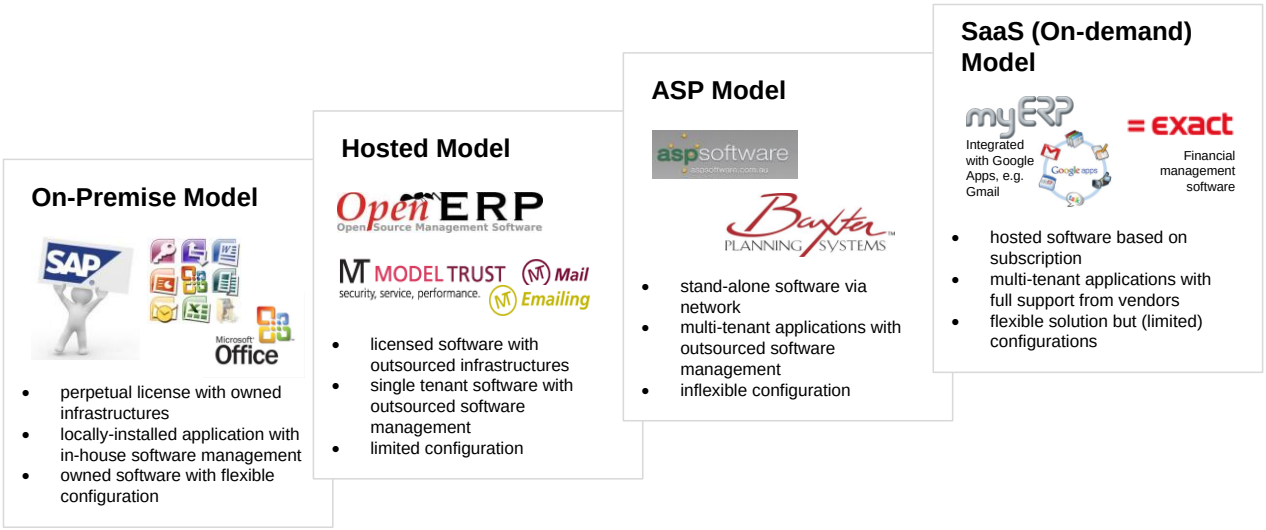


Figure 2.2 Vendors offer various software delivery models to clients

Within SaaS on-demand provisioning model, standardized services of SaaS applications are accessed via IP-based network which is remotely controlled by SaaS providers who offer pay-per-use or pay-per-period fee instead of purchasing software license. Therefore, SaaS applications are installed, executed, and maintained by providers [Sun et al., 2007] who offer continuous enhancement [Olsen, 2006] toward the applications in order to prolong software subscriptions while improving its quality. On the other hand, SaaS adopters can reduce execution risks in SaaS adopters' side since they do not require to provide upfront investments in systems and license [Greschler & Mangan, 2002], and do not need to invest as much in IT infrastructure and the dedicated resources [Choudhary, 2007]. SaaS software delivery model also supports multi-tenancy in which single back-ends can serve multiple clients which are often referred as tenants [Aulbach et al., 2008]. Nevertheless, high level standardization and over cost reduction effort by SaaS providers can lead to limited possibilities to customize SaaS applications in order to meet specific customer needs since software license is not owned by SaaS adopters who only subscribe to providers [Xin & Levina, 2008]. Customization upon the applications may require details of services which will be composed and bounded together as needed. For this reason, Service Oriented Architecture (SOA) approach can help the process of customizing services and thus it is believed as one of SaaS characteristics [Turner et al., 2003; Stuckenberg & Heinzl, 2010].

We have seen in this subchapter that SMEs are more likely to adopt SaaS ERP system in the future. However, evaluation and assessment upon SaaS adoption during SaaS lifecycle is limited in literatures and practices. In order to understand more about adoption processes during the delivery of SaaS applications, the next subchapter will discuss about SaaS lifecycle, which is comprised of main processes which determine the successful of SaaS adoption within enterprises.

2.2 SaaS lifecycle outlines three main processes

In Subchapter 2.1, Software as a Service (SaaS) concept has briefly discussed in order to provide basic understanding toward this growing concept. A study by Gartner predicted that SaaS role will grow more importantly in business sector through 2013 when SaaS revenue is predicted more than $14 billion for SaaS adoption within enterprise application software (EAS) markets [Mertz et al., 2009]. Moreover, even though SaaS model was initially targeted for SMEs, large enterprises have become aware toward this software delivery model and have adopted this model within their business process, e.g. CitiGroup and Cisco [Xin & Levina, 2008]. Enterprises who subscribe to providers consider the following reason when they adopt SaaS: easy-to-standardize applications, support on core business processes, expert opinions toward new technologies, and evaluation upon SaaS-based applications [Benlian et al., 2009]. On the other hand, providers are more likely to invest in quality of services

under SaaS subscription model [Choudhary, 2007] since they can extend their engagement with enterprises by continuously providing high quality services during the lifecycle of delivering SaaS applications. This subchapter will address SaaS lifecycle, which is mainly comprised of designing, delivering, and maintaining the applications, which are delivered to SaaS adopters through subscription scheme according to SaaS contract. Therefore, discussion upon subscription scheme within SaaS concept will also be addressed in this subchapter in order to outline different types of subscription mechanisms, which are usually offered by SaaS providers.

Burstein et al. [2005] studied about lifecycle of SaaS and defined sequence of processes, which are involved during the delivery of SaaS applications. They include *deployment, discovery, composition, selection, mediation, execution, monitoring, compensation, replacement*, and *auditing*. SaaS delivery mode is designed, published and advertised by SaaS providers during *deployment* process. Then, appropriate services are discovered by enterprises as SaaS adopters during *discovery* process. After services are discovered, they are combined to achieve a particular goal by seeing the perspective of SaaS providers and SaaS adopters within *composition* process. Next, engagement process starts when SaaS contract is agreed during *selection* process. Before services are delivered to SaaS adopters, *mediation* process ensures the interoperability level of services, e.g. by providing training to users. Within *execution* process, services are delivered in a particular order while they are monitored during *monitoring* process. This process will also be related to *compensation* and *replacement* process in which transaction and data integrity, and replacement of services are conducted, respectively. At the end, *auditing* process is necessary to ensure that services are performed as expected according to SaaS contract.

However, SaaS lifecycle in Burstein et al. [2005] has not accommodated continuous improvements in addressing customer adaptation toward the delivered applications. Catalyst Resources [2011] suggested a continuous lifecycle of SaaS which includes *acquisition* (purchasing and deployment)*, installation and setup* (configuration and provisioning)*, usage,* and *monitoring and renewal*. The acquisition phase includes evaluation and purchasing of SaaS applications while the installation and setup phase covers installation, deployment and customization of the applications. Within the usage phase, provisioning and training is conducted toward the installed applications, which are continuously supported by SaaS providers; whereas monitoring and renewing applications are incorporated within the maintenance and renewal phase.

Furthermore, SaaS lifecycle should show both perspectives of providers and adopters during the delivery of SaaS applications. To address these issues, SaaS lifecycle should be seen as a continuous process of delivering SaaS applications as depicted in Figure 2.3. The pink and blue-four-sided box shows both perspectives of SaaS adopters and providers while the pink and blue-hexagonal box represents service preparation. The green and grey-squared box represents processes of delivering services of SaaS application whereas the yellow-waved box shows results of these processes. The lifecycle of SaaS includes three main processes, which are *discovery, selection and engagement,* and *enactment* which are represented by the green-squared boxes.

There are five types of subscription scheme [Software & Information Industry Association, 2001] which is usually offered within SaaS delivery model. They are *subscription based scheme*, *usage based scheme, transaction based scheme, value based scheme,* and *fixed fee scheme*. These five types of subscription scheme are differentiated according to payment over services. The *subscription based scheme* represents that service fees are paid according to the number of actual end-users of the software, while the *usage based scheme* means that service fees are paid depending on the number of servers which run SaaS applications or the number of concurrent users. Under *transaction based scheme*, SaaS adopters will be charged for each transaction via SaaS applications [Carraro & Chong, 2006b], while the achievement toward business goals of SaaS adopters will determine service fees under the *value based scheme*. The *fixed fee scheme* is run according to period of services. The type of subscription scheme should be agreed by both vendors and clients before a SaaS application is delivered.

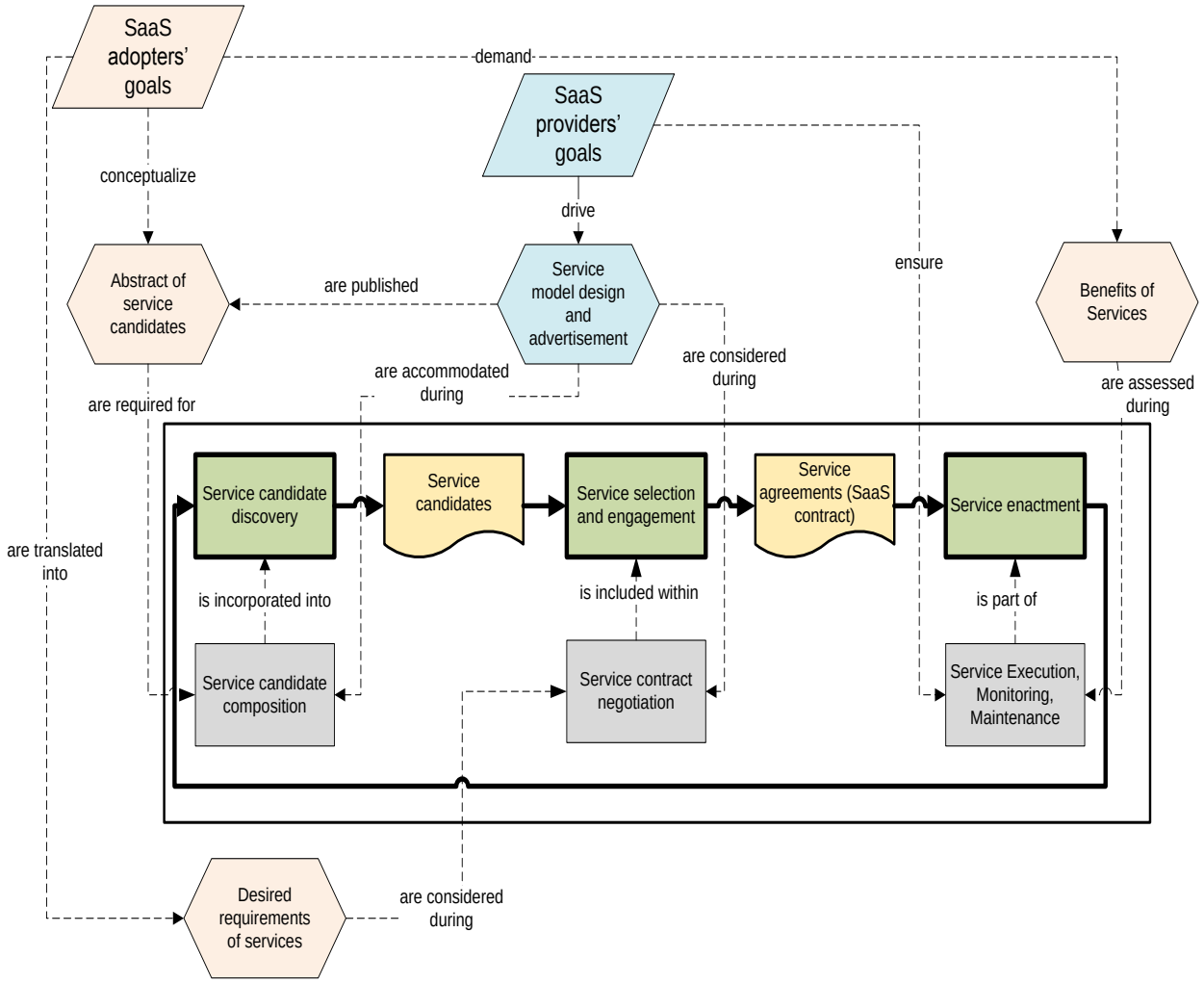


Figure 2.3 SaaS lifecycle shows interaction between SaaS providers and SaaS adopters (adapted from Burstein et. al, 2005)

In this subchapter, we have presented SaaS lifecycle which shows the process of delivering SaaS applications that accommodates the perspective of SaaS providers and SaaS adopters. The SaaS lifecycle is indeed a continuous process in delivering services through SaaS applications under the chosen subscription scheme which is described within a SaaS contract. However, the benefits of SaaS which can be derived from delivering the applications may not be explained yet by seeing both perspectives which are interacted within the lifecycle of SaaS. In the next subchapter, SaaS benefits will be explained along with the associated risks which might be encountered in the exchange of achieving these benefits.

2.3 SaaS model raises challenges and benefits

In Subchapter 2.2, we have described about Software as a Service (SaaS) lifecycle which includes three main processes: *discovery, selection and engagement,* and *enactment*. However, there is still a missing link on how to understand the arguments from providers to invest on the development on SaaS applications, and from adopters to use the applications. Furthermore, the benefits from the perspective of SaaS providers and SaaS adopters are still not yet discussed. Yet, SaaS delivery model has raised both technical and management challenges because this concept is still immature in concept and limited in practice [Janssen & Tan, 2010].

From technical point of view, SaaS model creates interdependencies across different platform since it introduces "constellation of services" [Hoogvliet, 2008] in which multiple users are provided with the same user interface and procedures. These interdependencies are highly dependent to providers

because the delivered SaaS applications are limited in use within a particular period which is defined in SaaS contract and are managed by expertise which requires specific skills. While from management point of view, SaaS model creates new challenges in which enterprises have little experiences with this new concept and rather hesitate when their core business applications are outsourced from providers. As a result, potential hidden cost and risks might due to happen because of contracting problem, e.g. data confidentiality, and dispute over payment.

Nevertheless, SaaS model is still of interest to both SaaS providers and adopters [Hoogvliet, 2008]. From the point of view of SaaS provider, investment on the development of SaaS applications can be beneficial since these applications are relatively quicker and easier to market. This is considered because SaaS applications are likely to fulfill specific requirements, for instance Gmail application to serve hosted-mail services. In this case, since the application is hosted in Google server as vendors of Gmail, this application can be updated easily and can be fixed frequently, and therefore by these continuous services, customer supports can be improved. From the point of view of SaaS adopters, the fact that no installation is needed can help to reduce IT investments which are also relatively predictable. Service level can also be controlled since Service Level Agreements (SLAs) which are described within a SaaS contract ensure that support and services should be delivered accordingly while preserving security and privacy of data [Dippenaar, 2008]. However, both parties have their own views toward the benefits from delivering SaaS applications.

From the perspective of SaaS providers, more effective control toward SaaS applications can be conducted because segregation of duties are agreed within a SaaS contract in which the period of maintaining the applications are also described formally. The segregation of duties may include orchestrator role by providers or third parties which are responsible to select services within SaaS applications and ensure that services are operated according to the promised benefits which are included within SLAs. By ensuring continuous service delivery, SaaS providers can align their services and knowledge through an ongoing training and support toward the delivered applications [Software-as-a-Service Executive Council, 2006]. Yet, SaaS model demands long-term investment in expertise's competencies and skills.

Meanwhile, enterprises want to ensure that corporate applications will be available whenever they are needed, and at a service performance level they had expected [Zucco, 2006]. By using ready-to-use of IT applications, enterprises can transfer the responsibility of managing corporate applications to SaaS providers. These IT applications, which are then referred as SaaS applications, can be immediately put into use via a secured internet access within shorter implementation time while reducing implementation cost. Therefore, their management burden can be possibly reduced disregarding the fact that only few enterprises that are comfortable handing over control of IT applications which are related to their critical business process to an outside company, e.g. software vendor.

Within this subchapter, we would like to discuss more on SaaS benefits from different perspective of SaaS providers and adopters according to current literatures, and which part of SaaS lifecycle will fit to address these benefits from both perspectives. By realizing SaaS benefits from many perspectives, we aim at minimizing potential conflicts which might arise from different opinions toward benefits of SaaS at different process of SaaS lifecycle. For this reason, this subchapter will be divided into three sub-subchapters. First, the perspective of SaaS providers will be addressed pertaining to SaaS benefits. We mainly focus on the discussion over *what can be promised* by providers toward their clients with regard to adopting SaaS applications. Second, the discussion upon SaaS benefits from the point of view of SaaS adopters are presented by referring to former literatures which developed SaaS maturity level in order to ensure that this software delivery model meets *what can be expected* by clients from their providers through the delivery of SaaS applications. The discussion over SaaS benefits from both perspectives also includes challenges toward adopting the model. Third, SaaS benefits are conceptualized by considering whole lifecycle of SaaS.

2.3.1 Software providers promise SaaS benefits

In order to ensure that service capability and technical descriptions are provided, both SaaS providers and SaaS adopters should agree upon Service Level Agreements (SLAs) which are described within a SaaS contract [Kemp Little LLP, 2010]. By ensuring that SLAs are delivered, the providers promise a certain level of benefits that can be gained from adopting SaaS application according to the contract. The key areas which should be covered within a SaaS contract are presented as following.

- *Basic cost*, e.g. setup costs and storage fees
- *Additional fees*, e.g. customization costs, training fees, integration fees
- *Locked in* or escalating discounts for incremental spending
- *Additional services*, e.g. up-time guarantees (usually 99.5% to 99.9%) and penalties
- *Service levels and credits*, e.g. disaster recovery & business continuity, site and network security
- *Data ownership*, including information security, customer data, personal data
- *Periodical service charge*, including pilot periods
- *Termination* and the related consequences, and *exit strategy*

From SaaS lifecycle which has been discussed in Subchapter 2.2, we can classify the development of SLAs within a SaaS contract during *discovery,* and *selection and engagement* processes. During this process, SaaS providers and SaaS adopters negotiate about service descriptions, conditions, and the related fees. SaaS providers promise to deliver services according to the agreed SaaS contract while SaaS adopters ensure that their business goals and IT goals are achieved during the delivery of services.

Table 2.1 SaaS model raises challenges and benefits for providers (adapted from Sääksjärvi et al., 2005)

Challenges for SaaS providers	Benefits for SaaS providers
1. SaaS providers are challenged by the fact that they need to integrate existing product and services within enterprise business process [1],[2],[3],[5]. 2. SaaS providers initially have their turnover reduced when their revenues come from service fees of implementing SaaS applications and the related infrastructures, instead of directly gain revenues from license sales and consultation fees [1],[2],[3],[6]. 3. SaaS providers are more likely to have their business started with high investment for developing SaaS applications and the related infrastructures [1],[2],[3]. 4. SaaS providers may experience performance and scalability issues due to complex technical solutions which are needed for different enterprise business processes [1],[3][5],[6]. 5. SaaS providers should be able to accommodate customizations due to customer adaptation, which may result in higher costs [1],[3]. 6. SaaS providers should put more efforts in upgrading software version frequently [2].	1. SaaS providers can have more opportunities to gain economic of scale in both production and distribution costs [1],[2],[4],[5],[6]. 2. SaaS providers can have more cash flows, which are predictable under which subscription scheme is applied [1],[2],[3],[5]. 3. SaaS providers can have possibilities on having their services expanded by the potential customers who subscribe to SaaS applications [2],[3],[6]. 4. SaaS providers can have their sales cycle shortened comparing to that of traditional software sales [1],[2],[3]. 5. SaaS providers can manage to have lower version management and maintenance cost [2],[6]. 6. SaaS providers may create a barrier to entry for competitors due to vendor-dependency [1].

Note: [1]Cherry Tree, 2000; [2]Software & Information Industry Association, 2001; [3]Hoch et al., 2001; [4]Mizoras & Goepfert, 2003; [5]Ekayanaka et al., 2003; [6]Walsh, 2003

Despite promising benefits of SaaS to their clients, SaaS providers may gain significant benefits by delivering their product through SaaS delivery model. Sääksjärvi et al. [2005] presented a list of significant benefits (value propositions) for SaaS providers. Yet, SaaS model also raises several issues for providers. Table 2.1 provides both of SaaS benefits and challenges which may be faced by SaaS providers. There are six benefits listed in the "Benefits for SaaS providers" column of the table while six issues are presented in the "Challenges for SaaS providers".

From SaaS lifecycle which has been discussed in Subchapter 2.2, we can classify the development of SLAs within a SaaS contract during *discovery,* and *selection and engagement* processes. During this process, SaaS providers and SaaS adopters negotiate about service descriptions, conditions, and the related fees. SaaS providers promise to deliver services according to the agreed SaaS contract while SaaS adopters ensure that their business goals and IT goals are achieved during the delivery of services. Despite promising benefits of SaaS to their clients, the providers may gain significant benefits by delivering their product through SaaS delivery model. Sääksjärvi et al. [2005] presented a list of significant benefits (value propositions) for SaaS providers. Yet, SaaS model also raises several issues for providers. Table 2.1 provides both of SaaS benefits and challenges which may be faced by SaaS providers. There are six benefits listed in the "Benefits for SaaS providers" column of the table while six issues are presented in the "Challenges for SaaS providers".

From Table 1.1, we may know that most of articles agreed that SaaS providers may gain economic of scales in both production and distribution costs when delivering SaaS applications to clients which are then referred as SaaS adopters. SaaS providers can also have more predictable cash flows under which subscription schemes are applied when the applications are delivered while expanding their potential customers since services toward the applications can be maintained through these subscriptions. The whole sales cycle can be shortened because the applications do not need to be installed locally in enterprise sites. On the other hand, SaaS providers are more likely to deal with a complex network of suppliers in order to integrate existing business process while their performance is monitored by clients. They also need to invest more in capacity and resources during the early phase of SaaS development and deployment rather than those to be invested during implementation and maintenance.

2.3.2 Clients perceive SaaS benefits

From the point of view of clients, SaaS benefits are numerous according to Sääksjärvi et al. [2005]. The clients, which are referred as SaaS adopters, may gain similar benefits which are usually found in traditional IT outsourcing, e.g. better focus on core business competencies, easier access to technical expertise, and more predictable costs. However, these benefits rather seemed to be conditional benefits which can be achieved only if SaaS providers could be able to fulfill their promised benefits which are usually formalized in Service Level Agreements (SLAs) within a SaaS contract. The promised benefits are very dependent to providers' ability to provide reliable applications and the related services at anytime and from anywhere. Furthermore, SaaS adopters have less challenges comparing to those challenges which might be faced by SaaS providers which have been described in (Sub) Subchapter 2.3.1. Both of the benefits and challenges are summarized in Table 2.2. There are twelve benefits and four risks as presented in the column of "Benefits for SaaS adopters" and "Challenges for SaaS adopters", respectively. Yet, it is more likely that SaaS adopters perceive SaaS benefits according to the established promised benefits which are published by vendors.

To fulfil their promised benefits, several SaaS providers argued that SaaS model can be achieved incrementally. Within this incremental model, SaaS adopters can perceive SaaS benefits from their point of view. Research groups from business communities have reported about key characteristics of SaaS and maturity level for SaaS model.

Table 2.2 SaaS model raises challenges and benefits for clients (adapted from Sääksjärvi et al., 2005)

Challenges for SaaS adopters	Benefits for SaaS adopters
1. SaaS adopters may have more risks in losing their business-critical data by exposing it to providers [1],[3],[5]. **2.** SaaS adopters may be bounded by a long-term contract (switching costs) in exchange for lower price solutions [1],[3]. **3.** SaaS adopters may expect high availability and reliability of services, and good performance of services, but they are very dependent on the technical solutions provided by providers [1],[4],[5]. 4. SaaS adopters have less tailoring and integration options [1],[3],[4],[5].	1. SaaS adopters would be offered with a complete package of integrated applications and the related services [1],[2],[3],[5],[6]. 2. SaaS adopters would be offered with "best of breed" applications under which the chosen subscription scheme would be applied [1],[2],[3],[4]. 3. SaaS adopters would be offered with various subscription schemes under which a wider and more flexible of payment methods are provided [1],[2],[3],[5],[6]. 4. SaaS adopters would be provided with shorter implementation time of SaaS applications [1],[2],[3],[4],[5]. 5. SaaS adopters would be able to have access to superior IT infrastructures with high reliability, security, and scalability [2],[5],[6]. 6. SaaS adopters would be able to access the applications at anytime and any location [1],[3],[4],[6]. 7. SaaS adopters incur less initial costs [1],[3],[4],[6]. 8. SaaS adopters would be able to focus more on their core business process rather than on technology to support their business process [1],[2],[3],[4],[5],[6]. 9. SaaS adopters would be provided with continuous supports and services from technical expertise [1],[2],[3],[5],[6]. 10. SaaS adopters would be updated with the latest technology and software versions [1],[2],[3],[5],[6]. 11. SaaS adopters would be equipped with a broader selection over SaaS applications [1],[2],[6]. 12. SaaS adopters would be equipped with the availability to customize the applications [1],[2].

Note: [1]Cherry Tree, 2000; [2]Software & Information Industry Association, 2001; [3]Hoch et al., 2001; [4]Mizoras & Goepfert, 2003; [5]Ekayanaka et al., 2003; [6]Walsh, 2003

Carraro and Chong [2006a] from Microsoft identified SaaS as *line-of-business services* which provide customizable solutions that enable enterprise business process, and *consumer-oriented services* which facilitate software customizations in order to meet client adaptations toward SaaS applications. They characterized a well-designed SaaS application as those which has the following key attributes: *scalable*[1]*, multi-tenant-efficient*[2]*,* and *configurable*[3]. By considering these characteristic, a maturity model which focuses on SaaS application architecture was developed within four levels. The Microsoft's maturity model is comprised of *Level 1: Ad Hoc/Custom, Level 2: Configurable, Level 3: Configurable, Multi-Tenant-Efficient,* and *Level 4: Scalable, Configurable, Multi-Tenant-Efficient.* Ad hoc level (Level 1) represents traditional server-client applications through ASP model while Configurable level (Level 2) indicates that tenants do not necessarily to modify the application in the code level. Within configurable and

[1] Scalability attribute means that maximizing the use of the application resources concurrently and efficiently by e.g. enabling statelessness, optimizing duration of software lock-in, sharing pooled resources including network connection, and moving to more powerful servers (scale-up) and running the application in more servers (scale-out).

[2] Multi-tenancy requires architecture that maximizes sharing of resources across different clients which are referred as tenants but that is still be able to meet a particular customer requirement and to differentiate data from different tenants.

[3] Customizing the application means treating separate instances for each tenant in a way that configuring the application will not change how the way of the application works for other tenants while adding less extra costs for configuring the application.

multi-tenant efficient level (Level 3), metadata is kept separately among tenants while scalable, configurable, multi-tenant efficient level (Level 4) accommodates customer adaptations toward the application.

In the year of 2008, Ried et al. from the research group of Forrester developed a maturity model to guide strategic transformation from traditional client-server applications toward SaaS-based applications. The focus of this SaaS maturity model is on SaaS application domain from single application SaaS to business domain and further to dynamic business applications as a service. The Forrester's maturity model incorporates six maturity levels, which are *Level 0: Outsourcing*, *Level 1: Manual ASP, Level 2: Industrial ASP, Level 3: Single-App SaaS, Level 4: Business-domain SaaS*, and *Level 5: Dynamic-business-apps-as-a-service*. Each maturity level can also be characterized within the key attributes of SaaS applications by Microsoft; those attributes are scalable, multi-tenant efficient, and configurable. At Level 0 and 1, the applications can be mapped into ASP applications who handle similar application to multiple tenants; whereas at Level 2 and 3, the applications can be called SaaS service because SaaS providers facilitate configuration options for multiple tenants through software package or web-base distributed software. At Level 4 and 5, custom extensions and dynamic composition is facilitated by the providers for specific tenants.

Meanwhile in scientific communities, Kang et al. [2010] defined a maturity model which is comprised of two axis; they are *service component axis* and *maturity level axis*. The former axis represents layers that separate business, services, system, and data; while the latter axis represents an incremental level of current situation of available SaaS services. The maturity model is represented within four levels, which are *Level 1 (Ad hoc/base), Level 2: Standardization, Level 3: Integration*, and *Level 4: Virtualization*. At Level 1, service model is still non-flexible and Service Level Agreements (SLAs) that define level of services are incorporated within a simple contract without any concrete policies. At Level 2, service model can be configured but are limited to pre-defined instances that are given by service provider while using shared and publicized database without any support for multi-tenant environment. At Level 3, service provider enables multi-tenant environment within which data schema and database are shared among tenants and also develops standardized measurable variables for SLAs. At Level 4, service model underpins service oriented architecture (SOA) approach which mainly focuses on resource maximization through encapsulation and modulation of services.

Kang's model [2010] also characterizes SaaS services by adopting key attributes of SaaS which is defined by Microsoft's, which are *scalable, multi-tenant efficient,* and *configurable*, and also adding three more attributes, which are *standard support, integration,* and *security*. These six attributes are categorized into technical function which is related to technical issues, including database management, technology updates, and configurable user interface. While business function is also important to successfully adopting SaaS applications within enterprises; this function is related to the promised benefits from SaaS vendor which guarantees the continuity of business activity supported by the delivered applications. Therefore, business function cover the key attributes of *market, scalability [of business], development,* and *communication area*.

In order to incorporate both perspective of SaaS provider and adopter, Sorenson and Chen [2008] develop a maturity model that focuses on the business relationships between the provider and the adopter. The business relationships include internal relationship within provider organization, internal relationship within adopter organization, provider-to-customer relationship, and customer-to-provider relationship. The maturity model covers five levels from 1 to 5, which are *ad-hoc transaction, repeatable transaction, configurable transaction, long-term relationship,* and *strategic partnership*. Several quality approaches are also defined for each maturity level in order to evaluate this business relationship, including Balanced Scorecard, Return on Investment (ROI), and value analysis.

2.3.3 SaaS benefits can be appreciated through the whole lifecycle

We have already presented the benefits of Software as a Service (SaaS) from the perspective of SaaS providers and adopters. From the work of Sääksjärvi et al. [2005], both of these perspectives may be contrasting each other since the providers may face issues which are related to adopters' benefits. For instance, the providers may spend high investment on infrastructure high investment in the early phase of SaaS adoption while the adopters incur less cost on infrastructure in this phase. This contrasting view shows that SaaS generates benefits for the adopter while it is in fact not realistic for the provider to accomplish the benefits alone due to limited resources and capacities.

The perspective of the providers pertaining to SaaS benefits are mostly posed in the early phase of SaaS lifecycle when Service Level Agreements (SLAs) are agreed within a SaaS contract. Hence, the benefits are promised upfront while the achievement of these benefits in the later phase of SaaS lifecycle can be conflicting. Meanwhile, the perceived benefits are conceptualized by the adopters when SaaS is implemented. However, conflicting interest may occur during the implementation of SaaS applications, and thus the perceived benefits may stray from the promised benefits. For this reason, the benefits should be considered before, during, and after the SaaS applications are delivered, or in other words, the benefits need to be appreciated during the whole lifecycle of SaaS.

In order to successfully deliver SaaS during the lifecycle, a good design of services is needed. Therefore, the design of services should accommodate established design principles as guidance when a SaaS application is developed. There have been few discussions with regard to SaaS application architecture [Öztürk, 2010; Tekinerdogan, 2011]. Moreover, other literatures outline that SaaS application architecture should be designed by employing the design principles of Service Oriented Architecture (SOA) [Carraro & Chong, 2006b; Watson, 2010]. Additional layer of metadata services [Aktas et al., 2011] is added in the architecture in order to incorporate SaaS characteristic of multi-tenant and scalability.

The rest of this sub-chapter will discuss design principles of Service Oriented Architecture (SOA) which can be seen as an enabler of SaaS model. The design principles can be use to approach benefits of SaaS during the whole lifecycle by considering a good design of services within SaaS delivery model. Additionally, in order not to be confused between the concept of SaaS and SOA, Laplante et al. [2008] uses Zachman's enterprise architecture model in order to distinguish both terms.

In order to face the changing of business requirements, business services should be designed as agile as possible following the design principles of SOA [SOA Systems Inc, 2009]. They include *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability, and service composability*. A marriage between SaaS and SOA concept has been studied by many researchers [Guo et al., 2007; Watson, 2010; Nassif & Capretz, 2010]. Guo et al [2007] discussed about how multi-tenant application as SaaS key important attributes can be designed, developed and managed by utilizing SOA concept. In order to successfully deliver SaaS applications, the design principles of multi-tenancy enablement layer should be considered when the applications are designed. Those principles are *security isolation, performance isolation, availability isolation, administration isolation,* and *on-the-fly-customization.* The design principles multi-tenancy enablement layer within SaaS framework incorporate the design principles of SOA, including standardized service contract, service loose coupling, service abstraction, service statelessness, service discoverability, and service composability. The importance of engaging SaaS with design principles of SOA was also studied by Watson [2010] who presented that applying these principles can help to maximize SaaS characteristic of *shared and virtualized infrastructure, automated self service, elastic and scalable,* and *price by consumption*. Whereas Nassif and Capretz [2010] presented a five-step model to show how a SaaS application can utilize SOA concept. The five-stages are *SaaS allocation, investigation, feature identification, service extraction,* and *service enrichment.* Therefore, by considering well-established concept of SOA, it is more likely that SaaS can achieve

goals of service oriented application [Kang et al., 2010]. In the next subchapter, these goals will be presented as strategic goals and benefits of Service Oriented Computing (SOC).

2.4 SaaS benefits accommodate many perspectives

Not every application might be benefited from Software as a Service (SaaS) model, but many enterprises will find significant benefits from SaaS adoption, e.g. reduced capital investment, fewer requirements for Information Technology (IT) infrastructures, and faster implementation comparing to on-premise software [Waters, 2005]. Particularly in realizing economic benefits of SaaS, several related studies have been conducted to define economic benefits of cloud computing [Weinman, 2008; Talukder et al., 2010]. The economic benefits of cloud adoption for Small Medium Sized Enterprises (SMEs) were proposed by Talukder et al. [2010], which include *strategic flexibility, cost reduction, software availability, scalability, skills and staffing, energy efficiency,* and *system redundancy and data backup*. It is important to note that *scalability* is also among the key attributes that characterize SaaS application.

In Subchapter 2.3, we have presented the benefits of SaaS from vendors' and adopters' perspectives, which are referred to as the promised benefits and the perceived benefits, respectively. However, the perceived benefits are highly associated with risk of adopting SaaS with the related expected and unexpected consequences. Thus, SaaS providers need to ensure that their promised benefits can be fulfilled with minimum costs and risks by providing risk assurance. Moreover, when SaaS model is matured, SaaS applications become open, modulated, and standardized [Ma, 2007]. In this situation, adaptation toward SaaS contract should be made available by providing, e.g. an exit option, in order to help increasing the vendor's competitive ability. The rest of this chapter will discuss about the benefits of Service Oriented Computing (SOC) which can be used to accommodate benefits of SaaS from both perspectives of vendors and adopters.

Any enterprise would expect to be successful in adopting SaaS within its business process while achieving benefits from adopting service-oriented applications. The strategic goals and benefits of Service Oriented Computing (SOC) were introduced to achieve the benefits from adopting service-oriented applications by incorporating Service Oriented Architecture (SOA) approach [SOA System Inc, 2009]. These benefits can also be referred to as the benefits of SOC.

Since the last decade, enterprises are very interested to establish a set of goals which are able to define the successful of SOA adoption [SOA Systems Inc, 2011]. Aiming at achieving successful adoption of SOA concept, Erl [2007] proposed seven strategic goals and benefits of SOC. They include *increased of inherent interoperability, increased of federation, increased of vendor diversification options, increased alignment of business and technology domains, increased of ROI, increased of organizational agility,* and *reduced of IT burden*. Nevertheless, the challenges remain exist on how to build a good service representing these SOC strategic goals and benefits which can adhere design principles of SOA. The design principles of SOA include *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability,* and *service composability*. These challenges are considered important for Small and Medium Sized Enterprises (SMEs) since big enterprises have a broader understanding about how and what to do with SOA concept. In most cases, these big enterprises align their IT goals with business objectives through their SOA architectures. This alignment is studied further by Sarno [in press] who aims at aligning service portfolio deliverables with design principles of SOA. Furthermore, SOA is also believed as one of the enablers of Software as a Service (SaaS) [Janssen & Joha, 2011].

Meanwhile, an enterprise which implements an Enterprise Resource Planning (ERP) system is reported to achieve significant benefits [Yusuf et.al, 2004], including automation of business process, accessing management information in a timely manner, and improvement of supply chain with the use

of e-communication and e-commerce. Other benefits include the improvement of information quality, including visibility, speeds, and better access, costs and controls. However, there are still several compelling reasons for not acquiring an ERP system. The reasons include small organization size; current situation is well enough while additional huge effort is needed to implement such a complex system; and high investment and maintenance costs with unclear benefits; these reasons explain low adoption rate of ERP system. However, the assessment of benefits toward the adoption of SaaS ERP system is limited in practice.

Yet, a successful ERP practices can be approached by assessing ERP readiness in an enterprise. Sarno and Herdiyanti [2010b] evaluated ERP readiness in an enterprise by assessing an Enterpise Maturity Level (EML) according to the COBIT (Control Objective for Information and related Technology) framework [IT Governance Institute, 2007] for the corresponding IT Process in an enterprise. Since the IT Processes can be mapped into the Functional Domains (FDs) within an ERP system, the EML value represents the ERP practices in the enterprise. By considering this value, the enterprise can improve its ERP practices by means of IT policies and the related procedures during planning, implementation, and delivery of ERP services.

Shang and Seddon [2000] presented a framework which can be used for assessing benefits of an ERP system. The framework focuses on benefits in management point of view and provides foundation for system planning and management. It covers five dimensions with the related sub dimensions which cover operational, managerial, strategic, IT infrastructure, and organizational dimension. A preliminary study was conducted by Sedera, *et al.* [2001] regarding benefit measurements of an Enterprise System using qualitative and quantitative factors using the Balanced Scorecard approach. The factors are categorized into four perspectives, which are client and community relationships, people, learning, and growth, internal business process, and resource management. Each perspective has several factors to measure performance. For instance, in the perspective of client and community relationships, the factors include survey on client satisfaction, awareness pools of community perception, assessment of self awareness, and research on consumers.

2.5 PLS Path modeling serves foundation for assessment

Structure Equation Model (SEM) has been regarded as a promising second-generation technique of statistical instruments which can be used to confirm a hypothesis which is analyzed according to empirical data. This technique was introduced as an alternative to overcome three limitations that were found in the first-generation techniques, including regression-based approaches and factor analysis. The limitations of the first-generation techniques include postulation of structuring a simple model, [simplified] assumptions that all variables are regarded as observable, and presumption of error-free measurement [Haenlein & Kaplan, 2004].

Furthermore, SEM technique allows the construction of simultaneous relationship of exogenous and endogenous latent variables [Gefen et al., 2000] and enables researcher to construct unobservable variables which are measured by indicators while model measurement error of the observed variables [Chin, 1998]. This technique aims at testing and estimating estimate causal relationship between variables, especially Latent Variables (LVs) based on statistical data, and qualitative causal assumptions. It assumes that there are linear relationships between variables. According to Tenenhaus, *et.al* [2005], Partial Least Squares (PLS) for SEM is referred to as 'PLS Path modeling'.

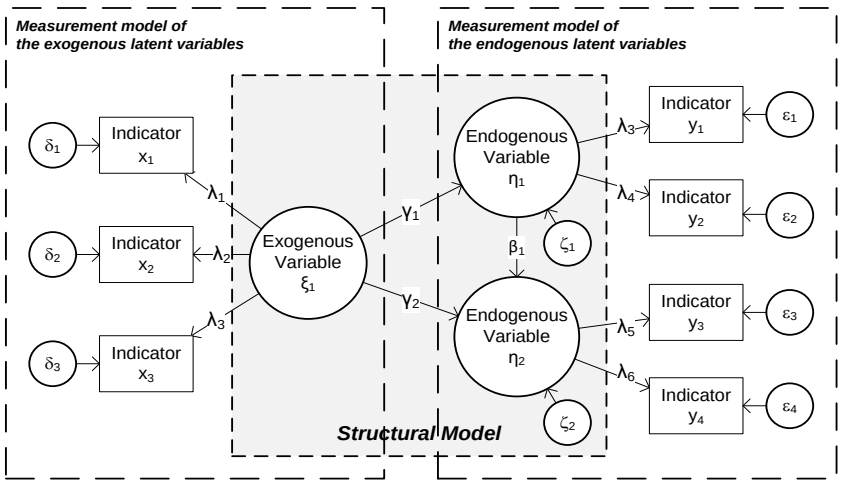
PLS Path modeling assumes that there are linear relationships between variables. The structure of the PLS Path modeling contains structural model or inner model, and measurement model or outer model as depicted in Figure 2.4. The structure is comprised of boxes, rounds, and arrows. The boxes represent indicators which are observable while rounds represent endogenous or exogenous variables which are unobservable and can be approached through a set of indicators. An endogenous variable is

dependent to other variables whereas the exogenous variable is independent. The arrows represent causation or path coefficient, which can help to measure the strength of relationship between (endogenous or exogenous) variables or across (endogenous or exogenous) variables, or between an (endogenous or exogenous) variable and the associated indicators. In addition, multi-collinearity issue might happen between two or more variables since these variables essentially measure the same thing. The best way to solve this issue is to remove or combine the variables by considering relative importance of those variables to the overall model.

The method has advantages of fewer demand regarding sample size comparing with other statistical method, do not require normal distribution for input data, can be applied to complex structural equation models with a large number of constructs, is able to handle both reflective and formative constructs, better suited for theory development than for theory testing, and useful for prediction. Theoretical assumption with empirical data is tested while a sound understanding of the theory structure is needed.

Furthermore, a theory can be structured into three different types of concepts, which are *theoretical concepts, empirical concepts*, and *derived concepts* [Haenlein & Kaplan, 2004]. An abstracted concept is represented by theoretical concepts which are comprised of unobservable attributes while empirical concepts represent ascertained concepts within which relation between the attributes are directly observed under suitable circumstances. A tied empirical but unobserved concept is represented as derived concepts. In addition, there are three possible types of relationship that may link these concepts, which are *non-observational hypotheses, theoretical definitions,* and *correspondence rules*. A theoretical concept is linked with other theoretical concepts by posing a non-observational hypothesis whereas theoretical and derived concepts are connected through a theoretical definition. Empirical concepts are linked with theoretical or derived concepts through correspondence rules which provide empirical significance to theoretical terms.

By referring to different types of concepts, a comprehensive methodology which is proposed in the research presented in this thesis is constructed by converting theoretical and derived concepts into unobservable (latent) variables and converting empirical concepts into indicators. These concepts are linked by a set of hypotheses which represent (possible) types of relationships between the concepts. Considering these relationships, three set of equations can be described as following.



Note:
λ (lambda): path coefficient within measurement model (or between indicator and variable)
β (beta): path coefficient between latent endogenous variable
γ (gamma): path coefficient between exogenous variable and endogenous variable
δ (delta): measurement error for indicators of exogenous variable
ε (epsilon): measurement error for indicators of endogenous variable
ζ (zeta): random disturbance term

Figure 2.4 PLS Path Modeling serves methodology assessment (adapted from: Urbach and Ahlemann, 2010)

a) Indicators–measurement error–(unobservable latent)exogenous variables

The first equation is related to defining indicators of the exogenous variable which is represented as a symbol of *x*. The indicator is equal to the sum of its associated measurement error (δ) and the exogenous variable (ξ). By using the path diagram depicted in Figure 2.3 as an example, the following equation can be formulated:

$$x_1 = \lambda_1 \xi_1 + \delta_1$$
$$x_2 = \lambda_2 \xi_1 + \delta_2$$
$$x_3 = \lambda_3 \xi_1 + \delta_3$$

b) Indicators–measurement error–(unobservable latent)endogenous variables

The second equation is related to defining indicators of the endogenous variable which is represented as a symbol of *y*. The indicator is equal to the sum of its associated measurement error (ε) and the endogenous variable (η). By using the path diagram depicted in Figure 2.3 as an example, the following equation can be formulated:

$$y_1 = \lambda_3 \eta_1 + \varepsilon_1$$
$$y_2 = \lambda_4 \eta_1 + \varepsilon_2$$
$$y_3 = \lambda_5 \eta_2 + \varepsilon_3$$
$$y_4 = \lambda_6 \eta_2 + \varepsilon_4$$

c) (Unobservable latent)exogenous variables–(unobservable latent) endogenous variables

The third equation is related to defining relationship between the exogenous variable (ξ) and endogenous variable (η). By using the path diagram depicted in Figure 2.3 as an example, the following equation can be formulated:

$$\eta_1 = \gamma_1 \xi_1 + \zeta_1$$
$$\eta_2 = \beta_1 \eta_1 + \gamma_2 \xi_1 + \zeta_2$$

The first and the second equations represent measurement equations that indicate *correspondence rules* relationship which build the *outer model (measurement model)*; whereas the third equation represents *non-observational hypotheses* and *theoretical definitions* relationship that build the *inner model (structural model)*. These two models can be subsumed by using the term of *structural equation model*.

Furthermore, both of exogenous and endogenous variables cannot be measured directly and therefore, indicators in the outer model are measured by which different facets of both (unobservable) variables can be covered. There are two groups of indicators, which are *reflective indicators* and *formative indicators*. The later indicators may cause changes in a (unobservable) variable while the former indicators depend on the construct of the variable. Moreover, the reflective indicators should always be highly positively correlated whereas the formative indicators can have positive, negative, or even no correlation. Therefore, a change in one indicator amongst formative indicators does not necessarily imply a similar (directional) change in other indicators. Consequently, if the unobservable variable can be regarded as giving "rise to something observed", then reflective indicators should be used. In contrast, if the unobservable variable can be considered as perceiving "a set of explanatory combinations of indicators", then formative indicators should be used.

For instance, the unobservable variable "timeliness" can be operationalized by the three reflective indicators, which are accommodation of last-minute requests, punctuality in meeting deadlines, and speed of returning phone-calls [Haenlein & Kaplan, 2004]. Therefore, a timely person is the one who can accommodate last-minute requests more frequently, and can be more punctual in meeting

deadlines, and can return phone calls more promptly. Meanwhile, the unobservable "life-stress" can be constructed by combining three formative indicators, which are job loss, divorce, and death in family. Hence, a person with high degree of life-stress does not imply that (s)he has become unemployed, has got divorced, and has lost her/his parents; one of these events alone may be sufficient in increasing life-stress.

In order to develop a research which implements PLS Path modeling, several steps should be conducted. A framework for applying PLS Path modeling was developed by Urbach and Ahlemann [2010] which proposed six main steps to implement the model. The steps include *problem definition and research design*, *theoretical foundation, model construction and instrument development, data collection, model validation*, and *interpretation*. Each of the steps involve several activities to conduct the research within each of the steps a certain research product will be resulted. *Problem definition and research design* are more related on defining research backgrounds, research goals, and research approaches; whereas *theoretical foundation* aims at reviewing existing literatures which are related to the proposed research. *Model construction and instrument development* involve activities on developing a structural model, the related measurement models, and survey instruments to gather data. *Data collection* involves activities on gathering data by e.g. distributing surveys, collecting surveys, and assessing quality of the collected data. *Model validation* reflects activities on validating the measurement models, the structural models, and performing bootstrapping to do significance testing. Then, *interpretation* steps include analyzing and interpreting the results from the model by confirming or rejecting hypothesis and providing identification of further research in the related areas.

2.6 Semi-structured interviews provide reliable information

Semi-structured interviews are among data collection techniques [Harrell & Bradley, 2009] that are commonly used for qualitative research which aims at understanding respondents' point of view prior to specific issues which are incorporated within an interview guide which is prepared ahead of time before interviews are conducted [Lindlof & Taylor, 2002]. However, interview questions in this guide are not highly structured whereby they allow respondents to give their ideas and opinions upon the issues which are posed by interviewers. These ideas and opinions will be followed up by interviewers in order to gain more information with regard to topics of interviews while creating comfortable conversation without imposing meanings. Therefore, semi-structured interviews include open-ended questions which allow interviewees express their views in their own terms even though probes may be needed when interviewers need to delve deeply into the topics and to ensure that the answers from interviewees are complete and consistent.

This data collection technique is initiated by a main research question from which interview questions will be designed and incorporated into an interview guide. The guide should provide a reference to determine possible sources of information, including sample groups of respondents. After respondents are chosen, a list of interview questions can be developed. These questions can be designed as *descriptive questions* which result in a narrative description about a specific topic; *structural questions* which result in a list of questions or statements to verify relationships and terms over a specific topic; or *contrast questions* which can help to gain further information that an interviewer has already obtained from interviewees. An example for descriptive questions is "How can technical descriptions within a SaaS contract be defined"; whereas an example of structural questions is "What do the technical descriptions cover". A contrast question could be "So customers are involved within the development of a SaaS contract. What other parties are involved during this process".

After interview questions and respondents are prepared, data collection can be conducted according to interview schedules which are agreed by both interviewers and interviewees or respondents. This data collection process should follow an interview protocol [Gugiu & Rodriguez-Campos, 2007] which should contain *introduction, rules, questions and probes*, and *closing and thank you note*. When data is

being collected, interviewers should be able to document and record the interview as accurately as possible while maintain its confidentiality. From this collected data, an analysis about interview result should be elaborated in advance within an interview notes which should be written with a polished and understandable language. Furthermore, it is also important to differentiate between answers provided by respondents and information added by interviewers due to ethical code of conducting interviews in a scientific and consistent manner.

Semi-structured interview technique is considerably less formal than a structured interview while the former technique is a better way of catching the point of view of interviewees and getting inside information. The former technique which is most commonly used in social research [Wengraf, 2001], allow interviewers develop in-depth analysis by incorporating experiences and perceptions of individuals of interviewees, and thus it can produce rich and empirical data about a specific topic from the point of views of interviewees [Cousin, 2009]. Therefore, complex questions and issues can be addressed and clarified while providing learning opportunities and also dealing with sensitive issues.

However, semi-structured interview technique is highly dependent to the skill and the subjectivity of interviewers. This skill requirement could be problematic since it could happen that an interviewer fails to listen closely and thus keep repeating the same questions. The semi-structured interview is also considerably expensive and time consuming since it involves two-ways discussions among interviewers and interviewee. Therefore, samples of respondents tend to be small which may affect to the reliability and representativeness of data which is collected during interviews.

In order to have a broader understanding about SaaS benefits, questionnaire-method is also considered within the research which is presented in this thesis. Regardless limitations of this method, including lack sense of accuracy [Bryman, 2008], a structured-questionnaire can produce generalisable results [Harris & Brown, 2010] that can help to understand the structure of SaaS benefits, rather than estimate the benefits in detail. For this reason, the technique of sampling non-probability accidental sampling will be employed. This technique enables anyone who is deemed suitable as a data source to fill out questionnaires, and this person can be regarded as a sample [Schillewaert et al., 1998].

2.7 Conclusion

In Subchapter 2.1 we have discussed about the adoption of Enterprise Resource Planning (ERP) within Small Medium Sized Enterprises (SMEs) through which Software as a Service (SaaS) concept is implemented. SMEs are likely to adopt ERP system in order to experience revenue growth and margin growth in the same stage as larger enterprises while they also consider no up-front investment when adopting the system. Software vendors answer these urgent needs by introducing ERP system which is tailored for SMEs through SaaS delivery model. SaaS which is on-demand provisioning model is a growing concept which is currently being discussed within both business practice and scientific communities. With regard to SaaS ERP system, some practices are found, e.g. SAP business ByDesign, but not yet addressing customer adaptation during the whole life cycle of delivering the system.

The lifecycle of SaaS that has been discussed in Subchapter 2.2 imply that SaaS delivery model is indeed a continuous process in order to address the changes of business requirements over SaaS applications. Three processes are included within SaaS lifecycle, including *discovery, selection and engagement,* and *enactment*. It is important to note that business changes should be aligned with SaaS contract which is valid under the chosen subscription scheme. Therefore, adaptation toward a SaaS contract might be needed during the lifecycle in order to address changes in business requirements and technology.

In realizing benefits of SaaS, three perspectives which are mainly discussed in the research presented in this thesis. They are the promised benefits by vendor, the perceived benefits by clients, and the process benefits by appreciating the design principles of Service Oriented Architecture (SOA) during the delivery of SaaS application within SaaS lifecycle. These perspectives are briefly discussed in Subchapter 2.3. In order to accommodate these different perspectives, an established concept of benefits in Service Oriented Computing (SOC) is incorporated. Seven strategic goals and benefits of SOC are briefly discussed in Subchapter 2.4 in order to give an idea of these benefits which were proposed by Erl [2007]. These benefits can also be referred as the benefits of SOC which includes *increased of inherent interoperability, increased of federation, increased of vendor diversification options, increased alignment of business and technology domains, increased of ROI, increased of organizational agility,* and *reduced of IT burden*. In addition, the benefits of SOC enable the implementation of the design principles of SOA, while the SOA concept enables SaaS model.

The benefits of SaaS are realized by implementing a comprehensive methodology to assess the benefits which are proposed in the research presented in this thesis. This comprehensive methodology applies a statistical technique namely PLS Path modeling which has been discussed in Subchapter 2.5. The advantages of using this second-generation technique of statistical instruments includes less sampe size while can provide a large number of constructs of relationship between variables. Therefore, this technique fits best for the purpose of theory development within which a sound understanding pertaining to theory structure is needed. Moreover, the comprehensive methodology incorporates techniques to collect data which includes semi-structured interviews and questionnaires. The former technique has been discussed in Subchapter 2.6. By implementing this technique, specific issues can be addressed by understanding the point of view of interviewees while allowing respondents to give their ideas and opinios upon those issues. Therefore, a rich understanding toward different perspective can be expected through the comprehensive methodology. Furthermore, a questionnaire method will be employed by applying the technique of sampling non-probability accidental sampling in order to have a broader understanding toward SaaS benefits. In the next chapter, we will discuss further about the design of these different perspectives and how the comprehensive methodology can be used to assess these perspectives.

CHAPTER

3

CONCEPTUAL MODEL

"Be not, then, faint of heart, and grieve not: for you are bound to rise high if you are believers."
[Surah Ali Imran, 139]

Theoretical background of the research presented in this thesis has been discussed in Chapter 2. These research foundations present current literatures that relate to the research and thus scientific contribution from the research can be well outlined. Following this, the research should be able to clearly indicate its position in the development of a particular field of study in scientific communities. By indicating research position, the research can be conducted in order to meet the research questions by applying the research approach.

In this chapter, we would like to employ a qualitative analysis in order to understand the benefits of Software as a Service (SaaS) from three important perspectives, which are the perspective of SaaS providers, the perspective of SaaS adopters, and the perspective of the lifecycle process of SaaS. Therefore, this chapter aims at addressing the second sub-question, the third sub-question, and the fourth sub-question (Q2, Q3, Q4) which have been presented in Subchapter 1.2, which are:

Q2) How can the benefits of SaaS be understood from the point of view of vendors as SaaS providers? [*explorative studies from literatures and descriptive analysis by identifying characteristics of the promised benefits according to literatures*]

Q3) How can the benefits of SaaS be understood from the point of view of SMEs as SaaS adopters? [*explorative studies from literatures and descriptive analysis by identifying characteristics of the perceived benefits according to literatures and developing SaaS maturity model*]

Q4) How can the benefits of SaaS be understood from the point of view of the lifecycle process of SaaS? [*explorative studies from literatures and descriptive analysis by employing the design principles of SOA within the process of delivering SaaS application during SaaS lifecycle*]

In the light of exploring SaaS benefits qualitatively, this chapter will be divided into five subchapters. We present Subchapter 3.1 in order to incorporate the promised benefits which are proposed by the providers. The Subchapter 3.1 aims at answering the second sub-question. The key characteristics of such benefits will be presented from which an interview guideline for SaaS providers is developed. In Subchapter 3.2, maturity model of SaaS will be developed in conjunction with describing key characteristics of the perceived benefits from the adopters. Subchapter 3.2 aims at answering the third sub-question. According to this maturity model, an interview guideline for SaaS adopters will also be developed along with a questionnaire that is able to enhance interview results. Subchapter 3.3 will describe how both guidelines can be elaborated by incorporating the design principles of SOA within the whole processes of SaaS lifecycle. Subchapter 3.3 aims at addressing the fourth sub-question. In Subchapter 3.4, we construct the benefits of SOC by referring to the strategic goals and benefits of SOA in order to provide a basic understanding toward SaaS benefits. Then, Subchapter 3.5 provides a conclusion toward our qualitative analysis in this research.

3.1 SLAs take the perspective of vendors when promising SaaS benefits

Software as a Service (SaaS) benefits which are perceived by SaaS adopters are mostly conditional based on the pre-condition of the promised benefits which are offered by SaaS providers. Despite the service levels which are agreed by both providers and adopters during service selection and engagement process, the promised benefits are proposed to be realistic if the providers are able to offer immediate customer value which could be benefited by the adopters. For this reason, we approach the promised benefits by operationalizing level of services to be fulfilled by the providers. In this subchapter, key attributes of Service Level Agreements (SLAs) will be discussed in order to define variables which can be used to indicate the promised benefits.

According to Kemp Little LLP [2010], the key areas that should be covered within a SaaS contract can be grouped into three key attributes that are able to represent key attributes of SLAs. They are related to *service costs, service availability,* and *data security*. Service costs may include basic cost based on type of subscription which is chosen by the adopters; additional fees, including application extensions; locked-in or escalating discounts for incremental spending; and periodical service charge that may determine cost of services. Service availability is related to additional services, e.g. up-time guarantees, continuity of services in case of disaster, and termination of services. Data security is related to data ownership, information security, and business enterprise and individual customer data.

Meanwhile, enterprises expect that business information which is provided by Information Technology (IT) can meet certain level of information criteria which should be fulfilled by vendors in order to achieve business and IT goals. Failing to meet these criteria will result in information adequacy and may affect business performance. These information criteria include *effectiveness, efficiency, confidentiality, integrity, availability, compliance, and reliability* [IT Governance Institute, 2007]. An effectiveness criterion is related to the relevancy and consistency of business information which is provided to the right person in the right time; while managing enterprise resources optimally can be included within an efficiency criterion. A confidentiality criterion indicates that business information is protected and validated only for specific people who are authorized to access the information; whereas an integrity criterion aims at providing the information in meeting the demand from business. An availability criterion and a reliability criterion show that information can be provided at anytime and can be operated accountably, respectively. A compliance criterion ensures that business information is provided by conforming to laws and regulations related to enterprise business process.

By combining information criteria with key attributes of SLAs, we propose indicators of key benefits of SaaS with respect to the promised benefits which are offered by SaaS providers. We refer these indicators as key characteristics of the promised benefits of SaaS. They are *resource efficiency, process effectiveness, data confidentiality, integrated information, service availability, service reliability*, and *regulatory compliance* which will be discussed further as following.

a) *Resource efficiency*
   Enterprise's resources that are related to IT management include tangible and intangible resources, e.g. IT infrastructures and software applications; financial resources, e.g. IT investments and revenue generation; and people resources, e.g. IT staff and help desk. By outsourcing IT applications from vendors through a SaaS model, a transfer of risks in managing enterprise resources is due to happen since the development and maintenance of IT applications are in the hand of vendors who incur higher initial costs, particularly related to IT infrastructures while should also effectively use enterprise resource in order to administer and maintain the applications. As a result, enterprises which adopt SaaS would be able to put more of their efforts on managing business process and more flexible to switch into different SaaS subscriptions according to business needs. In case of multiple customers (tenants) within the

same database and schema, cost savings can be expected by the providers in the long run since operational costs tend to be lower as the delivered applications are matured regardless higher initial costs. Furthermore, cost savings can also be attained by the providers from cost license of additional customization, including branding applications, management workflows, application extensions, and access controls as technical complexities growing when the applications are customized and scaled up to bigger capacity of servers.

b) *Process effectiveness*
One of the goals of delivering IT applications through SaaS is to promote multi-tenancy. This principle requires an enterprise architecture which is designed to incorporate a customized (virtual) application instance for each tenant. Multiple tenants share the same SaaS application which is run under the same server with the same data-storage mechanism within which each tenant data is separated toward each other. Each tenant is able to customize its own metadata while modifications to the application are limited since the same application with a single instance of the code is being used by multiple tenants. While being multi tenant efficient, a design experience is needed for customizing metadata and the related metadata service (runtime engine). For this reason, highly skilled expertise from vendors is needed in order to successfully promote the optimization of enterprise resources. As a result, each tenant can run its business process effectively with continuous supports and updates from vendors which provide seamlessly live upgrades while manage its resources efficiently. Furthermore, SaaS applications can be delivered in a shorter implementation time since the applications do not need to be installed locally in the tenant's site.

c) *Data confidentiality*
Within multi-tenant architecture, SaaS applications can be run under the same database which incorporate different database schema for each tenant, or even further shared database with shared schema. For this reason, the data architecture should be both robust and secure in order to satisfy tenants who are concerned about protecting enterprise data which is considered vital for their business process, particularly related to finances, trade secrets, and employees' data. Under Service Level Agreements (SLAs), tenants can specify level of data security which is needed to guarantee strong safety toward their enterprise data by implementing multiple defense levels to protect the data against internal and external threats. Building adequate security is a paramount task, and thus promoting SaaS basically means transferring the risk of managing different levels of security threats and finding solution to address them. For this reason, SaaS providers which are more familiar with the applications can provide the right types of security considering enterprise resources and capabilities, by utilizing different security patterns, including filtering, permissions, and encryption.

d) *Integrated information*
SaaS applications allow clients or SaaS adopters to access their data within a centralized-network based application with less processing overhead, which can be substantial when their data is stored in a locally-installed application, since it would cost the adopters with a relatively high infrastructure supports and maintenance. All data of all tenants can be stored in the same server which enables a single or shared database schema. Therefore, data aggregation/data mining can be done much simpler by running queries across customers, and looking for trends. Depending on technical and business considerations, multi-tenant data management can be distinguish into separate database, shared database with different schema, and shared database with the same database schema. Among these data management approaches, the shared database with shared database schema has the lowest hardware and backup costs due to sharing of database server while incurring additional development effort and costs in the area of security. While shared database with separate schema approach is appropriate to accommodate smaller number of database tables which are needed for each tenant comparing to a large number of tenants which can be accommodated by shared database and shared

schema. Despite a relatively simple procedure to backup and restore a tenant's data, separate database approach often leads to higher hardware requirements and maintenance efforts.

e) *Service availability*
Because SaaS applications do not necessarily to be installed locally, tenants can access the applications at anytime and any location via a secured internet connection depending on the user authorization and subscription schemes. The schemes are varied and based on number of users and period of usage. Under the chosen scheme, SLAs can be defined in conjunction with level of service availability to support business continuity, e.g. disaster recovery and backup planning. Meanwhile, SaaS vendors should accommodate scalability principles toward the applications and data within which increasing total workload of the application and increasing total capacity of storing the data can be made possible. There are two scaling techniques for databases, which are scaling up and scaling out. The latter technique means partitioning and replicating a database into multiple servers while scaling up means moving to a larger server which has more powerful processors and quicker disk drives.

f) *Service reliability*
SaaS applications are expected to perform under the stated conditions as specified in SLAs during a specific period of time according to the chosen subscription scheme. However, it is possible that the applications are incrementally deployed and tested during the lifecycle of SaaS. By incorporating multi-tenancy principle, the applications can be released reliably in order to improve the application's quality regardless chance of failures that might happen during the updating process. The release management can be done within a much simpler process since any updates toward application packages which may contain code and database changes typically only needs to be installed in vendors' servers which are shared by multiple tenants. Yet, reliability is hard to measure and therefore it can only be estimated. To what extent the reliability of service might perform without failure, should be directed to fulfil service level which is defined in SLAs within a SaaS contract.

g) *Regulatory compliance*
Enterprises are subject to regulatory laws which are inherently related to their business process, or related to their position as business enterprise within a country within which regulatory procedures, e.g. financial reporting, are applied. Because these regulatory laws may be changed overtime and may affect their business process, enterprises expect to have their business data secured and supported with the latest technology. Therefore, SaaS applications should be able to be customized in order to meet the demand of new regulatory system while minimizing the risk of applying a new release of software version toward business data, including the possible downtime which may occur during the release process.

We present Table 3.1 to incorporate the key characteristics of the promised benefits of SaaS which have been discussed earlier in this subchapter. According to this table, the promised benefits may fulfil benefits that are usually expected from client's point of view [Sääksjärvi et al., 2005]. By referring to the key characteristics, we design an interview guideline and a questionnaire guideline in order to gather information pertaining to SaaS adoption from the perspective of the vendors. These guidelines for SaaS providers are provided in *Appendix B, part I*. Moreover, the key characteristics of the promised benefits will be designated as exogenous variables which are structured within a methodology for assessing benefits of SaaS discussed further in Chapter 4.

Furthermore, SaaS providers can also gain significant benefits for their business by promising SaaS benefits to their clients. For instance by managing client's resource efficiently, SaaS providers can have more opportunities to gain economic of scale in both production and distribution under the assumption that the client will continuously subscribe to the application. By improving service availability and reliability, they can also have more predictable cash flows under which the chosen subscriptions are applied. As a result, they may have more opportunities to expanding their business due to vendor due to vendor-dependency toward the delivered applications.

Table 3.1 Key characteristics of SaaS benefits can fulfil the expectation of SaaS benefits from client's perspective

Key characteristics of the promised benefits of SaaS	SaaS benefits from client's perspective [Sääksjärvi et al., 2005]
1. Resource efficiency	– SaaS adopters are provided with "best-of-breed" applications depending on the chosen subscription – SaaS adopters are offered with different kinds of subscription schemes within which a wider and more flexible of payment methods are provided – SaaS adopters relatively invest less initial costs – SaaS adopters are able to focus on their core business process rather than on technology to support their business process
2. Process effectiveness	SaaS applications are delivered within a relatively shorter implementation time and thus SaaS adopters are able to utilize the applications immediately after a SaaS contract is signed.
3. Data confidentiality	SaaS applications are equipped with high security access supported with reliable IT infrastructures.
4. Integrated information	SaaS adopters are provided with a complete package of an integrated application and supported services.
5. Service availability	– SaaS adopters would be able to access the applications at anytime and any location – SaaS adopters would be equipped with a broader selection of SaaS applications
6. Service reliability	SaaS adopters would be provided with continuous supports and services from technical expertise.
7. Regulatory compliance	– SaaS adopters would be updated with the latest technology and software versions – SaaS adopters would be equipped with the availability to customize the applications

3.2 SaaS Maturity model takes the perspectives of clients when perceiving SaaS benefits

In Subchapter 3.1, we have presented key characteristics of Software as a Service (SaaS) benefits which can be promised by vendors. This subchapter will incorporate the benefits from the point of view of SaaS adopters. In order to accommodate the perspective of SaaS adopters, a SaaS maturity model will be developed by considering the key attributes and the key benefits of SaaS adoption within the existing SaaS maturity model. We present a depth analysis to identify the key attributes in *Appendix A, part I:* "Key attributes of SaaS adoption from the existing SaaS maturity model" and the key benefits in *Appendix A, part II:* "Key benefits of SaaS adoption from the existing SaaS maturity model", respectively. According to this maturity model, an interview guideline and questionnaire guide to perceive benefits from SaaS adopters will be developed. The rest of this subchapter will discuss about the developed SaaS maturity model which is presented in this thesis.

Within *Appendix A*, we have presented a depth analysis toward the existing SaaS maturity models in both business and scientific communities from which benefits of SaaS can be identified in each maturity level. From Microsoft's model, we identified three groups of key benefits, which are related to *efficient and effective services, interoperability of services,* and *integrated and secured services*; whereas we found four groups of key benefits within Forrester's model, which are *business and IT alignment, business and community engagement, dynamic and interoperable services,* and *agile delivery*. Kang's model resulted in three groups of key benefits, which are *integrated services, effective and efficient services, and SOA benefits.*

Table 3.2 The developed maturity model incorporates benefits of SaaS in each maturity model

<table>
<tr><th rowspan="2">Maturity Level</th><th rowspan="2">Key characteristics of the perceived benefits of SaaS</th><th colspan="3">Key benefits of SaaS from the perspective of the adopters</th><th rowspan="2">The related key attributes of SaaS applications</th></tr>
<tr><th>Microsoft [Carraro & Chong, 2006a]</th><th>Forrester [Ried et al., 2008]</th><th>Kang et al. [2010]</th></tr>
<tr><td>0 (Potential)</td><td>Utility based: only pay per use or pay per user</td><td rowspan="3">efficient and effective services</td><td rowspan="2">business and IT alignment</td><td rowspan="3">effective and efficient services</td><td>Market</td></tr>
<tr><td>1 (Prospective)</td><td>SLA driven: define policy and delivery parameters to measure performance</td><td>- Standard Support
- Market</td></tr>
<tr><td>2 (Promising)</td><td>- Shared resources efficient: allow configurations while keeping each tenant data separated
- Community contribution: perform strategic corporate social responsibility</td><td rowspan="3">business and community engagement</td><td>- Standard Support
- Configurability
- Market</td></tr>
<tr><td>3 (Achieving)</td><td>- Reliability and fault tolerance: ensure continuous service delivery while eliminating disruption to business
- Flexible and scalable: be elastic but scalable in order to meet business changes</td><td rowspan="2">interoper-ability of services</td><td>integrated services</td><td>- Standard Support
- Configurability
- Multi-tenant efficiency
- Integration
- Scalability
- Market</td></tr>
<tr><td>4 (Stabilizing)</td><td>- Collaborative and smart: maintain flexibility of configuring applications equipped with continuous support and services
- Credible and accountable: maintain reliability and availability of services</td><td>dynamic and interoperable services</td><td rowspan="2">SOA benefits</td><td>- Standard Support
- Configurability
- Multi-Tenant efficiency
- Scalability
- Integration
- Market
- Development
- Scalability (of business)</td></tr>
<tr><td>5 (Optimizing)</td><td>- Nimbleness: optimize enterprise resources through infrastructure sharing while ensuring data confidentiality
- Sustainable and successful: continuously improve services while fostering pace and stability of delivering value to tenants</td><td>integrated and secured services</td><td>agile delivery</td><td>- Standard Support
- Configurability
- Multi-Tenant efficiency
- Scalability
- Integration
- Security
- Market
- Development
- Scalability (of business)
- Communication</td></tr>
</table>

The key benefits from the existing maturity models will serve inputs to developing a maturity model which can characterize the perceived benefits of SaaS from the point of view of SaaS adopters. The rest of this (sub) subchapter will discuss about the developed maturity model which incorporates the key benefits of SaaS from the existing maturity levels when determining key characteristics of the perceived benefits of SaaS for each maturity level of SaaS. Therefore, the developed maturity level will provide information about to what extent the perceived benefits can be fulfilled by an enterprise when assessing the adoption of SaaS applications within its business process.

From Table 3.2, we can indicate six levels of maturity within which each level represents key characteristics of the perceived benefits of SaaS. The maturity levels are *Level 0 (Potential), Level 1(Prospective), Level 2 (Promising), Level 3 (Achieving), Level 4 (Stabilizing),* and *Level 5 (Optimizing)*. The first three levels (Level 0 to Level 2) from the lowest level are represented as an attributive word which shows that in these earlier levels, achieving benefits are dependent to many factors, e.g. capabilities of the adopters to entail risk of outsourcing to the providers, clear understanding toward service level from both the adopters and the providers, and capabilities of the providers to ensure such level can be achieved. While in the next three levels (Level 3 to Level 5), benefit generations are likely due to happen because these levels shows that enterprises have been aware that IT can help to manage effectively and efficiently and to align business and IT goals. Therefore, enterprises may actively contribute to the achievement of more benefits of SaaS in the higher levels of maturity model.

Furthermore, we have mapped the key characteristic of the perceived benefits of SaaS within the developed maturity model into the key benefits of SaaS from the perspective of the adopters according to the existing maturity models, including the model which is developed by Microsoft [Carraro & Chong, 2006a], Forrester [Ried et al., 2008], and Kang et al. [2010]. The key attributes of SaaS applications which are related to each maturity model have also been identified in Table 3.2. This mapping provides important relationship between key attributes that can indicate characteristic capabilities of SaaS-based applications and certain benefits of SaaS which can be expected from adopting the applications.

There are ten key characteristics which are distributed across different levels of the developed maturity model. Those characteristics are *utility based* at Level 0 (Potential)*; SLA driven* at Level 1 (Prospective); *shared multitenant efficient*, and *community contribution* at Level 2 (Promising); *reliability and fault tolerance* and *flexible and scalable* at Level 3 (Achieving); *collaborative and smart* and *credible and accountable* at Level 4 (Stabilizing); and *nimbleness* and *sustainable and successful* at Level 5 (Optimizing). Each of the level and the related key characteristics of the perceived benefits of SaaS will be discussed further as following.

a) Level 0 (Potential)

   The first level of maturity represents an early adoption of SaaS which is coming from on-demand outsourcing of software delivery model which is commonly adopted by large enterprises. Typically, traditional client-server application is delivered through application service provider (ASP) model of software delivery. At this level, each enterprise has its own customized version the application which is run on a server in the vendor's site. Because the vendor who offers this model to an enterprise cannot be able to leverage the same application to other enterprises, Level 0 (Potential) cannot qualify as SaaS model.

   Moreover, an enterprise may still experience few benefits of transferring risks of managing Information Technology (IT)-related process and the related infrastructures, including installing, operating, maintaining during lifecycle of software delivery model. This opportunity can be regarded as a starting point for the enterprise to potentially achieve benefits from service oriented applications which have been rapidly growing for the last decades. Furthermore, this level does allow an enterprise to gain benefits from *utility-based* of paying per usage or per period since the infrastructure to support the application are outsourced to vendors which consolidate server hardware and administer the IT process within the enterprises. This situation may show efficient and effective management of enterprise resources while aligning business and IT goals.

b) Level 1 (Prospective)

   At this level, the vendors provide packaged applications, e.g. Enterprise Resource Planning (ERP) which is typically offered as a Manual ASP business models that are targeted for midsize enterprises. The packaged applications are not unique like those were developed in Level 0 (Potential), instead they are identical applications which are provided by the vendors

for multiple clients. Therefore, all instances within the applications incorporate the same code of implementation.

Level 1 (Prospective) has similar benefits to Level 1 (Potential) from which enterprises may have a prospective position in gaining benefits from service-oriented applications. In order to standardize their services toward clients, the providers provide a formal contract which describes Service Level Agreements (SLAs). Hence, the benefits are *SLA-driven* from which the vendors and the enterprises agree upon service level which is delivered by the applications in order to measure performance. This situation ensures that a standardized support from vendors should be provided for each tenant regardless lacks of configuration options and lacks of multitenant supports from the vendors.

c) Level 2 (Promising)

The vendors still provide packaged applications like those provided in Level 1. However, Small Medium Sized Enterprises (SMEs) which is targeted in this level of maturity model may configure the applications limited to database and application setting while the vendors kept their data separated from other tenant's data. The enterprises are allowed to change the look-and-feel of the applications within which each instance are wholly isolated from other instances.

Level 2 (Promising) has similar benefits to Level 1 (Prospective) from which enterprises may position themselves strategically as a new entrance to SaaS market. The enterprises may expect *shared resources efficient* benefits within which sufficient infrastructures, e.g. sufficient hardware and storage, are provided by the vendors. At this level, the enterprise may also get benefits of *community contribution* from which enterprises that adopt the similar applications may share their experiences, challenges, and feedback toward the applications.

d) Level 3 (Achieving)

The vendors provide SaaS based applications which are focused on SMEs since they are supported with scalable infrastructures that are shared by multiple clients (tenants). A single instance is provided for all of the clients can be regarded as SaaS adopters while database are integrated across multi tenants. Therefore, authorization and security policy should be structured in order to ensure that each tenant's data is kept separated from other tenants. However, the scalability of the applications is limited considering that SaaS has not yet employed multi-tenant architecture.

The benefits o SaaS in this level include *reliability and fault tolerance* which are provided by the vendors as SaaS providers that allow much more efficient use of enterprise resources, particularly related to IT, which then are translated into cost efficient and effective IT supports. This level also offers the benefits of *flexible and scalable* within which services are scalable in order to meet business changes but customization is only limited for configuring the applications.

e) Level 4 (Stabilizing)

This level of maturity model shows that the providers host multiple tenants with their own configuration options within a single instance. This characteristic is similar to Level 3 (Achieving), but the SaaS applications in Level 4 (Stabilizing) are possible to be scaled up and scaled out depending on the capabilities of vendors and the demands of the adopters. Scaling the data is also possible in this level. Therefore, the development of database size can also be anticipated through a scalable infrastructure.

The benefits which can be expected at this level include *collaborative and smart* by maintaining flexibility of configuring applications. The adopters are also supported with continuous services depending on types of subscriptions which are defined during the agreement of SaaS contract. The benefits of *credible and accountable* can also be expected since the vendors guarantee the reliability and availability of services within SLAs. The vendors aim

at stabilizing their services by keeping relationship with their tenants while expanding their (possible) services to potential customers.

f) Level 5 (Optimizing)

At the optimized level of maturity mode, the providers enable a tenant load balancer within with identical instances are incorporated and each tenant's data are kept separate. The adopters are also able to configure applications and data to meet their needs which are facilitated through metadata service. The configurations can include user interface of the applications, business rules and the related workflow, custom extensions, and access control which is dependent to the chosen types of subscriptions. In order to flexibly customize the applications as necessary, configuration options can be grouped into several scopes and should be supported by a good design interface which facilitates configuration toward the applications. In order to deliver an agile and integrated service, the design of the applications should follow the design principles of Service Oriented Architecture (SOA) which can improve service composition, integration, and communication.

This level may represent optimized benefits of SaaS which accumulate the benefits which may be expected in the lower level of maturity model. These benefits include *nimbleness* which shows that enterprise resources are optimized by shared infrastructure, shared database and shared data schema, while also ensuring data confidentiality across multiple tenants. The providers also ensure that enterprise data can only be accessible for users who are authorized to process the data. If the SaaS providers can be entrusted, then *sustainable and successful* benefits are likely to happen through continuously supports and services toward the application. As a result, the providers can deliver value to the adopters which are supported with a comprehensive application and integration platform that satisfy business demands.

Following the developed maturity model of SaaS in Table 3.2, we design an interview guideline and a questionnaire guideline in order to gather information pertaining to SaaS adoption from the perspective of the adopters. These guidelines for SaaS adopters are provided in *Appendix B, part II*. The key characteristics of the perceived benefits of SaaS within the developed model will be designated as exogenous variables within a comprehensive methodology to assess SaaS benefits which will be discussed further in Chapter 4.

3.3 Design principles of SOA can indicate SaaS benefits

Delivering an application through Software as a Service (SaaS) delivery model will require continuous improvement and supports from SaaS providers to SaaS adopters. SaaS application should be innovative and should be capable of being integrated within a scalable infrastructure while managing enterprise resources efficiently and effectively. On the other hand, it should also be flexible, reliable, interoperable, and agile in order meet business requirements. In order to face the changes over business requirements, the lifecycle process of SaaS pertaining to the delivery of SaaS application should employ the principles of delivering service-oriented applications.

In the light of improving the conceptualization of SaaS benefits, we engage SaaS software delivery model with Service Oriented Architecture (SOA) approach by considering the design principles of SOA [Guo et al., 2007; SOA Systems Inc, 2009; Watson, 2010]. By utilizing these principles, SaaS benefits can be assessed during the whole lifecycle of delivering SaaS and can be directed toward the achievement of strategic goals and benefits of Service Oriented Computing (SOC). This subchapter will discuss about the eight design principles of SOA which are later regarded as key drivers to successfully deliver SaaS applications during the whole lifecycle of SaaS. These principles are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability, and service composability* [Erl, 2007].

Table 3.3 The design principles of SOA emphasize important definition of a good service design

The design principles of SOA	Key points of the principle definition
Standardized service contract	– A service contract should be conceptualized by both SaaS providers and adopters since it defines service level and the related consequences for not being able to deliver certain level of services. – A service contract should accommodate technical descriptions of services; information about service availability, data authorization, and data management; additional services, period of contract, and fees and payment.
Service loose coupling	– A service should be interoperable and agile within which information about services can be shared while remaining independent with other services when executing the process to perform the service. – A service should be provided with configuration options to incorporate business changes.
Service abstraction	– Information about services should be provided only those which are necessary for service communication. – The details of service implementation should be provided appropriately to support vendor diversification options.
Service reusability	– A specific service is less reusable than more generic service. – A service should be designed for multipurpose to accommodate business changes.
Service autonomy	– A service should be autonomous to guarantee that it has controls toward its underlying logic. – A self governed service is autonomous and robust to multiple service requestors or users.
Service statelessness	– A stateless service may reduce its dependencies and thus may increase its availability to multiple service requestors or users. – Level of service availability should be included within service contract.
Service discoverability	– Service discovery mechanism should be provided to service requestors or users. – Service capabilities should be communicated to service requestors or users.
Service composability	– A service should be composed variably because of possible complex configurations to accommodate business changes. – The composability level is closely related to service capability and is inherently dependent to service granularity.

The standardized service contract, the service loose coupling, the service abstraction, and the service discoverability can be included within the early processes of SaaS lifecycle when the providers and the adopters discover services, select the most appropriate one with respect to adopters' resources and providers' capabilities, and decide Service Level Agreements (SLAs) within a SaaS contract. This process represent *service discovery* and *service selection and engagement* processes of SaaS lifecycle. Meanwhile, *service enactment* process incorporates business changes that may implicate service delivery. This process which is in the tail of the lifecycle can involve the service reusability, the service autonomy, the service statelessness, and the service composability which is also related to *service selection and engagement* process. We summarize key points of definition of the design principles in Table 3.3 while the rest of this subchapter will provide brief explanation pertaining to incorporating the design principles of SOA within the lifecycle of SaaS.

a) Standardized service contract

This principle holds an essential part of service contract since it defines content of services, including service specification, technical details of service delivery, and the related regulations which may affect service delivery during the lifecycle of SaaS. The service contract in SaaS software delivery model is usually known as a SaaS contract. Within this contract, additional (legal) documents are included which enable a set of conditions to be accepted by SaaS adopters in order to have services delivered by SaaS providers. These conditions are represented within Service Level Agreements (SLAs) which ensure that the services are delivered according to the description of service levels and the related regulations. The contract may also include payment term according to the chosen subscriptions by the adopters, and the mechanism of reducing payment fees according to the payment term.

Considering the importance of having service level defined as clearly as possible beforehand, the SaaS contract should be conceptualized by both SaaS providers and adopters during service selection and engagement. The adopters may find appropriate services during service discovery process within which the providers publish information with regard to services they are ought to deliver. The contract should state technical descriptions over the delivered applications, e.g. basic cost, period of services, and SLAs; information about availability of services, data management, data confidentiality, and user authorization; and additional services and the related fees. During the contract engagement, it is important to have a formal contract involving people who are responsible for the project of adopting SaaS applications before such project is implemented. For a contract to be valid, both the providers and the adopters should indicate that they agree to its terms and conditions.

b) Service loose coupling

The loose coupling principle promotes services which are interoperable and agile which represent interdependencies among services. Therefore, a service may require information from other services while remaining independent when executing its process. Pertaining to SaaS applications, a single instance is used within multitenant environment while each tenant's data is keep separated. By implementing low dependencies, data confidentiality can be preserved while optimizing enterprise resources and service performance.

This principle ensures that services within SaaS applications can be configured in order to incorporate business changes. To what extent this configuration might be applied should be provided within SaaS contract during service selection and service engagement process. It is also possible to define granularity of services by both the providers and the adopters during service discovery. This possibility shows that business requirements from the adopters are accommodated before the applications are delivered, while the configuration options enable changes over the applications after they are delivered. To indicate performance improvement, these changes should be able to deliver significant impact toward the adopters' business process.

c) Service abstraction

The principle of service abstraction aims at providing only information which is necessary for service communication. For this reason, distinct layers over service architecture for SaaS applications are needed. Referring to Kang et al. [2010], SaaS applications can be designed within four layers of architecture that business, services, system, and data. Abstracting services is also important to keep data confidentiality of each customer (tenant) without tenant knows the details over implementation.

This situation raises high dependency over services from a specific vendor. From the point of view of SaaS adopters, it is important to know the implementation details pertaining to the delivery of SaaS applications in order to prepare for future multiple provider diversifications. Meanwhile, the providers should be able to differentiate themselves among other software vendors, particularly who offer similar products and services. The implementation details may

also include how the applications and the related services are governed by the providers and what role may the adopters involve during this process.

d) Service reusability

This principle is the core part of delivering service-oriented applications. The reusability principle inclines to have more generic specific service since a specific service is less reusable and thus less reusable services cannot be used by multiple service requestors. Hence, a single instance within multitenant environment should be designated as a generic service which can be accessed simultaneously by multiple tenants who may access their own database in the same server accommodated by the providers.

In order to accommodate business changes, services which are provided within SaaS applications should be designed for multipurpose within multitenant environment. The providers should be able to reuse the services in order to serve various business processes and to accommodate changes in business requirements and technology the process of service enactment within SaaS lifecycle. To what extent a service can be reused should be decided when a SaaS contract is agreed during the service selection and engagement.

e) Service autonomy

A service should be autonomous in order to guarantee that a service has control over its underlying logic. There are two types of autonomy [Erl, 2005], which are *service-level autonomy*, and *pure autonomy*. The latter type of autonomy refers to a service which has a complete control over its underlying logic; while the service-level type of autonomy represents the capability of sharing its resources although it has a distinct boundary that separate the service with any other services. A service which is autonomous has self-governance to its logic and thus it is available and robust to multiple service requestors.

In the light of providing reliable services, the providers should be able to design services autonomously. The services provided with regard to the delivered applications should be able to cope with redundant service logic and thus they are able to be reused. It is important to know to what extent the adopters might be dependent toward the delivered applications although the adopters do not necessarily understand the logic underlying the services provided in the application. This can be specified during the process of selecting and engaging services. An autonomous service can be noticed during the process of service enactment since the design principle of service autonomy is related to the implementation of services.

f) Service statelessness

A service should ideally provide information when it is necessary; otherwise it will be stateless. By being stateless, a service may reduce its dependencies and increase its availability to multiple requestors. Therefore, this principle supports effective process and efficient resources by providing information if it is necessary.

In conjunction with SaaS applications, services which are provided to the adopters should be available during the lifecycle of SaaS. Depending on the period of services, the availability of services can be defined and the related conditions should be mentioned within SLAs during the process of service selection and engagement. Furthermore, the availability of services can be updated during the implementation of SaaS applications which is included within the process of service enactment. It is also important to consider the possibility to increase the scalability of application and data during the process of service enactment and thus, SLAs within a SaaS contract should be updated accordingly.

g) Service discoverability

The principle of service discoverability represents the ability of service to provide a discovery mechanism for service requestors who need information about capabilities of a service. This information is provided by service providers which build services and the related descriptions. The providers publish service descriptions that they are ought to offer to service requestors or

even the requestors may be able to demand services from which the providers may fulfil these requirements.

Within a contract of delivering SaaS applications, it should be noted that enterprises which adopt services demand easy access toward the delivered applications. To what extent the related services to support these applications should also be made as clearly as possible and thus the adopters may locate the services efficiently. It is also important to communicate capabilities of services which are provided to assist the adoption of SaaS-based applications toward users.

h) Service composability

The service composability principle represents that a service can be composed variably due to complex configuration to support service-oriented solutions. The composability principle is closely related to the capabilities of a service and inherently dependent to the granularity of that service.

With regard to the delivered SaaS applications, the providers should incorporate the ability to customize the applications which is usually defined during the process of selecting and engaging services. The custom options over the applications might be limited to application and data, but the applications should support multitenant environment. Therefore, the applications can be adjusted continually during the process of service enactment in order to accommodate business changes.

In order to understand SaaS benefits during the whole lifecycle of SaaS, we elaborate both interview guidelines and questionnaire guidelines for SaaS providers and for SaaS adopters which are presented in *Appendix B* by incorporating the design principles of SOA. We aim at focusing on elaborating the design principle during the process of discovering services, selecting and engaging services, and executing services. Therefore, this elaboration can help to understand what a good service design which is promised by the providers and what a good service design which is expected by the adopters. Furthermore, by considering well-established concept of SOA, it is likely that SaaS software delivery model can help enterprises to achieve goals of service oriented application.

3.4 The benefits of SOC drives the achievement of SaaS benefits

We have presented key characteristics of the benefits of Software as a Service (SaaS) from the perspective of SaaS providers and SaaS adopters in Subchapter 3.1 and Subchapter 3.2, accordingly. However, both benefits only involve parts of SaaS lifecycle. For instance, the promised benefits by SaaS providers are conceptualized during the process of service discovery, and service selection and engagement; whereas the perceived benefits by SaaS adopters are conceptualized during the process of service enactment. Meanwhile, SaaS benefits should also be conceptualized during the whole lifecycle of SaaS since conceptualizing the benefits of SaaS in a separate lifecycle process of SaaS within different perspectives may result in disagreement toward each other. For this reason, we employ the design principles of Service Oriented Architecture (SOA) during the whole processes of SaaS lifecycle.

In order to accommodate different perspectives of conceptualizing SaaS benefits, we refer to the strategic goals and benefits of Service Oriented Computing (SOC) which were introduced by Erl [2007]. These benefits can also be referred to as the benefits of SOC. The strategic goals and benefits of SOC, aim at achieving successful adopting service-oriented applications. They include seven so-called established benefits, which are *increased of inherent interoperability, increased of federation, increased of vendor diversification options, increased alignment of business and technology domains, increased of ROI, increased of organizational agility,* and *reduced of IT burden*. These benefits will be discussed further as following.

a) Increased of inherent interoperability

Interoperability is related to the accessibility to exchange information. In order to facilitate the easiness of exchanging information, enterprise data needs to be integrated which might result more complex issues in managing the data. With regard to service architecture to accommodate this process, interoperable services facilitate universality of multilingual access toward an application; allow collaboration of communities from different disciplines and incorporate varying needs of different perspectives of people who work together to share enterprise resources.

The goal of service oriented computing is to increase the inherent interoperability of a service while minimizing its dependency. The service should be reusable, available, discoverable, autonomous, loosely-coupled, and standardized and composed effectively in order to increase its interoperability. These characteristics of inherent interoperability can help an enterprise to ensure the ease-of-interoperability while it can focus more on its core business process.

b) Increased of federation

A federated management of enterprise resources which are related with Information Technology (IT) allows abstraction of information in order to protect the underlying details of service implementation while ensuring that services are delivered according to their descriptions. In order to increase federation of services, standardization becomes an important aspect which should be considered when a service is designed. Therefore, this standardization can lead to a harmonized IT environment regardless the details of solution logics which underlie the implementation of services.

The goal of service oriented computing is to increase federation of services within which enterprise resources are united while maintaining their self-governance. This federation can be accomplished through standardized but composable services each of which are encapsulated consistently within various environment. Therefore, a service should be standardized, loosely-coupled and abstracted in order to protect the underlying implementation of service.

c) Increased of vendor diversification options

Vendor diversification options refer to the ability of an enterprise to choose technology products which are offered by vendors from their "best-of-breed" product. Although a vendor-diversification environment does not necessarily provide benefits to an enterprise, but it is beneficial for the enterprise to have diversification options when it is necessary. Therefore, the enterprise may have more freedom to customize and even to replace the technology which is not tied by any specific vendor platform.

A contract of delivering the solution of service-oriented applications should be standardized in order not to rely on a specific vendor platform and the related technologies while the details of service implementation is hidden in order to accommodate the possibilities for future vendor diversifications. Therefore these details can be abstracted and thus the enterprise is allowed to diversify the delivered applications.

d) Increased alignment of business and technology domains

Business and IT alignment is often associated with the capabilities of technology to address business requirements which are expressed by business logics. These logics should facilitate immediate business changes and therefore business logics which are represented within a service design should be capable of aligning automation technology with business requirements.

For this reason, a service should be designed by incorporating business and technology perspectives while accommodating business changes and technology innovation. It should be reusable, discoverable, composable and autonomous to facilitate business changes. However, a

service contract should be standardized in order to keep the constant alignment between business and IT goals.

e) Increased of ROI

A cost effective solution is often measured in terms of return on investment (ROI). However, IT investments mostly require financial overhead upfront and it often continues arising while benefits of these investment are not yet to see. Therefore, IT investments are usually problematic since these investments involve complex environment of delivering services to support business while accommodating business changes and maintaining continuous services.

A service should be created by incorporating an agnostic solution logic that fits to multi purposes which can be composed repeatedly for different service requestors in order to automate different business logics in different service-oriented solutions. Therefore, a service should be standardized and abstracted but loosely-coupled; able to reuse but autonomous and remain stateless; discoverable and composable in order to provide more value while minimizing the risk of miscommunication of services.

f) Increased of organization agility

Organization agility is often represented as the capabilities of responding to business changes in order to address immediate strategic actions rapidly and gain strategic benefits significantly. Thus, business changes would require less custom development effort since business logics to accommodate the changes are positioned as reusable IT assets. However, it is important to acknowledge that service oriented applications are more focused on a strategic solution in establishing an agile organization rather than a tactical solution in delivering solution logic rapidly as commonly found in an agile development approach.

A service should be designed in a highly standardized manner but in preserving its reusability for multi purposes of a specific business requirements and enterprise resources. Business changes also include changing toward regulatory standards that are related to service-oriented applications. Therefore, a service can be repeatedly composed into different configuration options while remain loosely-coupled in abstracting services. Therefore, it should be autonomous while being stateful in order to increase its availability and discoverability.

g) Reduced of IT burden

Service oriented applications were introduced to increase business value by leveraging IT effectively and efficiently while minimizing operational costs and reducing redundant business logics through reusability concept which accommodate service composition. As a result, an organization can respond to business changes in a more agile manner and thus create less IT burden toward the organization.

In order to reduce IT burden within an enterprise, a service contract should accommodate reusability and composability by autonomously reducing redundant business logic. A service should be governed by considering loosely coupled and abstracted concept within which service implementation in accommodating business changing would not hinder the operational of business process. Therefore, it is important for a service to be stateful, and discoverable in order to increase its scalability and to minimize miscommunication, respectively.

Furthermore, Erl [2007] particularly refers to successful adoption of SOA concept in order to achieve the benefits of SOC while Janssen & Joha [2011] argued that SOA is one of the enablers of SaaS. Therefore, in the research presented in this thesis, we aim at achieving the strategic goals and benefits of SOC through different perspectives of SaaS benefits during the lifecycle of SaaS.

Table 3.4 The relationship between the key characteristics of the promised benefits and the benefits of SOC can be initiated in order to structure the benefits of SaaS from vendor's perspective

No	Key characteristics of the promised benefits of SaaS	The strategic goals and benefits of SOC
1.	**resource efficiency**	- increased of ROI - reduced of IT burden - increased alignment of business and technology domains
2.	**process effectiveness**	
3.	**data confidentiality**	increased alignment of business and technology domains
4.	**integrated information**	- increased of vendor diversification options - increased alignment of business and technology domains
5.	**service availability**	- increased of inherent interoperability - increased of organizational agility - increased alignment of business and technology domains
6.	**service reliability**	
7.	**regulatory compliance**	- increased of federation - increased of organizational agility - increased alignment of business and technology domains

In the light of addressing the goal of the research, we would like to set upon different structures of SaaS benefits each of which incorporates different perspectives of SaaS providers, SaaS adopters, and the lifecycle process of SaaS. Therefore, we hope to find a sound understanding of SaaS benefits that can be approached from different perspectives. By directing SaaS benefits from different perspectives into the achievement of the benefits of SOC, we hope to have a basic understanding of SaaS benefits across different perspectives, and to find significance contribution from each perspective toward the achievement of SaaS benefits.

In order to assess the benefits of SaaS which will be structured further in Chapter 4, we present our initial judgment towards the structure of SaaS benefits which are conceptualized from different perspectives. Furthermore, a standardized definition toward SaaS benefits can be expected by referring to the benefits of SOC while incorporating different perspectives to enrich the achievements of the benefits of SaaS. For this reason, we indicate the relationships between different perspectives in conceptualizing SaaS benefits and the benefits of SOC. These relationships show the link between the benefits of SOC and the three perspectives, i.e. the promised benefits, the perceived benefits, and the lifecycle process of SaaS which employ the design principles of SOA. Each perspective can be indicated by the key characteristics of the associated perspective.

The first relationship is depicted in Table 3.4 which shows the relationship between the key characteristics of the promised benefits of SaaS, and the benefits of SOC. This relationship serves a basic judgment to study the contributions of different characteristics of the promised benefits toward the achievement of the benefits of SOC. It is noted from this table that every characteristic can help to achieve increased alignment of business and technology domains.

Resource efficiency and *process effectiveness* characteristic aims at managing enterprise resources efficiently and effectively from which business managements expect an improved of business value over IT investments. Therefore, these characteristics can lead to the achievement of the increased of return on investment (ROI), the reduced of IT burden, and the increased alignment of business and technology domains. Meanwhile, enterprise data should be kept secured in order to prevent misused of the data which might harm business performance. This goal is both expected by business management who demand a highly secured business environment for exchanging data, and by IT experts who provide services to fulfil the demand from business.

Table 3.5 The relationship between the key characteristics of the perceived benefits and the benefits of SOC can be initiated in order to structure the benefits of SaaS from client's perspective

No	Key characteristics of the perceived benefits of SaaS	The developed SaaS maturity level	The strategic goals and benefits of SOC
1.	**utility based**	*Level 0: Potential*	- reduced of IT burden - increased alignment of business and technology domains
2.	**SLA driven**	*Level 1: Prospective*	increased alignment of business and technology domains
3.	**shared multitenant efficient**	*Level 2: Promising*	- increased of ROI - increased of federation - increased alignment of business and technology domains
4.	**community contribution**		
5.	**reliability and fault tolerance**	*Level 3: Achieving*	- increased of ROI - increased of vendor diversification options - increased of federation - increased alignment of business and technology domains
6.	**flexible and scalable**		
7.	**collaborative and smart**	*Level 4: Stabilizing*	- increased of vendor diversification options - increased of federation - increased of organizational agility - increased alignment of business and technology domains
8.	**credible and accountable**		
9.	**nimbleness**	*Level 5: Optimizing*	- increased of inherent interoperability - increased of organizational agility - increased alignment of business and technology domains
10.	**sustainable and successful**		

Hence, *data confidentiality* is important to help the achievement of the increased alignment of business and technology domains. Moreover, business managements demand a helicopter overview toward their business performance. *Integrated (business) information* is thus needed to serve this purpose which can also help to achieve the increased alignment of business and technology domains. By having integrated information over their business, enterprises are able to have more possibilities to diversify vendor to supply their business needs since they are allowed to choose "best-of-breed" technology products which fit on the purpose for their business process, and even each process within product lifecycle. For this reason, integrated information characteristic can also lead to the achievement of the increased of vendor diversification options. Service availability and service reliability are of important aspects in order to successfully deliver IT solutions continuously to enterprises. If services related to IT solutions are delivered continuously, then inherent interoperability of the services can be increased. By being available and reliable within a certain period of service delivery, the services can respond to business changes strategically in order to accommodate business needs. Therefore, *service availability* and *service reliability* characteristics can also help to achieve the benefits of the increased of organizational agility, and the increased alignment of business and technology domains. Furthermore, by having abilities to respond to business changes, enterprises can also indicate a *regulatory compliance* characteristic within which different regulations might be applied within enterprise business process overtime. Thus, *regulatory compliance* characteristic can help to achieve the benefits of increased of federation; while keeping the benefits of the increased of organizational agility, and the increased alignment of business and technology domains.

We present Table 3.5 in order to understand the relationship between the key characteristics of the perceived benefits of SaaS and the benefits of SOC. This table provides a proposition to study the significance of different characteristics of the perceived benefits toward the achievement of the benefits of SOC. From this table, we may also further identify adoption of different transformations of SaaS-based application that can indicate different achievement of the benefits of SaaS and the benefits of SOC. It is noted from this table that almost all of the perceived benefits can help to achieve the benefit of increased of alignment of business and technology domains.

Table 3.6 The relationship between the design principles of SOA and the benefits of SOC can be initiated in order to structure the benefits of SaaS from process's perspective during the lifecycle of SaaS (adapted from Erl, 2007)

No	The design principles of SOA	The strategic goals and benefits of SOC
1.	standardized service contract	- increased of inherent interoperability - increased of federation - increased of vendor diversification options - increased alignment of business and technology domains - increased of ROI - increased of organizational agility - reduced of IT burden
2.	service loose coupling	- increased of inherent interoperability - increased of federation - increased of vendor diversification options - increased of ROI - increased of organizational agility - reduced of IT burden
3.	service abstraction	
4.	service reusability	- increased of inherent interoperability - increased alignment of business and technology domains - increased of ROI - increased of organizational agility - reduced of IT burden
5.	service autonomy	- increased of inherent interoperability - increased of vendor diversification options - increased alignment of business and technology domains - increased of ROI - increased of organizational agility - reduced of IT burden
6.	service statelessness	- increased of inherent interoperability - increased of ROI - increased of organizational agility - reduced of IT burden
7.	service discoverability	- increased of inherent interoperability - increased alignment of business and technology domains - increased of ROI - increased of organizational agility - reduced of IT burden
8.	service composability	

An investment toward IT solutions often involves a decision upon the person who will operate the system, and how the system will be maintained. The latter decision is considered important since it will prolong a good service which is provided by the IT solutions. By transferring the risk of prolonging a good service, an enterprise indicates a *utility based* characteristic by outsourcing an IT solution through a SaaS model which is paid per use and or per period. Hence, this characteristic can lead to the achievement of the reduced of IT burden while increasing alignment of business and technology domains by providing IT solution. Moreover, the IT solution is delivered according to Service Level agreements (SLAs) between vendors and customers. By being an *SLA driven*, an enterprise can align their business and technology domains.

Meanwhile, utilizing SaaS software delivery model aims at delivering a *shared multitenant efficient*. Following this, the increased of ROI can be expected and alignment of business and technology domains can be increased since enterprise resources are managed effectively and efficiently. Therefore, *reliable services* can be expected while minimizing level of *fault tolerance*. In this case, the increased of ROI and the increased alignment of business and technology domains can also be expected since services to support IT solutions are always available and reliable within a certain period of delivering services.

On the other hand, services should be *flexible and scalable* in order to accommodate different business requirements. By referring to standard best practices of delivering IT solutions through a SaaS delivery model, enterprises may also contribute to community since enterprises can help to provide a rich implementation of SaaS concept in general and of standard best practices in particular. The characteristic of *community contribution* can help to increase federation and alignment of business and technology domains by considering enterprise contribution to enrich the implementation of SaaS concept. Furthermore, enterprises can also gain the benefits of the increased of vendor diversification options by having their IT solutions delivered in a flexible and scalable manner while remain being *collaborative and smart* in responding business changes.

Credibility and accountability can help to improve organizational agility while aligning business and technology domains. As a result, enterprises can maintain their *nimbleness* in responding to business changes while optimizing their ability to gain benefits from SaaS. Therefore, the benefits of the increased of inherent interoperability and the increased of organizational agility can be expected considering *sustainable and successful* delivery of IT solutions through SaaS. An increased alignment of business and technology domains is likely to come since enterprises are able to expect continuous supports of IT solutions within their business process.

Furthermore, we present Table 3.6 in order to represent the relationship between the design principles of Service Oriented Architecture (SOA) and the benefits of SOC. This relationship was proposed by Erl [2007] who aimed at realizing benefits of service-oriented solutions by employing the principles of SOA when designing a service-oriented application. In the research presented in this thesis, we elaborate his idea by engaging SaaS software delivery model with the design principles by which we design and implement services pertaining to SaaS applications during the whole lifecycle of SaaS. According to Table 3.6, it is noted that all of the design principles can help to achieve the following four strategic goals and benefits of SOC: the increased of inherent interoperability, the increased of ROI, the increased of organizational agility, and the reduced of IT burden. The fact that the design principles are interrelated each other and so are the benefits of SOC would be disregarded when developing the model of SaaS benefit structure in Chapter 4 in order to simplify the research scope while keeping the aim of answering the research question.

3.5 Conclusion

We have presented earlier in this chapter that the benefits of Software as a Service (SaaS) can be appreciated from three perspectives, which are the perspective of SaaS providers which represent vendors who provide SaaS applications, the perspective of SaaS adopters which represent clients who adopt SaaS applications, and the perspective of the lifecycle process of SaaS during the delivery of SaaS applications. The key characteristics of the benefits of SaaS in each perspective have been discussed subsequently in Subchapter 3.1, Subchapter 3.2, and Subchapter 3.3. Furthermore, the key characteristics in each perspective are directed to the achievement of the strategic goals and benefits of Service Oriented Computing (SOC), which are often referred to as the benefits of SOC that has been discussed in Subchapter 3.4.

The key characteristics of the promised benefits of SaaS are driven from the key criteria of delivering services through IT supports which are usually stated in Service Level Agreements (SLAs) by considering that operationalizing these key criteria in SLAs will likely result in achieving benefits of SaaS. The key characteristics of the promised benefits of SaaS include *resource efficiency, process effectiveness, data confidentiality, integrated information, service availability, service reliability*, and *regulatory compliance* as have been discussed in Subchapter 3.1.

Meanwhile, the key characteristics of the perceived benefits of SaaS can be identified during the adoption of SaaS-based application which can be characterized by certain key attributes of SaaS applications. Within Subchapter 3.2, we have presented six levels of SaaS-maturity model which can

help to identify the key characteristic of the perceived benefits and key attributes of SaaS applications at different levels of maturity model. The *Level 0-Potential* can be indicated by *utility based* characteristic from which very limited SaaS benefits can be expected when adopting a traditional-client server application that is delivered through application service provider (ASP) model. Even though this application cannot be regarded as a SaaS application, the application can be indicated by *market* attribute of SaaS-based application. The *Level 1-Prospective* can be indicated by *SLA driven* characteristic from which limited SaaS benefits can be expected when adopting (manual) ASP-based application. The application at Level 1 adds *standard support* attribute from Level 0. The *Level 2-Promising* can be indicated by the characteristic of *shared multitenant efficient*, and *community contribution* from which promising benefits can be expected when adopting (industrial) ASP-based application. The application at Level 2 adds *configurability* attribute from Level 1. The *Level 3-Achieving* can be indicated by the characteristic of *reliability and fault tolerance* and *flexible and scalable* from which SaaS benefits can be expected from reliable services and effective supports toward traditional SaaS-based application. The application at Level 3 adds *multi-tenant efficiency*, *integration,* and *scalability* attributes from Level 2. The *Level 4-Stabilizing* can be indicated by the characteristic of *collaborative and smart* and *credible and accountable* from which SaaS benefits can be expected from continuous services and limited configuration options toward customizable SaaS-based application. The application at Level 4 adds *development* and *scalability (of business)* attributes from Level 3. The *Level 5-Optimizing* can be indicated by the characteristic of *nimbleness* and *sustainable and successful* from which SaaS benefits can be optimized through stable but interoperable services within dynamic SaaS-based application. The application at Level 5 adds *security* and *communication* attribute from Level 4.

Furthermore, the perspective of the lifecycle process of SaaS is addressed by incorporating the design principles of Service Oriented Architecture (SOA) during the whole lifecycle. The design principles of *standardized service contract, service loose coupling, service abstraction,* and *service discoverability* are incorporated during the process of *service discovery* and *service selection and engagement* during the SaaS lifecycle; while the design principles of *service reusability, service autonomy, service statelessness,* and *service composability* are incorporated within the process of *service selection and engagement* and *service enactment* during the SaaS lifecycle. These principles have been discussed thoroughly in Subchapter 3.3.

In Subchapter 3.4, we have discussed about the benefits of SaaS which is a set of common goals and benefits which is commonly used for enterprises who aim at delivering service-oriented application. By referring to these benefits, the key characteristics of benefits from each perspective are directed to the achievement of the benefits of SOC. From this mapping, we aim at presenting a better view on how to overcome different opinions in realizing the benefits of SaaS.

CHAPTER

4

METHODOLOGY FOR SAAS BENEFIT ASSESMENT

"Those who believe and do right: Joy is for them, and bliss (their) journey´s end."
[Surah Ar-Ra'd, 29]

The research presented in this paper aims at assessing benefits of Software as a Service (SaaS) by considering different perspectives in realizing the benefits of SaaS. These perspectives are the perspective of vendors as SaaS providers, the perspective of Small Medium Sized Enterprises (SMEs) as SaaS adopters, which both are engaged within different processes of SaaS lifecycle. The benefits which are conceptualized by SaaS providers are represented as the promised benefits while those conceptualized by SaaS adopters are represented as the perceived benefits. Furthermore, conflicting interest might occur when SaaS benefits are conceptualized from different perspectives. As a result, the promised benefits which are proposed by SaaS provider during the early phase of SaaS lifecycle (before the application is implemented) can stray from the perceived benefits which are realized by SaaS adopters during the later phase of SaaS lifecycle (when the application is implemented). For this reason, we also consider the design principles of Service Oriented Architecture (SOA) during the lifecycle process of SaaS in order to deliver good services in the whole lifecycle of SaaS. We have presented the key characteristics of SaaS benefits in each perspective in Chapter 3. This chapter aims at addressing the fifth sub-question presented in Subchapter 1.2, which is:

Q5) What methodology can be used to structure the benefits of SaaS? [*descriptive analysis by developing a comprehensive methodology to assess SaaS benefits*]

In order to accommodate different perspectives in conceptualizing the benefits, we refer to the strategic goals and benefits of Service Oriented Computing (SOC) which can also be referred to as the benefits of SOC. We have presented our initial judgments regarding the relationship between different perspectives in realizing SaaS benefits and the benefits of SOC in Subchapter 3.4. The underlying relationship between different perspectives of SaaS benefits and the benefits of SOC can be understood by testing the following hypotheses.

Hypothesis 1 (H_1) : *Benefits of SaaS which are promised by providers enable the achievement of strategic goals and benefits of Service Oriented Computing (SOC).* The H_1 can be translated into 18 sub-hypotheses as discussed further in *Appendix C, Part I.*

Hypothesis 2 (H_2) : *Benefits of SaaS which are perceived by adopters can be directed to the achievement of strategic goals and benefits of Service Oriented Computing (SOC).* The H_2 can be translated into 16 sub-hypotheses as discussed further in *Appendix C, Part I.*

Hypothesis 3 (H_2) : *Benefits of SaaS can be appreciated during the whole lifecycle of SaaS by incorporating the design principles of SOA.* By incorporating these principles, it is more likely that SaaS can achieve strategic goals and benefits of SOC. The H_3 can be translated into 44 sub-hypotheses as discussed further in *Appendix C, Part I.*

In the light of assessing benefits of SaaS, this subchapter will focus on designing a comprehensive methodology to approach the benefits. Following this, we apply Structure Equation Modeling (SEM) by utilizing Partial Least Squares (PLS) Path modeling method in order to estimate the benefits by considering causal relations represented in our hypotheses. We apply PLS approach using SEM in this research by considering the following reasons:

- The relationship between SaaS maturity, the design principles of SOA, and the benefits of Service Oriented Computing (SOC) is relatively new - although there is a number of literatures discussed the design principles of SOA, and the benefits of SOC (e.g. Erl, 2007; Sarno, *in press*)
- Path diagrams to structure the benefits of SaaS from different perspectives, are relatively complex within which large number of LVs and indicator variables are involved
- Latent variables (LVs) that represent the benefits of SaaS are explicitly estimated according to a limited theoretical information, and therefore a causal predictive analysis is performed

The comprehensive methodology consists of three main steps in order to understand the benefits of SaaS, conceptualize the structures of SaaS benefits, and estimate the achievement of the benefits of SaaS. **First**, data gathering methods should be applied in order to collect research data regarding benefits of SaaS. In this research, we employ interview-method and questionnaire-method which both aims at understanding the benefits of delivering SaaS ERP system within SMEs. In order not to be handicapped by divergent views on conceptualizing SaaS benefits from critical actors which are SaaS providers and adopters, both data gathering methods are equipped with questions which are related to the lifecycle process of SaaS when delivering the system within SMEs. Therefore, the design principles of SOA are accommodated within interview and questionnaire questions which are directed to SaaS providers and adopters. The application of this step is discussed further in *Appendix B* about collecting research data, and *Appendix E* about identifying research data.

Second, a structural modeling method should be considered to structure benefits of SaaS. In this research, we employ PLS Path modeling method which includes designing a path diagram to indicate relationships between variables and indicators within conceptual model of SaaS benefits that have been discussed in Chapter 3. Following this, three path diagrams are constructed in order to conceptualize the benefits of SaaS. The path diagrams provide structures of indicators and variables which can be used to estimate the benefits of SaaS. A number of Latent Variables (LVs) and the associated indicators are structured in order to represent the conceptualization of SaaS benefits in each diagram which represents the promised benefits from SaaS providers, the perceived benefits from SaaS adopters, and the benefits of good services from the implementation of the design principles or SOA during the whole lifecycle of SaaS. Furthermore, each of the conceptualization of these benefits is directed to the achievement of the benefits of SOC. This chapter will discuss further about structuring three path diagrams that can represent each perspective when realizing benefits of SaaS.

Third, causal relations of variable constructs within benefit structures in each path diagram are estimated by following PLS Path modeling. This method is chosen since the comprehensive methodology aims at contributing to theory development rather than contributing to theory testing. Furthermore, constructing benefits of SaaS by delivering a SaaS ERP system is relatively new concept and newly developed [Götz et al., 2010; Esposito Vinzi et al., 2010]. Thus, predicting the SaaS benefits are considered more important in the research rather than estimating the parameters of SaaS benefits in specific. The application of this step will be discussed further in Chapter 6 about quantitative analysis of the benefits of SaaS.

The rest of this chapter will discuss about structuring the aforementioned hypotheses which are posed in the research into three path diagrams which are structured following the PLS Path modeling. The three path diagrams will be developed according to conceptual models which have been discussed in Chapter 3. Each of the path diagrams aims at answering three hypotheses which have been discussed

earlier in this chapter, accordingly. They are related to structuring the promised benefits, the perceived benefits, and process benefits which will be discussed further as followings. For this reason, Subchapter 4.1 will discuss about the promised benefit model that aims at answering the first hypothesis, while Subchapter 4.1 will discuss about the perceived benefit model that aims at answering the second hypothesis. Then, Subchapter 4.3 will discuss about the process benefit model to answer the third hypothesis. We also present a conclusion in Subchapter 4.4 to outline the important findings throughout this chapter.

4.1 The promised benefit model affirms the first hypothesis

This subchapter aims at developing a model in order to answer the first hypothesis in the research, which is "*Benefits of SaaS which are promised by providers enable the achievement of strategic goals and benefits of Service Oriented Computing (SOC)*". For this reason, we would like to discuss about the model of the promised benefits by referring to standardized notations which are explained within the Partial Least Squares (PLS) Path modeling.

From Subchapter 3.1, we have identified key characteristics of the promised benefits of SaaS, which are *resource efficiency, process effectiveness, data confidentiality, integrated information, service availability, service reliability*, and *regulatory compliance*. We operationalize the key characteristics of the promised benefits as indicator of exogenous variables. According to these characteristics, we define three promised benefits which are *technology-enabled business support benefits*, *interactive support benefits,* and *comprehensive support benefits* as depicted in "exogenous variables"-column in Table 4.1. We refer the key characteristic benefits as "indicators of exogenous variables" while the promised benefits as "exogenous variables" as can be seen further in Table 4.1.

The *technology-enabled business support benefits* acts as the first exogenous variables (ξ_{a1}) which can be reflected by two (reflective) indicators representing the key characteristics of the promised benefits of resource efficiency (x_{a11}), and process effectiveness (x_{a12}). The *interactive support benefits* represent the second exogenous variables (ξ_{a2}) which can be reflected by three (reflective) indicators representing the key characteristics of the promised benefits of service availability (x_{a21}), service reliability (x_{a22}), and data confidentiality (x_{a23}). The *comprehensive support benefits* acts as the third exogenous variables (ξ_{a3}) which can be reflected by two (reflective) indicators representing the key characteristics of the promised benefits of integrated information (x_{a31}) and regulatory compliance (x_{a32}). Meanwhile, we operationalize the strategic goals and benefits of SOC, or simply the benefits of SOC, for the related promised benefits as "endogenous variables". In order to establish the benefits of SOC, we provide a list of indicators which can be used to measure these (unobservable) endogenous variables. The indicators are represented as reflective indicators since they are designated to be positively correlated with the (unobservable) endogenous variables and thus the benefits of SOC as the endogenous variables can be measured by the associated indicators altogether.

There are seven endogenous variables which represent the benefits of SOC. They are *increased of inherent interoperability, increased of federation, increased of vendor diversification options, increased alignment of business and technology domains, increased of ROI, increased of organizational agility,* and *reduced of IT burden*. The increased of inherent interoperability (η_{a1}) can be constructed by three reflective indicators, which are *ease-of-access* (y_{a11}), *ease-of-information exchange* (y_{a12}), and *community collaboration* (y_{a13}). The increased of federation (η_{a2}) can be constructed by two reflective indicators, which are *standardization of IT environment* (y_{a21}), and *protection of implementation details* (y_{a22}). The increased of vendor diversification options (η_{a3}) can be constructed by two reflective indicators, which are *standardization of IT environment* (y_{a31}), and *protection of implementation details* (y_{a32}).

Table 4.1 Defining and operationalizing the promised benefits from the key characteristics of the promised benefits provide a clear understanding toward the structure of the promised benefit model

Indicators of exogenous variables	Exogenous variables	Endogenous variables	Indicators of endogenous variables
- resource efficiency ($\mathbf{x_{a11}}$) - process effectiveness ($\mathbf{x_{a12}}$)	technology-enabled business support benefits (ξ_{a1})	increased of ROI (η_{a5})	- ability to incorporate multi-purpose (y_{a51}) - ability to provide cost-effective solution (y_{a52})
		reduced of IT burden (η_{a7})	- scalability of IT products (y_{a71}) - value of business by leveraging IT products (y_{a72})
		increased alignment of business and technology domains (η_{a4})	- automation of technology innovation (y_{a41}) - capability of addressing immediate business changes (y_{a42})
- service availability ($\mathbf{x_{a21}}$) - service reliability ($\mathbf{x_{a22}}$) - data confidentiality ($\mathbf{x_{a23}}$)	interactive support benefits (ξ_{a2})	increased of inherent interoperability (η_{a1})	- ease-of-access (y_{a11}) - ease-of-information exchange (y_{a12}) - community collaboration (y_{a13})
		increased of organizational agility (η_{a6})	- capability of responding to business changes (y_{a61}) - strategic solution in establishing an agile organization (y_{a62})
		increased alignment of business and technology domains (η_{a4})	- automation of technology innovation (y_{a41}) - capability of addressing immediate business changes (y_{a42})
- integrated information ($\mathbf{x_{a31}}$) - regulatory compliance ($\mathbf{x_{a32}}$)	comprehensive support benefits (ξ_{a3})	increased of vendor diversification options (η_{a3})	- ability to choose "best-of-breed" of IT products (y_{a31}) - free of vendor lock-in (y_{a32})
		increased of federation (η_{a2})	- standardization of IT environment (y_{a21}) - protection of implementation details (y_{a22})
		increased of organizational agility (η_{a6})	- capability of responding to business changes (y_{a61}) - strategic solution in establishing an agile organization (y_{a62})
		increased alignment of business and technology domains (η_{a4})	- automation of technology innovation (y_{a41}) - capability of addressing immediate business changes (y_{a42})

The increased alignment of business and technology domains (η_{a4}) can be constructed by two reflective indicators, which are *automation of technology innovation* (y_{a41}), and *capability of addressing immediate business changes* (y_{a42}). The increased of ROI (η_{a5}) can be constructed by two reflective indicators, which are *ability to incorporate multi-purpose* (y_{a51}), and *ability to provide cost-effective solution* (y_{a52}). The increased of organizational agility (η_{a6}) can be constructed by two reflective indicators, which are *capability of responding to business changes* (y_{a61}), and *strategic solution in establishing an agile organization* (y_{a62}). The reduced of IT burden (η_{a6}) can be constructed by two reflective indicators, which are *scalability of IT products* (y_{a71}), and *value of business by leveraging IT products* (y_{a72}).

The structural development of the promised benefits in Table 4.1 results in different sub-hypotheses that should be designated in order to study the relationships between the (exogenous or endogenous) variables and the associated indicators, and between exogenous and endogenous variables within the first model. For this reason, we re-design 18 (initial) sub-hypotheses in Table C.1 as discussed within *Appendix C, Part II*. Following this, there are 32 (developed) sub-hypotheses in total within which 22 *correspondence rules* relationship are structured to build the *outer model (measurement model),* and 10 *non-observational hypotheses* and *theoretical definitions* relationship are structured to build the *inner model (structural model)*. The (developed) sub-hypotheses can be found in Table C.4 within *Appendix C, Part II*. Both the structural development of the promised benefits and the (developed) sub-hypotheses are important to structure the model of the promised benefits as depicted in Figure 4.1.

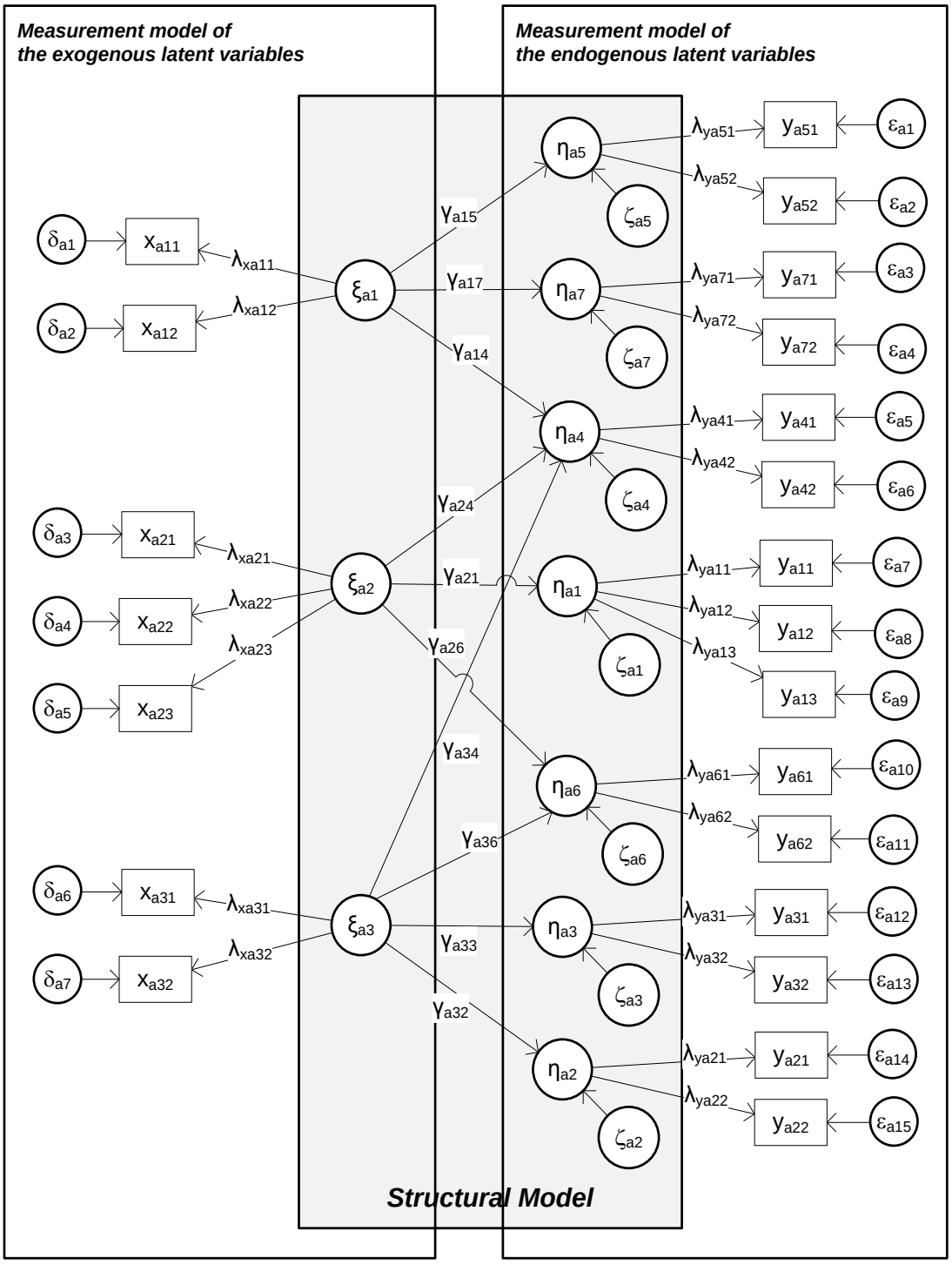


Figure 4.1 Path diagram for the promised benefits shows the relation between the promised benefits, and the benefits of SOC

Table 4.2 A set of equations can be structured according to path diagram for the promised benefit model

No	Equation
1.	$x_{a11} = \lambda_{xa\,11}\xi_{a1} + \delta_{a1}$
2.	$x_{a12} = \lambda_{xa\,12}\xi_{a1} + \delta_{a2}$
3.	$\eta_{a5} = \gamma_{a15}\xi_{a1} + \zeta_{a5}$
4.	$y_{a51} = \lambda_{ay\,51}\eta_{a5} + \varepsilon_{a1}$
5.	$y_{a52} = \lambda_{ya\,52}\eta_{a5} + \varepsilon_{a2}$
6.	$\eta_{a7} = \gamma_{a17}\xi_{a1} + \zeta_{a7}$
7.	$y_{a71} = \lambda_{ya\,71}\eta_{a7} + \varepsilon_{a3}$
8.	$y_{a72} = \lambda_{ya\,72}\eta_{a7} + \varepsilon_{a4}$
9.	$\eta_{a4} = \gamma_{a14}\xi_{a1} + \gamma_{a24}\xi_{a2} + \gamma_{a34}\xi_{a3} + \zeta_{a4}$
10.	$y_{a41} = \lambda_{ya\,41}\eta_{a4} + \varepsilon_{a5}$
11.	$y_{a42} = \lambda_{ya\,42}\eta_{a4} + \varepsilon_{a6}$
12.	$x_{a21} = \lambda_{xa\,21}\xi_{a2} + \delta_{a3}$
13.	$x_{a22} = \lambda_{xa\,22}\xi_{a2} + \delta_{a4}$
14.	$x_{a23} = \lambda_{xa\,23}\xi_{a2} + \delta_{a5}$
15.	$\eta_{a1} = \gamma_{a21}\xi_{a2} + \zeta_{a1}$
16.	$y_{a11} = \lambda_{ya\,11}\eta_{a1} + \varepsilon_{a7}$
17.	$y_{a12} = \lambda_{ya\,12}\eta_{a1} + \varepsilon_{a8}$
18.	$y_{a13} = \lambda_{ya\,13}\eta_{a1} + \varepsilon_{a9}$
19.	$\eta_{a6} = \gamma_{a26}\xi_{a2} + \gamma_{a36}\xi_{a3} + \zeta_{a6}$
20.	$y_{a61} = \lambda_{ya\,61}\eta_{a6} + \varepsilon_{a10}$
21.	$y_{a62} = \lambda_{ya\,62}\eta_{a6} + \varepsilon_{a11}$
22.	$x_{a31} = \lambda_{x31}\xi_{a3} + \delta_{a6}$
23.	$x_{a32} = \lambda_{xa\,32}\xi_{a3} + \delta_{a7}$
24.	$\eta_{a3} = \gamma_{a33}\xi_{a3} + \zeta_{a3}$
25.	$y_{a31} = \lambda_{ya\,31}\eta_{a3} + \varepsilon_{a12}$
26.	$y_{a32} = \lambda_{ya\,32}\eta_{a3} + \varepsilon_{a13}$
27.	$\eta_{a2} = \gamma_{a32}\xi_{a3} + \zeta_{a2}$
28.	$y_{a21} = \lambda_{ya\,21}\eta_{a3} + \varepsilon_{a14}$
29.	$y_{a22} = \lambda_{y22}\eta_{a3} + \varepsilon_{a15}$

Figure 4.1 shows a path diagram which structures the benefits of SaaS which are conceptualized by providers. This conceptualization can be referred to as the promised benefits which are directed to the achievement of the benefits of SOC. The path diagram structures the promised benefits within a measurable model and thus it provides a better understanding in assessing the benefits. Furthermore, a set of equations need to be described in order to measure possible relationships which have been structured in Table 4.2. The model of the promised benefit includes 29 equations within which seven equations are defined to structure the *inner model or structural model* while seven equations are defined for the *outer model* or *measurement model of the exogenous latent variables*. The rest of equations which are 15 equations represent *outer model* or *measurement model of the endogenous latent variables*.

4.2 The perceived benefit model answers the second hypothesis

The second hypothesis in the research presented in this thesis aims at answering the following premise: "*Benefits of SaaS which are perceived by adopters can be directed to the achievement of strategic goals and benefits of Service Oriented Computing (SOC)*". In this (sub) subchapter, we would like to develop a model of perceived benefits in order to answer the second hypothesis in the research. In the light of satisfying the second hypothesis, a second model of perceived benefit is developed within three steps. **First**, we define the key characteristics of the perceived benefits as (reflective) indicators of the (unobservable) exogenous variables. The indicators of the exogenous variables for the second model are *utility based* (x_{b11}), *SLA driven* (x_{b21}), *shared multitenant efficient* (x_{b31}), *community contribution* (x_{b32}), *reliability and fault tolerance* (x_{b41}), *flexible and scalable* (x_{b42}), *collaborative and smart* (x_{b51}), *credible and accountable* (x_{b52}), *nimbleness* (x_{b61}), and *sustainable and successful* (x_{b62}). **Second**, the levels of SaaS maturity model are indicated as the exogenous variables, which are *Level 0-Potential* (ξ_{b1}), *Level 1-Prospective* (ξ_{b2}), *Level 2-Promising* (ξ_{b3}), *Level 3-Achieving* (ξ_{b4}), *Level 4-Stabilizing* (ξ_{b5}), and *Level 5-Optimizing* (ξ_{b6}). **Third**, by referring to the operationalization of the benefits of SOC which have been structured in Subchapter 3.4, we include the endogenous variables and the related indicators of the endogenous variables within the second model. Therefore, the endogenous variables for the second model are similar with the first model but the second model has different relationship structures. In order not to be confused with the similar notation for both models, we indicate the second model by adding the character of "b" for each item in the model as depicted in Table 4.3.

According to Table 4.3, the exogenous variable of Level 0-Potential (ξ_{b1}) is comprised of the indicator of utility based (x_{b11}) whereas the exogenous variable of Level 1-Prospective (ξ_{b2}) is comprised of the indicator of SLA driven (x_{b21}). The exogenous variable of Level 2-Promising (ξ_{b3}) is indicated by the indicator of shared multitenant efficient (x_{b31}), and community contribution (x_{b32}); whereas the exogenous variable of Level 3-Achieving (ξ_{b4}) contains the indicator of reliability and fault tolerance (x_{b41}), and flexible and scalable (x_{b42}). The exogenous variable of Level 4-Stabilizing (ξ_{b5}) is approached by the indicator of collaborative and smart (x_{b51}), and credible and accountable (x_{b52}; while the exogenous variable of Level 5-Optimizing (ξ_{b6}) is comprised of the indicator of nimbleness (x_{b61}), and sustainable and successful (x_{b62}). Meanwhile, the increased of federation (η_{b2}) can be constructed by two (reflective) indicators, which are *standardization of IT environment* (y_{b21}), and *protection of implementation details* (y_{b22}). The increased of vendor diversification options (η_{b3}) can be approached by two (reflective) indicators: *standardization of IT environment* (y_{b31}), and *protection of implementation details* (y_{b32}). The increased alignment of business and technology domains (η_{b4}) can be constructed by two (reflective) indicators, which are *automation of technology innovation* (y_{b41}), and *capability of addressing immediate business changes* (y_{b42}). The increased of ROI (η_{b5}) can be approached by two (reflective) indicators, which are *ability to incorporate multi-purpose* (y_{b51}), and *ability to provide cost-effective solution* (y_{b52}). The increased of organizational agility (η_{b6}) can be constructed by two (reflective) indicators, which are *capability of responding to business changes* (y_{b61}), and *strategic solution in establishing an agile organization* (y_{b62}). The reduced of IT burden (η_{b6}) can be constructed by two (reflective) indicators, which are *scalability of IT products* (y_{b71}), and *value of business by leveraging IT products* (y_{b72}).

The structural development of the perceived benefits as depicted in Table 4.3 results in different sub-hypotheses that should be developed in order to study the relationships between the (exogenous or endogenous) variables and the associated indicators, and between exogenous and endogenous variables within the second model. For this reason, we elaborate 16 (initial) sub-hypotheses which are presented in Table C.2 into 41 (developed) sub-hypotheses which are presented in Table C.5. We discuss about these hypotheses in *Appendix C, Part III*.

Table 4.3 Operationalization of the perceived benefits provide a clear understanding toward the structure of the perceived benefit model

Indicators of exogenous variables	Exogenous variables	Endogenous variables	Indicators of endogenous variables
utility based ($\mathbf{x_{b11}}$)	Level 0: Potential (ξ_{b1})	reduced of IT burden (η_{b7})	- scalability of IT products (y_{b71}) - value of business by leveraging IT products (y_{b72})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
SLA driven ($\mathbf{x_{b21}}$)	Level 1: Prospective (ξ_{b2})	increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
- shared multitenant efficient ($\mathbf{x_{b31}}$) - community contribution ($\mathbf{x_{b32}}$)	Level 2: Promising (ξ_{b3})	increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of federation (η_{b2})	- standardization of IT environment (y_{b21}) - protection of implementation details (y_{b22})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
- reliability and fault tolerance ($\mathbf{x_{b41}}$) - flexible and scalable ($\mathbf{x_{b42}}$)	Level 3: Achieving (ξ_{b4})	increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of vendor diversification options (η_{b3})	- ability to choose "best-of-breed" of IT products (y_{b31}) - free of vendor lock-in (y_{b32})
		increased of federation (η_{b2})	- standardization of IT environment (y_{b21}) - protection of implementation details (y_{b22})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
- collaborative and smart ($\mathbf{x_{b51}}$) - credible and accountable ($\mathbf{x_{b52}}$)	Level 4: Stabilizing (ξ_{b5})	increased of vendor diversification options (η_{b3})	- ability to choose "best-of-breed" of IT products (y_{b31}) - free of vendor lock-in (y_{b32})
		increased of federation (η_{b2})	- standardization of IT environment (y_{b21}) - protection of implementation details (y_{b22})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
- nimbleness ($\mathbf{x_{b61}}$) - sustainable and successful ($\mathbf{x_{b62}}$)	Level 5: Optimizing (ξ_{b6})	increased of inherent interoperability (η_{b1})	- ease-of-access (y_{b11}) - ease-of-information exchange (y_{b12}) - community collaboration (y_{b13})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})

Acceding to Table C.5 in *Appendix C, Part III*, there are 41 sub-hypotheses in total, within which 25 *correspondence rules* relationship are structured to build the *outer model (measurement model),* and 16 *non-observational hypotheses* and *theoretical definitions* relationship are structured to build the *inner model (structural model)*. Both the structural development of the perceived benefits and the (developed) sub-hypotheses are important to structure the model of the perceived benefits as depicted in Figure 4.2.

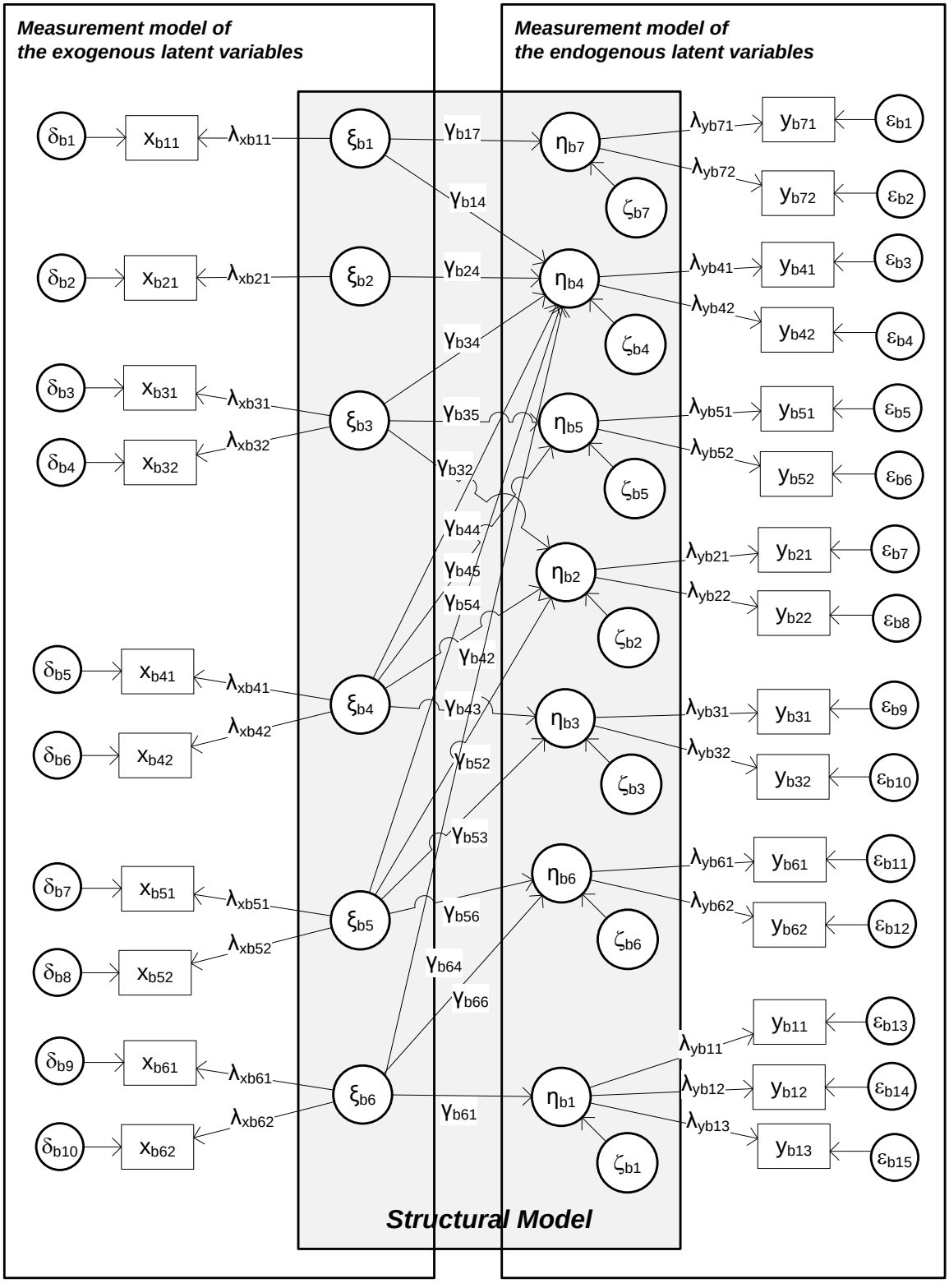


Figure 4.2 Path diagram for the perceived benefits shows the relation between the perceived benefits, and the benefits of SOC

Table 4.4 A set of equations can be structured according to path diagram for the perceived benefits

No	Equation
1.	$x_{b11} = \lambda_{xb11}\xi_{b1} + \delta_{b1}$
2.	$\eta_{b7} = \gamma_{b17}\xi_{b1} + \zeta_{b7}$
3.	$y_{b71} = \lambda_{yb71}\eta_{b7} + \varepsilon_{b1}$
4.	$y_{b72} = \lambda_{yb72}\eta_{b7} + \varepsilon_{b2}$
5.	$x_{b21} = \lambda_{xb21}\xi_{b2} + \delta_{b2}$
6.	$\eta_{b4} = \gamma_{b14}\xi_{b1} + \gamma_{b24}\xi_{b2} + \gamma_{b34}\xi_{b3} + \gamma_{b44}\xi_{b4} + \gamma_{b54}\xi_{b5} + \gamma_{b64}\xi_{b6} + \zeta_{b4}$
7.	$y_{b41} = \lambda_{yb41}\eta_{b4} + \varepsilon_{b3}$
8.	$y_{b42} = \lambda_{yb42}\eta_{b4} + \varepsilon_{b4}$
9.	$x_{b31} = \lambda_{xb31}\xi_{b3} + \delta_{b3}$
10.	$x_{b32} = \lambda_{xb32}\xi_{b4} + \delta_{b4}$
11.	$\eta_{b5} = \gamma_{b35}\xi_{b3} + \gamma_{b45}\xi_{b4} + \zeta_{b5}$
12.	$y_{b51} = \lambda_{yb51}\eta_{b5} + \varepsilon_{b5}$
13.	$y_{b52} = \lambda_{yb52}\eta_{b5} + \varepsilon_{b6}$
14.	$\eta_{b2} = \gamma_{b32}\xi_{b3} + \gamma_{b42}\xi_{b4} + \gamma_{b52}\xi_{b5} + \zeta_{b2}$
15.	$y_{b21} = \lambda_{yb21}\eta_{b2} + \varepsilon_{b7}$
16.	$y_{b22} = \lambda_{yb22}\eta_{b2} + \varepsilon_{b8}$
17.	$x_{b41} = \lambda_{xb41}\xi_{b4} + \delta_{b5}$
18.	$x_{b42} = \lambda_{xb42}\xi_{b4} + \delta_{b6}$
19.	$\eta_{b3} = \gamma_{b43}\xi_{b4} + \gamma_{b53}\xi_{b5} + \zeta_{b3}$
20.	$y_{b31} = \lambda_{yb31}\eta_{b3} + \varepsilon_{b9}$
21.	$y_{b32} = \lambda_{yb32}\eta_{b3} + \varepsilon_{b10}$
22.	$x_{b51} = \lambda_{xb51}\xi_{b5} + \delta_{b7}$
23.	$x_{b52} = \lambda_{xb52}\xi_{b5} + \delta_{b8}$
24.	$\eta_{b6} = \gamma_{b56}\xi_{b5} + \gamma_{b66}\xi_{b6} + \zeta_{b6}$
25.	$y_{b61} = \lambda_{yb61}\eta_{b6} + \varepsilon_{b11}$
26.	$y_{b62} = \lambda_{yb62}\eta_{b6} + \varepsilon_{b12}$
27.	$x_{b61} = \lambda_{xb61}\xi_{b6} + \delta_{b9}$
28.	$x_{b62} = \lambda_{xb62}\xi_{b6} + \delta_{b10}$
29.	$\eta_{b1} = \gamma_{b61}\xi_{b6} + \zeta_{b1}$
30.	$y_{b11} = \lambda_{yb11}\eta_{b1} + \varepsilon_{b13}$
31.	$y_{b12} = \lambda_{yb12}\eta_{b1} + \varepsilon_{b14}$
32.	$y_{b13} = \lambda_{yb13}\eta_{b1} + \varepsilon_{b15}$

A set of equations that correspond to the perceived benefit model is presented in Table 4.4. There are 32 equations in total which are needed to measure possible relationship between indicators (of the exogenous variable or of the endogenous variable) and the (exogenous or endogenous) variables, and between the exogenous and endogenous variables. The associated measurement error is also incorporated which is represented as delta (δ), epsilon (ε) and zeta (ζ).

4.3 The process benefit model substantiates the third hypothesis

In this (sub) subchapter, the third hypothesis in the research will be addressed: "*Benefits of SaaS can be appreciated during the whole lifecycle of SaaS by incorporating the design principles of SOA.*" For this reason, we would like to define indicators to measure the design principles of SOA which will be presented later on as (unobservable) exogenous variables within the model. The indicators of these exogenous variables are specified by applying the design principles of SOA during the lifecycle of SaaS under the assumption that the principles can contribute to the successful delivery of services within each process of the lifecycle. The design principles of SOA are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability, and service composability*.

We argue that the design principle of standardized service contract (ξ_{c1}) should be considered during the process of discovering services within which the providers of SaaS applications need to publish information with regard to the descriptions of services they are able to deliver. This information should be consistent in order not to befuddle the adopters who may look for appropriate services by considering the information published by the providers. In order to consistently publish the information, the providers should make provision for different business requirements by introducing a standard package of services. For this reason, we define the first indicator for the design principle of standardized service contract that is referred as *consistency of information about services (related to the delivery of SaaS applications) which is published by the providers* (x_{c11}).

Furthermore, in the process of selecting and engaging services, a certain level of services should be specified by considering both perspectives of the providers and the adopters. For this reason, the design principle of standardized service contract (ξ_{c1}) imply that Service Level Agreements (SLAs) should be specified as clearly as possible by both perspectives within a formalized SaaS contract. This design principle aims at specifying an articulate and crystal clear explanation about the level of services, including content of services, technical details of services, and laws and regulations while ensuring that both the providers and the adopters would agree upon the contract within which period of service delivery and mechanism of payments should also be defined. The second indicator for this principle is referred as *description level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters* (x_{c12}).

The design principle of service loose coupling (ξ_{c2}) aims at ensuring that services pertaining to the applications can be configured in accommodating business changes during and after SaaS applications are implemented. To what extent the configurations are allowed should be defined within SaaS contract which is agreed during the process of service selection and engagement. These configuration options are rather generally applied for all of tenants who adopt the applications. Therefore, we refer the first indicator for this principle as *availability of configuration options for services (related to the delivery of SaaS applications) which are specified by both the providers and the adopters* (x_{c21}).

Furthermore, the granularity of services can also be defined during the discovery of services within which information about services that are published by the providers can be adjusted to enable the business requirements from the adopters before the applications are implemented. Hence, the second indicator for the design principle of service loose coupling (ξ_{c2}) is defined as *granularity level of services (related to the delivery of SaaS applications) which incorporate both perspective of the providers and the adopters* (x_{c22}).

Data confidentiality is of important issues when implementing SaaS applications. From the perspective of adopters, credential information of business process should be kept internally to people who are authorized to access and utilize the information. For this reason, the design principle of service abstraction (ξ_{c3}) should be considered during the process of service discovery within which

information about services within SaaS applications are published by SaaS providers without exposing the implementation details of the applications to the adopters. This consideration indicates the first indicator for the design principle of service abstraction, which is referred as *generality level of information about services (related to the delivery of SaaS applications) which are published by the providers* (x_{c31}).

To what extent the details of SaaS implementations should be specified during the process of service selection and engagement, including the role of the providers who abstract the implementation details within distinct layers of business, services, system, and data; while these abstractions should accommodate adopters' requirement for future vendor diversification. Therefore, the second indicator for the design principle of service abstraction (ξ_{c3}) can be referred as *the depth information about service implementations (related to the delivery of SaaS applications) which satisfy both requirements of the providers and the adopters* (x_{c32}).

Reusability is of the core principle which underlies the delivery of service-oriented applications. The design principle of service reusability (ξ_{c4}) aims at providing multipurpose services within multi-tenant environment. Therefore, to what extent these services can be reused should be defined within a formal SaaS contract during the process of selecting and engaging services. Then, the first indicator for this principle can be defined which is *multipurpose level of services (related to the delivery of SaaS applications) which are expected by the adopters* (x_{c41}).

The design principle of service reusability (ξ_{c4}) may also reflect that the providers should be able to reuse services within SaaS applications in order to accommodate changes in business requirements and technology. Therefore, this principle is also included within the process of service enactment which incorporates maintainability of services according to SaaS contract. For this reason, the second indicator for this principle can be abstracted which is *frequency of reusable services (related to the delivery of SaaS applications) which are developed by the providers in meeting the demand of the adopters* (x_{c42}).

An autonomous service is expected by both the providers and the adopters of SaaS applications because it may increase its availability within multi-tenant environment by increasing the self-governance over its underlying logic. During the process of service selection and engagement, to what extent the adopters might be dependent toward services which are available within SaaS applications should be defined in order to prepare for future vendor diversification options although they do not necessarily understand the underlying logic behind the services. This situation generates the first indicator for the design principle of service autonomy (ξ_{c5}) which is *governance level of services (related to the delivery of SaaS applications) which are defined by the providers* (x_{c51}).

The design principle of service autonomy (ξ_{c5}) should also be appreciated during the process of service enactment. An autonomous service should be able to cope with redundant service logic which might reduce the performance of SaaS applications within which the service is delivered. For this reason, the second indicator for this principle can be defined as *capability of autonomous services (related to the delivery of SaaS applications) in meeting business changes from the adopters* (x_{c52}).

Services within SaaS applications should be available whenever they are needed; otherwise, they should be stateless in order to effectively use enterprise resources. To what extent these services remain available can be defined within a SaaS contract during the process of selecting and engaging services. Therefore, the design principle of service stateless (ξ_{c6}) can be appreciated during this process within which availability level of services can be specified within the contract. This specification initiates the first indicator for this principle which is referred as *availability level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters* (x_{c61}).

Depending on the period of service delivery which is defined within a SaaS contract, the availability level of services can be updated in meeting the demand from business. This includes the possibility to increase scalability of SaaS applications and data during service enactment process which might result updates toward SLAs within SaaS contract. Following this, the second indicator for the design principle of service stateless (ξ_{c6}) can be identified which is *possibility of scaling application and data (related to the delivery of SaaS applications) in accommodating business changes from the adopters* (x_{c62}).

The design principle of service discoverability (ξ_{c7}) aims at providing discovery mechanisms to access information about services which are published by the providers. The providers publish capabilities of services they are able to deliver to the adopters of SaaS applications during the process of service discovery. This reflects the first indicator for the design principle of service discoverability which can be referred as *accessibility level of services (related to the delivery of SaaS applications) which are developed by the providers* (x_{c71}).

Furthermore, discovery mechanisms are important for the adopters to be able to access the information in order to fulfil their requirements toward services within SaaS applications. During the process of service selection and engagement, to what extent these services can be located efficiently through the discovery mechanisms can be defined formally within a SaaS contract. Hence, we refer the second indicator for the design principle of service discoverability (ξ_{c7}) as *availability of mechanisms of discovering services (related to the delivery of SaaS applications) which are developed by the providers* (x_{c72}).

The design principle of service composability (ξ_{c8}) accommodates complex configurations which are usually found during the delivery of service-oriented solutions. A service is expected to be composed variably in meeting specific demand from different tenants as the adopters of SaaS applications. Therefore, the custom options should be defined before the applications are implemented. During the process of service selection and engagement, these options should be identified within a formal SaaS contract. We refer the first indicator of this principle as *custom option level of services (related to the delivery of SaaS applications) in meeting business changes from the adopters* (x_{c81}).

Moreover, custom options might be limited to application and data since SaaS applications are mostly vendor specific. Nonetheless, multi-tenant environment should accommodate specific tenants who adopt the applications. Therefore, the custom options can be adjusted during the process of service enactment in order to accommodate business changes. Following this, we refer the second indicator for the design principle of service composability (ξ_{c8}) as *flexibility of custom options for services (related to the delivery of SaaS applications) which are expected by the adopters* (x_{c82}).

According to the specification of indicators of exogenous variables which are presented earlier in this (sub) subchapter, we found 16 indicators each of which help to achieve the benefits of SOC through the design principles of SOA which are appreciated during the whole lifecycle of SaaS. Following this specification, the third model can be structured which is then referred as the process benefit model as depicted in Table 4.5. This structure is based on the operationalization of the indicators of exogenous variables, the exogenous variables which represent the design principles of SOA, and the endogenous variables which represent the benefits of SOC. According to this table, we may see that each (unobservable) exogenous variable have two (reflective) indicators that are designated to be positively correlated with the variables. Therefore, the exogenous variables can be measured by the associated indicators altogether. The similar situation is applied for the (unobservable) endogenous variables which are represented as the benefits of SOC that have a list of (reflective) indicators. There are eight exogenous variables which are correlated with one or more endogenous variables that are seven types of variables in total. Following this, we elaborate the (initial) sub-hypotheses that are presented in Table C.3 into the (developed) sub-hypotheses that are presented in Table C.4 in *Appendix C, Part IV*.

Table 4.5 Operationalization of the process benefits provide a clear understanding toward the structure of the process benefit model

Indicators of exogenous variables	Exogenous variables	Endogenous variables	Indicators of endogenous variables
- consistency of information about services (related to the delivery of SaaS applications) which is published by the providers ($\mathbf{x_{c11}}$) - description level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters ($\mathbf{x_{c12}}$)	standardized service contract (ξ_{c1})	increased of inherent interoperability (η_{b1})	- ease-of-access (y_{b11}) - ease-of-information exchange (y_{b12}) - community collaboration (y_{b13})
		increased of federation (η_{b2})	- standardization of IT environment (y_{b21}) - protection of implementation details (y_{b22})
		increased of vendor diversification options (η_{b3})	- ability to choose "best-of-breed" of IT products (y_{b31}) - free of vendor lock-in (y_{b32})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
		increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		reduced of IT burden (η_{b7})	- scalability of IT products (y_{b71}) - value of business by leveraging IT products (y_{b72})
- availability of configuration options for services (related to the delivery of SaaS applications) which are specified by both the providers and the adopters ($\mathbf{x_{c21}}$) - granularity level of services (related to the delivery of SaaS applications) which incorporate both perspective of the providers and the adopters ($\mathbf{x_{c22}}$)	service loose coupling (ξ_{c2})	increased of inherent interoperability (η_{b1})	- ease-of-access (y_{b11}) - ease-of-information exchange (y_{b12}) - community collaboration (y_{b13})
		increased of federation (η_{b2})	- standardization of IT environment (y_{b21}) - protection of implementation details (y_{b22})
		increased of vendor diversification options (η_{b3})	- ability to choose "best-of-breed" of IT products (y_{b31}) - free of vendor lock-in (y_{b32})
		increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		reduced of IT burden (η_{b7})	- scalability of IT products (y_{b71}) - value of business by leveraging IT products (y_{b72})
- generality level of information about services (related to the delivery of SaaS applications) which are published by the providers ($\mathbf{x_{c31}}$) - the depth information about service implementations (related to the delivery of SaaS applications) which satisfy both requirements of the providers and the adopters ($\mathbf{x_{c32}}$)	service abstraction (ξ_{c3})	increased of inherent interoperability (η_{b1})	- ease-of-access (y_{b11}) - ease-of-information exchange (y_{b12}) - community collaboration (y_{b13})
		increased of federation (η_{b2})	- standardization of IT environment (y_{b21}) - protection of implementation details (y_{b22})
		increased of vendor diversification options (η_{b3})	- ability to choose "best-of-breed" of IT products (y_{b31}) - free of vendor lock-in (y_{b32})
		increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		reduced of IT burden (η_{b7})	- scalability of IT products (y_{b71}) - value of business by leveraging IT products (y_{b72})

Table 4.5 Operationalization of the process benefits provide a clear understanding toward the structure of the process benefit model – *cont'd*

Indicators of exogenous variables	Exogenous variables	Endogenous variables	Indicators of endogenous variables
- multipurpose level of services (related to the delivery of SaaS applications) which are expected by the adopters ($\mathbf{x_{c41}}$) - frequency of reusable services (related to the delivery of SaaS applications) which are developed by the providers in meeting the demand of the adopters ($\mathbf{x_{c42}}$)	service reusability (ξ_{c4})	increased of inherent interoperability (η_{b1})	- ease-of-access (y_{b11}) - ease-of-information exchange (y_{b12}) - community collaboration (y_{b13})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
		increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		reduced of IT burden (η_{b7})	- scalability of IT products (y_{b71}) - value of business by leveraging IT products (y_{b72})
- governance level of services (related to the delivery of SaaS applications) which are defined by the providers ($\mathbf{x_{c51}}$) - capability of autonomous services (related to the delivery of SaaS applications) in meeting business changes from the adopters ($\mathbf{x_{c52}}$)	service autonomy (ξ_{c5})	increased of inherent interoperability (η_{b1})	- ease-of-access (y_{b11}) - ease-of-information exchange (y_{b12}) - community collaboration (y_{b13})
		increased of vendor diversification options (η_{b3})	- ability to choose "best-of-breed" of IT products (y_{b31}) - free of vendor lock-in (y_{b32})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
		increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		reduced of IT burden (η_{b7})	- scalability of IT products (y_{b71}) - value of business by leveraging IT products (y_{b72})
- availability level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters ($\mathbf{x_{c61}}$) - possibility of scaling application and data (related to the delivery of SaaS applications) in accommodating business changes from the adopters ($\mathbf{x_{c62}}$)	service stateless (ξ_{c6})	increased of inherent interoperability (η_{b1})	- ease-of-access (y_{b11}) - ease-of-information exchange (y_{b12}) - community collaboration (y_{b13})
		increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		reduced of IT burden (η_{b7})	- scalability of IT products (y_{b71}) - value of business by leveraging IT products (y_{b72})

The elaboration from the (initial) sub-hypotheses into the (developed) sub-hypotheses is needed in order to study the relationship between the (exogenous or endogenous) variables and the associated indicators, and between exogenous and endogenous variables within the third model. There are 75 sub-hypotheses in total, within which 31 *correspondence rules* relationship are structured to build the *outer model (measurement model),* and 44 *non-observational hypotheses* and *theoretical definitions* relationship are structured to build the *inner model (structural model).*

Table 4.5 Operationalization of the process benefits provide a clear understanding toward the structure of the process benefit model – *cont'd*

Indicators of exogenous variables	Exogenous variables	Endogenous variables	Indicators of endogenous variables
- accessibility level of services (related to the delivery of SaaS applications) which are developed by the providers ($\mathbf{x_{c71}}$) - availability of mechanisms of discovering services (related to the delivery of SaaS applications) which are developed by the providers ($\mathbf{x_{c72}}$)	service discoverability (ξ_{c7})	increased of inherent interoperability (η_{b1})	- ease-of-access (y_{b11}) - ease-of-information exchange (y_{b12}) - community collaboration (y_{b13})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
		increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		reduced of IT burden (η_{b7})	- scalability of IT products (y_{b71}) - value of business by leveraging IT products (y_{b72})
- custom option level of services (related to the delivery of SaaS applications) in meeting business changes from the adopters ($\mathbf{x_{c81}}$) - flexibility of custom options for services (related to the delivery of SaaS applications) which are expected by the adopters ($\mathbf{x_{c82}}$)	service composability (ξ_{c8})	increased of inherent interoperability (η_{b1})	- ease-of-access (y_{b11}) - ease-of-information exchange (y_{b12}) - community collaboration (y_{b13})
		increased alignment of business and technology domains (η_{b4})	- automation of technology innovation (y_{b41}) - capability of addressing immediate business changes (y_{b42})
		increased of ROI (η_{b5})	- ability to incorporate multi-purpose (y_{b51}) - ability to provide cost-effective solution (y_{b52})
		increased of organizational agility (η_{b6})	- capability of responding to business changes (y_{b61}) - strategic solution in establishing an agile organization (y_{b62})
		reduced of IT burden (η_{b7})	- scalability of IT products (y_{b71}) - value of business by leveraging IT products (y_{b72})

In addition, the sub-hypotheses to estimate the relationship between the endogenous variables and the indicators of endogenous variables are developed by considering initial work by Erl [2007] who argued that the design principles of SOA can help to achieve the strategic goals and benefits of SOC. Following his work, we develop the third model by considering that the design principles can be appreciated within the lifecycle of SaaS. Although this results in an extensive model, the third model can be used to help understanding the benefits of SaaS not from the point of view of actors, but from the point of view of processes in delivering SaaS applications during SaaS lifecycle.

In order to develop the third model, we structure a path diagram according to the pre-defined (exogenous and endogenous) variables, and the associated indicators of (exogenous or endogenous) variables which have been presented in Table 4.5. The path diagram for the third model is presented in Figure 4.3. This diagram can be used to understand the relationships between variables that are structured within the third model which incorporates three main concepts, which are the lifecycle of SaaS, the design principles of SOA, and the strategic goals and benefits of SOC.

The indicators of exogenous variables represent measurable factors that can be used to appraise the design principles of SOA when these principles are appreciated during the lifecycle of SaaS. These indicators are labeled as "x" while "c" character represents the third model, and the first number that follows character "c" represents to which an indicator of the exogenous variable belong to. An exogenous variable (ξ) can have one or more indicators that are labeled as the second number that follows character "c". For example, the first indicator for the first exogenous variable in the third

model is labeled as "x_{c11}", which can be translated as "the first indicators of the first exogenous variable within the third model". A similar logic is also applied to label the indicators of the endogenous variable which is labeled as "y" and the endogenous variable which is labeled as "η". In addition, label "δ" and "ε" represents measurement errors related to the relationship between the exogenous variables and the associated indicators, and the endogenous variables and the associated indicators, respectively. Measurement errors for the relationship between the exogenous variables and endogenous variables are represented as "ζ".

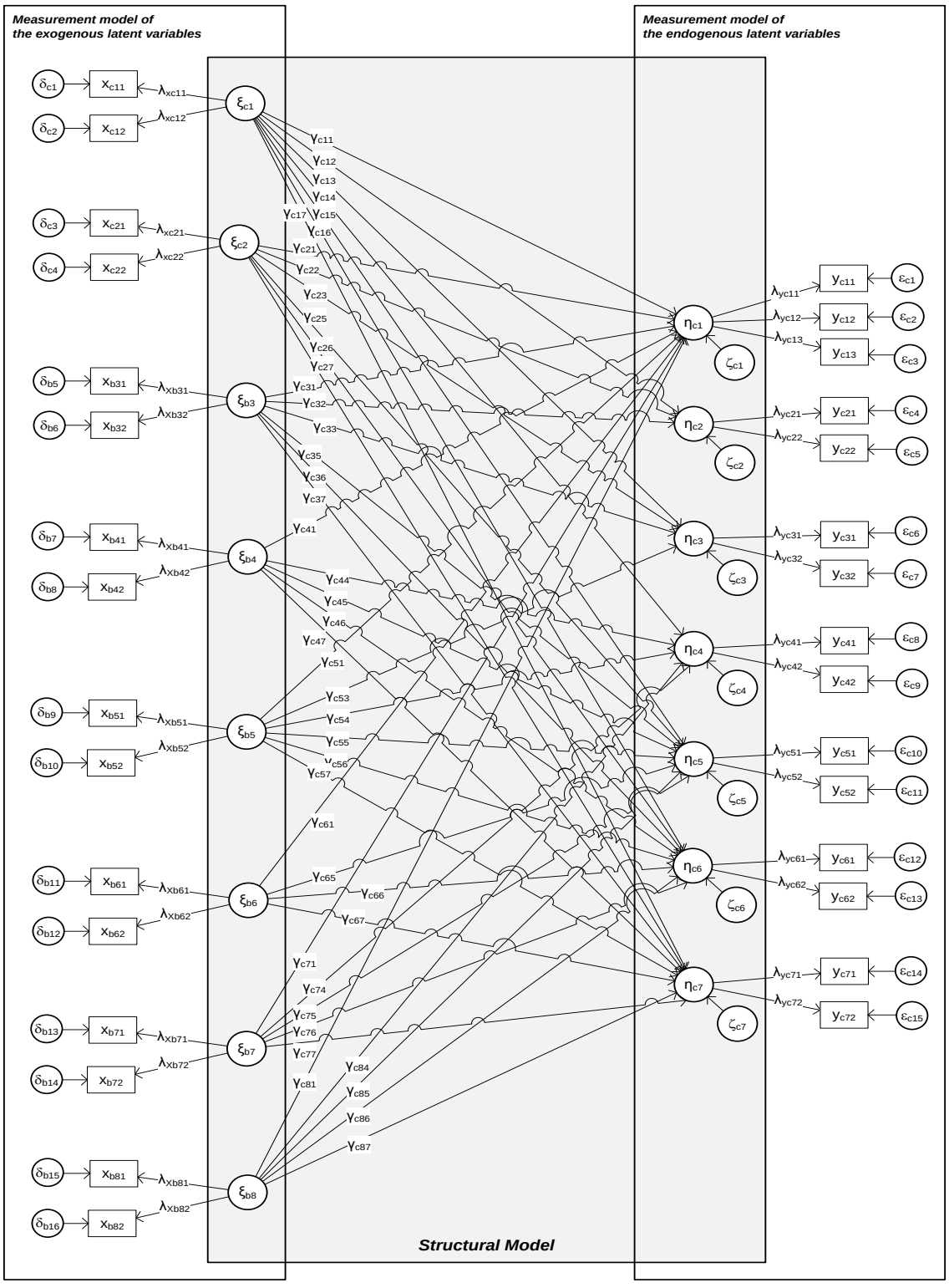


Figure 4.3 Path diagram for the process benefits shows the relation between the design principles of SOA, and the benefits of SOC

Table 4.6 A set of equations can be structured according to path diagram for the process benefits

No	Equation
1.	$x_{c11} = \lambda_{xc11}\xi_{c1} + \delta_{c1}$
2.	$x_{c12} = \lambda_{xc12}\xi_{c1} + \delta_{c2}$
3.	$\eta_{c1} = \gamma_{c11}\xi_{c1} + \gamma_{c21}\xi_{c2} + \gamma_{c31}\xi_{c3} + \gamma_{c41}\xi_{c4} + \gamma_{c51}\xi_{c5} + \gamma_{c61}\xi_{c6} + \gamma_{c71}\xi_{c7} + \gamma_{c81}\xi_{c8} + \zeta_{c1}$
4.	$y_{c11} = \lambda_{yc11}\eta_{c1} + \varepsilon_{c1}$
5.	$y_{c12} = \lambda_{yc12}\eta_{c1} + \varepsilon_{c2}$
6.	$y_{c13} = \lambda_{yc13}\eta_{c1} + \varepsilon_{c3}$
7.	$\eta_{c2} = \gamma_{c12}\xi_{c1} + \gamma_{c22}\xi_{c2} + \gamma_{c32}\xi_{c3} + \zeta_{c2}$
8.	$y_{c21} = \lambda_{yc21}\eta_{c2} + \varepsilon_{c4}$
9.	$y_{c22} = \lambda_{yc22}\eta_{c2} + \varepsilon_{c5}$
10.	$\eta_{c3} = \gamma_{c13}\xi_{c1} + \gamma_{c23}\xi_{c2} + \gamma_{c33}\xi_{c3} + \gamma_{c53}\xi_{c5} + \zeta_{c3}$
11.	$y_{c31} = \lambda_{yc31}\eta_{c3} + \varepsilon_{c6}$
12.	$y_{c32} = \lambda_{yc32}\eta_{c3} + \varepsilon_{c7}$
13.	$\eta_{c4} = \gamma_{c14}\xi_{c1} + \gamma_{c44}\xi_{c4} + \gamma_{c54}\xi_{c5} + \gamma_{c74}\xi_{c7} + \gamma_{c84}\xi_{c4} + \zeta_{c4}$
14.	$y_{c41} = \lambda_{yc41}\eta_{c4} + \varepsilon_{c8}$
15.	$y_{c42} = \lambda_{yc42}\eta_{c4} + \varepsilon_{c9}$
16.	$\eta_{c5} = \gamma_{c15}\xi_{c1} + \gamma_{c25}\xi_{c2} + \gamma_{c35}\xi_{c3} + \gamma_{c45}\xi_{c4} + \gamma_{c55}\xi_{c5} + \gamma_{c65}\xi_{c6} + \gamma_{c75}\xi_{c7} + \gamma_{c85}\xi_{c8} + \zeta_{c5}$
17.	$y_{c51} = \lambda_{yc51}\eta_{c5} + \varepsilon_{c10}$
18.	$y_{c52} = \lambda_{yc52}\eta_{c5} + \varepsilon_{c11}$
19.	$\eta_{c6} = \gamma_{c16}\xi_{c1} + \gamma_{c26}\xi_{c2} + \gamma_{c36}\xi_{c3} + \gamma_{c46}\xi_{c4} + \gamma_{c56}\xi_{c5} + \gamma_{c66}\xi_{c6} + \gamma_{c76}\xi_{c7} + \gamma_{c86}\xi_{c8} + \zeta_{c6}$
20.	$y_{c61} = \lambda_{yc61}\eta_{c6} + \varepsilon_{c12}$
21.	$y_{c62} = \lambda_{yc62}\eta_{c6} + \varepsilon_{c13}$
22.	$\eta_{c7} = \gamma_{c17}\xi_{c1} + \gamma_{c27}\xi_{c2} + \gamma_{c37}\xi_{c3} + \gamma_{c47}\xi_{c4} + \gamma_{c57}\xi_{c5} + \gamma_{c67}\xi_{c6} + \gamma_{c77}\xi_{c7} + \gamma_{c87}\xi_{c8} + \zeta_{c7}$
23.	$y_{c71} = \lambda_{yc71}\eta_{c7} + \varepsilon_{c14}$
24.	$y_{c72} = \lambda_{yc72}\eta_{c7} + \varepsilon_{c15}$
25.	$x_{c21} = \lambda_{xc21}\xi_{c2} + \delta_{c3}$
26.	$x_{c22} = \lambda_{xc22}\xi_{c2} + \delta_{c4}$
27.	$x_{c31} = \lambda_{xc31}\xi_{c3} + \delta_{c5}$
28.	$x_{c32} = \lambda_{xc32}\xi_{c3} + \delta_{c6}$
29.	$x_{c41} = \lambda_{xc41}\xi_{c4} + \delta_{c7}$
30.	$x_{c42} = \lambda_{xc42}\xi_{c4} + \delta_{c8}$
31.	$x_{c51} = \lambda_{xc51}\xi_{c5} + \delta_{c9}$
32.	$x_{c52} = \lambda_{xc52}\xi_{c5} + \delta_{c10}$
33.	$x_{c61} = \lambda_{xc61}\xi_{c6} + \delta_{c11}$
34.	$x_{c62} = \lambda_{xc62}\xi_{c6} + \delta_{c12}$
35.	$x_{c71} = \lambda_{xc71}\xi_{c7} + \delta_{c13}$
36.	$x_{c72} = \lambda_{xc72}\xi_{c7} + \delta_{c14}$
37.	$x_{c81} = \lambda_{xc81}\xi_{c8} + \delta_{c15}$
38.	$x_{c82} = \lambda_{xc82}\xi_{c8} + \delta_{c16}$

According to Table 4.6, there are 38 equations in total which can be found in the process benefit model. From this number, there are 16 equations which represent the outer model or measurement model of the exogenous latent variables while there are 15 equations that represent the outer model or measurement model of the endogenous latent variables. The rest of the number belongs to the inner model or structural model which is presented within seven equations. The equations provided in Table 4.6 are essential to measure the design principles of SOA which are appreciated during the lifecycle of SaaS and further to accomplish the benefits of SOC.

4.4 Conclusion

The comprehensive methodology which is presented in the research is comprised of three main steps. **First**, two types of interviews need to be conducted in order realize the benefits of SaaS from the implementation of an Enterprise Resource Planning (ERP) system which is adopted by Small Medium sized Enterprises (SMEs). The first type of interview aims at understanding benefits of SaaS ERP from the perspective of providers or the promised benefits, while the second type of interview aims at understanding the benefits from the perspective of adopters or the perceived benefits. In order not to be handicapped by divergent views on conceptualizing SaaS benefits, both types of interviews are elaborated with questions which are related to the design of the whole life cycle of delivering SaaS ERP system. Therefore, eight design principles of Service Oriented Architecture (SOA) are accommodated within both types of interviews. By incorporating these principles, we aim at approaching SaaS benefits not only by conceptualizing the promised benefits and the perceived benefits, but also by employing the design principles of SOA for designing the whole lifecycle of SaaS. We hope to enrich methodology assessment to conceptualize benefits of SaaS while aiming at standardization on conceptualizing SaaS benefits within different processes of SaaS lifecycle. For this reason, we refer to the benefits of strategic goals and benefits of Service Oriented Computing (SOC) in order to accommodate different perspectives of SaaS.

Second, three path diagrams are constructed from the result of the interviews. The first path diagram is designed to study the relationship between the promised benefits and the benefits of SOC while the second path diagram estimates the relationship between the perceived benefits and the benefits of SOC. We have presented three path diagrams in Subchapter 4.1, Subchapter 4.2, and Subchapter 4.3, subsequently. These path diagrams aim at structuring the benefits of SOC which can be approached from different perspectives of benefits during a specific process within SaaS lifecycle. The third path diagrams consider the whole lifecycle of SaaS by incorporating the design principles of SOA. A number of variables are structured within the path diagrams in which the promised benefits and the perceived benefits, and the design principles of SOA are linked with the benefits of SOC, accordingly. The promised benefits are designated by seven exogenous (latent) variables which are constructed by seven indicators that outline benefits of SaaS which commonly are conceptualized through providers' perspectives; while the perceived benefits are represented by ten exogenous (latent) variables which are determined by ten indicators that show key attributes of SaaS maturity model. The design principles of SOA are also represented by eight exogenous (latent) variables which address eight design principles of SOA.

Third, causal relations between latent variables (LVs) are estimated using a Partial Least Squares (PLS) Path modeling method for Structure Equation Model (SEM). This method is chosen since the methodology aims at contributing to theory development rather than contributing to theory testing. Furthermore, constructing benefits of SaaS by delivering ERP system is relatively new concept and newly developed [Götz et al., 2010; Esposito Vinzi et al., 2010]. Thus, predicting these SaaS benefits are considered more important rather than estimating these parameters in specific. By considering the path diagrams which are constructed in the second step, path coefficient within measurement model is defined to represent causal relations between endogenous and exogenous variables. These causal relations are estimated to confirm or reject the sub-hypotheses (SH) which are represented in each of

the three path diagrams that incorporate each of the (main) hypotheses. According to Table 3.12, the first hypothesis (H_1) in the research can be translated into 18 sub-hypotheses while the second hypothesis (H_2) in the research can be translated into 16 sub-hypotheses. The third hypothesis (H_3) in the research can be translated into 44 sub-hypotheses.

We have presented the (initial) development of three path diagrams in Subchapter 4.1, Subchapter 4.2, and Subchapter 4.3. They present the promised benefit model, the perceived benefit model, and the process benefit model, consecutively. In the promised benefit model, we presented 32 sub-hypotheses in total within which 22 *correspondence rules* relationship are structured to build the *outer model (measurement model),* and 10 *non-observational hypotheses* and *theoretical definitions* relationship are structured to build the *inner model (structural model)*. The promised benefit model also has 29 equations in order to measure relationship between variables within the model. In the perceived benefit model, there are 42 sub-hypotheses in total, within which 25 *correspondence rules* relationship are structured to build the *outer model (measurement model),* and 17 *non-observational hypotheses* and *theoretical definitions* relationship are structured to build the *inner model (structural model)*. The model of the perceived benefits has 32 equations in total. Meanwhile, the process benefit model includes 75 sub-hypotheses in total, within which 31 *correspondence rules* relationship are structured to build the *outer model (measurement model),* and 44 *non-observational hypotheses* and *theoretical definitions* relationship are structured to build the *inner model (structural model)*. The process benefit model incorporates 38 equations in total.

CHAPTER

5

QUALITATIVE ANALYSIS: CASE STUDY

Then, when they reached the Valley of the Ants, an ant said: "Ants! Enter your dwellings, so that Sulayman and his troops do not crush you unwittingly." [Surah Al Naml, 18]

This thesis aims at assessing benefits of Software as a Service (SaaS) which have been conceptualized in Chapter 3, and have been structured in Chapter 4. In order to implement the comprehensive methodology, we incorporate a case study in this chapter by presenting sources of the data which can be used for the research. In this chapter, we are particularly interested in performing qualitative analysis to understand the benefits of SaaS from the perspective of SaaS providers. For this reason, we use Exact Software Nederland as our caase study who offers financial management application namely Exact Online which is delivered through SaaS model.

Exact Software Nederland was originally a student company which was started in 1984 and is now grown into a global solution for entrepreneurial information technology. Their main target customers are Small Medium Sized Enterprises (SMEs) which are supported with enterprise applications that can add value to their business process management. The application solutions are developed by considering a real-time insight within a SME and are collaborated with its industry and business structure. The solutions are offered in 125 different countries with more than 40 languages and supported with its offices in 40 countries.

Exact Online is a SaaS application for managing the financial affairs of small businesses, in which each month is paid for the use. While local software installations are required, this SaaS application provides easier sharing information with others. For instance, entrepreneurs can grant to update the records by its business partner, and also by the auditor for auditing the financial statements. It also provides facilities with which the data of bank account can be automatically read and processed and reported to the tax office. It also supports electronic invoicing to customers. From this perspective, it takes some information about orchestration of a small enterprise.

In the research presented in this thesis, Exact Software Nederland acts as a SaaS provider who offers the application to their SMEs' clients, which act as SaaS adopters. The delivery of this SaaS application can be reflected within a SaaS lifecycle as depicted in Figure 5.1. The lifecycle in the workflow presented in this figure shows three main processes pertaining to the delivery of the application. They are *service discovery, service selection and engagement*, and *service enactment*. It is important to note that Figure 5.1 only shows a general process that represents the delivery of a SaaS application from the provider to the clients by considering the lifecycle of SaaS.

According to Figure 5.1, the development and deployment of services within Exact Online application are included within the *service discovery* process within which Exact Software Nederland publishes information related to the applications to SMEs, e.g. software features, subscription scheme and prices, and the promised benefits which can be gained if an SME adopts the application. These promised benefits are formalized within Service Level Agreements (SLAs) which should be agreed in

the next process, which is *service selection and engagement*, in order to formally deliver services related to Exact Online. During this process, a SaaS contract should be agreed by both the provider and SMEs. SaaS contract should cover description of services, periodical service charge and payment mechanisms, customer services and software supports, data ownership and security, and business continuity and up-time guarantees. After the contract is agreed by both parties, the provider grants access toward the application for authorized users and provides training for using the application during the *service enactment* process. According to the chosen subscription, services within Exact Online application will be delivered continuously and supported with customer services at anytime and anywhere, and updated with new versions automatically. Additional features are also offered as application extensions which can be added during lifecycle.

In this chapter, we would like to explore more about general information pertaining to Exact Online application, a business case of Exact Online which delineates the scope of case study used in the research, and summary from data gathering which is conducted in both Exact Software Nederland as a SaaS provider and its customers as SaaS adopters. Therefore, this chapter aims at addressing the following sixth research question:

Q6) How can the benefits of SaaS be assessed by employing the proposed methodology? [*explanatory analysis through a case study*]

In order to address the Q5 question, we divide this chapter into four subchapters. Subchapter 5.1 will discuss about general information regarding the application whereas a business case will be developed within Subchapter 5.2 based on the information provided in Subchapter 5.1. Next in Subchapter 5.4, a summary from data gathering will be presented within which a comprehensive methodology to assess benefits of SaaS will be elaborated according to the comprehensive methodology presented in Chapter 4. Then, we conclude this chapter within Subchapter 5.4.

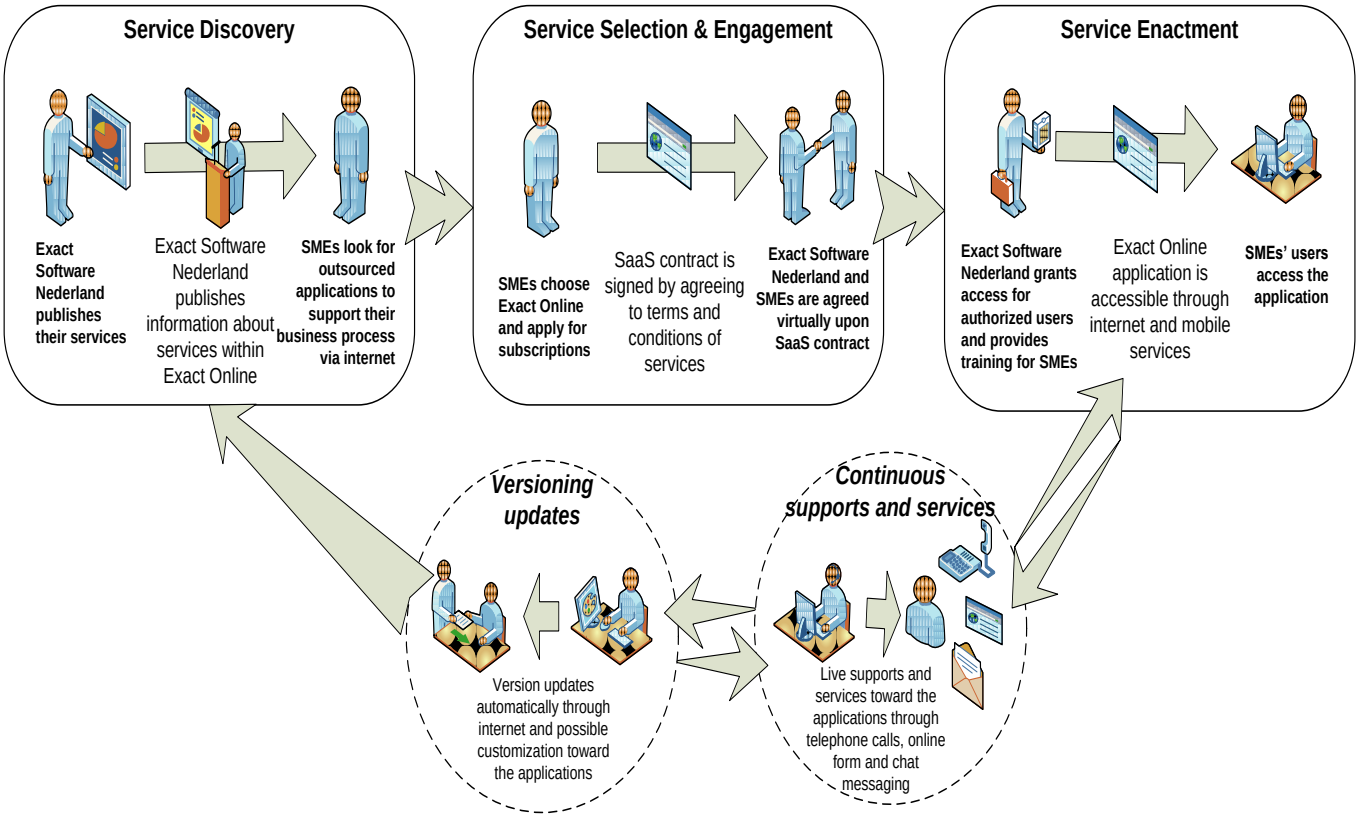


Figure 5.1 During SaaS lifecycle under the chosen subscription scheme, Exact Software Nederland provides services toward Exact Online application

5.1 Exact Online handles complex financial management

Exact Online application is financial management software that is developed by Exact Software Nederland to provide safe and easy online accounting for business enterprises. This application software is particularly designed for Small Medium Sized Enterprises (SMEs), entrepreneurs, accountants, and accounting firms. In general, there are two types of software which are offered for managing financial issues within enterprises; they are Exact Online and Exact Online Accounting software. The latter is designed particularly for accountants and accounting firms whereas Exact Online software is basically designed for accountants and accounting firms. Additionally, there is similar software, namely Exact Online Handel; however, the main feature of this software is not only about managing financial issues, but also logistic issues within trading companies. In the research presented within this thesis, we would focus on the software specialized in managing financial issues. Hence, our discussion would cover Exact Online and Exact Online Accounting software.

Exact Online and Exact Online Accounting software are delivered through Software as a Service (SaaS) model. SMEs, enterprises, accountants, and accounting firms which are then referred as SaaS adopters, are able to access the software via a secured internet through supportable internet browsers, i.e. Internet Explorer (), Safari (), and Mozilla Firefox (). They are also supported by the latest mobile technology, i.e. iPhone for both software and Android for Exact Online only. Therefore, SaaS adopters do not need to install the software locally in their company site while Exact Software Nederland as a SaaS provider can control and update the software automatically at anytime and anywhere. SaaS adopters may subscribe to the applications by choosing available types of subscription offered by the provider.

The software is equipped with drop-down menus and mouse-and-click menus. The main features of the software are built by incorporating drop-down navigation in which similar software features can be grouped within one drop-down menu. Therefore, the navigation of the website page of the software can be more flexible and easier to understand for users since similar features are grouped within the same menus while maintaining its Graphical User Interface (GUI). Users can choose a feature by clicking on it and a new (static/floating) page will be appeared; this navigation represents mouse-and-click menus. For instance, under the "Home" menu, five features can be found; they include overview of financial statement, updated news from the provider, personal information details, financial document management, overview of accountants, and import/export document. Each of these features has one or more functionalities which can be clicked by users and can be provided to them in a new window.

Depending on the type of software, the application is provided with different types of subscriptions. The Exact Online software is provided within three types of subscription, which depend on features that can be assessed, number of users, number of administrations, etc. They are Premium, Advanced, and Basis which each has different prices of subscription per month. Meanwhile, Exact Online Accounting software is offered within two types of subscription, which are Exact Online Accounting Basis and Exact Advanced Online Accounting. Not to add the confusion between the subscription and the software name, Exact Online Accounting software is also provided within Exact Online Salaris subscription which supports online payroll management within enterprises.

By incorporating financial issues within one application, enterprise data can be integrated with financial management. Thus, enterprise business process can be conducted accountably with respect to standard and regulations in accounting and reporting financial information. On the other hand, users may experience difficulties in operating the application since there are numerous mouse-and-click menus which are interlinked to other features of the application. However, this nested information is provided in a flowing window which can be closed anytime while the main window of the application remains existed.

5.2 A business case simplifies Exact case study

We have presented brief information related to Exact Online application in Subchapter 5.1. Following this information, we develop a case study as depicted in Figure 5.2 in order to delineate the scope of case study which is required in the research. This figure is abstracted from the available information in electronic news and publications in Exact Online website [see http://www.exactonline.nl/]. The focus of the case study is on the Exact Online application to manage financial management within enterprises. Our focus will be on two software products offered under the name of Exact Online application: Exact Online and Exact Online Accounting software. Both of them will be discussed in Figure 5.3 and Figure 5.4. Furthermore business-usecase diagrams which are developed from this business case can be found in *Appendix D*.

External reporting of financial and business information has become a fundamental aspect of the proper functioning of government to balance public and private interest as well as the functioning of enterprises in pursuit of transparent financial management [OECD, 1997]. However, government regulation in business and the associated reporting processes demands unnecessary, inconsistent and complicated processes which lead to waste of both public and private money [Madden, 2009]. This regulatory burden pushes government to rationalize financial and business information which have to be reported by business toward government in an efficient manner.

In order to integrate the process and reports of financial and business information, a Standard Business Reporting (SBR) program was initiated by the Dutch Government in 2007. The NL Standard Business Reporting Program [Dutch Government, n.d.] was aimed at achieving a single reporting language, and implementing automation of business-to-government financial reporting. Within this program Dutch taxonomy of financial data was developed [Standard Business Reporting Programma, 2010]. The Dutch taxonomy uses eXtensible Business Reporting Language (XBRL) to automate the reporting process from business to government with respect to financial accounts, taxes, and financial statistics.

The main purpose of SBR program is to reduce reporting business-on-business by allowing businesses and their financial system to be part of a government reporting portal. In the portal, financial reports are simply moved digitally across multiple agencies. The technology supporting SBR enables a uniform platform when exchanging financial information in a timely and cost-effective manner. OECD [2009] indicates that there are various benefits of highly effective SBR, e.g. a single reporting language across agencies; reduction in reporting burdens to government; a single secure sign-on within SBR portals; opportunities to streamline the process of passing or aggregating data across agencies; increased interoperability of managing financial information; increased access to compare business performance; and improved data quality by reducing errors which are usually caused by manual financial process.

Seeing these potential benefits of SBR, Exact Software Nederland provides financial management application which is introduced under Software as a Service (SaaS) subscription scheme. For this reason, Exact Online application is introduced to automate financial management of an enterprise via an online accounting package which supports SBR program [Exact Group B.V., 2011] by linking enterprise financial information to tax administration offices.

There are two types of application software which are offered under the name of Exact Online application. The first type is business accounting software for enterprise while the second type is accounting software for accountants and accounting firms. The latter is then referred as Exact Online Accounting software whereas the first type will be referred as Exact Online software. There are different types of subscriptions, extensions, users and administrations which are offered by the provider. The prices of these services are described according to specific functionalities which can be accessed by enterprises. Not to add the confusion over the software names, Exact Online Handel software is also offered for trading companies to automate their financial and logistic processes. However, since the focus of this software is not in the financial management, the business case provided in the case study will only focus on the Exact Online and Exact Online Accounting software.

Figure 5.2 Exact business case delineates case study description in the research

Exact Online software

The Exact Online software is offered within three types of subscription, which are Premium, Advanced, and Basis. Depending on the subscription which is chosen, different software features can be accessed by users. Software features and users can also be extended with additional prices. This application provides benefits for Small Medium Sized Enterprises (SMEs) and entrepreneurs, including:

- Easy and secured access, including i-Phone and Android
- An overview of financial statement
- Fast time processing
- Low subscription fees and no upfront investment
- Easily collaborate online with your bookkeeper or accountant
- Much time and cost savings with useful links, i.e. exchanging bank files and fuel costs
- Easy to extend
- More than 61,700 administrations are conducted with Exact Online software

When a user accesses the Exact Online software, (s)he will be provided with an overview of the application which is then referred as "Cockpit". Moreover, there are four main groups of features which are represented under menu-tab at the banner on the top-side of the webpage. They are "Home", "Financieel", "Verkoop", and "Inkoop". The Home menu provides general features including: an overview of specific users which are presented as "Cockpit" in which financial statements are provided in tables and graphs; while the rest of the menus are related to financial management of enterprises.

Furthermore, this software accommodates online communications between SMEs or entrepreneurs, and their clients, e.g. third-party accountant which is assigned to handle their financial administration. It is also equipped with continuous services and supports from help-desk which is provided by the SaaS vendor. The help-desk is reachable via chat-messaging and telephone calls. Additionally, the software is supported with forum communities and product blog which update information with regard to problem-solving toward the use of the application.

Depending on the chosen subscription, standard functionalities toward the application are offered to SMEs who can also add new functionalities as extensions, or add-on. These functionalities include *ledger account, administration, import & export, accounts receivable and payable management and electronic VAT return; helpdesk, access auditing, digital document management, payment reminders, account management & Chamber of Commerce link; electronic invoices; sending electronic invoices; credit reporting; coupling with add-on; number of users; number of meekijkgebruikers (user watch); number of administrations; banking; invoice; subscriptions; assets; budget; cost analysis; currency*. The functionalities cover the following features:

-. *online invoice*, e.g. sending invoice by post, email, or electronically; setting up invoice layout; invoice history; sending invoice reminders to clients; organizing invoice reports
-. *online banking integrated with bank payment and receipt,* e.g. online banking supported with recognized Dutch bank files; approving claims; reading bank statement and financial transactions
-. *budgeting controls,* e.g. creating (multiple) budgets in order to detect any deviations within actual results from the forecasted budget
-. *managing asset depreciation,* e.g. registering fixed assets according to purchase invoices; choosing different depreciation methods
-. *cost analysis,* e.g. allocating costs to a cost centre (department) and a cost object (product/service)
-. *foreign currency management,* e.g. managing and revaluation of foreign exchange positions; registering and reporting foreign currency
-. *managing subscriptions,* e.g. managing different customer subscriptions; adjusting subscription rates; generating status overview of invoices ; capturing bills

Meanwhile, more than 20 add-ons are also offered, including Image Capture for Invoices, Credit Checker, and PM Report. Furthermore, Exact Online Add-on program facilitates software developers, application developers and Web developers to integrate their own smart solutions into Exact Online. By subscribing to the program, they can link their solutions to the Exact Online software and help promoting their solutions to SMEs.

Figure 5.3 Main features of Exact Online software give an insight toward the software

Exact Online Accounting software

The Exact Online Accounting software is a variant of accounting solutions which are provided by the Exact Softaware Nederland for accountant and accounting firms who act as financial advisor to entrepeneurs. This software is equipped with input, control, and reporting activities pertaining to financial management and is completed with collaboration and communication facilities with entrepeneurs as the customers of accountant and accounting firms. Therefore, they are able to quickly respond to business changes and the latest market developments.

The software is offered within two types of subscriptions, namely Advanced Accounting, and Basis Accounting. Depending on the chosen subscriptions, different package of functionalities are offered to accountant and accounting firms. The functionalities include *ledger account, administration, import & export, accounts receivable and payable management and electronic VAT return; helpdesk, access to customer records, digital document management, payment reminders, customer relationship Chamber link; collaborate with customers, view and modify records of the customers; payroll; scan and recognize; number of administrations; number of office users; number of client users; accounting tolls; internet banking; budget; cost analysis; currency; invoice; subscriptions; and assets*.

Standard functionalities which are offered within the Advanced Accounting subscription is more complete comparing to the Basis Accounting subscription. The Basis Accounting subscription is only equipped with four functionalities, which are related to *ledger account, helpdesk* and *collaboration with customers*, and *assets*; whereas the Advanced Accounting subscription is basically the Basis Accounting subscription with additional functionalities, which include *accounting tolls, internet banking, budget, cost analysis,* and *currency*. For both types of subscription, *number o administrations* and *number of office users* are of extra order while *number of client users* is only available in the Advanced Accounting subscription as an extension. However, the Exact Online Accounting software is not equipped with additonal add-on that can be added by accountant and accounting firms to improve the performance of the software.

The software offers substantial benefits for accountant and accounting firms who are able to work flexibly with their customers and supported with handy links and customer supports, including:

- Easy access, including i-Phone
- Flexible collaboration with customers
- Efficient operations with useful links, i.e. SBR, banking integration
- Monthly subscription fees and no upfront investment
- Reliable and secured IT management, including automatic updates toward the software
- More than 53,000 administrations are conducted with Exact Online Accounting software

A user will be provided with five main menus, which are “Administraties”, “Template”, “Overachtten”, “Salaris”, and “Administratie: Beheer”. Moreover, there are five main groups of features which are represented under menu-tabs at the banner on the top-side of the web page of the software. They are “Home”, “Financieel”, “Verkoop”, “Inkoop”, and “Medewerker”. The “Home” tab provides general features of the software, including: specific overview of financial statements according to user authorization, including “Accountant’s cockpit” in which financial statements are provided in tables and graphs; while the rest of the features under this tab is related to documentations, export/import, system setting, and news update toward the software. “Financieel”, “Verkoop”, and “Inkoop” tab are related to managing financial issues within enterprise while “Medewerker” tab is related to managing employee, including payroll (Salaris). Therefore, customers of the accountants and accounting firms are able to enter payroll changes instantly and with alerts, and are provided with digital file of their staff information.

Therefore, the Exact Online Accounting software is offered as an effective accounting tool to monitor, analyze, and manage financial reporting. The main benefits which are underlined by this sotftware including *accountancy cockpit* within which all of financial information related to customers are presented; *custom templates* within which financial information are kept secured; *scan and recognize* invoices which increase efficiency in managing financial information; and *preferable collaboration with customers* that match with the chosen subscription.

Figure 5.4 Main features of Exact Online Accounting software give an insight toward the software

5.3 Exact promises benefits of SaaS

From the interviews with the representatives of Exact Online software from Exact Software Nederland (Exact), we conclude several findings from the data identification which is provided in detail within *Appendix E, Part I*. **First**, Exact Online and Exact Online Accounting software is actually the same basic application with different target users. The former software is targeted for entrepreneurs and Small Medium Sized Enterprises (SMEs) while the latter software is targeted for accountants and accounting firms. By providing extensions and add-ons, Exact enables targeted users to upgrade their current subscriptions to meet the demand of their business.

Second, extensions and add-ons are of different features which are provided to users. While extensions are internally developed by Development team of Exact Online software, add-ons are provided by third-parties which purchase Software Development Kit of Exact Online software from Exact Software Nederland. By purchasing Software Development Kit, third-parties can have an access to link Exact Online software within their developed applications. Therefore, users of Exact Online can be provided with more features that can help them to manage financial issues within their enterprise. However, the management of these add-ons is separated from Exact Online software and thus, users of Exact Online software will need to have different agreement with third parties who provides add-ons. The list of these add-ons is provided in the website of Exact Online software.

Third, Exact Software Nederland offers a complete package of software for a specific industry, i.e. trading companies. Exact Handle is developed by incorporating features of financial management from Exact Online software, which is further added, with features that is needed for a trading company. By considering that Exact Handle represents an enterprise application based on SaaS model, i.e. Enterprise Resource Planning (ERP) system, this development confirms that Exact Online software provides a base of SaaS ERP system within which managing financial issues are within core business process of any enterprises. In addition, the current ERP solution, which is provided by Exact Software Nederland, is on-premise software which is locally-installed in client's enterprise.

Fourth, there are five internal stakeholders within Exact Software Nederland, which are involved during the whole lifecycle process of delivering Exact Online software. They are proposition team, development team, sales team, support team, and product owner. The proposition team analyzes market needs toward an application that can satisfy business goals for a certain target market. This market research includes possible development toward the existing applications that are offered by Exact Software Nederland, i.e. Exact Online software. The development team is in charge of the development, including design, building, and testing, and the maintenance of all applications, which are offered to clients by Exact Software Nederland. After an application is launched, the sales team is responsible to do marketing of this application to the targeted market. During the delivery of the application to clients, the support team provides services to assist clients, e.g. if they have issues when using the application. In addition, clients may ask for a consultant from this team to come to their sites for individual assistance toward the application. Furthermore, feedbacks and suggestions from clients regarding the application are handled by the support team who are then deliver these inputs to the development team who may discuss about future development toward the application with the product owner. The product owner will decide whether the application needs to be developed further to satisfy business requirements in the targeted markets.

An example on how these internal stakeholders are involved is presented as following. According to market research, there is a growing trend for integrating an enterprise application with many web-applications, e.g. Google apps. The proposition team can propose for a new extension for Exact Online software to the development team who will discuss about this proposition with the product owner. Once the product owner decides this proposition, the development team can start the development of the new extension and launch this extension to clients after it has been tested.

Table 5.1 Key benefits of Exact Online and Exact Online Accounting software represent key characteristic of the promised benefits of SaaS

Key characteristics of the promised benefits of SaaS	The benefits of Exact Online Software which is promised by Exact Online	The benefits of Exact Online Software which is promised by Exact Online Accounting
1. Resource efficiency	– Low subscription fees and no upfront investment – Much time and cost savings with useful links, i.e. exchanging bank files and fuel costs	– Monthly subscription fees and no upfront investment – Efficient operations with useful links, i.e. SBR, banking integration
2. Process effectiveness	– An overview of financial statement – Easy and secured access, including i-Phone and Android – Fast time processing	– Reliable and secured IT management, including automatic updates toward the software – Easy access, including i-Phone and Android
3. Data confidentiality	Easy and secured access, including i-Phone and Android	Reliable and secured IT management, including automatic updates toward the software
4. Integrated information	Easily collaborate online with your bookkeeper or accountant	Flexible collaboration with customers
5. Service availability	Easy and secured access, including i-Phone and Android	Easy access, including i-Phone and Android
6. Service reliability	– Easy to extend – Easy and secured access, including i-Phone and Android	Reliable and secured IT management, including automatic updates toward the software
7. Regulatory compliance	– More than 61,700 administrations are conducted with Exact Online – Much time and cost savings with useful links, i.e. exchanging bank files and fuel costs – Easy to extend	– More than 53,000 administrations are conducted with Exact Online Accounting software – Efficient operations with useful links, i.e. SBR, banking integration

When the new extension is ready to launch, the sales team will provide marketing for this new extension by either adding new feature toward the existing subscriptions, or introducing this extension in a separate offer. Similar proposition might come from the support team who bundles feedbacks and suggestions from users of the application. The development team who receives this proposition will discuss the possibility for adding a new extension toward the application. Furthermore, the internal stakeholders might cooperate with the external stakeholders, including clients and third-parties. Clients of Exact Online software include entrepreneurs and the users within SMEs while clients of Exact Online Accounting software include accountants and the users within accounting firms. Third parties are other enterprises who want to integrate their application into Exact Online (including Exact Online Accounting). By purchasing Software Development Kit from Exact Software Nederland, third parties can provide link into the Exact Online software as add-ons. We present the related stakeholders in Figure 5.5.

Fifth, the benefits of secured access have been proven by providing a certified-secured access (*e-sure*) for Exact Online software. By keeping the aim of supporting people in being control over their business process, Exact Software Nederland focuses in optimizing the delivery of SaaS benefits while letting people focusing on their business process. The SaaS benefits, which are published in the website that provides information about this application, might be too general in representing benefits, which can be gained for specific clients who adopt Exact Online software to help in managing their financial issues. Regardless this limited information about the benefits, the published benefits can be used as an initial judgment to understand the key benefits, which are promised from the application. For this reason, we present Table 5.1 in order to help us analyzing further benefits of SaaS which can be promised for Exact Online software.

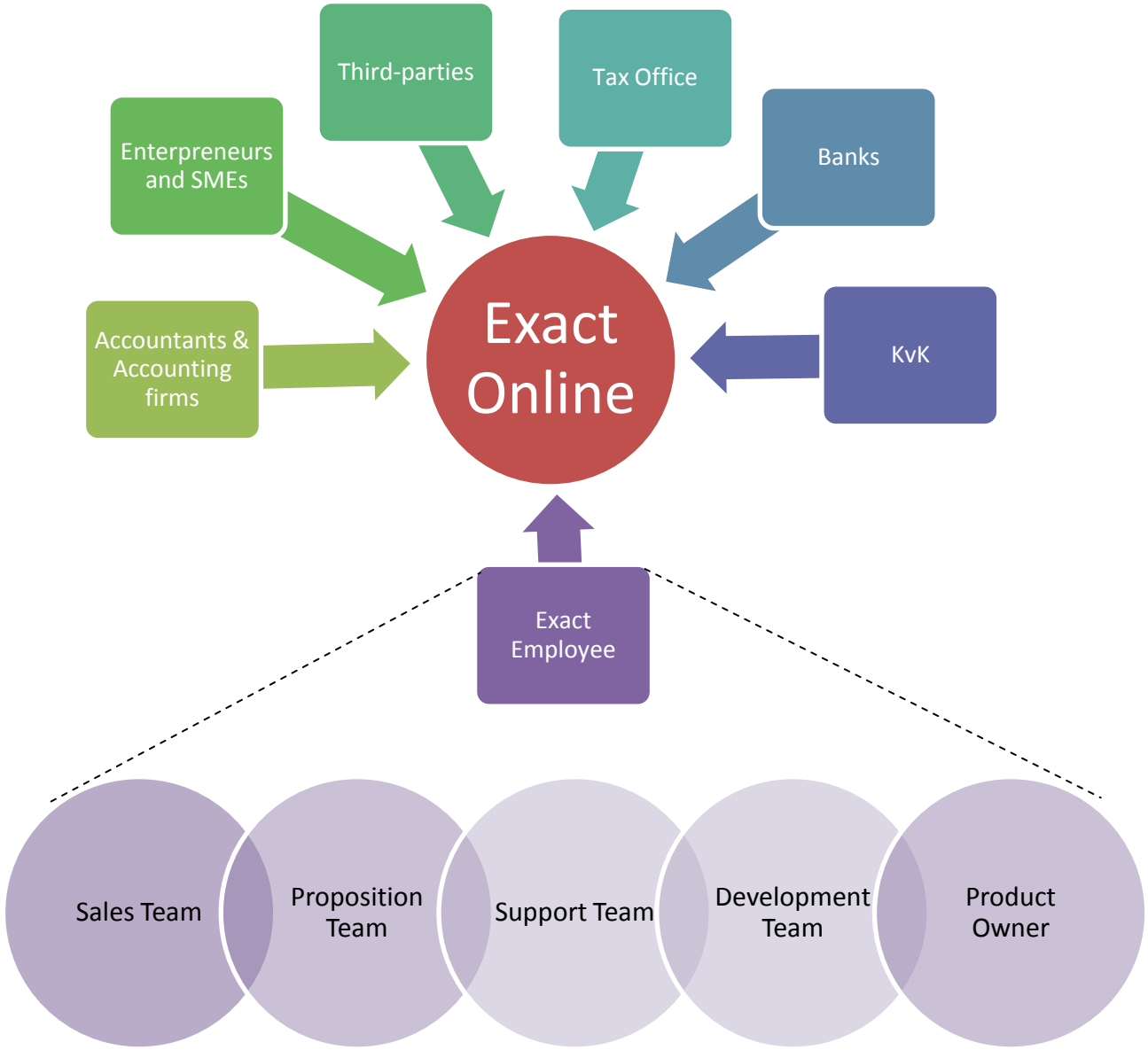


Figure 5.5 Stakeholders of Exact Online application involves internal employees and external parties

5.4 Conclusion

We presented our case study in this chapter in order to provide basic understanding toward what we are looking for when performing data gathering about Exact Online, which is provided as SaaS-based application by Exact Software Nederland (Exact). We have presented our desk research regarding Exact Online application in Subchapter 5.1 from which a business case has been developed in Subchapter 5.2. According to this desk research, we conducted interviews within Exact regarding the delivery of Exact Online as a SaaS-based application.

From the interviews with Exact, we found that some benefits from adopting Exact Online software can address the promised benefits of SaaS which are proposed in the research, which are *technology-enabled business support benefits, interactive support benefits,* and *comprehensive support benefits*. After identifying data from the interviews, we found that these benefits can be fulfilled to some extent when delivering the application. Among these benefits, *interactive support benefits* are of key benefits, which are delivered through the adoption of the application.

Exact guarantees high security standard to protect client's data by providing a certified-secured access (*e-sure*) toward the applications. As a pioneer of financial management software in the Netherlands, this company gains popularity and trustworthy in successfully addressing financial issues through a SaaS model. This ensures that the applications can address *interactive support benefits*. Furthermore, *comprehensive support benefits* are likely to be delivered since the applications provides collaborations with many entities related to financial management, including enterprises, accounting firms, suppliers, banks, with tax-office; while ensures regulatory compliance regarding financial issues. Thus, Exact Online applications can be regarded as a SaaS-based application, which can deliver *technology-enabled business support benefits* by introducing an efficient and effective financial management to support business process of an enterprise, while the enterprise can focus on its core business process.

CHAPTER

6

QUANTITATIVE ANALYSIS

"And said, 'My Lord, my bones have gone frail and my head is crowned with white, but in calling on You, My Lord, I have never been disappointed'." [Surah Maryam, 4]

Software as a Service (SaaS) model has been receiving a lot of attention for the last ten years in business and scientific communities. This software delivery model is also seen as a new era that can bring further discussion on software development [Goth, 2008] which can help to align what vendors deliver and their clients' expectations. Meanwhile, there has been a limited discussion on to what extent this model can be benefited for both vendors and clients by considering quantitative analysis to assess the benefits, which can be achieved from adopting a SaaS-based application. In the light of realizing potential benefits of SaaS, the research which is presented in this thesis aims at assessing the benefits qualitatively and quantitatively from three perspectives, which are the perspective of vendors or SaaS providers, the perspective of clients or SaaS adopters, and the perspective of processes of SaaS lifecycle.

We have presented the conceptualization of the benefits of SaaS in Chapter 3, which can represent a qualitative analysis toward the benefits from the three perspectives. Following this, a comprehensive methodology to assess these benefits has already been proposed in Chapter 4, which incorporates the models of benefit structures in order to conceptualize the benefits of SaaS. In this chapter, we would like to analyze the result of implementing the proposed methodology for a case study, which has been discussed in Chapter 5. For this reason, we apply quantitative analysis by applying a statistical technique, which has been widely applied in business and research communities, particularly in social science. In this research, we employ Partial Least Squares (PLS) for Structure Equation Modeling (SEM), that is also referred to as 'PLS Path modeling'. We will build the models of SaaS benefits using a free-software that facilitates the application of PLS Path modeling, namely SmartPLS version 2.0 (available in: http://www.smartpls.de). The models are built by referring to the identification of research data which is discussed further in *Appendix F* in order to answer the following seventh sub-question.

Q7) To what extent, the achievement of the benefits of SaaS can be evaluated? [*explanatory analysis by an evaluation*]

The rest of this chapter will discuss about the development of the models of benefit structures in SmartPLS. Subchapter 6.1, Subchapter 6.2, and Subchapter 6.3 will discuss about the development of three models of benefit structures, which are the promised benefit model, the perceived benefit model, and the process benefit model, sequentially. The promised benefit model will be developed according to the benefit structures from the perspective of SaaS providers, which has been discussed in Subchapter 4.1; while the perceived benefit model will be developed, based on the benefit structures from the perspective of SaaS adopters, which has been discussed in Subchapter 4.2. The process benefit model will be developed based on the benefit structures from the perspective of the lifecycle process of SaaS, which has been discussed in Subchapter 4.3. Then, we will present a conclusion of this chapter in Subchapter 6.4.

6.1 The promised benefit model cannot be validated

The perspective of SaaS providers about SaaS benefits are referred to as the promised benefits. To understand these benefits, we have conducted two interviews in Exact Software Nederland about the adoption of Exact Online application which has been discussed in Chapter 5. These two interviews unlikely result in very small sample sizes of two samples which will be used to validate the model of the promised benefit. This situation can lead up to weakly validating the model, or even being unable to validate the model. Nevertheless, we have identified the research data which has been collected during the interviews as discussed further in *Appendix E, Part I*. From this identification, we would like to know to what extent each sample can fulfil the promised benefits which are proposed in this research, which are *technology-enabled business support benefits*, *interactive support benefits,* and *comprehensive support benefits* (see Subchapter 4.1 for further explanation about these benefits). This is done by determining value of indicators which characterize the promised benefits. The *technology-enabled business support benefits* can be indicated by *resource efficiency* and *process effectiveness*; while the *interactive support benefits* can be indicated by *service availability, service reliability*. The *comprehensive support benefits* can be indicated by *integrated information*, and *regulatory compliance*.

We also determine the value that can characterize the benefits of Service Oriented Computing (SOC), including *increased of inherent interoperability, increased of federation, increased of vendor diversification options, increased alignment of business and technology domains, increased of ROI, increased of organizational agility,* and *reduced of IT burden*. The increased of inherent interoperability can be indicated by *ease-of-access*, *ease-of-information exchange*, and *community collaboration*; while the increased of federation can be indicated by *standardization of IT environment* and *protection of implementation details*. The increased of vendor diversification options can be indicated by *standardization of IT environment* and *protection of implementation details*; whereas the increased alignment of business and technology domains can be indicated by *automation of technology innovation*, and *capability of addressing immediate business changes*. The increased of ROI can be indicated by *ability to incorporate multi-purpose*, and *ability to provide cost-effective solution*; while the increased of organizational agility can be indicated by *capability of responding to business changes*, and *strategic solution in establishing an agile organization*. The reduced of IT burden can be indicated by *scalability of IT products*, and *value of business by leveraging IT products*.

We extracted the answers from two interviewees by categorizing the list of interview questions into the related indicators of the promised benefits and the benefits of SOC. Then, we determined the value of each answer from the identification of interview results and calculated the average of the values in the same categorization of indicators of the promised benefits and the benefits of SOC. The values lie within 5-point range of likert scale. We present the result of this calculation in Table F.1 in *Appendix F*. According to the value of indicators in Table F.1, we built the model of the promised benefits using SmartPLS tool as depicted in Figure 6.1. It is important to note that although the model can be built correctly without any structural errors, it cannot be validated due to very small sample sizes.

Furthermore, the sample size can be determined by considering which one of the following ways is higher: [Chin, 1998] 1) the construct with the largest number of formative indicators, or 2) the dependent latent variable with the largest number of relationship. Then, the sample size required for PLS would be 5 to 10 times the largest number from either 1) or 2). In this case, the model requires at least 30 cases. Another recommendation is at least 77 cases (statistical test: linear multiple regression: Fixed model, R^2 deviation from zero, power = 0.8; p-value = 0.05; medium effect size (F^2)=0.15, only R^2 upper 13% will be detected as significant) when we use G*Power 3 software to determine sample size which is developed by Faul et al. [2009] that is available for free in the official website of the software [visit: http://www.psycho.uni-duesseldorf.de/abteilungen/aap/gpower3/].

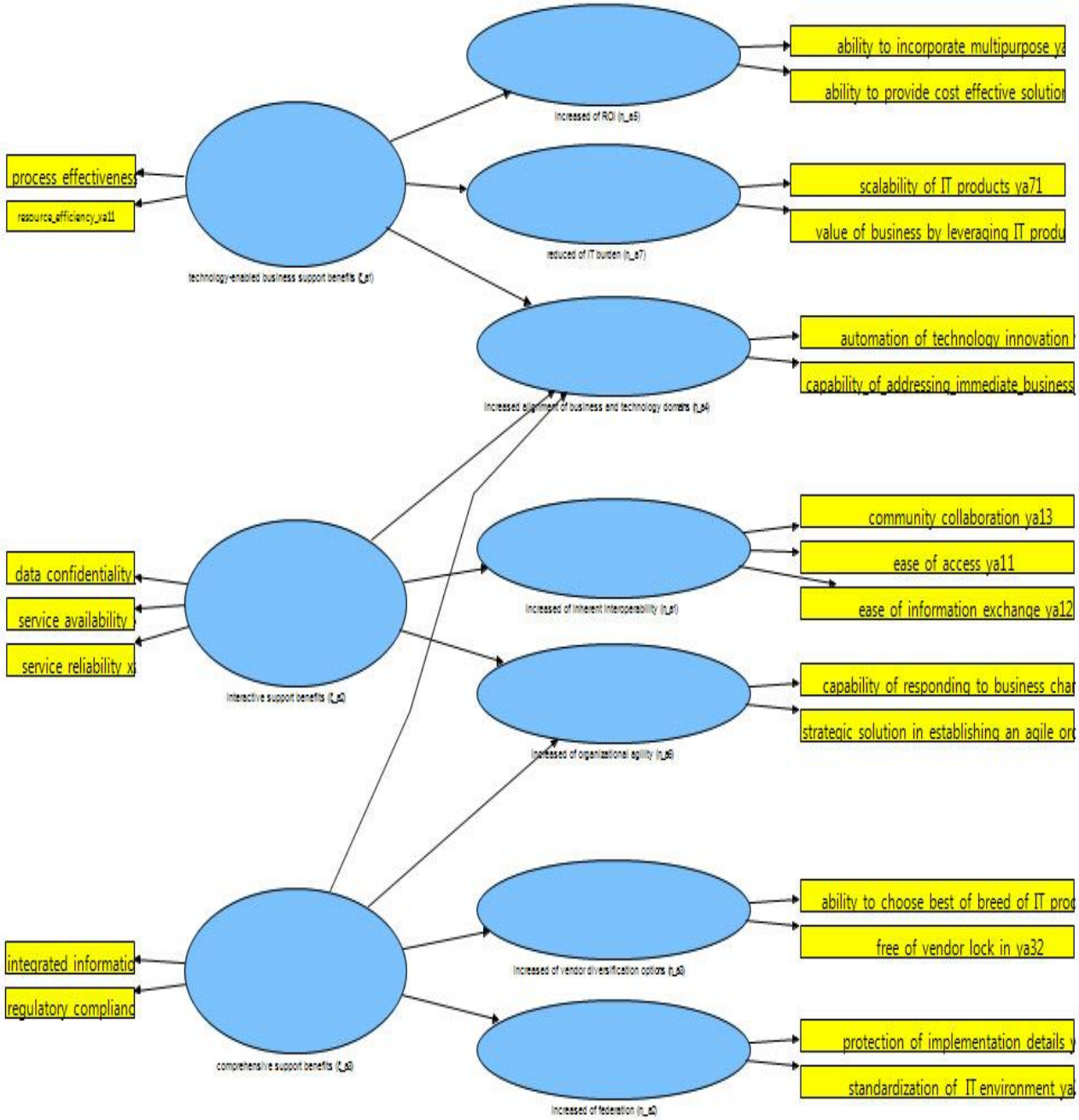


Figure 6.1 The promised benefit model can be built in SmartPLS, but cannot be validated due to very small sample size

6.2 The perceived benefit model can be validated

In order to build the model of the perceived benefits which can represent the perspective SaaS adopters toward SaaS benefits, we delivered a questionnaire to the users of Gmail application. We have collected data from 44 respondents from which we identified the questionnaire result as discussed in *Appendix E, Part II*. From this identification, we would like to know to what extent users can realize benefits of using Gmail as SaaS-based email application at different level of SaaS maturity model which is developed in this research. The developed SaaS maturity model includes six levels of maturity, which are *Level 0 (Potential), Level 1(Prospective), Level 2 (Promising), Level 3 (Achieving), Level 4 (Stabilizing),* and *Level 5 (Optimizing)*. Each level of maturity represents certain perceived benefits which can be expected when adopting a SaaS-based application (see Subchapter 4.2 for further explanation about these benefits). We would like determine value of indicators which characterize the benefits at different level in order to know the achievement of the benefits of SaaS from the perspective of users.

Level 0-Potential can be indicated by *utility based* while Level 1-Prospective can be indicated by *SLA driven*. Level 2-Promising can be indicated by *shared multitenant efficient*, and *community contribution;* whereas Level 3-Achieving can be indicated by *reliability and fault tolerance*, *and flexible and scalable*. Level 4-Stabilizing can be indicated by *collaborative and smart*, and *credible and accountable*; whereas Level 5-Optimizing can be indicated by *nimbleness*, and *sustainable and successful.*

Furthermore, we would like to also determine the value of indicators that can characterize the benefits of Service Oriented Computing (SOC). The increased of inherent interoperability is indicated by *ease-of-access*, *ease-of-information exchange*, and *community collaboration*; while the increased of federation is indicated by *standardization of IT environment* and *protection of implementation details*. The increased of vendor diversification options is indicated by *standardization of IT environment* and *protection of implementation details*; whereas the increased alignment of business and technology domains is indicated by *automation of technology innovation*, and *capability of addressing immediate business changes*. The increased of ROI is indicated by *ability to incorporate multi-purpose*, and *ability to provide cost-effective solution*; while the increased of organizational agility is indicated by *capability of responding to business changes*, and *strategic solution in establishing an agile organization*. The reduced of IT burden is indicated by *scalability of IT products*, and *value of business by leveraging IT products*.

Figure 6.2 The perceived benefit model can be built and validated within SmartPLS

Table 6.1 Overview of the report provides the result of AVE and composite reliability

Latent Variables (LVs)	AVE	Composite Reliability
Level 0: Potential (ξ_{b1})	1.00	1.00
Level 1: Prospective (ξ_{b2})	1.00	1.00
Level 2: Promising (ξ_{b3})	0.71	0.83
Level 3: Achieving (ξ_{b4})	0.62	0.76
Level 4: Stabilizing (ξ_{b5})	0.91	0.96
Level 5: Optimizing (ξ_{b6})	0.68	0.81
increased alignment of business and technology domains (η_{b4})	0.89	0.94
increased of ROI (η_{b5})	0.87	0.93
increased of federation (η_{b2})	0.83	0.91
increased of inherent interoperability (η_{b1})	0.61	0.82
increased of organizational agility (η_{b6})	0.87	0.93
increased of vendor diversification options (η_{b3})	0.66	0.79
reduced of IT burden (η_{b7})	0.72	0.84

We extracted the responses from the questionnaires by categorizing the list of questionnaire questions into the related indicators of the perceived benefits and the benefits of SOC. Then, we determined the value of each answer from the identification of these responses, and calculated the average of the values in the same categorization of indicators of the perceived benefits and the benefits of SOC. We used 5-point range of likert scale to determine the value of these indicators as depicted in Table F.2 in *Appendix F, Part II*. According to this table, we built the model of the perceived benefits using SmartPLS tool as depicted in Figure 6.2.

In order to validate the constructs of the perceived benefit model, we are particularly interested in seeing certain information that is provided in the report after running the model with PLS Algorithm (Path Weighting scheme; data metric=mean 0,var 1; maximum iterations=100; abort criterion=0.0000001; initial weights=1). They are *overview* that provides information about AVE to assess convergent validity of the constructs and composite reliability that aims at ensuring that variables in each model is reliable, and *latent variable correlations* that provides information about correlation among variables to assess discriminant validity of the constructs.

The constructs of the perceived benefits have good convergent validity if the AVE for each variable is equal or greater than 0.5 while the constructs have good discriminant validity if the composite reliability is equal or greater than 0.7. We present the value of AVE and composite reliability for the perceived benefits in Table 6.1. From this table we found that all of the AVE is greater than 0.5, and the composite reliability is greater than 0.7. Therefore, the constructs have good convergent validity and discriminant validity.

Furthermore, discriminant validity of the constructs can be categorized as "good" if only all correlations are lower than the AVE squared root. We present the results from the latent variable correlations that as depicted in Table 6.2. We found that not all of the correlations of the LVs are lower than the AVE squared root, although with very small differences (0.01-0.03).

Table 6.2 Latent variable correlations of the report provides the result of correlations between LVs within the constructs of the perceived benefit

	Level 0: Potential (ξ_{b1})	Level 1: Prospective (ξ_{b2})	Level 2: Promising (ξ_{b3})	Level 3: Achieving (ξ_{b4})	Level 4: Stabilizing (ξ_{b5})	Level 5: Optimizing (ξ_{b6})	increased alignment of business and technology domains (η_{b4})		
Level 0: Potential (ξ_{b1})	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-
Level 1: Prospective (ξ_{b2})	0.37	1.00	0.00	0.00	0.00	0.00	0.00	1.00	**Yes**
Level 2: Promising (ξ_{b3})	0.51	0.47	1.00	0.00	0.00	0.00	0.00	0.84	**Yes**
Level 3: Achieving (ξ_{b4})	0.30	0.49	0.44	1.00	0.00	0.00	0.00	0.79	**Yes**
Level 4: Stabilizing (ξ_{b5})	0.28	0.27	0.41	0.28	1.00	0.00	0.00	0.95	**Yes**
Level 5: Optimizing (ξ_{b6})	0.40	0.42	0.57	0.55	0.26	1.00	0.00	0.82	**Yes**
increased alignment of business and technology domains (η_{b4})	0.57	0.50	0.79	0.71	0.54	0.65	1.00	0.94	**Yes**
increased of ROI (η_{b5})	0.70	0.38	0.66	0.40	0.79	0.46	0.74	0.93	**Yes**
increased of federation (η_{b2})	0.41	0.87	0.53	0.69	0.37	0.62	0.60	0.91	**Yes**
increased of inherent interoperability (η_{b1})	0.60	0.41	**0.79**	0.50	0.43	0.78	0.84	0.78	**No**
increased of organizational agility (η_{b6})	0.40	0.45	0.64	0.67	0.28	**0.96**	0.75	0.93	**No**
increased of vendor diversification options (η_{b3})	0.48	0.60	0.67	0.50	0.75	0.62	0.72	0.81	**Yes**
reduced of IT burden (η_{b7})	0.76	0.53	0.58	0.58	0.38	0.73	0.78	0.85	**Yes**

Then, we test the hypotheses of the perceived benefit model which have been discussed in *Appendix C, Part III,* in order to study the relationships between the (exogenous or endogenous) variables and the associated indicators, and between exogenous and endogenous variables. This is done by considering the result of *path coefficients* within the report. However, to test the hypotheses, we need t-value statistic with bootstrapping.

Table 6.2 Latent variable correlations of the report provides the result of correlations between LVs within the constructs of the perceived benefit – *cont'd*

	increased of ROI (η_{b5})	increased of federation (η_{b2})	increased of inherent interoperability (η_{b1})	increased of organizational agility (η_{b6})	increased of vendor diversification options (η_{b3})	reduced of IT burden (η_{b7})		
Level 0: Potential (ξ_{b1})	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-
Level 1: Prospective (ξ_{b2})	0.00	0.00	0.00	0.00	0.00	0.00	1.00	-
Level 2: Promising (ξ_{b3})	0.00	0.00	0.00	0.00	0.00	0.00	0.84	-
Level 3: Achieving (ξ_{b4})	0.00	0.00	0.00	0.00	0.00	0.00	0.79	-
Level 4: Stabilizing (ξ_{b5})	0.00	0.00	0.00	0.00	0.00	0.00	0.95	-
Level 5: Optimizing (ξ_{b6})	0.00	0.00	0.00	0.00	0.00	0.00	0.82	-
increased alignment of business and technology domains (η_{b4})	0.00	0.00	0.00	0.00	0.00	0.00	0.94	-
increased of ROI (η_{b5})	1.00	0.00	0.00	0.00	0.00	0.00	0.93	-
increased of federation (η_{b2})	0.46	1.00	0.00	0.00	0.00	0.00	0.91	**Yes**
increased of inherent interoperability (η_{b1})	0.64	0.61	1.00	0.00	0.00	0.00	0.78	**Yes**
increased of organizational agility (η_{b6})	0.49	0.62	0.79	1.00	0.00	0.00	0.93	**Yes**
increased of vendor diversification options (η_{b3})	0.81	0.75	0.74	0.60	1.00	0.00	0.81	**Yes**
reduced of IT burden (η_{b7})	0.66	0.63	0.78	0.74	0.65	1.00	0.85	**Yes**

For this reason, we perform a bootstrapping analysis (case=44; sample sizes=1000) within the SmartPLS for the perceived benefit model. The result from the bootstrapping analysis can be seen in Figure 6.3 within which the t-statistic value is presented in the arrows that connecting exogenous variables and endogenous variables, and connecting variables and their indicators. The t-value should be higher than 1.96 (two tailed; 5%) in order for the path coefficient to be significant, and thus the hypotheses about significance relationship in the constructs could not be rejected. We found that not the entire path coefficients which represent the causal relationships were found to be significant as depicted in Table 6.3.

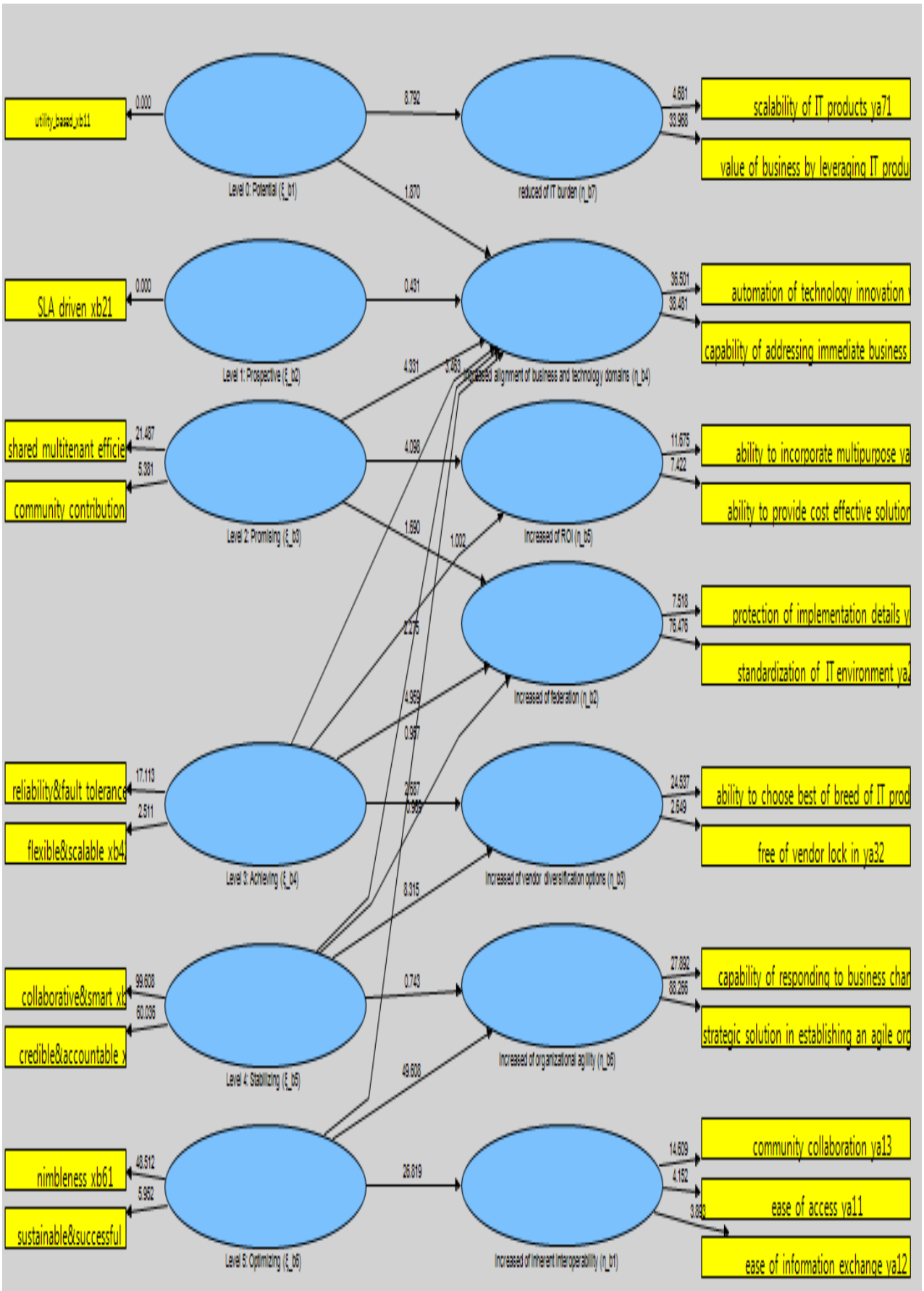


Figure 6.3 Not all the relations within the constructs of the perceived benefit model were found to be significant (path coefficient < 1.96)

Table 6.3 Not the entire path coefficients within the model of the perceived benefits were found to be significant

Path coefficient	The developed sub-hypotheses to structure the perceived benefits	t-value	could not be rejected?
λ_{xb11}	There is a significant relationship between operationalizing *utility based* and perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model during SaaS adoption.	0.00	No
γ_{b17}	There is a significant relationship between perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model and expecting a *reduced of IT burden* by the adopters.	8.79	Yes
λ_{yb71}	There is a significant relationship between expecting a *reduced of IT burden* and increasing *scalability of IT products* pertaining to SaaS applications.	4.68	Yes
λ_{yb72}	There is a significant relationship between expecting a *reduced of IT burden* and increasing *value of business by leveraging IT products* pertaining to SaaS applications.	33.97	Yes
γ_{b14}	There is a significant relationship between perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.	1.87	No
λ_{xb21}	There is a significant relationship between operationalizing *SLA driven* and perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model during SaaS adoption.	0.00	No
γ_{b24}	There is a significant relationship between perceiving benefits of SaaS at *Level 1- Prospective* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.	0.43	No
λ_{yb41}	There is a significant relationship between expecting an *increased alignment of business and technology domains* and increasing *automation of technology innovation* during SaaS adoptions.	36.50	Yes
λ_{yb42}	There is a significant relationship between expecting an *increased alignment of business and technology domains* and increasing *capability of addressing immediate business changes* during SaaS adoptions.	38.48	Yes
λ_{xb31}	There is a significant relationship between operationalizing *shared multitenant efficient* and perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model during SaaS adoption.	21.49	Yes
λ_{xb32}	There is a significant relationship between operationalizing *community contribution* and perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model during SaaS adoption.	5.38	Yes
γ_{b35}	There is a significant relationship between perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model and expecting an *increased of ROI* by the adopters	4.10	Yes
λ_{yb51}	There is a significant relationship between expecting an *increased of ROI* and increasing *ability to incorporate multi-purpose* during SaaS adoptions.	11.68	Yes
λ_{yb52}	There is a significant relationship between expecting an *increased of ROI* and increasing *ability to provide cost-effective solution* during SaaS adoptions.	7.42	Yes
γ_{b32}	There is a significant relationship between perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model and expecting an *increased of federation* by the adopters	1.69	No
λ_{yb21}	There is a significant relationship between expecting an *increased of federation* and increasing *standardization of IT environment* during SaaS adoptions.	7.52	Yes
λ_{yb22}	There is a significant relationship between expecting an *increased of federation* and increasing *protection of implementation details* during SaaS adoptions.	76.48	Yes
γ_{b34}	There is a significant relationship between perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.	4.33	Yes
λ_{xb41}	There is a significant relationship between operationalizing *reliability and fault tolerance* and perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model during SaaS adoption.	17.11	Yes
λ_{xb42}	There is a significant relationship between operationalizing *flexible and scalable* and perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model during SaaS adoption.	2.51	Yes
γ_{b45}	There is a significant relationship between perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model and expecting an *increased of ROI* by the adopters	1.00	No

Table 6.3 Not all the entire path coefficients within the model of the perceived benefits were found to be significant – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the perceived benefits	t-value	significance ?
γ_{b43}	There is a significant relationship between perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model and expecting an *increased of vendor diversification options* by the adopters	2.69	Yes
λ_{yb31}	There is a significant relationship between expecting an *increased of vendor diversification options* and increasing *ability to choose "best-of-breed" of IT products* during SaaS adoptions.	24.54	Yes
λ_{yb32}	There is a significant relationship between expecting an *increased of vendor diversification options* and increasing *free of vendor lock-in* during SaaS adoptions.	2.65	Yes
γ_{b42}	There is a significant relationship between perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model and expecting an *increased of federation* by the adopters	4.96	Yes
γ_{b44}	There is a significant relationship between perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.	3.46	Yes
λ_{xb51}	There is a significant relationship between operationalizing *collaborative and smart* and perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model during SaaS adoption.	99.61	Yes
λ_{xb52}	There is a significant relationship between operationalizing *credible and accountable* and perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model during SaaS adoption.	60.04	Yes
γ_{b53}	There is a significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased of vendor diversification options* by the adopters	8.32	Yes
γ_{b52}	There is a significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased of federation* by the adopters	0.97	No
γ_{b56}	There is a significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased of organizational agility* by the adopters	0.74	No
λ_{yb61}	There is a significant relationship between expecting an *increased of organizational agility* and increasing *capability of responding to business changes* during SaaS adoptions.	27.89	Yes
λ_{yb62}	There is a significant relationship between expecting an *increased of organizational agility* and increasing *strategic solution in establishing an agile organization* during SaaS adoptions.	88.27	Yes
γ_{b54}	There is a significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.	2.28	Yes
λ_{xb61}	There is a significant relationship between operationalizing *nimbleness* and perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model during SaaS adoption.	48.51	Yes
λ_{xb62}	There is a significant relationship between operationalizing *sustainable and successful* and perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model during SaaS adoption.	5.95	Yes
γ_{b61}	There is a significant relationship between perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model and expecting an *increased of inherent interoperability* by the adopters	26.82	Yes
λ_{yb11}	There is a significant relationship between expecting an *increased of inherent interoperability* and increasing *ease-of-access* during SaaS adoptions.	14.61	Yes
λ_{yb12}	There is a significant relationship between expecting an *increased of inherent interoperability* and increasing *ease-of-information exchange* during SaaS adoptions.	4.15	Yes
λ_{yb13}	There is a significant relationship between expecting an *increased of inherent interoperability* and increasing *community collaboration* during SaaS adoptions.	3.89	Yes
γ_{b66}	There is a significant relationship between perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model and expecting an *increased of organizational agility* by the adopters	49.61	Yes
γ_{b64}	There is a significant relationship between perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.	0.96	No

Furthermore, by referring to Chin [1998], we found that the sample size required for the model of the perceived benefits is at least 50 cases (number of the largest relationship of the dependent latent variable equals to five). By using G*Power 3 software, we found that the sample size should be at least 98 cases (statistical test: linear multiple regression: Fixed model, R^2 deviation from zero, power = 0.8; p-value = 0.05; medium effect size (F^2)=0.15, only R^2 upper 13% will be detected as significant).

6.3 The process benefit model can be validated

The process benefit model is developed by considering the lifecycle process of SaaS lifecycle during the delivery of SaaS based application. In this research, we consider the process as the delivery of Exact Online application, and Gmail application. For Exact Online application, we collected data from interviews with two representatives of Exact Software Nederland; while we collected 22 responses from questionnaires which are delivered to the users of Gmail application. From this data collection, we found 24 samples which can be used as an input to know to what extent the benefits of SaaS can be expected during the whole lifecycle process of SaaS. In order to deliver good services during the lifecycle, we employ to the design principles of Service Oriented Architecture (SOA), which includes eight principles. They are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability,* and *service composability*.

SaaS benefits are determined by indicating to what extent these principles can be accommodated during the lifecycle process of SaaS. For this reason, we would like to determine value of indicators which can characterize the design principles of SOA which further can lead to the achievement of the benefits of Service Oriented Computing (SOC). The design principle of standardized service contract can be indicated by *consistency of information about services,* and *description level of services*; while the design principle of service loose coupling can be indicated by *availability of configuration options for service,* and *granularity level of services*. The design principle of service abstraction can be indicated by *generality level of information about services*, and *the depth information about service*; while the design principle of service reusability can be indicated by *multipurpose level of services*, and *frequency of reusable services*. The design principle of service autonomy can be indicated by *governance level of services* and *capability of autonomous services*; whereas the design principle of service stateless can be indicated by *availability level of services,* and *possibility of scaling application and data*. The design principle of service discoverability can be indicated by *accessibility level of services,* and *availability of mechanisms of discovering services*; while the design principle of service composability can be indicated by *custom option level of services,* and *flexibility of custom options for services*.

Moreover, we would also like to determine the value of indicators that are able to characterize the benefits of SOC. They include *ease-of-access*, *ease-of-information exchange*, *community collaboration*, *standardization of IT environment*, *protection of implementation details*, *standardization of IT environment*, *protection of implementation details*, *automation of technology innovation*, *capability of addressing immediate business changes*, *ability to incorporate multi-purpose*, *ability to provide cost-effective solution*, *capability of responding to business changes*, *strategic solution in establishing an agile organization*, *scalability of IT products*, and *value of business by leveraging IT products*.

The value of the indicators of the design principles of SOA and the benefits of SOC is determined by extracting the results from interviews, and the responses from questionnaires, respectively. We use average-function to determine the value of questionnaire questions, or interview questions which lead to the same indicators of either the design principles of SOA or the benefits of SOC. We employ 5-points of likert scale in order to determine the values which can be depicted in Table F.3 in *Appendix F, Part III*. Following this table, we built the model of the process benefits using SmartPLS tool as presented in Figure 6.4.

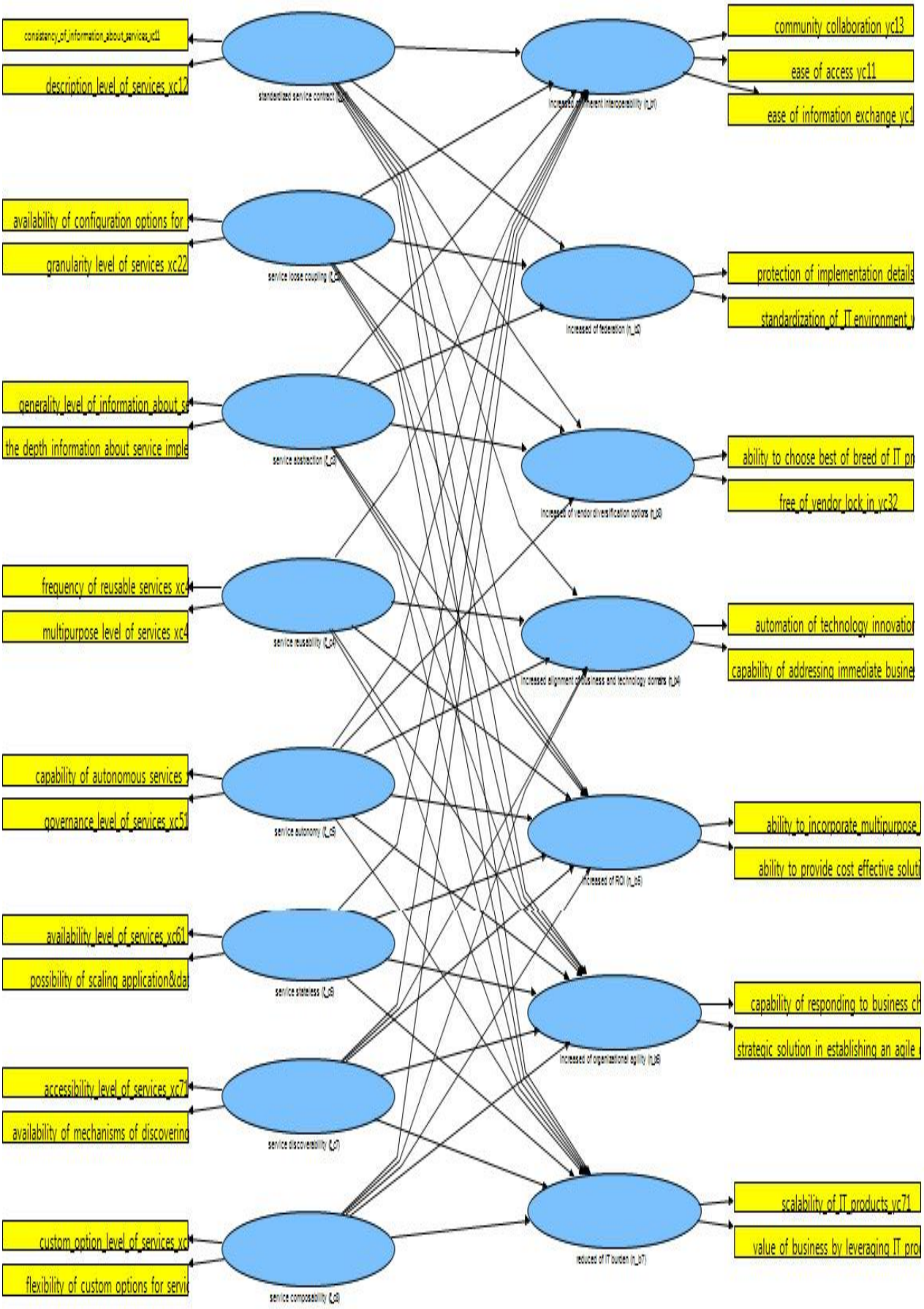


Figure 6.4 The process benefit model can be built and validated within SmartPLS

Table 6.4 Overview of the report provides the result of AVE and composite reliability

Latent Variables (LVs)	AVE	Composite Reliability
increased alignment of business and technology domains (η_b4)	0.85	0.92
increased of ROI (η_b5)	0.63	0.77
increased of federation (η_b2)	0.90	0.95
increased of inherent interoperability (η_b1)	0.78	0.91
increased of organizational agility (η_b6)	0.86	0.92
increased of vendor diversification options (η_b3)	0.84	0.91
reduced of IT burden (η_b7)	0.77	0.87
service abstraction (ξ_c3)	0.80	0.89
service autonomy (ξ_c5)	0.77	0.87
service composability (ξ_c8)	0.71	0.83
service discoverability (ξ_c7)	0.79	0.88
service loose coupling (ξ_c2)	0.72	0.84
service reusability (ξ_c4)	0.80	0.89
service stateless (ξ_c6)	0.70	0.83
standardized service contract (ξ_c1)	0.61	0.76

In order to validate the constructs of the process benefit model, we are particularly interested in seeing certain information that is provided in the report after running the model with PLS Algorithm (Path Weighting scheme; data metric=mean 0,var 1; maximum iterations=100; abort criterion=0.0000001; initial weights=1). We would like to focus on the information about *overview* that provides information about AVE to assess convergent validity of the constructs and composite reliability that aims at ensuring that variables in each model is reliable, and *latent variable correlations* that provides information about correlation among variables to assess discriminant validity of the constructs.

The constructs of the process benefits have good convergent validity if the AVE for each variable is equal or greater than 0.5 while the constructs have good discriminant validity if the composite reliability is equal or greater than 0.7. We present the value of AVE and composite reliability for the process benefits in Table 6.4. From this table we found that all of the AVE is greater than 0.5, and the composite reliability is greater than 0.7. Therefore, the constructs of the process benefit model have good convergent validity and discriminant validity. Furthermore, discriminant validity of the constructs can be categorized as "good" if only all correlations are lower than the AVE squared root. We present the results from the latent variable correlations that as depicted in Table 6.5. We found that not all of the correlations of the LVs are lower than the AVE squared root, although with very small differences (0.01-0.06).

Then, we test the hypotheses of the process benefit model which have been discussed in *Appendix C, Part IV,* in order to study the relationships between the (exogenous or endogenous) variables and the associated indicators, and between exogenous and endogenous variables. This is done by considering the result of *path coefficients* within the report. However, to test the hypotheses, we need t-value statistic with bootstrapping.

Table 6.5 Latent variable correlations of the report provides the result of correlations between LVs within the constructs of the process benefit

	increased alignment of business and technology domains (η_b4)	increased of ROI (η_b5)	increased of federation (η_b2)	increased of inherent interoperability (η_b1)	increased of organizational agility (η_b6)	increased of vendor diversification options (η_b3)	reduced of IT burden (η_b7)	service abstraction (ξ_c3)		
increased alignment of business and technology domains (η_b4)	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	**-**
increased of ROI (η_b5)	0.61	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	**Yes**
increased of federation (η_b2)	0.37	0.73	1.00	0.00	0.00	0.00	0.00	0.00	0.95	**Yes**
increased of inherent interoperability (η_b1)	0.37	0.51	0.70	1.00	0.00	0.00	0.00	0.00	0.88	**Yes**
increased of organizational agility (η_b6)	0.89	0.84	0.62	0.59	1.00	0.00	0.00	0.00	0.93	**Yes**
increased of vendor diversification options (η_b3)	0.77	0.77	0.73	0.74	0.91	1.00	0.00	0.00	0.92	**Yes**
reduced of IT burden (η_b7)	0.73	**0.89**	0.79	0.53	0.88	0.84	1.00	0.00	0.88	**No**
service abstraction (ξ_c3)	0.63	0.66	0.69	0.47	0.70	0.66	0.65	1.00	0.89	**Yes**
service autonomy (ξ_c5)	0.71	0.40	0.18	0.17	0.50	0.48	0.46	0.54	0.88	**Yes**
service composability (ξ_c8)	0.84	0.67	0.40	0.60	**0.90**	**0.88**	0.66	0.52	0.84	**No**
service discoverability (ξ_c7)	0.16	0.33	0.64	**0.95**	0.39	0.58	0.36	0.32	0.89	**No**
service loose coupling (ξ_c2)	0.42	0.68	0.82	0.64	0.65	0.69	0.70	0.58	0.85	**Yes**
service reusability (ξ_c4)	0.75	0.78	0.63	0.53	**0.93**	0.82	0.81	0.67	0.89	**No**
service stateless (ξ_c6)	0.53	0.68	0.28	0.39	0.57	0.52	0.54	0.47	0.84	**Yes**
standardized service contract (ξ_c1)	0.21	0.70	**0.84**	0.33	0.45	0.54	0.75	0.41	0.78	**No**

Table 6.5 Latent variable correlations of the report provides the result of correlations between LVs within the constructs of the process benefit – *cont'd*

	service autonomy (ξ_c5)	service composability (ξ_c8)	service discoverability (ξ_c7)	service loose coupling (ξ_c2)	service reusability (ξ_c4)	service stateless (ξ_c6)	standardized service contract (ξ_c1)		
increased alignment of business and technology domains (η_b4)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	-
increased of ROI (η_b5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	-
increased of federation (η_b2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95	-
increased of inherent interoperability (η_b1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	-
increased of organizational agility (η_b6)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	-
increased of vendor diversification options (η_b3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	-
reduced of IT burden (η_b7)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	-
service abstraction (ξ_c3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	-
service autonomy (ξ_c5)	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	-
service composability (ξ_c8)	0.50	1.00	0.00	0.00	0.00	0.00	0.00	0.84	**Yes**
service discoverability (ξ_c7)	-0.05	0.41	1.00	0.00	0.00	0.00	0.00	0.89	**Yes**
service loose coupling (ξ_c2)	0.19	0.44	0.52	1.00	0.00	0.00	0.00	0.85	**Yes**
service reusability (ξ_c4)	0.31	0.79	0.41	0.52	1.00	0.00	0.00	0.89	**Yes**
service stateless (ξ_c6)	0.58	0.55	0.15	0.40	0.37	1.00	0.00	0.84	**Yes**
standardized service contract (ξ_c1)	0.12	0.21	0.25	0.65	0.46	0.22	1.00	0.78	**Yes**

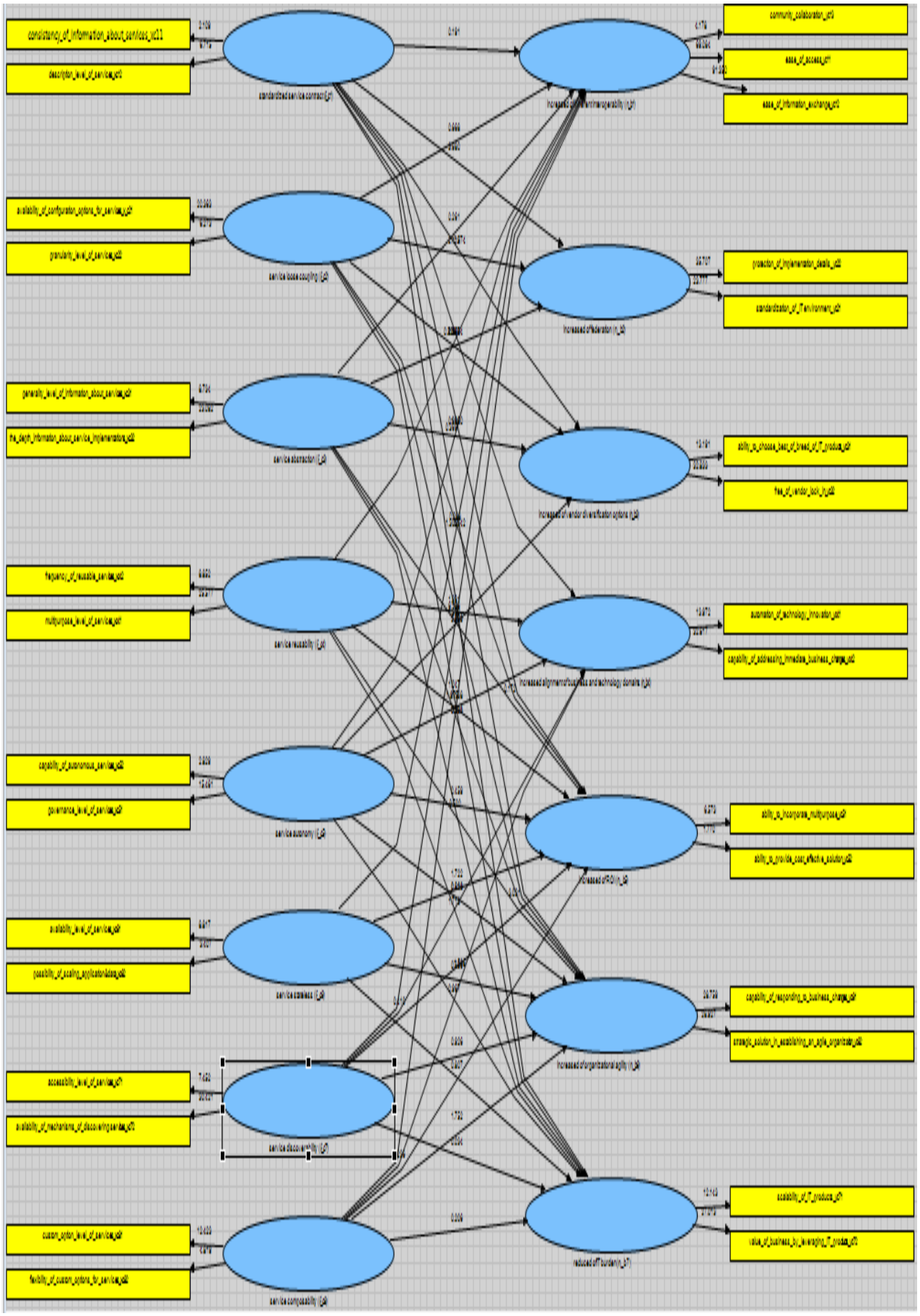


Figure 6.5 Many relations within the structural model of the prosess benefit constructs were not found to be significant (path coefficient < 1.96)

Table 6.6 Many path coefficients within the model of the perceived benefits were not found to be significant

Path coefficient	The developed sub-hypotheses to structure the perceived benefits	t-value	could not be rejected?
λ_{xc11}	There is a significant relationship between ensuring that *consistency of information about services (related to the delivery of SaaS applications) which is published by the providers* is considered during the lifecycle of SaaS and employing the design principle of *standardized service contract* during SaaS adoptions.	2.12	Yes
λ_{xc12}	There is a significant relationship between ensuring that *description level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *standardized service contract* during SaaS adoptions.	6.12	Yes
γ_{c11}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.	0.19	No
λ_{yc11}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of inherent interoperability* and increasing *ease-of-access* during SaaS adoptions.	4.18	Yes
λ_{yc12}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of inherent interoperability* and increasing *ease-of-information exchange* during SaaS adoptions.	69.08	Yes
λ_{yc13}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of inherent interoperability* and increasing *community collaboration* during SaaS adoptions.	91.35	Yes
γ_{c12}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of federation.*	3.68	Yes
λ_{yc21}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of federation* and increasing *standardization of IT environment* during SaaS adoptions.	35.71	Yes
λ_{yc22}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of federation* and increasing *protection of implementation details* during SaaS adoptions.	23.78	Yes
γ_{c13}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.	0.57	No
λ_{yc31}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of vendor diversification options* and increasing *ability to choose "best-of-breed" of IT products* during SaaS adoptions.	13.19	Yes
λ_{yc32}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of vendor diversification options* and increasing *free of vendor lock-in* during SaaS adoptions.	32.83	Yes
γ_{c14}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.	0.58	No
λ_{yc41}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased alignment of business and technology domains* and increasing *automation of technology innovation* during SaaS adoptions.	13.97	Yes
λ_{yc42}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased alignment of business and technology domains* and increasing *capability of addressing immediate business changes* during SaaS adoptions.	32.62	Yes
γ_{c15}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI.*	1.49	No

For this reason, we perform a bootstrapping analysis (case=22; sample sizes=1000) within the SmartPLS for the process benefit model. The result from the bootstrapping analysis can be seen in Figure 6.4 within which the t-statistic value is presented in the arrows that connecting exogenous variables and endogenous variables, and connecting variables and their indicators. The t-value should be higher than 1.96 (two-tailed; 5%) in order for the path coefficient to be significant, and thus the hypotheses about significance relationship in the constructs of the process benefit model could not be rejected. We found that many path coefficients which represent the causal relationships were not found to be significant as depicted in Table 6.6.

Table 6.6 Many path coefficients within the model of the perceived benefits were not found to be significant – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the perceived benefits	t-value	could not be rejected?
λ_{yc51}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of ROI* and increasing *ability to incorporate multi-purpose* during SaaS adoptions.	6.58	Yes
λ_{yc52}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of ROI* and increasing *ability to provide cost-effective solution* during SaaS adoptions.	1.77	Yes
γ_{c16}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.	0.34	No
λ_{yc61}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of organizational agility* and increasing *capability of responding to business changes* during SaaS adoptions.	28.76	Yes
λ_{yc62}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of organizational agility* and increasing *strategic solution in establishing an agile organization* during SaaS adoptions.	28.93	Yes
γ_{c17}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.	1.89	No
λ_{yc71}	There is a significant relationship between accomplishing the strategic goal and benefit of *reduced of IT burden* and increasing *scalability of IT products* pertaining to SaaS applications.	12.14	Yes
λ_{yc72}	There is a significant relationship between accomplishing the strategic goal and benefit of *reduced of IT burden* and increasing *value of business by leveraging IT products* pertaining to SaaS applications.	27.01	Yes
λ_{xc21}	There is a significant relationship between ensuring that *availability of configuration options for services (related to the delivery of SaaS applications) which are specified by both the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service loose coupling* during SaaS adoptions.	20.36	Yes
λ_{xc22}	There is a significant relationship between ensuring that *granularity level of services (related to the delivery of SaaS applications) which incorporate both perspective of the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service loose coupling* during SaaS adoptions.	6.27	Yes
γ_{c21}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.	0.67	No
γ_{c22}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of federation.*	2.12	Yes
γ_{c23}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.	1.95	Yes
γ_{c25}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.	0.09	No
γ_{c26}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.	2.60	Yes
γ_{c27}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.	0.70	No
λ_{xc31}	There is a significant relationship between ensuring that *generality level of information about services (related to the delivery of SaaS applications) which are published by the providers* is considered during the lifecycle of SaaS and employing the design principle of *service abstraction* during SaaS adoptions.	8.73	Yes
λ_{xc32}	There is a significant relationship between ensuring that *the depth information about service implementations (related to the delivery of SaaS applications) which satisfy both requirements of the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service abstraction* during SaaS adoptions.	23.08	Yes

Table 6.6 Many path coefficients within the model of the perceived benefits were not found to be significant – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the perceived benefits	t-value	could not be rejected?
γ_{c31}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.	0.26	No
γ_{c32}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of federation.*	2.19	Yes
γ_{c33}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.	1.00	No
γ_{c35}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.	0.17	No
γ_{c36}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.	0.33	No
γ_{c37}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden.*	0.52	No
λ_{xc41}	There is a significant relationship between ensuring that *multipurpose level of services (related to the delivery of SaaS applications) which are expected by the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service reusability* during SaaS adoptions.	8.85	Yes
λ_{xc42}	There is a significant relationship between ensuring that *frequency of reusable services (related to the delivery of SaaS applications) which are developed by the providers in meeting the demand of the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service reusability* during SaaS adoptions.	25.58	Yes
γ_{c41}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.	0.53	No
γ_{c44}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.	1.98	Yes
γ_{c45}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.	1.14	No
γ_{c46}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.	3.03	Yes
γ_{c47}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden.*	1.71	No
λ_{xc51}	There is a significant relationship between ensuring that *governance level of services (related to the delivery of SaaS applications) which are defined by the providers* is considered during the lifecycle of SaaS and employing the design principle of *service autonomy* during SaaS adoptions.	2.83	Yes
λ_{xc52}	There is a significant relationship between ensuring that *capability of autonomous services (related to the delivery of SaaS applications) in meeting business changes from the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service autonomy* during SaaS adoptions.	15.46	Yes
γ_{c51}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.	0.37	No
γ_{c53}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.	1.56	No
γ_{c54}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.	1.98	Yes

Table 6.6 Many path coefficients within the model of the perceived benefits were not found to be significant – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the perceived benefits	t-value	could not be rejected?
γ_{c55}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.	0.46	No
γ_{c56}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.	0.81	No
γ_{c57}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.	0.97	No
λ_{xc61}	There is a significant relationship between ensuring that *availability level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service autonomy* during SaaS adoptions.	8.82	Yes
λ_{xc62}	There is a significant relationship between ensuring that *possibility of scaling application and data (related to the delivery of SaaS applications) in accommodating business changes from the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service stateless* during SaaS adoptions.	3.41	Yes
γ_{c61}	There is a significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.	1.30	No
γ_{c65}	There is a significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.	1.72	No
γ_{c66}	There is a significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.	0.85	No
γ_{c67}	There is a significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.	0.81	No
λ_{xc71}	There is a significant relationship between ensuring that *accessibility level of services (related to the delivery of SaaS applications) which are developed by the providers* is considered during the lifecycle of SaaS and employing the design principle of *service discoverability* during SaaS adoptions.	7.45	Yes
λ_{xc72}	There is a significant relationship between ensuring that *availability of mechanisms of discovering services (related to the delivery of SaaS applications) which are developed by the providers* is considered during the lifecycle of SaaS and employing the design principle of *service discoverability* during SaaS adoptions.	30.42	Yes
γ_{c71}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.	6.19	Yes
γ_{c74}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.	0.83	No
γ_{c75}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.	0.41	No
γ_{c76}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.	0.93	No
γ_{c77}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.	0.03	No
λ_{xc81}	There is a significant relationship between ensuring that *custom option level of services (related to the delivery of SaaS applications) in meeting business changes from the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service composability* during SaaS adoptions.	12.42	Yes
λ_{xc82}	There is a significant relationship between ensuring that *flexibility of custom options for services (related to the delivery of SaaS applications) which are expected by the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service composability* during SaaS adoptions.	4.82	Yes

Table 6.6 Many path coefficients within the model of the perceived benefits were not found to be significant – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the perceived benefits	t-value	could not be rejected?
γ_{c81}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.	1.05	No
γ_{c84}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.	1.59	No
γ_{c85}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.	0.24	No
γ_{c86}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.	1.75	No
γ_{c87}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.	0.21	No

We found that the appropriate sample size required for the model of the process benefits is at least 80 cases (number of the largest relationship of the dependent latent variable equals to eight) by referring to Chin [1998]. The size of sample is suggested at least 109 cases using the G*Power 3 software (statistical test: linear multiple regression: Fixed model, R^2 deviation from zero, power = 0.8; p-value = 0.05; medium effect size (F^2)=0.15, only R^2 upper 13% will be detected as significant).

6.4 Conclusion

Although the model of the promised benefits cannot be validated due to very small sample size, the structure of the model can provide useful guideline on how to understand the benefits of SaaS from the perspective of vendors or SaaS providers. However, we should underline that the (developed) sub-hypotheses for the promised benefit model are not yet tested due to the limitation of sample sizes. Therefore, it is unlikely that the assessments of the promised benefits are bias and limited in use for explaining the achievement of benefits of SaaS from the perspective of SaaS provider.

The model of the perceived benefit in SmartPLS has been validated in Subchapter 6.2. We found there are nine (developed) sub-hypotheses which should be rejected since they are not significant, and therefore some relationships within the model of the perceived benefits should be taken into consideration when the model is implemented for different samples. The relationships that need our further attention are summarized in Table 6.7.

Table 6.7 Insignificant relationships within the model should be taken into consideration when understanding the perceived benefit model

Path coefficient within the perceived benefit model	Findings from Subchapter 6.2
utility based ↛ Level 0-Potential	There is no significant relationship between operationalizing *utility based* and perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model during SaaS adoption.
SLA driven ↛ Level 1-Prospective	There is no significant relationship between operationalizing *SLA driven* and perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model during SaaS adoption.
Level 0: Potential ↛ increased alignment of business and technology domains	There is no significant relationship between perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.

Table 6.7 Insignificant relationships within the model should be taken into consideration when understanding the perceived benefit model – *cont'd*

Path coefficient within the perceived benefit model	Findings from Subchapter 6.2
Level 1: Prospective ↛ increased alignment of business and technology domains	There is no significant relationship between perceiving benefits of SaaS at *Level 1- Prospective* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.
Level 2: Promising ↛ increased of federation	There is no significant relationship between perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model and expecting an *increased of federation* by the adopters
Level 3: Achieving ↛ increased of ROI	There is no significant relationship between perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model and expecting an *increased of ROI* by the adopters
Level 4: Stabilizing ↛ increased of federation	There is no significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased of federation* by the adopters
Level 4: Stabilizing ↛ increased of organizational agility	There is no significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased of organizational agility* by the adopters
Level 5: Optimizing ↛ increased alignment of business and technology domains	There is no significant relationship between perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.

The model of the process benefit in SmartPLS has been validated in Subchapter 6.3. We found there are 36 (developed) sub-hypotheses in total that should be rejected since they are not significant, and therefore the structure of the SaaS benefits within the model of the process benefits should be reconsidered before it is implemented for different samples. We summarize the relationships which should be taken into consideration in Table 6.8.

Table 6.8 Insignificant relationships within the model should be taken into consideration when understanding the perceived benefit model

Path coefficient within the perceived benefit model	Findings from Subchapter 6.2
standardized service contract ↛ increased of inherent interoperability	There is no significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
standardized service contract ↛ increased of federation	There is no significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of federation.*
standardized service contract ↛ increased of vendor diversification options	There is no significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.
standardized service contract ↛ increased alignment of business and technology domains	There is no significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.

Table 6.8 Insignificant relationships within the model should be taken into consideration when understanding the perceived benefit model – *cont'd*

Path coefficient within the perceived benefit model	Findings from Subchapter 6.2
standardized service contract ↛ increased of ROI	There is no significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
standardized service contract ↛ increased of organizational agility	There is no significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
standardized service contract ↛ reduced of IT burden	There is no significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
service loose coupling ↛ increased of inherent interoperability	There is no significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
service loose coupling ↛ increased of ROI	There is no significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
service loose coupling ↛ reduced of IT burden	There is no significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
service abstraction ↛ increased of inherent interoperability	There is no significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
service abstraction ↛ increased of vendor diversification options	There is no significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.
service abstraction ↛ increased of ROI	There is no significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
service abstraction ↛ increased of organizational agility	There is no significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
service abstraction ↛ reduced of IT burden	There is no significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
service reusability ↛ increased of inherent interoperability	There is no significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
service reusability ↛ increased of ROI	There is no significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.

Table 6.8 Insignificant relationships within the model should be taken into consideration when understanding the perceived benefit model – *cont'd*

Path coefficient within the perceived benefit model	Findings from Subchapter 6.2
service reusability ↛ reduced of IT burden	There is no significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
service autonomy ↛ increased of inherent interoperability	There is no significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
service autonomy ↛ increased of vendor diversification options	There is no significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.
service autonomy ↛ increased of ROI	There is no significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
service autonomy ↛ increased of organizational agility	There is no significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
service autonomy ↛ reduced of IT burden	There is no significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
service stateless ↛ increased of inherent interoperability	There is no significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
service stateless ↛ increased of ROI	There is no significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
service stateless ↛ increased of organizational agility	There is no significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
service stateless ↛ reduced of IT burden	There is no significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
service discoverability ↛ increased alignment of business and technology domains	There is no significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.
service discoverability ↛ increased of ROI	There is no significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
service discoverability ↛ increased of organizational agility	There is no significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.

Table 6.8 Insignificant relationships within the model should be taken into consideration when understanding the perceived benefit model – *cont'd*

Path coefficient within the perceived benefit model	Findings from Subchapter 6.2
service discoverability ↛ reduced of IT burden	There is no significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
service composability ↛ increased of inherent interoperability	There is no significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
service composability ↛ increased alignment of business and technology domains	There is no significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.
service composability ↛ increased of ROI	There is no significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
service composability ↛ increased of organizational agility	There is no significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
service composability ↛ reduced of IT burden	There is no significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.

CHAPTER

7

CONCLUSION

What is Faith? When your good deed pleases you and your evil deed grieves you, you are a believer. What is Sin? When a thing disturbs (the peace of) your heart, give it up [Narrated Ahmad].

Despite of heightened interest in assessing benefits of Software as a Service (SaaS) in both business and scientific communities, there have been massive recognitions of inherent difficulties in performing benefit assessment. For instance, many benefits that are promised by vendors regarding SaaS adoption within enterprise business process, are intuitively felt to be the most important in determining successfulness of the adoption, but are also the most difficult to measure since such assessment involve perceived benefits from enterprises, which adopt the application. Therefore, business goals and Information Technology (IT) goals seem hard to achieve due to complexities and difficulties associated with different perspectives of promising and perceiving SaaS benefits.

In the light of understanding SaaS benefits from the perspective of providers and adopters, the research presented in this thesis aims at appreciating successful adoption of SaaS by approaching the benefits from individual perspective in a specific lifecycle process of SaaS and by considering perspective of the whole lifecycle process of SaaS. The main purpose is to promote SaaS adoption within which the provider is able to promise benefits, which could offer immediate customer value, and thus those benefits may not be conflicting with the perceived benefits, which are conceptualized by the adopters. For example, there is unlikely an agreement toward cost-saving benefits since there has been difficulties in determining such benefits quantitatively which can satisfy both vendors and clients. Furthermore, secured access benefits can be conceptualized in contrast with cost-saving benefits since highly secured access is likely to result in higher costs, e.g. by providing extra (certified) security procedures to protect enterprise and individual data. However, it is beyond our discussion that the justification over one perspective would better off than the other perspective and thus no one would be worse off from SaaS adoption.

In this chapter, we would like to present our research findings, which aim at emphasizing important results from the research presented in this thesis. We have presented the steps of conducting the research in Chapter 1 to Chapter 6, while this chapter aims at presenting important findings from the research. In Subchapter 7.1 we would like to underline our contributions from the research. This subchapter also addresses the result from implementing the comprehensive, which is proposed in the research. Following this, we would like to discuss further possible research, which can be initiated from the research in Subchapter 7.2. This discussion also includes possible topics, which can be proposed from further research in the area of SaaS. Therefore, we would like to provide a thoughtful finishing chapter, which can serve a noteworthy advance in SaaS-related research both in theory development and useful practices.

7.1 Research findings

We aim at answering the following first sub-research question in Chapter 2:

Q1) What is the current state of SaaS adoption within SMEs according to literatures, including what are the existing benefits and challenges of adopting a SaaS ERP system?

From the literature studies, we found that vendors and clients may face different challenges and further may have different benefits during the whole lifecycle process of SaaS. In order to answer the Q1, we summarize benefits and challenges that we found from literatures in Figure 7.1. The list of SaaS benefits for clients is longer than the list of SaaS benefits for vendors; while the list of challenges for clients is shorter than the list of challenges for vendors.

In this research we aims at understanding SaaS benefits from three main perspectives, which are the perspective of vendors as SaaS providers, the perspective of clients as SaaS adopters, and the perspective of the lifecycle process of SaaS. Following this, we aim at answering the following second, third, and fourth sub-research questions in Chapter 3:

Q2) How can the benefits of SaaS be understood from the point of view of vendors as SaaS providers?
Q3) How can the benefits of SaaS be understood from the point of view of SMEs as SaaS adopters?
Q4) How can the benefits of SaaS be understood from the point of view of the lifecycle process of SaaS?

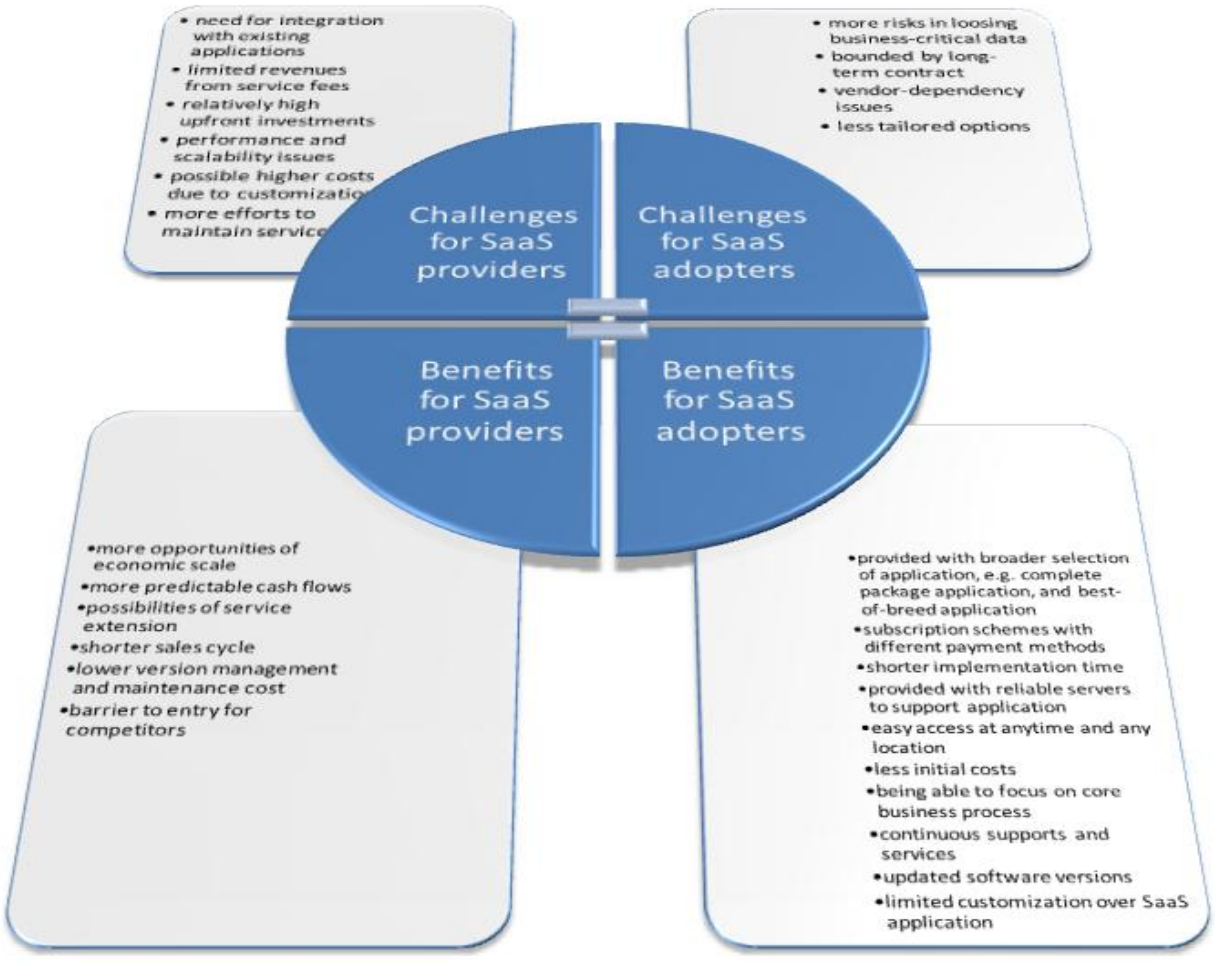


Figure 7.1 Benefits and challenges from adopting SaaS-based application are summarized from existing literatures

In order to answer Q2, Q3, and Q4 sub-questions, we have conceptualized the key characteristics of SaaS benefits from the perspective of SaaS providers, SaaS adopters, and the lifecycle process of SaaS in Subchapter 3.1, Subchapter 3.2, and Subchapter 3.3, consequently. We found there are seven key characteristics that can be included when promising benefits of SaaS, which are *resource efficiency, process effectiveness, data confidentiality, integrated information, service availability, service reliability*, and *regulatory compliance*. Meanwhile, we developed a SaaS maturity model in order to define key characteristics that can be expected when perceiving benefits of SaaS. They include *utility based* at Level 0 (Potential); *SLA driven* at Level 1 (Prospective); *shared multitenant efficient*, and *community contribution* at Level 2 (Promising); *reliability and fault tolerance* and *flexible and scalable* at Level 3 (Achieving); *collaborative and smart* and *credible and accountable* at Level 4 (Stabilizing); and *nimbleness* and *sustainable and successful* at Level 5 (Optimizing).

The perspective of the lifecycle process of SaaS is appreciated by incorporating the design principles of Service Oriented Architecture (SOA) during the whole lifecycle of SaaS. Furthermore, we approached the benefits in each perspective by considering different benefit appreciation when adopting SaaS-based application during different processes (phases) of SaaS lifecycle. We found that vendors ought to appreciate the benefits at relatively early phase of the lifecycle, which includes service discovery, and service selection and engagement. This is due to benefits of SaaS are introduced by vendors as part of strategic marketing to attract potential clients and further persuade key advantages in adopting a SaaS-based application apart from immatureness model of SaaS. In the other hand, clients are likely to appreciate the benefits during the delivery of SaaS-based application, including service selection and engagement, and service enactment. Clients ought to see practical benefits from adopting SaaS-based application, and therefore they would appreciate the benefits when they experience, e.g. an improvement toward business process by effectively managing enterprise resources, and an efficient technology support by saving costs.

Furthermore, we aim at answering the fifth sub-research question in Chapter 4:

Q5) What methodology can be used to structure the benefits of SaaS?

According to conceptual model of SaaS benefits in Chapter 3, we propose a methodology to answer the Q5. This comprehensive methodology aims at providing a general guidance to assess benefits of SaaS, which can address three aforementioned perspectives. The comprehensive methodology comprises three steps, which are gathering data, constructing path diagram, and estimating SaaS benefits. We constructed three different path diagrams in Chapter 4 to represent benefits of SaaS from the three perspectives of SaaS providers, adopters, and lifecycle process of SaaS. We refer the path diagrams as the promised benefit model, the perceived benefit model, and the process benefit model. These path diagrams represent SaaS benefits from the perspective of SaaS providers, from the perspective of SaaS adopters, and from the whole SaaS lifecycle, consequently. From these path diagrams, we also developed sub-hypotheses to structure the relationship within the models of SaaS benefits. There are 32 sub-hypotheses in the promised benefit model; while there are 42 sub-hypotheses within the perceived benefit model. There are 75 sub-hypotheses in total in the process benefit model.

In order to provide an application toward the comprehensive methodology, we provide a case study in Chapter 5 which aims at answering the six sub-research question:

Q6) How can the benefits of SaaS be assessed by employing the proposed methodology?

The Q6 is answered by providing qualitative analysis from the case study. However, Chapter 5 only provide information about how we address benefits of SaaS from the perspective of SaaS providers by collecting data about Exact Online software which is the application that is mainly discussed in this thesis. In addition, we address benefits of SaaS from the perspective of SaaS adopters by collecting data Gmail application, which is already-known application to provide hosted-email solution. Following this, research data is collected using two gathering methods, which are interviews and

questionnaires that are applied to Exact Online and Gmail application, respectively. The data collection tools are provided in *Appendix B* while the data identification results are provided in *Appendix E*.

From the interviews regarding Exact Online and Exact Online Accounting software which are both SaaS-based applications, we noted that Exact Software Nederland prefer to introduce key benefits of these applications which are rather general to any sizes of enterprises. To some extent, the key benefits address three benefits of the promised benefits, which are proposed in the research, which are *technology-enabled business support benefits*, *interactive support benefits,* and *comprehensive support benefits* [see Subchapter 4.1 for the promised benefits; see *Appendix E, Part I* for the identification toward these benefits]. Among these benefits, *interactive support benefits* are of important benefits which are amongst the benefits which are prominent in both applications [see conclusion in Subchapter 5.4 for further information]. Meanwhile, from the questionnaires, which are delivered to the users of Gmail as SaaS-based email application, we concluded that most respondents see potential, prospective and promising benefits at Level 0, Level 1, and Level 2 of the SaaS maturity model which is developed in this research. However the need to optimize benefits in higher level of maturity is imminent considering widely adoption of the application and possibilities of integrating Gmail with other applications, for instance: Enterprise Resource Planning system, e.g. myERP.

Moreover, we aim at answering the seventh sub-research question to quantitatively analyze the models of SaaS benefits, which have been developed in Chapter 6:

Q7) To what extent, the achievement of the benefits of SaaS can be evaluated? [*explanatory analysis by an evaluation*]

In order to answer the Q6, we apply a Partial Least Squares (PLS) Path modeling method for Structure Equation Model (SEM) using a statistical modeling tool, namely SmartPLS as discussed in Chapter 6. We found that the promised benefit model cannot be validated due to the very small sample size. Nevertheless, the model of the promised benefits can provide better structure in realizing the benefits of SaaS from the perspective of SaaS providers. There are nine relationships in the promised benefit model were found to be not significant due to the possible following reasons: insufficient sample size or insufficient constructs of the perceived benefit model. By considering the key limitation of this research, further research should be focused on incorporating more sample sizes to validate the model of the perceived benefits, and considering more variables that can indicate the perceived benefits.

Similar cases also happened for the model of the process benefits. Many path coefficients within the structural model are found to be insignificant. There are 39 relationships within the process benefit model were found to be not significant due to possible following reasons: very insufficient sample sizes, inadequate research data since data gathering methods were not well performed , or weak structure of the construct of the process benefit model. By considering the key limitation of this research, further research should be focused on incorporating more sample sizes to validate the model of the process benefits, choosing appropriate sample targets, and considering more variables that can indicate the perceived benefits.

By answering the Q1 to the Q7, we have presented how the main research question can be addressed by developing the comprehensive methodology, and by performing qualitative and quantitative analysis to implement the methodology. Therefore, we have answered the following research question:

"By adopting a SaaS model during the delivery of an ERP system within SMEs, what methodology can be used to assess benefits of SaaS from the perspective of SaaS providers, SaaS adopters and the lifecycle process of SaaS, and to what extent the achievement of SaaS benefits can be evaluated, in order to improve readiness toward SaaS adoption within enterprises?"

Additional important findings were also gathered with respect to SaaS benefits which can be approached through SaaS lifecycle by incorporating design principles of Service Oriented Architecture (SOA). We applied the design principles of SOA during the whole lifecycle by considering that these principles adhere to the business structures of SMEs which are known agile in conducting their diverse business process and are relatively simple in structuring their organization. From the data collected about Exact Online application, we found that Exact should consider collaboration with clients when conceptualizing SaaS contract; should consider possible accommodation of business changes within the application; should consider providing composable and accessible services which are available continuously. Meanwhile, after identifying the data from the users of Gmail application, we concluded that users should be aware of the importance of Terms and Conditions as a formal contract in order to hinder misunderstanding toward levels of services provided within the application. In the other hand, Google as Gmail provider should provide possibilities to accommodate changes in user requirements by providing continuous services regardless the fact that the application can be subscribed freely.

Regardless limited definitions for a SaaS benefits, we ought to provide better definition toward benefits of SaaS which can be conceptualized from three main perspectives. In this research, we contribute to provide definitions toward the promised benefits and the perceived benefits. Despite structural complexities which might arise from the proposed definitions, we hope to enrich the definitions of SaaS benefits, and therefore can provide possibilities to experience more benefits when adopting SaaS-based applications. Furthermore, we provide indicators that can help to realize the promised benefits and the perceived benefits. We discussed both indicators and the (promised and perceived) benefits in Chapter 3 while we provide more structural definitions in Chapter 4.

Although the accuracy of estimating constructs of variables using PLS Path modeling is potentially biased, but the constructs of SaaS benefit structures aim at providing predictive models in understanding the benefits of adopting SaaS-based application which can incorporate many perspectives. Therefore, the method fits the purpose of theory development in this research in order to enrich understanding toward the benefits of SaaS. Regardless uncertain statistical power due to smaller sample size, the models presented in this research provide relatively complex structural benefits of SaaS which can contribute to the newly developed model of SaaS.

Furthermore, we aimed at providing methodology to assess the benefits from adopting an Enterprise Resource Planning (ERP) system based on SaaS model in the earlier chapters of this thesis, while we discussed more about general SaaS-based applications that can be integrated with an ERP system, e.g. Exact Online and Gmail application, in the later chapters. We still have in our mind this aim while conducting the research, although we shall admit that we could not overcome the difficulties in finding suitable case study to serve this aim. However, the general SaaS-based applications can be regarded as important modules within a SaaS ERP system. The Exact Online which manages financial management issues provides important features within newly developed packages of enterprise systems that are introduced by Exact Software Nederland which aims at serving specific clients, i.e. Exact Handle which is a SaaS-based application for trading companies. Meanwhile, Gmail application which is part of Google apps is integrated with SaaS ERP system, i.e. myERP within which the application provides integration of contacts of clients that can improve effective and efficient communications with clients.

Therefore, by considering the aim of the research to assess benefits from adopting SaaS ERP system, the comprehensive methodology which is proposed in the research can be used as a reference in to improve readiness toward SaaS adoption within enterprises. The research is explorative in nature and therefore it shall not be seen as a general conclusion about benefit assessment for SaaS ERP adoption within SMEs. Different benefit structures and different application for case study to validate these structures can result in different outcomes. Yet, we should conclude the paper by reminding that the

result from applying case study in the research shall not be seen as general conclusion toward the benefits from adopting SaaS ERP system. Instead, the comprehensive methodology, which is proposed in the research, should be seen as a promising methodology to help practitioners when assessing the benefits from adopting a SaaS-based application in general, and SaaS ERP system in particular.

7.2 Discussion and further research

A key limitation of the research presented in this thesis is that although we address many perspectives in addressing the benefits of Software as a Service (SaaS), the model of benefits structures, which are developed in the research, are not well validated due to limited research data and applicability of data gathering methods in the chosen case study. In order to overcome this limitation, we provide useful references pertaining to data gathering methods, which can be used in better understanding the benefits of SaaS from the perspective of providers and adopters. We provide a list of interview questions and a list of questionnaires in *Appendix G*, which can be used for further research which can incorporate more reliable research data.

In the light of providing a broader understanding of SaaS benefits, a maturity model to incorporate SaaS benefits for vendors can also be developed in order to understand a certain benefit, which can be promised by vendors at different level of maturity. This maturity can be developed by following the Capability Maturity Model by Software Engineering Institute [Paulk et al., 1993a]. This model focuses on the perspective of software developer who performs software processes, which include a set of activities, methods, practices, and transformation guideline, which is used to develop and maintain software and the related products. The CMM provides a structural guideline within five levels of maturity, including *Level 1: Initial, Level 2: Repeatable, Level 3: Defined, Level 4: Managed* and *Level 5: Optimizing*. Each of the level can indicate a certain process capability, which can also be referred to as *behavioral characterization*, and can be composed of *key process area*, which is organized by *common features* for implementation. The *common features* contain *key practices* that can be used for *software process improvement, software process assessment,* and *software capability evaluations* [Paulk et. al., 1993b]. By considering the benefits that can be expected by vendors who deliver IT solutions through a SaaS model, a SaaS maturity model for vendors can be developed according to expected improvements, which were proposed in the CMM. These improvements cover three benefits, which are described as followings.

- As maturity level increases, a vendor can expect a reduced of the difference between targeted results and actual results.
- As maturity level increases, a vendor can expect a reduced of the variability of actual results around targeted results
- As organization matures, a vendor can expect a decreased of costs, a shorter development time, and an increased of productivity and quality.

Although the comprehensive methodology which is proposed in the research seem promising, and we do recommend the methodology in more applied settings in order to enhance its applicability, we should conclude the paper by warning that the models of benefits structure are weakly validated. Hence, we encourage future research the task for doing further validation tests with other validation methods. We also suggest further research to incorporate different types of variables to construct the models of SaaS benefits by considering, i.e. an approach for multi-criteria decision-making.

An approach for multi-criteria decision making can be applied in the models presented in the research in order to incorporate different aspects of decisions upon benefits of SaaS which can be prioritize based on their importance. One of a widely known approach for multi-criteria decision-making is Analytical Hierarchy Process (AHP). This approach can help to assess whether factors are of similar importance or magnitude with other factors [Saaty, 1990]. Furthermore, AHP approach is believed as

an ideal multi-objective decision support tool to assist a company who wants to make an outsourcing decision [Udo, 2000; Xia & Wu, 2005; Kumar & Bisson, 2008; Marijnissen, 2009]. The following steps can be followed when implementing AHP approach: defining problems, structuring problems into a hierarchy decision, constructing the pair-wise comparison matrices, and calculating level of importance.

Thesis Reflection

"Guide us to the straight path; the path of those to whom Thou hast been Gracious not of those who have incurred Thy displeasure, nor of those who have gone astray." [Surah Al-Fātiĥah, 6-7]

The research presented in this thesis was a result of a hard work, good collaborations, and long discussions before, during, and after the research was finalized as a partial fulfillment of the requirements for the degree of Master of Science in Engineering and Policy Analysis at Delft University of Technology. The first challenge was to delineate the scope of this research project since the project integrates exploratory, descriptive, and explanatory research which may require a prolonged discussion that could cause daunting circumstances when performing the project with no apparent end in sight. Finding suitable topic in the project, and appropriate person within the project committee should be done as early as possible since these factors are the key drivers to perform further steps in the research project. A project plan should also be structured in addressing *what*, *why*, *where*, and *how* aspect of the project will be performed. There is a saying: "If you want to get somewhere you have to know where you want to go and how to get there. Then never, never, never give up—Norman Vincent Peale".

An important consideration should also be taken into account when gathering data for a case study. Theoretically, steps for collecting data have been discussed in many literatures and have been performed by many practitioners in both scientific and business communities. However, they might not be as simple as it might look like. Instead, collecting data requires a prior consideration about background of case study, including analyzing the existing situation and the related issues which i.e. can be addressed within the research. Then, performing data gathering method demands patience particularly when waiting for responses and also requires profound insights when analyzing data from case study. It might take longer than the amount of time which is allocated by the researchers within the project plans. Moreover, the researchers might have limited time to conduct the research and therefore, this limitation determines how long they might collect data and start analyze the data after that. We experience in this research that collecting data is of critical phase in a case study-based research. We ought to have more respondents within the research, but we limited our analysis for relatively small sample sizes. In addition, we shifted our focuses when considering respondents for addressing SaaS benefits from the perspective of SaaS adopters by considering the users of a SaaS-hosted mail application, namely Gmail, instead of the clients of SaaS-based application which is discussed in this research, namely Exact Online software.

In the later phase of the research, analyzing data could be also challenging since the result from the analysis will determine research findings. In this research, we learnt that a good preparation for the design models should be done as early as possible, e.g. in parallel with data gathering phase while waiting for responses from respondents. By having the design models beforehand, analysis of data could be done more efficiently since we have already know what we are looking for, and how we are going to analyze the data. However, we found that building the statistical models from the design models should be appreciated thoroughly since it might require good foundations of statistical analysis and how to perform such analysis. Additional consideration should be taken into account when choosing the right statistical method that suits the research, e.g. social research. Finding the right tools to perform the method should also be taken into consideration since they might not be available freely and furthermore they might not be easy to use.

We learnt from the research that determining, gathering, and analyzing research data should have been conducted at earlier phase of the research. Conducting interviews and collecting responses are likely to result in longer time of acquiring research data comparing to the total time to conduct the research. In order to have sufficient sample sizes and appropriate research data, good interpersonal relationships are of great advantages. The data analysis can also be improved by having prior understanding toward how to use a statistical modeling tool and the related statistical terms which might be needed when analyzing the results from the model.

Without undermining the final phase of the research, we experienced that many discussions about research findings shall take place within which people who are involved during the research should be provided with sufficient information about the research. They include the graduation committee and if it is necessary, the respondents from the case study. The discussions should be able to help the researchers understand important contributions from the research in both scientific and business communities, and further should be able to address further research which can be initiated from the research. Suggestions and feedbacks toward the research should be addressed during the discussions to improve the quality of the research. Last but not least, good communication with the graduation committee and the company for the case study should be maintained during and after the research is completed. This can bring possible opportunities for a joint research in the future.

Glossary

Benefits of Service Oriented Computing (SOC)—A set of common goals and benefits in software engineering that can be used as a target state for an enterprise who would like to adopt service-oriented application. The strategic goals and benefits of SOC, or simply referred as the benefits of SOC, were proposed by Erl [2007] who also defined design principles of Service Oriented Architecture (SOA) that should be considered when designing service-oriented application which aims at achieving the benefits of SOC. There are seven benefits of SOC, which are *increased of inherent interoperability, increased of federation, increased of vendor diversification options, increased alignment of business and technology domains, increased of Return on Investment (ROI), increased of organizational agility,* and *reduced of Information Technology (IT) burden*.

Control Objectives for Information and related Technology (COBIT)—An IT process management framework published by IT Governance Institute (ITGI) for senior management, IT management, and professionals. It also defines IT controls, and IT assessment for the related domain within IT processes; the domains are plan and organize (PO), acquire and implement (AI), deliver and support (DS), and monitor and evaluate (ME). Each of the domain has IT Process which can be related to a set of business goals and IT goals which are also proposed within this framework.

Design principles of Service Oriented Architecture (SOA)—A set of design principles which is proposed by Erl [2007] who aims at providing best practices in designing good services for a service-oriented application. There are eight design principles, which are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability, and service composability*.

Enterprise Resource Planning (ERP)—A system that offers rich functionalities for enterprises to help them standardizing their management process. Typical functionalities within an ERP system include Product Forecasting, Production Scheduling, Materials Management, Inventory Management, Purchasing And Receiving, Sales Operations, Distribution and Logistics, Accounts Payable, Accounts Receivable, Fixed Asset, General Ledger, Product Marketing, Strategic Marketing, Technical Support, Cash and Bank Management, and Human Resource Management.

Partial Least Squares (PLS) Path modeling—A statistical modeling technique for Structure Equation Modeling (SEM) which contains two parts, which are structural model or inner model, and measurement model or outer model that are incorporated within a path diagram. This diagram incorporates (endogenous or exogenous) variables and the related indicators of variables. There are several advantages of using this modeling technique including less required sample size, incorporating a large number of constructs, more suitable for theory development, and for prediction.

SaaS maturity model—A model of maturity in order to indicate level of adoption of a SaaS-based application. There are three existing maturity model which is identified from literature studies within this research. They are Microsoft's maturity model, Forrester's maturity model, and Kang's maturity model. The Microsoft's maturity model presents an incremental development of functional features of a SaaS-based application; while Forrester's maturity model focuses on an incremental transformation of a SaaS-based application. Kang's model defines two axis, which are *service component axis* and *maturity level axis* in order to show incremental (major) activities within service architecture.

Furthermore, this research also proposes a SaaS maturity model that focuses on incremental benefits which can be expected by SaaS adopters when adopting a SaaS-based application to SaaS providers. The proposed maturity model also has defined a mapping of key attributes of SaaS-based applications, which were defined within the existing maturity models. Therefore, the maturity model can indicate incremental development of functional features, incremental transformation of a SaaS-based application, and incremental activities within service architecture.

Service Level Agreements (SLAs)—A certain level of services which are agreed before delivering services from vendors to clients. SLAs should be included within a service contract that covers certain key areas, including: costs and additional fees, period of services, and termination and the related consequences.

Small Medium Sized Enterprises (SMEs)—A categorization of enterprises which have a certain number of employees with a certain qualification. For instance, European Commission (EU) defines criteria as a general recommendation to define an enterprise which qualifies as small and medium sized enterprises (SMEs). An enterprise can be categorized into an SME if it has more than 10 employees up to 250 employees. Apart from this headcount, an SME should qualify either turnover from 10 million to 50 million, or balance sheet total from 10 million to 43 million [European Commission, 2005].

Software as a Service (SaaS)—A software delivery model whereby a SaaS adopter is able to subscribe commercial applications from SaaS providers which host applications centrally at their data centre [Software & Information Industry Association, 2000b]. These applications are installed locally [Carraro & Chong, 2006a], and are accessed via internet with a standard Web browser [Bleicher, 2006] by multiple customers which are commonly known as multi-tenancy [Knorr, 2006]. These customers or SaaS adopters do not pay to own the applications, but they do subscribe the applications based on period of usage, number of transactions, or fixed-fee agreement [Software & Information Industry Association, 2001].

On-demand software provisioning model—A way of outsourcing IT-based solutions from vendors to support business process of an enterprise. This software provisioning model includes *on-premise model, hosted model, Application Service Provider (ASP) model,* and *SaaS model*. On-premise model offers perpetual license of a locally-installed application, while hosted model provides licensed software of a hosted-based application. ASP model offers a hosted-based application which is usually deployed based on commercial application from other companies while IT supports, e.g. are exclusively offered as additional services. SaaS model offers a network-based application from ground up, and further provides an inclusive IT support, e.g. monitoring and maintenance, as part of services.

Structure Equation Model (SEM)—A second-generation technique of statistical modeling, which can be used to confirm a set of hypotheses. This technique allows simultaneous relationships for a complex construct, which includes Latent Variables (LVs) and the related indicators of variables. It is important to note that this modeling technique assumes linear relationships between variables.

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Appendix A: Indentifying the existing SaaS Maturity Models

In order to develop Software as a Service (SaaS) maturity model that focuses in realizing benefits of SaaS during the delivery of SaaS-based application, former studies related to SaaS maturity models should be identified. This identification aims at providing a basic understanding toward attributes that can contribute to the successful adoption of SaaS model. From the attributes, key benefits of SaaS adoption can be presented which can be used as references when developing the SaaS maturity model of SaaS benefits which is discussed further in Subchapter 3.2: "SaaS Maturity model can indicate the perceived benefits". For this reason, this appendix will be divided into two parts which address two key points of analyzing the existing SaaS maturity model. **First**, we will describe key attributes of SaaS adoption according to the existing SaaS maturity model. **Second**, key benefits of SaaS adoption will be structured by considering key attributes in the existing SaaS maturity model. These benefits will be referred to as key characteristics of the perceived benefits of SaaS.

I. Key attributes of SaaS adoption from the existing SaaS maturity model

In Chapter 2 (Subchapter 2.3.2), we have underlined that a SaaS application can be characterized by the following key attributes: *scalable, multi-tenant efficient, and configurable.* This part will discuss about how these attributes are reflected within two different SaaS maturity models each of which is developed by research group from business communities, which are Microsoft [Carraro & Chong, 2006a] and Forrester [Ried et al. , 2008]. First, we will discuss about the Microsoft's model and then we move forward to the Forrester's model.

The Microsoft's maturity model shows an incremental development model of SaaS through integration of functional features of SaaS application. There are four maturity levels within this model, which are *Level 1: Ad Hoc/Custom, Level 2: Configurable, Level 3: Configurable, Multi-Tenant-Efficient,* and *Level 4: Scalable, Configurable, Multi-Tenant-Efficient.* This maturity model can be seen in Figure A.1.

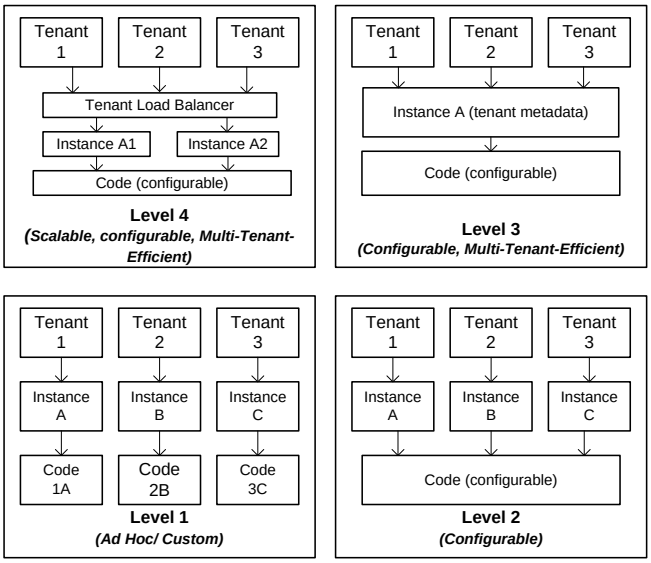

Figure A. 1 Microsoft Maturity model shows four levels of incremental capabilities of adopting SaaS (adapted from Kwok et al., 2008)

Table A. 1 SaaS maturity level by Microsoft shows incremental capabilities of a SaaS application (adapted from Sorenson & Chen, 2008)

Maturity Level	SaaS capabilities	Key Attributes			Benefits (+) and challenges (-)
		S[1]	*MT*[2]	*C*[3]	
1 (Ad Hoc/ Custom)	Multiple different application versions are customized individually for each tenant; while each tenant runs its own instance independently on host's server –*Application Service Provider (ASP)* [see Seltsikas and Currie, 2005] for traditional client-server applications	-	-	-	(+) Vendor can reduce their operational costs by consolidating infrastructures, e.g. servers for multiple instances of application, and administration, e.g. central control for multiple tenants (+) Vendor can move enterprise system of client-server applications to SaaS-based applications with relatively little development effort, without re-architecting the whole system.
2 (Configur-able)	Multiple identical instances are customized for each tenant in which the same code base is applied but isolated one another; while configuration options are provided – *code base sharing*	-	-	√	(+) Vendor can manage software versioning efficiently since any changes made to the code base can be provided to all of tenants at once (-) Vendors are required to provide sufficient infrastructures in order to support a potentially large number of instances of SaaS applications which are run concurrently
3 (Configur-able, Multi-Tenant-Efficient)	Single instance are provided for each tenant with a unique configurable metadata while maintaining data security – *configurable metadata*	-	√	√	(+) Vendors ensure that tenants' data are kept separate toward one another. (+) Vendors can more efficiently manage their computer resources since they can have less server space because they do not need to provide many servers for as many instances as the number of tenants. (-) Vendors may have limited scalability of applications, e.g. scaling up is possible unless portioning is used to manage database performance.
4 (Scalable, configur-able, Multi-Tenant-Efficient)	Multiple identical instances are provided for multiple customers - *tenant load balancer*	√	√	√	(+) Vendors ensure that tenants' data are kept separate toward one another while enabling configuration of metadata for multiple customers on a load-balanced farm of identical instances. (+) Vendors can scale out the application to many tenants without re-architecting their application. (+) Vendors need to increase system's capacity with further programming code [Limbăşan and Rusu, 2011].

Note: [1]***S****calability*; [2]***M****ulti-tenant efficiency,* [3]***C****onfigurability*

Furthermore, we present Table A.1 to show the capability of each level of maturity, and the related key attributes which cover these capabilities. Additional column is given for benefits which are conceptualized from the perspective of vendors when implementing SaaS to clients (tenants).

Table A. 2 SaaS maturity level by Forrester shows incremental transformation of a SaaS application (adapted from Sorenson & Chen, 2008)

Maturity Level	SaaS applications	Key Attributes			Benefits (+) and challenges (-)
		S[1]	*MT*[2]	*C*[3]	
0 (Outsour-cing)	Single application is provided to one tenant – *delegation of operation of existing application*	-	-	-	(+) Vendor provides a unique application landscape for each tenant (-) Outsourcing vendor does not qualify as a SaaS provider
1 (Manual ASP)	Similar applications are provided to multiple tenants –*independent running application with limited customization*	-	-	-	(+) Each tenant (client) is able to customize the installation of the delivered applications within a dedicated running server (-) A provider requires significant IT skill resources in order to serve multiple tenants
2 (Industrial ASP)	Configured applications are provided to multiple tenants – *customer-specific configuration of identical software package*	-	-	√	(+) Each tenant (client) can ask the provider to configure the application specifically in meeting the demand of business (-) Software package is still the same software which was created for self-hosted deployment
3 (Single-App SaaS)	One packaged application is offered to multiple tenants – *alternative of traditional package applications scaled up to many servers*	-	√	√	(+) A provider offers a package of SaaS application which can serves multiple tenants. (-) Software customization is restricted to configuration over the application.
4 (Business-domain SaaS)	Configuration of multiple packaged applications and custom extensions are offered to multiple tenants – *specific configuration and custom extensions on multi-purpose and multi-tenant platform*	√	√	√	(+) SaaS provider incorporates business logic in the application and enables custom extensions with other applications.
5 (Dynamic-business-apps-as-a-service)	Dynamic composition of user-specific applications are offered based on packaged and custom business applications – *specific composition, and dynamic orchestration and provisioning in a multi-tenant environment*	√	√	√	(+) SaaS provider enables on-demand application under specific business needs and adaptation.

Note: [1]***S****calability*; [2]***M****ulti-****T****enant efficiency,* [3]***C****onfigurability*

The Forrester's maturity model is similar to Microsoft's maturity model, but it focuses on incremental transformation of SaaS applications within six levels of maturity model; they are *Level 0: Outsourcing*, *Level 1: Manual ASP, Level 2: Industrial ASP, Level 3: Single-App SaaS, Level 4: Business-domain SaaS*, and *Level 5: Dynamic-business-apps-as-a-service.* For this reason, we present Table A.2 to show transformation of SaaS applications in each level maturity and the related key attributes which characterize the application. Additional column is given for benefits which can be expected when implementing SaaS.

Table A. 3 SaaS maturity level by Kang et al [2010] shows incremental major activities within service architecture

Maturity Level	SaaS architecture	Technical Function[1]						Business Function[2]				Benefits (+) and challenges (-)
		S	*MT*	*C*	*SS*	*I*	*Sc*	*M*	*Sb*	*D*	*Co*	
1 (Ad hoc/Base)	Database and data schema are assigned for specific tenant within separated system and contract – *non flexible service structure*	-	-	-	-	-	-	√	-	-	-	(+) SaaS provider offers a simple ASP model (-) SaaS provider and SaaS adopter agree upon a simple contraction which is more likely to fail SaaS adoption
2 (Standard-ization)	Database and data schema are standardized for configurable packaged software from single tenant to which standardized SLAs are published – *standardized service structure*	-	-	√	√	-	-	√	√	-	-	(+) SaaS provider offer shared service with unique instance for each addition of user within configurable packaged software. (-) SaaS provider does not support multi-tenant environment
3 (Integra-tion)	Database and data schema are shared via web based applications for multi-tenant environment which realizes measurable SLAs to guarantee service levels – *integrated and flexible service structure*	√	√	√	√	√	-	√	√	√	-	(+) SaaS provider focuses on building multi-tenant environment while defining measurable SLAs. (-) SaaS provider only support multi-tenant platform with single instance.
4 (Virtual-ization)	SOA concept is utilized within SaaS architecture while optimizing SLAs – *dynamic modulated and encapsulated services*	√	√	√	√	√	√	√	√	√	√	(+)SaaS provider support multi-tenant environment while maximizing of practical use of resources.

Note: [1]***S=S****calability,* ***MT****=****M****ulti-****T****enant efficiency,* ***C****=Configurability,* ***SS****=Standard Support,* ***I****=Integration,* ***Sc****=Security,*
[2]***M****=****M****arket,* ***S****=Scalability (of business),* ***D****=Development,* ***Co****=Communication*

According to Table A.2, *Level 0: Outsourcing* represents that a vendor as service provider operates a unique application for each client, who is then referred as a tenant, and it cannot leverage the same application for other tenants. Therefore, the vendor does not qualify as SaaS provider. At *Level 1: Manual ASP*, the vendor acts as a service provider which provides packaged applications to multiple tenants each of which has a dedicated server running application instances within which software installation can be customized independently as if it is a self-hosted application.

At *Level 2: Industrial ASP*, the provider offers identical packaged applications with customer-specific configurations to many tenants. At *Level 3: Single-App SaaS*, the provider offer one-packaged business application as an alternative to traditional packaged applications. The application utilizes web based technologies to serve multiple tenants while its customization is restricted to configuration. At *Level 4: Business-domain SaaS*, the provider offers a well-defined business application which is similar with the application in the previous level but with additional features which incorporate business logic. Therefore, the application facilitates composition with other applications. At *Level 5: Dynamic-business-*

apps-as-a-service, an advanced SaaS provider offers a complete integrated application based on demand which embraces a new paradigm within application development. This new paradigm is "design for people, build for change". Composition is made possible specifically for tenants within specific levels of multi-tenant environments.

In order to balance the perspective of SaaS maturity model from scientific communities, we also discussed about a model developed by Kang et al. [2010] which define maturity level within two axis, which are *service component axis* and *maturity level axis* in order to understand incremental major activities within service architecture. The former axis represents four layers of architecture that separate business, services, system, and data; while the latter axis represents an incremental level of current situation of available SaaS services. The maturity level represents four levels, which are *Level 1 (Ad hoc/base), Level 2: Standardization, Level 3: Integration*, and *Level 4: Virtualization*. Within each level, technical and business function can be characterized in order to understand incremental transformation of major activities within service architecture. For this reason, we adapt Kang's maturity model and identify both functions within each level of maturity as shown in Table A.3.

II. Key benefits of SaaS adoption from the existing SaaS maturity model

We have outlined key attributes of the existing Software as a Service (SaaS) maturity models which have been developed in both business and scientific communities in part I in this appendix. Benefits and challenges pertaining to SaaS adoption in each level have also been addressed in each maturity level for those existing SaaS maturity models. Following this, we will discuss about key benefits of SaaS from the perspective of SaaS adopters in each maturity level of Microsoft's model, Forrester's model, and Kang's model. We elaborate key attributes of SaaS in each maturity level and propose key characteristic of the perceived benefits of SaaS which can be conceptualized from the point view of the adopters.

Table A.4 shows Microsoft's maturity model which enable benefits of SaaS for both of the providers and the adopters. In order to enable the achievement of enterprise's business goals, the discussion over SaaS benefits are focused on the benefits which can be perceived by the adopters. Acceding to Table A.4, we identify key benefits of SaaS from the perspective of the adopters in order to represent the perceived benefits of SaaS.

Table A. 4 Key benefits of SaaS adoption can be derived from Microsoft's maturity model

Maturity Level	Benefits from both perspectives of the providers and the adopters	Key benefits of SaaS from the perspective of the adopters	The related key attributes of SaaS applications
1 **(Ad hoc/Base)**	- SaaS providers: reducing costs by consolidating infrastructures, e.g. a host server can accommodate independent instances of different tenants, and putting less development effort without re-architecting the whole enterprise, e.g. when the enterprise moves to SaaS based applications - SaaS adopters: having their own customized version of applications while running its own instance of applications in the host server	- *Cost efficient* : less initial costs - *Effective data management* : less complex management of data	*Market*: incurring less development efforts, particularly for SMEs

Table A. 4 Key benefits of SaaS adoption can be derived from Microsoft's maturity model – *cont'd*

Maturity Level	Benefits from both perspectives of the providers and the adopters	Key benefits of SaaS from the perspective of the adopters	The related key attributes of SaaS applications
2 **(Configur-able)**	- SaaS providers: managing software release and versioning more effectively - SaaS adopters: accommodating business changes through configuration options which are provided by the providers which design a separate instance for each tenant while using the same code of implementation for all tenants	- *High reliability and availability* (R&A): more effective release management without affecting application's performance - *Effective IT support*: more configurations toward application behavior and looks	- *Standard Support*: implementing standard code for all instance - *Configurability*: providing detailed configuration options for each tenant despite being identical in the code level - *Market*: promoting look and feel configurable applications - *Scalability (of business)*: focusing on enterprise business process while transferring IT-related risks to the providers
3 **(Configur-able, Multi-Tenant-Efficient)**	- SaaS providers: allocating their server resources efficiently since less server space is needed through a single instance approach that serves every tenants - SaaS adopters: mining data more effectively through a single instance approach while being ensured that their data is kept separate from other tenants	- *Cost efficient and effective IT supports*: more efficient resource management - *Efficient access management* : secured access toward customer's data	- *Scalability*: enabling (limited) scaling up toward applications - *Multi-Tenant efficiency*: providing a single instance for multiple tenants - *Configurability*: providing a unique experience and feature set to configure metadata despite being in the same application instances - *Standard Support*: standard authorization and policies to secure tenant's data - *Integration*: easy-to-integrate across multiple tenants - *Security*: securing business data for each tenant - *Market*: promoting a unique look and feel configuration options of metadata - *Scalability (of business)*: optimizing enterprise resources to improve business performance - *Development*: incorporating different business demands for each tenant

There are nine key benefits of SaaS from the perspective adopters, which are cost efficient, effective data management, high Reliability and Availability (R&A), effective IT support, cost efficient and effective IT supports, efficient access management, Super Efficient and Effective Services (SEES), interoperable services, and Secure Information Aggregation (SIA). These benefits are identified by considering the capabilities of SaaS applications in each maturity level. Cost efficient benefits and effective IT support benefits are prerequisite to achieve the benefits of cost efficient and effective IT support and thus is directed to the achievement of SEES benefits. Less complex data management enables good access management and can further enable Secure SIA benefits; while high R&A benefits support interoperable services. As a result, we may have three groups of benefits that characterize SaaS benefits from the perspective of SaaS adopters; they are related to *efficient and effective services, interoperability of services,* and *integrated and secured services*. We elaborate this identification by incorporating key attributes of SaaS applications which can help to indicate the achievement of the SaaS benefits.

Table A. 4 Key benefits of SaaS adoption can be derived from Microsoft's maturity model – *cont'd*

Maturity Level	Benefits from both perspectives of the providers and the adopters	Key benefits of SaaS from the perspective of the adopters	The related key attributes of SaaS applications
4 (Scalable, configur-able, Multi-Tenant-Efficient)	- SaaS providers: supporting multiple tenants while keeping their data separated; and enabling configuration of metadata on a load-balanced farm of identical instances - SaaS adopters: customizing and configuring applications in order to meet business demands, including configuration changes toward user interface and branding, workflow and business rules, extension toward data model, and allocating access rights. .	- *Super Efficient and Effective Services* (SEES): cost-efficient on enterprise resource management for both providers and adopters while provide and configure applications effectively - *Interoperable services*: scalable and configurable applications in meeting the demand from each tenant without re-architecting the applications - *Secure Information Aggregation* (SIA) more effective and secured data aggregation	- *Scalability*: enabling scaling up and scaling out toward the applications - *Multi-Tenant efficiency*: supporting multiple tenants through tenant load balancer comprised of identical instances - *Configurability*: providing wizard for configuring applications - *Standard Support*: supporting a specific configuration for each tenant - *Integration*: rolling out changes and fixes once for all tenants - *Security*: keeping each tenant's database secured without causing information overload - *Market*: supporting flexible software configuration as necessary depending on scopes which represent hierarchical configuration units - *Scalability (of business)*: improving business operational efficiently while effectively improve business performance - *Development*: promoting business growth - *Communication*: easy-to-communicate across multiple tenants

Meanwhile Forrester's model also enables benefits of SaaS from both perspectives of the vendors and adopters as depicted in Table A.5. From these benefits, we identify key benefits of SaaS from the perspective of the adopters by considering transformation of SaaS applications from the existing enterprise applications as an opportunity for competitive advantage and how vendors can capitalize on this opportunity. SaaS benefits are conceptualized to outperform the opportunity.

According to Table A.5, we identify 12 key benefits which are distributed in each level of maturity model. They are *risk transfer* at Level 0 (Outsourcing); *best practice benchmarking* and *community growth* at Level 1 (Manual ASP); *cost efficient,* and *business and IT alignment* at Level 2 (Industrial ASP); *effective IT support* and *cost efficient* at Level 3 (Single-App-SaaS); *interoperable services* and *business research centre* at Level 4 (Business-domain SaaS); *dynamic and interoperable services*, *agile delivery*, and *business and community engagement* at Level 5 (Dynamic-business-apps-as-a-service). These benefits are equipped with key attributes of the applications in each level of maturity model. Generally, the benefits are perpetuated in higher level maturity by enhancing the benefits which can be found in lower level maturity. For instance, *risk transfer* benefits can be represented as *cost efficient* and *effective IT support* which can further encourage *business and IT alignment* benefits. *Best practice benchmarking* and *community growth* can encourage the achievement of *business research centre* and further toward *business and community engagement* benefits while *interoperable services* can encourage the achievement of *dynamic and interoperable services,* and *agile business*. Therefore, we can classify these benefits into four main groups, which are *business and IT alignment, business and community engagement, dynamic and interoperable services,* and *agile delivery*.

Table A. 5 Key benefits of SaaS adoption can be derived from Forrester's maturity model

Maturity Level	Benefits from both perspectives of the providers and the adopters	Key benefits of SaaS from the perspective of the adopters	The related key attributes of SaaS applications
0 (Outsour-cing)	- SaaS providers: providing a unique application landscape for each tenant, usually large enterprises - SaaS adopters: having their existing application delegated to a unique application landscape	*Risk transfer* : more efficient maintenance supports	–
1 (Manual ASP)	- SaaS providers: providing similar configured ASP applications to multiple tenants, usually midsize enterprises - SaaS adopters: being able to customize applications as if it is a self-hosted application	- *Best practice benchmarking*: more identical ASP applications in the same business sector - *Community growth* : more people involved more knowledge transfer exchanged	*Market*: promoting identical ASP applications in the same business sector
2 (Industrial ASP)	- SaaS providers: providing configured ASP applications to multiple tenants, usually SMEs - SaaS adopters: having a sophisticated ASP application with specific configuration	- *Cost efficient* : more standardized functions across tenants - *Business and IT alignment*: configured applications in order to meet business demands	- *Standard Support*: providing ASP standardized applications - *Configurability*: providing configuration options for each tenants - *Market*: promoting best practice standard - *Scalability (of business)*: standardizing enterprise business process
3 (Single-App SaaS)	- SaaS providers: escalating capability to serve multiple tenants, especially SMEs with a single SaaS application which enable SaaS characteristic - SaaS adopters: accessing SaaS application at anytime in anywhere	- *Effective IT support*: more flexible access through web-based application - *Cost efficient* : more scalable infrastructures	- *Multi-Tenant efficiency*: providing one packaged SaaS application to multiple tenants - *Configurability*: providing (limited) configuration options - *Standard Support*: supporting standardized packaged SaaS applications - *Market*: promoting identical one package of SaaS application in the same business sector - *Scalability (of business)*: optimizing enterprise resources limited to one specific SaaS application

However, it is not necessarily to be the best fit for every vendor to target the highest maturity level considering different business process within enterprises. Forrester's model provides a guidance to strategically transform a software delivery model of a vendor into a SaaS model.

Furthermore, in order to accommodate SaaS model which is developed within scientific communities, we will discuss about key benefits from Kang's maturity model. We identify key benefits of SaaS from Kang's maturity model as depicted in Table A.6. These benefits are related to the development of service components which represent the core features of structuring SaaS applications in each level maturity level.

Table A. 5 Key benefits of SaaS adoption can be derived from Forrester's maturity model – *cont'd*

Maturity Level	Benefits from both perspectives of the providers and the adopters	Key benefits of SaaS from the perspective of the adopters	The related key attributes of SaaS applications
4 **(Business-domain SaaS)**	- SaaS providers: expanding potential customers through multiple package applications and custom extensions - SaaS adopters: being able to customize extensions on multipurpose and multitenant platform	- *Interoperable services* : scalable and configurable applications in meeting different business - *Business research centre*: more possible solutions toward custom extensions for multiple packaged SaaS applications across different tenants	- *Scalability*: enabling a platform for additional business logic - *Multi-Tenant efficiency*: providing multiple packaged applications and custom extensions on multipurpose and multitenant environment - *Configurability*: providing tenant-specific configuration - *Standard Support*: standard services to configure multiple package applications - *Integration*: promoting configured applications for multipurpose and multitenant platform - *Market*: promoting a well defined business application - *Scalability (of business)*: satisfying requirements of large enterprises - *Development*: enabling migration a complete business domain toward SaaS applications
5 **(Dynamic-business-apps-as-a-service)**	- SaaS providers: providing a comprehensive application and integrated platform in specific tenant and specific user within the applications - SaaS adopters: composing user specific application according to packaged applications and custom extensions	- *Dynamic and interoperable services* : dynamic orchestration and provisioning of services of SaaS applications within a multitenant environment - *Agile delivery*: more possible user-specific applications which are composed according to multiple packaged and custom business applications - *Business and community engagement* : more research and implementation practice toward a new paradigm of application development "design for people, build for change"	- *Scalability*: providing a dynamic provisioning and comprehensive application - *Multi-Tenant efficiency*: accommodating user-specific applications on various level - *Configurability*: providing possibility to compose packaged applications specifically according to user requirements - *Standard Support*: providing packaged applications while enabling user-specific configurations - *Integration*: providing integration platform on demand - *Market*: designing for people, building for change - *Scalability (of business)*: agile delivery in accommodating business changes - *Development*: developing a new paradigm of application development - *Communication*: involving communities during application development

Table A. 6 Key benefits of SaaS adoption can be derived from Kang's maturity model

Maturity Level	Benefits from both perspectives of the providers and the adopters	Key benefits of SaaS from the perspective of the adopters	The related key attributes of SaaS applications
1 (Ad hoc/Base)	- SaaS providers: providing simple contracts that reflects the necessity of specific tenants - SaaS adopters: accessing separated applications and dedicated database and data schema	*Simple business management*: less complex service components	*Market*: specific ASP business model for each tenant
2 (Standard-ization)	- SaaS providers: providing shared service with different instances for each configured applications - SaaS adopters: being able to configure limited to predefined instance given by the provider	- *Cost efficient*: configuration options from predefined instance - *Standardized services*: standardized SLAs for configurable packaged software	- *Standard Support*: standardized SLAs - *Configurability*: providing shared service while enabling user-specific configuration options - *Market*: promoting shared service with configurable packaged software - *Scalability (of business)*: promoting shared and publicized database with dedicated data schema
3 (Integra-tion)	- SaaS providers: building multitenant environment while providing simple configuration options - SaaS adopters: ensuring SLAs are fulfiled through a set of measurable variables	- *Effective IT support*: more measurable SLAs - *Integrated services*: connecting services within multi tenant environment	- *Scalability*: enabling (limited) scaling up toward applications - *Multi-Tenant efficiency*: focusing on building multi tenant environment - *Configurability*: providing a simple configuration option - *Standard Support*: standardized scheme for defining measurable SLAs - *Integration*: connecting services within multitenant environment - *Market*: promoting multitenant environment - *Scalability (of business)*: realizing measurable SLAs - *Development*: accommodating simultaneous multitenant environment

There are seven benefits which can be identified, including *simple business management*, *cost efficient, standardized services, effective IT support, integrated services, cost efficient and effective IT support,* and *SOA benefits*. In general, benefits in each level represent the fundamental foundation to achieve benefits in the higher level in the maturity model. Therefore, we categorize these benefits into three groups, which are *integrated services, effective and efficient services, and SOA benefits*. The key benefit of *simple business management* and *standardized services* are incorporated within *integrated services* while *cost efficient* and *effective IT support* is incorporated within *effective and efficient services*. The benefit of *SOA benefits* represent that a matured model employs design principles of SOA in order to support the virtualization of system space within an optimized multitenant environment. Therefore, enterprise resources can be optimized via modulation and encapsulation of services. Furthermore, we will address specific benefits that can be expected by incorporating the design principles of SOA during the lifecycle process of SaaS in Subchapter 3.4.

Table A. 6 Key benefits of SaaS adoption can be derived from Kang's maturity model – *cont'd*

Maturity Level	Benefits from both perspectives of the providers and the adopters	Key benefits of SaaS from the perspective of the adopters	The related key attributes of SaaS applications
4 (Virtual-ization)	- SaaS providers: facilitating multitenant environment while maximizing enterprise resources - SaaS adopters: configuring applications to incorporate business changes without getting attached to code of implementation	- *Cost efficient and effective IT support*: optimal resource allocation - *SOA benefits*: service modulation and encapsulation	- *Scalability*: achieving virtualization through cloud computing - *Multi-Tenant efficiency*: optimizing multitenant environment through well-defined set of metadata - *Configurability*: providing a set of function by giving interlinked service combination instead of customizing code of applications - *Standard Support*: incorporating standard SOA approach - *Integration*: connecting services while optimizing multitenant environment - *Security*: keeping data separate within database on cloud computing within an optimized SLA - *Market*: optimizing enterprise resources through virtual system space - *Scalability (of business)*: utilizing full SOA services - *Development*: moving toward virtual system space with load balancing - *Communication*: integrating service combination while optimizing SLA policy to customers

Appendix B: Collecting research data

This appendix contains information about data gathering methods which is used within the research presented in this thesis. There are two methods used to collect data for the research; they are semi-structured interview and questionnaires. The latter method is used to tackle more respondents in order to improve reliability of the research by accommodating sufficient number of research population; while the semi-structured interview aims at gathering in-depth analysis with regard to SaaS benefits. Respondents of the interviews are representatives from Exact Software Nederland who acts as a SaaS application provider offering Exact Online application, and respondents of the questionnaires are anonymous users act as SaaS adopters who adopt Gmail application which is a SaaS-based application. In addition, Exact Online application is financial management software which is the core of integrated solutions for specific customers; while Gmail application is hosted email application which is integrated with other complete application solutions, e.g. myERP and NetSuite ERP. Both the applications are delivered by utilizing SaaS model and thus they can be referred as a (part of) SaaS ERP system.

The rest of this appendix will discuss about one interview guide, and one questionnaire template which can be used as a guidance to gather information from perspectives of SaaS providers and adopters, respectively. The interview guides will be presented in the first part of Appendix B, while the questionnaire templates will be presented in the second part of the appendix.

I. Interview Guide to gather information from SaaS providers

This interview guide is a part of a master thesis project which is related to three main concepts, which are Enterprise Resource Planning (ERP), Software as a Service (SaaS), and Service Oriented Architecture (SOA). This thesis project is written as a partial fulfillment to accomplish a degree of Master of Science in Engineering and Policy Analysis at Delft University of Technology. The goal of this project is to provide methodology for assessing benefits of the adoption of ERP system which is delivered through Software as a Service (SaaS) model within Small Medium Sized Enterprises (SMEs). These benefits are conceptualized from both perspectives of SaaS providers and adopters. Furthermore, SaaS benefits are also conceptualized from the perspective of the lifecycle process of SaaS during the delivery of SaaS applications by considering the design principles of SOA. In order to have a general understanding toward the benefits from these different perspectives, SaaS benefits are directed toward the achievement of an established concept of benefits by Thomas Erl [2007], who proposed the strategic goals and benefits of Service Oriented Computing (SOC).

In this interview guide, the first part of the perspective from SaaS providers will be addressed. For this reason, the benefits of SaaS are conceptualized by considering the promised benefits of SaaS which can be defined by operationalizing Service Level Agreements (SLAs) in a formalized SaaS contract. The promised benefits are related to three main benefits, which are *technology-enabled business support benefits*, *interactive support benefits,* and *comprehensive support benefits*. The first benefits, *technology-enabled business support benefits* can be indicated by two key characteristics, which are *resource efficiency,* and *process effectiveness*; while the second benefits, *interactive support benefits*, can be indicated by three key characteristics, which are related to *service availability, service reliability,* and *data confidentiality*. The third benefits, *comprehensive support benefits*, can be indicated by two key characteristics, which are *integrated information,* and *regulatory compliance*. These characteristics are referred as the key characteristics of the

promised benefits of SaaS. With regard to this, a list of interview questions is structured by following the descriptions of the key characteristics from which the questions can be derived.

In order to have a better understanding toward the process of delivering SaaS applications, we elaborate the interview questions by considering the design principles of SOA which can be appreciated during the lifecycle process of SaaS. There are eight design principles of SOA which are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability,* and *service composability.* The design principles can be reflected within the SaaS lifecycle which cover three main processes which are *discovery, selection and engagement,* and *enactment.* During the process of discovering services, *the standardized service contract, the service loose coupling, the service abstraction,* and *the service discoverability* principle can be appreciated; while the process of selecting and engaging services, all of the eight design principles can be considered mainly due to specification of SLAs which shall incorporate all principles. Meanwhile, *service enactment* process incorporates business changes that may implicate service delivery. This process which is in the tail of the lifecycle can incorporate the design principle of *the service reusability, the service autonomy, the service statelessness,* and *the service composability*. Each of the design principles is further broken down into multiple questions.

The interview questions will be provided to the Exact Software Nederland which acts as a SaaS provider that provides SaaS applications, namely Exact Online and Exact Online Accounting, to its customers which acts as SaaS adopters. The interview starts with general questions related to specific role of the Exact's representatives which is chosen as the target of the interview. Following this, specific questions pertaining to the adoption of the SaaS applications are presented. These questions are grouped into two themes, which are related to the applications and the benefits of SaaS which includes two sections, which are the promised benefits of SaaS, and the design principles of SOA. Please note that this guide is only a reference during the interview since it aims at eliciting information by performing a semi-structured interview. Thus, it is possible to interviewees to ask further information about the questions to the interviewers during the interview and it is also possible that the interview might stray from this interview guide.

General questions

Name of interviewee: Click here to enter text.

This question is not relevant for analyzing the results from interviews. However, it is possible if the interviewee does not wish his/her name to be exposed.

Gender: ◉ Female ○ Male

This is a general question.

Job title of interviewee: Choose an item.

This is relevant to analyze the reliability of information that is provided by the interviewee. The job titles can be chosen from the following list:

- Accountant
- Administrator
- Auditor
- Business Analyst
- CEO
- CFO
- Consultant
- Director
- Engineer
- Finance Analyst
- Help desk
- Instructor
- Manager
- Officer
- Operator
- Production Supervisor
- Project Manager
- Sales rep
- Scientist
- Senior Accountant
- Specialist
- Software Developer
- Student
- Supervisor
- Systems Analyst
- Technician
- Vice president/executive
- Other

Business sector of organization: Choose an item.
This is a general question about organization based on business sector. The business sector can be chosen from the following list:

- Accommodation and Food Services
- Administrative and Support, Waste Management and Remediation Services
- Agriculture, Forestry, Fishing and Hunting
- Arts, Entertainment and Recreation
- Construction
- Finance and Insurance
- Information
- Management of Companies and Enterprises
- Manufacturing
- Mining, Quarrying, and Oil and Gas Extraction
- Public Administration
- Real Estate and Rental and Leasing
- Retail Trade
- Transportation and Warehousing
- Utilities
- Other

Number of employees: Choose an item.
This question can indicate the size of the organization.

Year started with service-orientation and SaaS thinking in the organization: Choose an item.
This question can indicate the degree of innovation within the organization.

Specific questions

These interview questions are structured within two general themes, which are related to SaaS-based applications, and benefits of SaaS. The first theme covers information about functionalities of Exact Online and Exact Online Accounting software as SaaS-based applications. A desk research study has been conducted pertaining to the information about these applications through the website of both applications. During the interview, the result of this desk study is cross-checked with the representative of Exact in order to clarify the actual functionalities of both applications. For this reason, a several use-cases will be presented along with general questions regarding the performance of the applications.

In the light of understanding the performance of both applications, the second theme follows within which the benefits of both applications are appreciated from the perspective of Exact Software Nederland as a SaaS provider. The interview questions are divided into two consecutive sections. First, the main promised benefits will be considered, which are *technology-enabled business support benefits*, *interactive support benefits,* and *comprehensive support benefits*. Therefore, the questions in this first section will be divided into three groups, each of which is structured according to the description of the key characteristics of the promised benefits. Those characteristics are *resource efficiency, process effectiveness, data confidentiality, integrated information, service availability, service reliability*, and *regulatory compliance*. Second, the design principles of SOA will be appreciated during the lifecycle of SaaS. Therefore, eight groups will be presented in the second section, which are *the standardized service contract, the service loose coupling, the service abstraction, the service reusability, the service autonomy, the service statelessness, the service discoverability,* and *the service composability.*

The interview duration for each theme is approximately 30'-45'; thus the interview is approximately conducted within 60'-90'. Please record the interview and make notes of important points from the interviewees' answers during the interview.

:: Exact Online Software ::

SOFTWARE FEATURES

- **Key Questions :**
  - Types of subscriptions
  - Different functionalities for different types of subscriptions
  - Extensions and add-ons
  - Help desk support
- **Specific Questions :**
  1) There are three types of subscriptions: Basis, Advanced, and Premium. What are the main differences between these types of subscriptions? What are the most preferable subscriptions among the three types of subscriptions?
  2) What is the difference between "extensions" and "add-ons"? What are the most popular extensions and add-ons?
  3) Is there any possibility to develop new extensions or add-ons which are requested by clients? If it is possible, is there any (formal) procedure to accommodate the request from clients?
  4) Is there any prioritization when performing a help desk support for different types of subscription? Is there any (formal) procedure to perform a help desk support?

Figure B. 1 The Basis subscription of Exact Online Software offers general features of a financial management software for SMEs

SOFTWARE USERS

- **Key Questions :**
  - Types of users
  - User authorization procedure
  - User management
  - Data confidentiality

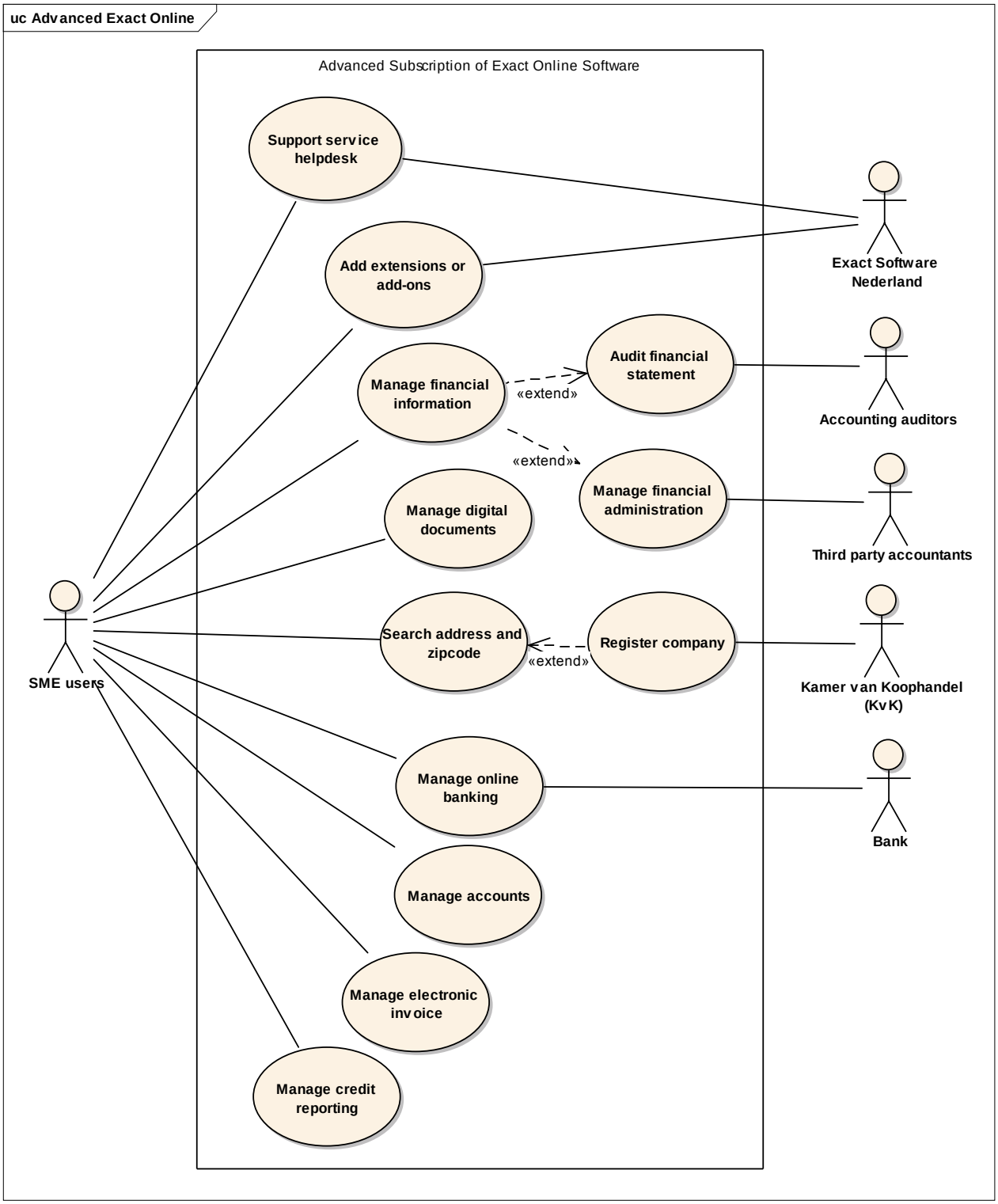

Figure B. 2 The Advanced subscription of Exact Online Software extends the features from the basis subscription

- **Specific Questions :**
  5) There are three types of users: *users, meekijkgebruikers,* and *administraties*. What are the main differences between those three types of users?
  6) Is there any procedure to perform user authorization? Is the procedure defined formally in a contract? How would the user authorization procedure be conducted?
  7) How would the users be managed? How frequent would the user accounts be managed?
  8) How would Exact ensure that the personal and enterprise data would be protected?
  9) Is there any procedure for disaster and recovery plan? Is the procedure defined formally in a contract?

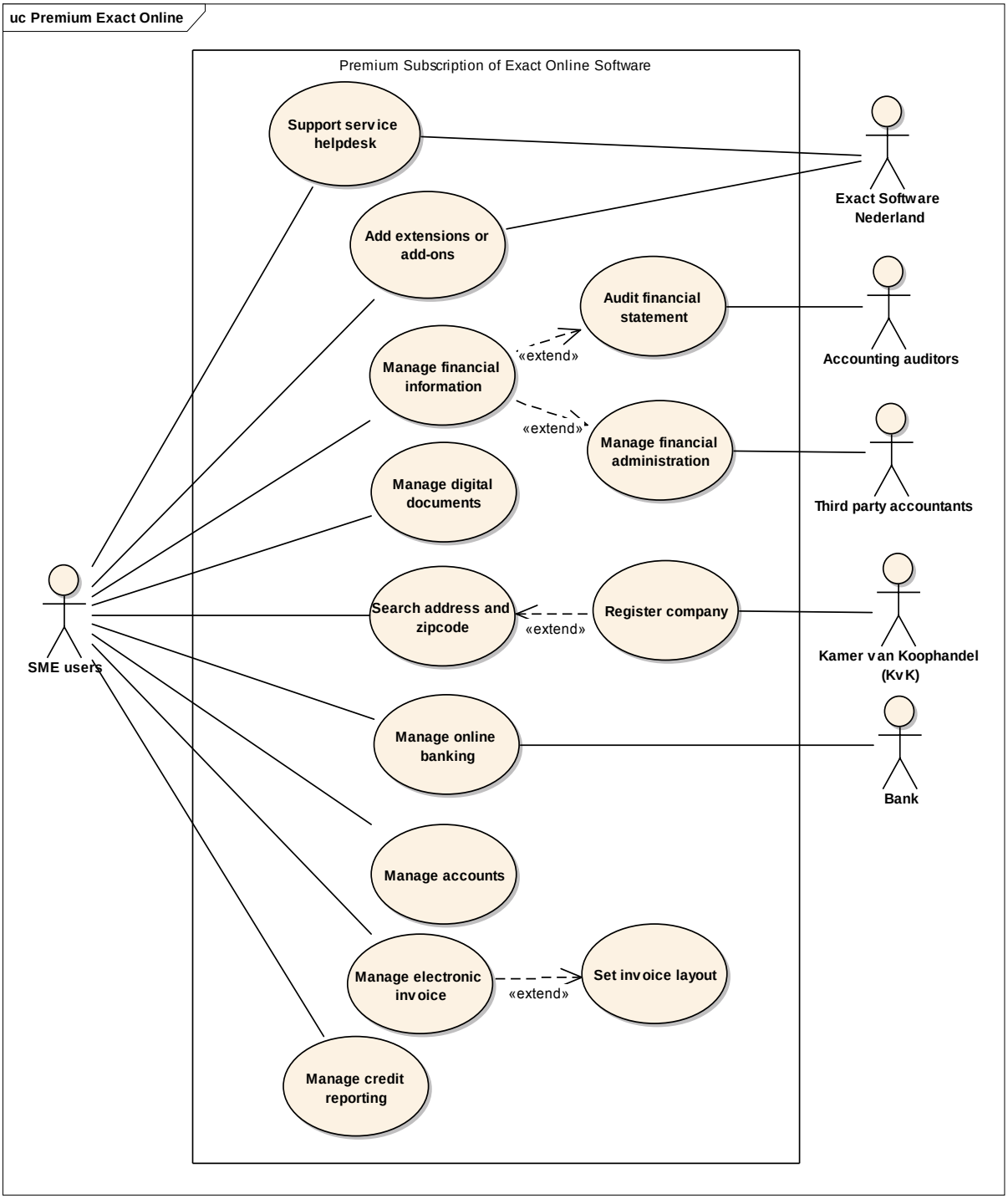

Figure B. 3 The Premium subscription of Exact Online Software covers almost all features of financial management software for SMEs

:: Exact Online Accounting Software ::

SOFTWARE FEATURES

- **Key Questions :**
  - Types of subscriptions
  - Different functionalities for different types of subscriptions
  - Extensions
  - Help desk support

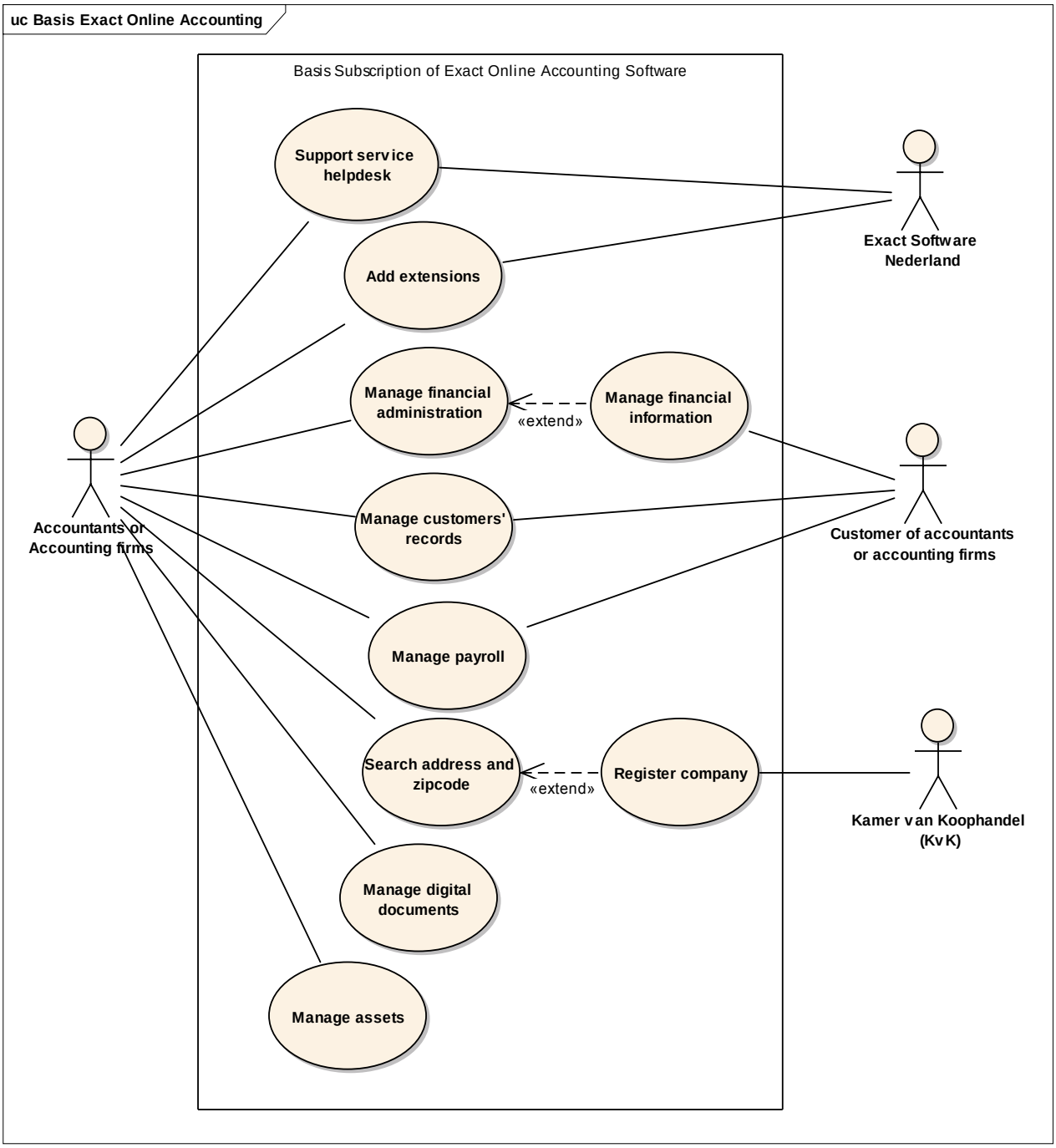

Figure B. 4 The Basis subscription of Exact Online Accounting Software offers a general feature of a financial management software for accountants and accounting firms

Figure B. 5 The Advanced subscription of Exact Online Accounting Software extends the features from the basis subscription

- **Specific Questions :**

10) There are two types of subscriptions: Basis, and Advanced. What are the main differences between these types of subscriptions? What are the most preferable subscriptions among the three types of subscriptions?
11) What is the difference between "extensions"? Why there isn't any add-on available? What are the most popular extensions?
12) Is there any possibility to develop new extensions which are requested by clients? If it is possible, is there any (formal) procedure to accommodate the request from clients?
13) Is there any prioritization when performing a help desk support for different types of subscription? Is there any (formal) procedure to perform a help desk support?

SOFTWARE USERS

- **Key Questions :**
  - Types of users
  - User authorization procedure
  - User management
  - Data confidentiality
- **Specific Questions :**

14) There are three types of users: *administraties, kantoorgebruikers,* and *clientgebruikers*. What are the main differences between those three types of users?
15) Is there any procedure to perform user authorization? Is the procedure defined formally in a contract? How would the user authorization procedure be conducted?
16) How would the users be managed? How frequent would the user accounts be managed?
17) How would Exact ensure that the personal and enterprise data would be protected?
18) Is there any procedure for disaster and recovery plan? Is the procedure defined formally in a contract?

SaaS benefits: the promised benefits and the design principles of SOA

:: The promised benefits of SaaS ::

1) What are the main benefits which can be promised to customers after the adoption of SaaS applications, namely Exact Online and Exact Online Accounting software?
2) To what extent the benefits can be operationalized? Could you give me an example of the benefits of Exact Online and Exact Online Accounting software?
3) Could you think of any benefits which are unique to either Exact Online or Exact Online Accounting software that are rarely found in other applications?

Table B. 1 The benefits of Exact Online and Exact Online Accounting are described in a published information about both applications

The benefits of Exact Online[4]	The benefits of Exact Online Accounting
• Easy and secured access, including i-Phone and Android • An overview of financial statement • Fast time processing • Low subscription fees and no upfront investment • Easily collaborate online with your bookkeeper or accountant • Much time and cost savings with useful links, i.e. exchanging bank files and fuel costs • Easy to extend • More than 61,700 administrations are conducted with Exact Online software	• Easy access, including i-Phone • Flexible collaboration with customers • Efficient operations with useful links, i.e. SBR, banking integration • Monthly subscription fees and no upfront investment • Reliable and secured IT management, including automatic updates toward the software • More than 53,000 administrations are conducted with Exact Online Accounting software

[4] http://www.exact.nl/uw-bedrijf/branches/accountancy/exact-online-accountancy/voordelen-exact-online-accountancy

4) Could you think of any (other) benefits which have not been mentioned yet?

Table B. 2 The benefits of SaaS which are expected by clients can be used as a reference to promise the benefits of adopting SaaS applications

Key characteristics of the promised benefits of SaaS	SaaS benefits which are expected by clients [Sääksjärvi et al., 2005]
1. **Resource efficiency**	– SaaS adopters are provided with "best-of-breed" applications depending on the chosen subscription – The adopters are offered with different kinds of subscription schemes within which a wider and more flexible of payment methods are provided – The adopters relatively invest less initial costs – The adopters are able to focus on their core business process rather than on technology to support their business process
2. **Process effectiveness**	SaaS applications are delivered within a relatively shorter implementation time and thus SaaS adopters are able to utilize the applications immediately after the contract is signed.
3. **Data confidentiality**	SaaS applications are equipped with high security access supported with reliable IT infrastructures.
4. **Integrated information**	SaaS adopters are provided with a complete package of an integrated application and supported services.
5. **Service availability**	– SaaS adopters would be able to access the applications at anytime and any location – SaaS adopters would be equipped with a broader selection over SaaS applications
6. **Service reliability**	SaaS adopters would be provided with continuous supports and services from technical expertise
7. **Regulatory compliance**	– SaaS adopters would be updated with the latest technology and software versions – SaaS adopters would be equipped with the availability to customize the applications

5) We define seven characteristics of the promised benefits of SaaS, which are related to *resource efficiency, process effectiveness, data confidentiality, integrated information, service availability, service reliability,* and *regulatory compliance*. To what extent, the benefits of Exact Online and Exact Online Accounting software could cover these characteristics?

Table B. 3 The benefits of Exact Online and Exact Online Accounting can represent key characteristics of the promised benefits of SaaS

Key characteristics of the promised benefits of SaaS	The benefits of Exact Online Software which is promised by Exact Online	The benefits of Exact Online Software which is promised by Exact Online Accounting
1. **Resource efficiency**	– Low subscription fees and no upfront investment – Much time and cost savings with useful links, i.e. exchanging bank files and fuel costs	– Monthly subscription fees and no upfront investment – Efficient operations with useful links, i.e. SBR, banking integration
2. **Process effectiveness**	– An overview of financial statement – Easy and secured access, including i-Phone and Android – Fast time processing	– Reliable and secured IT management, including automatic updates toward the software – Easy access, including i-Phone and Android
3. **Data confidentiality**	Easy and secured access, including i-Phone and Android	Reliable and secured IT management, including automatic updates toward the software
4. **Integrated information**	Easily collaborate online with your bookkeeper or accountant	Flexible collaboration with customers
5. **Service availability**	Easy and secured access, including i-Phone and Android	Easy access, including i-Phone and Android
6. **Service reliability**	– Easy to extend – Easy and secured access, including i-Phone and Android	Reliable and secured IT management, including automatic updates toward the software
7. **Regulatory compliance**	– More than 61,700 administrations are conducted with Exact Online – Much time and cost savings with useful links, i.e. exchanging bank files and fuel costs – Easy to extend	– More than 53,000 administrations are conducted with Exact Online Accounting software – Efficient operations with useful links, i.e. SBR, banking integration

TECHNOLOGY-ENABLED BUSINESS SUPPORT BENEFITS

- **Key Questions :**
  - Resource efficiency
  - Process effectiveness
- **Specific Questions :**

6) As one of an outsourcing (software) company which aims at delivering software products through SaaS model, would you consider that this type of outsourcing be efficient in transferring risks from clients to vendors?
7) Would you agree that the SaaS model is efficient in saving costs while optimizing enterprise resources?
8) Do you think that the model can be effectively delivered within a shorter implementation time?
9) Would you agree that SaaS model is effective in improving business process management within the client's enterprise?
10) Could you think of any trade-off that may incur due to the adoption of SaaS model?
11) Is there any challenge that might be faced during the delivery of services, e.g. limited number of highly skilled expertise?

INTERACTIVE SUPPORT BENEFITS

- **Key Questions :**
  - Service availability
  - Service reliability
  - Data confidentiality
- **Specific Questions :**

12) How would the availability of services related to the SaaS applications be defined? Is the service availability defined formally in a contract?
13) Is there any possibility to scale up and scale out the applications[5]? If it is possible, is the procedure of scaling the applications defined in a (formal) contract?
14) Are the applications deployed and tested before they are implemented? Is there any possibility that the applications would be deployed and tested when they are implemented? Is there any (formal) procedure in doing so?
15) How would the reliability of services be defined? Is the service reliability defined formally in a contract?
16) Would you think that the personal data and enterprise data of your clients are secured enough by considering the current data security procedure? Would your clients think so?

COMPREHENSIVE SUPPORT BENEFITS

- **Key Questions :**
  - Integrated information
  - Regulatory compliance
- **Specific Questions :**

17) How would multi-tenant data management be performed during the delivery of SaaS applications? Could you refer to a specific data management approach[6]?
18) Do you provide your clients with a centralized-network based applications or a locally-installed application supported with infrastructures?

[5] The scalling out technique means partitioning and replicating a database into multiple servers while the scaling up means moving to a larger server which has more powerful processors and quicker disk drives.

[6] Depending on technical and business considerations, multi-tenant data management can be distinguish into separate database, shared database with different schema, and shared database with the same database schema.

19) How would new laws and regulatory procedures be incorporated within the current applications? Is there any (formal) procedure in doing so? How frequent do you think that this process might happen?

:: The design principles of SOA which is appreciated during the lifecycle of SaaS ::

STANDARDIZED SERVICE CONTRACT

- **Key Questions :**
  - consistency of information about services (related to the delivery of SaaS applications) which is published by the providers
  - description level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters
- **Specific Questions :**

1) Do you think that every contract for any subscriptions of Exact Online and Exact Online Accounting software is conceptualized by both providers and adopters?
   a. Would you agree that the contract is conceptualized and formally signed by both parties during a contract meeting?
   b. In your opinion, who should be involved during the meeting?
   c. When does usually the meeting take place, before or after the project is started?
   d. How long does usually it take before a contract is signed?
   e. Are there any challenges which might be experienced during the meeting?
2) What does the contract cover?
   a. Are technical descriptions of services related to Exact Online and Exact Online Accounting software made available within the contract?
      technical descriptions include:
      - Basic cost, including setup costs and storage fees
      - Periodical service charge, including pilot periods
      - Service Level Agreement
   b. Does the contract contain information about availability of services and data?
      availability of services and data include:
      - Service levels and service credits, e.g. business continuity protection, Disaster Recovery & Business Continuity, Site and Network security
      - Termination and the related consequences, and exit strategy
   c. Does the contract contain information about how to manage and authorize data?
      data management and authorization include:
      - Security and privacy of data, e.g. information security, customer data, personal data
   d. Does the contract explain about additional services and fees which might be provided?
      Additional services and fees include:
      - Locked in or escalating discounts for incremental spending
      - Additional services, e.g. uptime guarantees and penalties
      - Integration with existing system
   e. Are there any other specifications which are not technically described within the contract?

SERVICE LOOSE COUPLING

- **Key Questions :**
  - availability of configuration options for services (related to the delivery of SaaS applications) which are specified by both the providers and the adopters
  - granularity level of services (related to the delivery of SaaS applications) which incorporate both perspective of the providers and the adopters
- **Specific Questions :**

3) What types of services do Exact Online and Exact Online Accounting software provide?
   a. To what extent, configuration options toward these services are available, including changes toward service description within the same scope?
   b. To what level, (the granularity levels of) these services are determined, including changes toward scope of services?
   c. To what extent, these services are independent[7] of other services, e.g. service to assign code of accounts is decoupled from service to request transaction code?
   d. Are there any possibilities to diversify providers which can provide similar services?
4) Are there any significant impacts which might affect business process within client's enterprise during the implementation of services, e.g. maintaining synchronization?

SERVICE ABSTRACTION

- **Key Questions :**
  - generality level of information about services (related to the delivery of SaaS applications) which are published by the providers
  - the depth information about service implementations (related to the delivery of SaaS applications) which satisfy both requirements of the providers and the adopters
- **Specific Questions :**

5) Do you think that (the published) information about services related to Exact Online and Exact Online Accounting is sufficient to represent the main feature of the applications? Could you think of any other information which should be published as well?
6) To what extent the detail of service implementation pertaining to the applications is made available to customers (in order to prepare for future provider diversification)?
7) Are the details of service governance made available by providers and accessible by customers?
8) Is all necessary (and additional) information about a service defined within a formal contract?

SERVICE REUSABILITY

- **Key Questions :**
  - multipurpose level of services (related to the delivery of SaaS applications) which are expected by the adopters
  - frequency of reusable services (related to the delivery of SaaS applications) which are developed by the providers in meeting the demand of the adopters
- **Specific Questions :**

9) To what extent, the services related to Exact Online and Exact Online Accounting software can accommodate business changes?
   a. Is there any possibility to refine service descriptions within a formal contract in order to incorporate business changes in requirements and technology? If it is possible, is there any formal procedure to do so?
   b. Are the services designed for multi-purposes to accommodate business changes?
10) To what extent, the services related to Exact Online and Exact Online Accounting software are reusable?
   a. Can a service be reused to serve various business processes?
   b. Could you think of any redundant services, e.g. within extensions and add-ons?

SERVICE AUTONOMY

- **Key Questions :**

[7] Basic pattern in loose-coupling: *location independence* through dynamic discovery, *communication independence* through web service standard, *security independence* through a federated security standard, and *instance independence* through a synchronous and asynchronous model [Linthicum, 2007]

  - governance level of services (related to the delivery of SaaS applications) which are defined by the providers
  - capability of autonomous services (related to the delivery of SaaS applications) in meeting business changes from the adopters

- **Specific Questions :**

  11) To what extent, service governance is defined? Is it defined in a formal contract?
  12) Are the services related to Exact Online and Exact Online Accounting software designed autonomously in meeting the demand of business changes?
  13) To what extent, a service can share its resources with other services?

SERVICE STATELESSNESS

- **Key Questions :**
  - availability level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters
  - possibility of scaling application and data (related to the delivery of SaaS applications) in accommodating business changes from the adopters

- **Specific Questions :**

  14) To what extent, the services related to Exact Online and Exact Online Accounting software are available?
    a. Are the services always available during the whole period of contract?
    b. Is there any possibility for service to remain stateful during the period of contract?
  15) Is there any possibility to increase the scalability of applications and data? If it is possible, is there any formal procedure to do so?

SERVICE DISCOVERABILITY

- **Key Questions :**
  - accessibility level of services (related to the delivery of SaaS applications) which are developed by the providers
  - availability of mechanisms of discovering services (related to the delivery of SaaS applications) which are developed by the providers

- **Specific Questions :**

  16) To what extent, the services related to Exact Online and Exact Online Accounting software can be accessed?
    a. Are the services easily accessed?
    b. Are the services located efficiently?
    c. Is there any formal mechanism to discover services?
  17) How are these services communicated to clients (SaaS adopters)?

SERVICE COMPOSABILITY

- **Key Questions :**
  - custom option level of services (related to the delivery of SaaS applications) in meeting business changes from the adopters
  - flexibility of custom options for services (related to the delivery of SaaS applications) which are expected by the adopters

- **Specific Questions :**

  18) Are the services related to Exact Online and Exact Online Accounting software can be adjusted continually in order to accommodate business changes?
    a. Are the services capable of being composed to serve different business purposes?
    b. Is the service capability delivered and communicated effectively?
    c. Are the services capable of being repeatedly reused and recomposed?

II. Questionnaire Guide for SaaS adopters

This questionnaire is a part of a master thesis project which is written as a partial fulfillment to accomplish a degree of Master of Science in Engineering and Policy Analysis at Delft University of Technology. One of the goals of the project is to provide methodology for assessing benefits of Software as a Service (SaaS) which can be conceptualized from the perspective of the user of SaaS-based applications. SaaS-based application is chosen because of its scalability and its capability to save costs. It is also able to drive innovation within an enterprise.

Among SaaS-based applications, Google apps offer an integrated SaaS-based application that includes Gmail, calendar, documents, spreadsheets, instant messaging and wikis. Google as one of a SaaS-based e-mail provider offers a free-gmail account to users with more storage space. Regardless of limited accessed of a web-based application, users of Gmail may gain significant benefits by subscribing to a Gmail account, since this hosted email can be subscribed freely, can be accessed anywhere and anytime, and can be integrated with other Google apps with a Single-Sign On (SSO). Comparing to a typical corporate email clients like Microsoft Outlook, Gmail might be a better off, but it might also face an issue of security and controls of data transfer via internet.

You have been selected to fulfil this questionnaire because you have been using a SaaS-based application, i.e. Google apps. First, a series of questions are presented in order to understand the benefits of SaaS when taking into account your perspective as a user of the SaaS-application, e.g. Gmail. Then, you are kindly asked to fill basic information about yourself. The questionnaire ends with an open field that is provided to accommodate your comments regarding this questionnaire. If you have any questions about this questionnaire, please do not hesitate to contact me by email (A.AnisahHerdiyantiPrabowo@student.tudelft.nl).

Benefits of SaaS which are perceived by users

The perspective of users of SaaS-based application will be addressed in this section, particularly related to SaaS benefits that can be perceived by users when using the application, e.g. managing email through Gmail app. In this research, these benefits can be indicated by several key characteristics, including *utility based, SLA driven, shared resources efficient, community contribution, reliability and fault tolerance, flexible and scalable, collaborative and smart, credible and accountable, nimbleness,* and *sustainable and successful.* These characteristics are incorporated within a particular level of SaaS maturity model which is developed within this research.

According to these key characteristics, a list of questions are structured in order to understand to what extent a user of a SaaS-based application can perceive different benefits at different levels of maturity. In each number, please choose the description that represents to what extent you would agree upon the current situation that might be experienced during the use of SaaS-based application, i.e. Gmail app. If there is no description that can represent this adoption, or if you have no information about this, please choose "no opinion".

1) How aware are you of Google apps, e.g. Gmail as one of a SaaS-based email application?
   - ○ I am fully aware of Google apps, e.g. Gmail as one of a SaaS-based email application.
   - ○ I am moderately aware of Google apps, e.g. Gmail as one of a SaaS-based email application.
   - ○ I am slightly aware of Google apps, e.g. Gmail as one of a SaaS-based email application.
   - ○ I am not aware of Google apps, e.g. Gmail as one of a SaaS-based email application.
   - ○ No opinion.

2) Based on your experience in using Gmail as a SaaS-based email application, how successful would you think this application in delivering services according to its intended features, e.g. email, messaging?

- ○ I would think that Gmail is very successful in delivering services according to its intended features, e.g. email, messaging.
- ○ I would think that Gmail is moderately successful in delivering services according to its intended features, e.g. email, messaging.
- ○ I would think that Gmail is slightly successful in delivering services according to its intended features, e.g. email, messaging.
- ○ I would think that Gmail is not successful at all in delivering services according to its intended features, e.g. email, messaging.
- ○ No opinion.

3) In your opinion, do you think the SaaS-based email application, i.e. Gmail app, is too complex, quite simple, or about right to meet your needs over a hosted-email application?

- ○ I would think that Gmail app feature is too complex for a hosted-email application.
- ○ I would think that Gmail app feature is somewhat too complex for a hosted-email application.
- ○ I would think that Gmail app feature is quite simple for a hosted-email application.
- ○ I would think that Gmail app feature is about right for a hosted-email application.
- ○ No opinion.

4) Would you agree that Gmail as a SaaS-based email application can help to improve the management of your resources effectively and efficiently, e.g. accessible at anytime and anywhere, saving storage in a hosted server?

- ○ Yes, I would agree entirely that Gmail can help to improve the management of resources effectively and efficiently.
- ○ Yes, I would agree but only to some degree that Gmail can help to improve the management of resources effectively and efficiently.
- ○ I am afraid I could not either agree or disagree upon this question.
- ○ No, I quite disagree if Gmail can help to improve the management of resources effectively and efficiently.
- ○ No, I strongly disagree if Gmail can help to improve the management of resources effectively and efficiently.

5) Would you agree that SaaS-based application provided by Google, e.g. Google apps, can help to improve IT engagement in a human's daily life?

- ○ Yes, I would agree entirely that Google apps can help to improve IT engagement in a human's daily life
- ○ Yes, I would agree but only to some degree that Google apps can help to improve IT engagement in a human's daily life
- ○ I am afraid I could not either agree or disagree upon this question.
- ○ No, I quite disagree if Google apps can help to improve IT engagement in a human's daily life.
- ○ No, I strongly disagree if Google apps can help to improve IT engagement in a human's daily life.

6) How convenient would you think the services provided by a SaaS-based e-mail application, e.g. Gmail, with other services provided by a locally-installed email application, e.g. Microsoft Outlook?

- ○ I would think that Gmail services are very convenient comparing with a locally-installed email application, e.g. Microsoft Outlook.
- ○ I would think that Gmail services are moderately convenient comparing with a locally-installed email application, e.g. Microsoft Outlook.
- ○ I would think that Gmail services are slightly convenient comparing with a locally-installed email application, e.g. Microsoft Outlook.
- ○ I would think that Gmail services are not convenient at all comparing with a locally-installed email application, e.g. Microsoft Outlook.
- ○ No opinion.

7) How likely would you think that both SaaS-based email application and locally-installed email application will collaborate to provide integrated offline and online email services in the future?

- ○ It is very likely that both applications will collaborate to provide integrated offline and online email services in the future.
- ○ It is moderately likely that both applications will collaborate to provide integrated offline and online email services in the future.
- ○ It is slightly likely that both applications will collaborate to provide integrated offline and online email services in the future.
- ○ It is unlikely that both applications will collaborate to provide integrated offline and online email services in the future.
- ○ No opinion.

8) According to you, how important is pricing in subscribing to a SaaS-based application, e.g. SaaS-based email application such as Gmail?

- ○ I think pricing is a very important factor when deciding to subscribe to a SaaS-based application, e.g. SaaS-based email application such as Gmail.
- ○ I think pricing is a moderately important factor when deciding to subscribe to a SaaS-based application, e.g. SaaS-based email application such as Gmail.
- ○ I think pricing is a slightly important factor when deciding to subscribe to a SaaS-based application, e.g. SaaS-based email application such as Gmail.
- ○ I think pricing is not an important factor when deciding to subscribe to a SaaS-based application, e.g. SaaS-based email application such as Gmail.
- ○ No opinion.

9) How important is to read Terms and Conditions before subscribing to a SaaS-based application, i.e. Gmail?

- ○ I think reading Terms and Conditions before subscribing to a SaaS-based application is very important.
- ○ I think reading Terms and Conditions before subscribing to a SaaS-based application is moderately important.
- ○ I think reading Terms and Conditions before subscribing to a SaaS-based application is slightly important.
- ○ I think reading Terms and Conditions before subscribing to a SaaS-based application is not important at all.

- No opinion.

10) In your opinion, how likely would you find that descriptions of services which are offered in a SaaS-based email application, i.e. Gmail, are stated within Terms and Conditions before agreeing to subscribe to the application?
    - It is very likely that such descriptions will be available within Terms and Conditions.
    - It is moderately likely that such descriptions will be available within Terms and Conditions.
    - It is slightly likely that such descriptions will be available within Terms and Conditions.
    - It is unlikely that such descriptions will be available within Terms and Conditions.
    - No opinion.

11) Based on your experience when using a SaaS-based application, i.e. Gmail, how likely would you move to other applications?
    - It is very likely that I would move to other applications in the future.
    - It is moderately likely that I would move to other applications in the future.
    - It is slightly likely that I would move to other applications in the future.
    - It is unlikely that I would move to other applications in the future.
    - No opinion.

12) As a user of SaaS-based application, e.g. Gmail, how easy is it to change the look-and-feel of the application, e.g. application interface?
    - I found that it is very easy to change the look-and-feel of the application.
    - I found that it is moderately easy to change the look-and-feel of the application.
    - I found that it is slightly easy to change the look-and-feel of the application.
    - I found that it is not easy at all to change the look-and-feel of the application.
    - No opinion.

13) How confident are you to let SaaS-based provider, i.e. Google, manage all critical information of your personal data within SaaS application, i.e. Gmail?
    - I am certainly sure that Google can manage all critical information of my personal data within Gmail.
    - I think only to some degree that Google can manage all critical information of my personal data within Gmail.
    - It is hard to say whether or not critical information of my personal data within Gmail can be managed by Google.
    - No, I do not think that Google can manage all critical information of my personal data within Gmail.
    - No opinion.

14) How aware are you of any procedure to manage your data that is described by Google who provides Gmail, e.g. within Terms and Conditions of services?
    - I am fully aware that there is such procedure within Terms and Conditions of services.
    - I am moderately aware that there is such procedure within Terms and Conditions of services.
    - I am slightly aware that there is such procedure within Terms and Conditions of services
    - I do not think there is such a procedure.

- ○ No opinion.

15) Would you agree if a community whose community member uses the identical SaaS application, e.g. SaaS-based email application, is created in order to share experiences, challenges, and feedback when using the application?
   - ○ Yes, I would certainly agree if such community is created.
   - ○ Yes, I would agree but only to some degree if such community is created.
   - ○ I am afraid I could not either agree or disagree upon this question.
   - ○ No, I quite disagree if such community is created.
   - ○ No, I strongly disagree if such community is created.

16) In your opinion, how likely would you think that Gmail as a SaaS-based email application can improve performance of a hosted email application comparing with a locally-installed application, e.g. Microsoft Outlook?
   - ○ I think it is very likely that Gmail can improve business performance comparing to a locally-installed application, e.g. Microsoft Outlook.
   - ○ I think it is moderately likely that Gmail can improve business performance comparing to a locally-installed application, e.g. Microsoft Outlook.
   - ○ I think it is slightly likely that Gmail can improve business performance comparing to a locally-installed application, e.g. Microsoft Outlook.
   - ○ I do not think business performance would be improved at all.
   - ○ No opinion.

17) How aware are you of any procedure to ensure business continuity, e.g. disaster recovery plan, which is provided by Google to keep personal data safe for its email product, namely Gmail?
   - ○ I am fully aware that there is a procedure to ensure business continuity which is provided by Google to keep personal data safe within Gmail.
   - ○ I am moderately aware that there is a procedure to ensure business continuity which is provided by Google to keep personal data safe within Gmail.
   - ○ I am slightly aware that there is a procedure to ensure business continuity which is provided by Google to keep personal data safe within Gmail.
   - ○ I do not think there is such procedure provided by Google for its Gmail product.
   - ○ No opinion.

18) Would you think that configuration options which are provided by Google within its email product, namely Gmail, are flexible in order to meet changes in user requirements?
   - ○ Yes, I would think the configuration options are very flexible in order to satisfy changes in user requirements.
   - ○ Yes, I would think that the configuration options are flexible but only to some extent these options can accommodate changes in user requirements.
   - ○ Yes, I would think that only few configuration options are provided to satisfy changes in user requirements.
   - ○ No, I do not think that the configuration options are provided in order to satisfy changes in user requirements.
   - ○ No opinion.

19) Would you regard services and help desk supports from Google who provides a SaaS-based email application, namely Gmail, are continuously available and reputably reliable?

- Yes, I would surely regard its services and supports are continuously available and reputably reliable.
- Yes, I would regard its services and supports are available but only to some degree they are available and thus only to some degree they can provide reliable services and supports.
- Yes, I would regard its services and supports are available but not reliable.
- No, I do not think its services and supports are reliable.
- No opinion.

20) To what extent Google as a SaaS-based email provider allows you as a user to customize Gmail which is a SaaS-based email application?

- Yes, we are allowed to customize the business rules and workflows of the application and provided with a good design interface to customize the application.
- Yes, we are allowed to customize the business rules and workflows of the application and but we are not provided with a good design interface to customize the application.
- Yes, but we are only allowed to configure user interface of the application.
- No, I do not think customizing the application would be possible.
- No opinion.

21) How aware are you of an emerging concept of Service Oriented Architecture (SOA)?

- I am fully aware of SOA concept.
- I am moderately aware of SOA concept.
- I am slightly aware of SOA concept.
- I am not aware of SOA concept.
- No opinion.

22) Would you regard Gmail as a SaaS-based email application as a SOA application?

- Yes, I would definitely think so.
- Yes, I would think the application is delivered as a service, but I do not have any information whether it is developed according to SOA concept.
- Yes, I would think the application is delivered as a service, but I do think that it is a SOA-based application.
- No, I would not think that the application represents a service-oriented application.
- No opinion.

23) Could you provide an example of a SOA-based application that employs a SaaS model?

Click here to enter text.

24) Do you have any idea whether or not Google as a SaaS-based email vendor provides a shared database and infrastructure to support Gmail as a SaaS-based email application?

- I am certain that Google provides a shared database and infrastructure to support Gmail.
- It is true that Google provides an integrated database, but I am not sure whether the database is shared with other Google clients.

- It is true that Google provides a shared infrastructure to support Gmail, but I am not sure whether it also provides a shared infrastructure with other Google clients.
- I do not think that Google provides neither a shared database nor a shared infrastructure.
- No opinion.

25) Would you agree upon this statement: "Google as a SaaS-based application vendor delivers services and help desk supports continuously while fostering pace and stability of the applications"?
- Yes, I would definitely agree upon this statement
- Yes, I would agree upon this statement but only to some degree.
- I am neutral upon this statement.
- No, I quite disagree upon this statement.
- No, I strongly disagree upon this statement.

26) Could you think of any (other) benefits of SaaS from the use of a SaaS-based email application, i.e. Gmail?

Click here to enter text.

Benefits of SaaS which can be appreciated during the processes of SaaS lifecycle

In order to have a better understanding toward the processes of SaaS lifecycle related to the delivery of SaaS applications, the questionnaire about SaaS benefits from user's perspective is equipped within questionnaire questions that aim at appreciating the design principles of Services Oriented Architecture (SOA) during the lifecycle of SaaS. According to these design principles, a list of statements is structured in each section that indicates situation within which the principles might be applied when services related to SaaS applications are specified at different processes of SaaS lifecycle.

Each statement has five different answer options, which are "completely agree", "agree to some degree", "neutral", "quite disagree", and "strongly disagree". In each statement, please choose one option that represents to what extent you would agree upon the current situation pertaining to services related to SaaS application you have been using, e.g. you have been using Gmail which is a SaaS-based email application. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

Service discovery, and service selection and engagement

In this section, four design principles of Service Oriented Architecture (SOA) will be appreciated during an earlier phase of SaaS lifecycle which includes two processes, which are discovering services, and selecting and engaging services. They are standardized service contract, service loose coupling, service abstraction, and service discoverability.

STANDARDIZED SERVICE CONTRACT

This principle is an essential part of service design since it aims at defining services as clearly as possible in order to reduce future issues which might be faced during the delivery of SaaS applications. In order to accommodate this principle, two characteristics should exist, which are *consistency of information about services*, and *description level of services*. These characteristics are listed as questionnaire statements in Table B.4 which aim at answering the following question: *Would you agree upon the following*

situation that might occur during the agreement of services within Terms and Conditions before subscribing to a SaaS-based application, e.g. Gmail?

Table B. 4 Agreement of servies should be listed within Terms and Conditions that can represent a SaaS contract

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
1)	Both of you as the user of SaaS application, e.g. Gmail, and vendor of SaaS application, e.g. Google who provide Gmail, contribute to the conceptualization service descriptions within Terms and Conditions.	○	○	○	○	○
2)	Service descriptions within Terms and Conditions are signed formally using a specific authorization procedure.	○	○	○	○	○
3)	SaaS application, e.g. Gmail, can be used directly after a user is subscribed to the application.	○	○	○	○	○
4)	Technical descriptions, including basic cost, periodical service charge, and Service Level Agreements, are provided in detail in service descriptions within Terms and Conditions of services.	○	○	○	○	○
5)	Service descriptions within Terms and Conditions of services contains information about the availability of services and data, including service levels, business continuity protection, termination and the related consequences.	○	○	○	○	○
6)	Service descriptions within Terms and Conditions of services contains information about how to perform data management and authorization, including data privacy and security, e.g. information security.	○	○	○	○	○
7)	Service descriptions within Terms and Conditions of services incorporates information about additional services and fees, including up-time guaranties and penalties, escalating discounts for incremental spending.	○	○	○	○	○
8)	Service descriptions within Terms and Conditions of services provides sufficient information about technical descriptions of services.	○	○	○	○	○

SERVICE LOOSE COUPLING

This principle promotes an interoperable service which is independent with other services but may require information from other services in order to optimize enterprise resources and business performance. In order to accommodate this principle, two characteristics should exist, which are *availability of configuration options for services*, and *granularity level of services*. These characteristics are listed as questionnaire statements in Table B.5 which aim at answering the following question: *Would you agree upon the following statements with regard to SaaS applications, e.g. Gmail?*

Table B. 5 SaaS application often offers a limited configuration options to users

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
9)	You are provided with the capability to configure services related to Gmail application, e.g. configure security and privacy level.	○	○	○	○	○
10)	You are provided with the capability to change scope of services related to Gmail application which have been described by Google, e.g. request other data security methods.	○	○	○	○	○
11)	It is possible for other SaaS providers (vendors) to provide similar services which are currently available within Gmail application.	○	○	○	○	○
12)	There is significant impact in the performance of mail management during the implementation of new services in Gmail, e.g. updates of application lay-outs and features.	○	○	○	○	○

SERVICE ABSTRACTION

This principle aims at providing necessary information for service communication. In order to accommodate this principle, two characteristics should exist, which are *generality level of (published) information about services*, and *the depth information about service implementations*. These characteristics are listed as questionnaire statements in Table B.6 which aim at answering the following question: *Would you agree upon the following statements with regard to information about services within Gmail application which is provided by Google as the provider of this SaaS-based email application?*

Table B. 6 Information about services should be published to users

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
13)	The information about services related to Gmail application, which are published by Google is sufficient to represent main features of the application.	○	○	○	○	○
14)	Google who develops Gmail application, provides information regarding the detail implementation of services related to the application, e.g. the underlying business logic that is used to manage the setting of mail server.	○	○	○	○	○
15)	Governance of services related to SaaS application is made available by Google who provides Gmail application and is accessible by users of the application.	○	○	○	○	○
16)	Additional information about services related to Gmail application is provided within Terms and Conditions of services.	○	○	○	○	○

SERVICE DISCOVERABILITY

This principle promotes an easy access toward capabilities of services which are related to SaaS application. In order to accommodate this principle, two characteristics should exist, which are *accessibility level of services*, and *availability of mechanisms of discovering services*. These characteristics are listed as questionnaire statements in Table B.7 which aim at answering the following question: *Would you agree upon the following statements with regard to discoverability aspect of services pertaining to Gmail application?*

Table B. 7 Services should be accessible and easily located by users

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
17)	Services related to Gmail application can be located easily.	○	○	○	○	○
18)	Discovering mechanisms of services related to Gmail application are published to users through an accessible media.	○	○	○	○	○
19)	Discovering mechanisms of services related to Gmail application are communicated to users.	○	○	○	○	○

Service selection and engagement, and service enactment

In this section, four design principles of Service Oriented Architecture (SOA) will be appreciated during the later phase of SaaS lifecycle which includes two processes, which are service selection and engagement, and service enactment. They are service reusability, service autonomy, service statelessness, and service composability.

SERVICE REUSABILITY

This principle is the core of delivering a service-oriented application which aims at designing multipurpose services which can be reused for different purposes. In order to accommodate this principle, two characteristics should exist, which are *multipurpose level of services*, and *frequency of reusable services*. These characteristics are listed as questionnaire statements in Table B.8 which aim at answering the following question: *Would you agree upon the following statements with regard to reusability aspect of services pertaining to Gmail application which is provided by Google as the vendor of this SaaS-based email application?*

Table B. 8 Services should be reused in order to accommodate new user requirements

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
20)	It is possible to change services related to Gmail application via a community-based sharing in order to accommodate changes in user requirements.	○	○	○	○	○
21)	Services related to Gmail application is designed for multipurpose in order to accommodate changes in user requirements.	○	○	○	○	○
22)	Services related to Gmail application can be reused to serve various user requirements.	○	○	○	○	○
23)	Services related to Gmail application can be redundant with other services in Google apps.	○	○	○	○	○

SERVICE AUTONOMY

This principle aims at designing reliable services which have self-governance to their logic while being capable of sharing their resources. In order to accommodate this principle, two characteristics should exist, which are *governance level of services*, and *capability of autonomous services*. These characteristics are listed as questionnaire statements in Table B.9 which aim at answering the following question: *Would you agree upon the following statements with regard to governance aspect of services pertaining to Gmail application?*

Table B. 9 Service governance should be informed to users

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
24)	Governance of services related to Gmail application, e.g. periodical updates and maintenance, is published periodically through user account in Gmail.	○	○	○	○	○
25)	Performance of Gmail application can be improved if services related to this application are autonomous in satisfying changes in user requirements, e.g. a service to send an email would be independent from a service to send an offline message of messenger within Gmail.	○	○	○	○	○
26)	Services related to Gmail application have controls toward their underlying (business or application) logic.	○	○	○	○	○
27)	Services related to Gmail applications can share their resources with other services although they remain independent toward each other.	○	○	○	○	○

SERVICE STATELESSNESS

This principle supports effective process and efficient resources by providing information if it is necessary. In order to accommodate this principle, two characteristics should exist, which are *availability level of services*, and *possibility of scaling application and data*. These characteristics are listed as questionnaire statements in Table B.10 which aim at answering the following question: *Would you agree upon the following statements with regard to availability aspect of services pertaining to Gmail application?*

Table B. 10 Services should be made available to users during the period of contract

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
28)	Services related to Gmail application are always available as long as user can have access to the application.	○	○	○	○	○
29)	Services related to Gmail application remain stateful unless they are needed as long as user can have access to the application.	○	○	○	○	○
30)	I would agree if Gmail application and Gmail data can be scaled up to bigger capacity of server.	○	○	○	○	○
31)	I would agree if Gmail application dan data can be scaled out to many servers.	○	○	○	○	○

SERVICE COMPOSABILITY

This principle enables complex customs options toward SaaS application and the related services. In order to accommodate this principle, two characteristics should exist, which are *custom option level of services*, and *flexibility of custom options for services*. These characteristics are listed as questionnaire statements in Table B.11 which aims at answering the following question: *Would you agree upon the following statements with regard to customization upon services related to Gmail application which is provided by Google?*

Table B. 11 A certain level of customization toward SaaS application should be communicated to users

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
32)	It is possible to customize services related to Gmail application, e.g. changing business logic of changing layouts within Gmail application.	○	○	○	○	○
33)	Services related to Gmail application can be reused and recomposed to accommodate changes in user requirements.	○	○	○	○	○
34)	Capability of services related to Gmail application is communicated effectively by Google who provides the application.	○	○	○	○	○

General questions

Name of respondent: Click here to enter text.

This question is not relevant for analyzing the results from questionnaire. However, it might be possible that the respondent leave this question blank as anonymous.

Age: Choose an item.

The age of the respondent may be relevant by indicating the interest in new innovations. However, it might be possible that the respondent leave this question blank.

Gender: ◉ Female ○ Male

This is a general question. Respondent should choose either male or female.

Job title of respondent: Choose an item.

This is relevant to analyze the reliability of information that is provided by the respondent. This question will be represented as a drop-down menu that presents a list of job titles which should be chosen by the respondent. The job titles include:

- Accountant
- Administrator
- Auditor
- Business Analyst
- CEO
- CFO
- Consultant
- Director
- Engineer
- Finance Analyst
- Help desk
- Instructor
- Manager
- Officer
- Operator
- Production Supervisor
- Project Manager
- Sales rep
- Scientist
- Senior Accountant
- Specialist
- Software Developer
- Student
- Supervisor
- Systems Analyst
- Technician
- Vice president/executive
- Other

Organization sector: Choose an item.

This is a general question about organization based on business sector, which includes:

- Accommodation and Food Services
- Administrative and Support, Waste Management and Remediation Services
- Agriculture, Forestry, Fishing and Hunting
- Arts, Entertainment and Recreation
- Construction
- Finance and Insurance
- Information
- Management of Companies and Enterprises
- Manufacturing
- Mining, Quarrying, and Oil and Gas Extraction
- Public Administration
- Real Estate and Rental and Leasing
- Retail Trade
- Transportation and Warehousing
- Utilities
- Other

Number of employees: Choose an item.
This question can indicate the size of the organization.

Year started with service-orientation and SaaS thinking in the organization: Choose an item.
This question can indicate the degree of innovation within the organization

Comments or suggestions regarding this questionnaire: Click here to enter text.
This question is to incorporate suggestions from respondents toward the questionnaire.

Appendix C: Developing hypotheses for the models of SaaS benefits

This appendix aims at presenting how the hypotheses within the models of SaaS benefits can be developed into sub-hypotheses in order to answer the main question in the research, which is:

> *"By adopting a SaaS model during the delivery of an ERP system within SMEs, what methodology can be used to assess benefits of SaaS from the perspective of SaaS providers, SaaS adopters and the lifecycle process of SaaS, and to what extent the achievement of SaaS benefits can be evaluated, in order to improve readiness toward SaaS adoption within enterprises?"*

The models of SaaS benefits include the promised benefit model, the perceived benefit model, and the process benefit model. In Part I, three hypotheses and the related sub-hypotheses will be presented according to the initial judgment about the underlying relationship between the perspective of SaaS benefits and the benefits of SOC. Each of the hypotheses will be developed into (initial) sub-hypotheses within Part I. However, these (initial) sub-hypotheses are not suitable enough to study the relationship between variables within the models of SaaS benefits. For this reason, we develop each of the hypotheses into so called the (developed) sub-hypotheses. The discussion upon the development of sub-hypotheses within the promised benefit model from the (initial) sub-hypotheses into the (developed) sub-hypotheses will be presented in Part II. Similar discussion for the perceived benefit model will be presented in Part III while Part IV discusses about the development of sub-hypotheses within the process benefit model.

I. Research hypotheses about the models of SaaS benefits

In the light of answering the research question of "*what methodology can be used to structure the benefits of SaaS?*", we define our main hypotheses which should be tested in order to understand the underlying relationship between the perspectives of SaaS benefits and the benefits of SOC. The perspectives of SaaS benefits include the perspective of SaaS providers, the perspective of SaaS adopters, and the perspective of lifecycle process of SaaS. Each of these perspectives can have different hypothesis which is presented as following.

Hypothesis 1 (H_1) : *Benefits of SaaS which are promised by providers enable the achievement of strategic goals and benefits of Service Oriented Computing (SOC).* The H_1 can be translated into 18 (initial) sub-hypotheses which are represented further in Table C.1.

Hypothesis 2 (H_2) : *Benefits of SaaS which are perceived by adopters can be directed to the achievement of strategic goals and benefits of Service Oriented Computing (SOC).* The H_2 can be translated into 17 (initial) sub-hypotheses which are represented further in Table C.2.

Hypothesis 3 (H_2) : *Benefits of SaaS can be appreciated during the whole lifecycle of SaaS by incorporating the design principles of SOA.* By incorporating these principles, it is more likely that SaaS can achieve strategic goals and benefits of SOC. The H_3 can be translated into 44 (initial) sub-hypotheses which are represented further in Table C.3.

Table C. 1 The first hypothesis (H_1) in the research can be translated into 18 (initial) sub-hypotheses

No	Key characteristics of the promised benefits of SaaS	The strategic goals and benefits of SOC	Sub-hypotheses
1.	**resource efficiency**	*increased of ROI*	**SH_{11}:** There is a significant relationship between improving ***resource efficiency*** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{12}:** There is a significant relationship between improving **resource efficiency** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{13}:** There is a significant relationship between improving **resource efficiency** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
2.	**process effectiveness**	*increased of ROI*	**SH_{21}:** There is a significant relationship between improving ***process effectiveness*** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{22}:** There is a significant relationship between improving **process effectiveness** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{23}:** There is a significant relationship between improving **process effectiveness** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
3.	**data confidentiality**	*increased alignment of business and technology domains*	**SH_{31}:** There is a significant relationship between improving **data confidentiality** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
4.	**integrated information**	*increased of vendor diversification options*	**SH_{41}:** There is a significant relationship between improving **integrated information** and expecting an *increased of vendor diversification options* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{42}:** There is a significant relationship between improving **integrated information** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
5.	**service availability**	*increased of inherent interoperability*	**SH_{51}:** There is a significant relationship between improving **service availability** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{52}:** There is a significant relationship between improving **service availability** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{53}:** There is a significant relationship between improving **service availability** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
6.	**service reliability**	*increased of inherent interoperability*	**SH_{61}:** There is a significant relationship between improving **service reliability** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{62}:** There is a significant relationship between improving **service reliability** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{63}:** There is a significant relationship between improving **service reliability** and expecting an *increased alignment of business and technology* domains within an enterprise who adopts SaaS applications
7.	**regulatory compliance**	*increased of federation*	**SH_{71}:** There is a significant relationship between improving **regulatory compliance** and expecting an *increased of federation* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{72}:** There is a significant relationship between improving **regulatory compliance** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{73}:** There is a significant relationship between improving **regulatory compliance** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications

Table C. 2 The second hypothesis (H_2) in the research can be translated into 16 (initial) sub-hypotheses

No	Key characteristics of the perceived benefits of SaaS	The developed SaaS Maturity Model	The strategic goals and benefits of SOC	Sub-hypotheses
1.	**utility based**	*Level 0: Potential*	*reduced of IT burden*	**SH_{11}:** There is a significant relationship between perceiving benefits at the ***Potential level of SaaS maturity model*** and achieving a *reduced of IT burden* within an enterprise who adopts SaaS applications
				SH_{11}: There is a significant relationship between perceiving benefits at the ***Potential level of SaaS maturity model*** and achieving an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
2.	**SLA driven**	*Level 1: Prospective*	*increased alignment of business and technology domains*	**SH_{21}:** There is a significant relationship between perceiving benefits at the ***Prospective level of SaaS maturity model*** and achieving an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
3.	• **shared multitenant efficient** • **community contribution**	*Level 2: Promising*	*increased of ROI*	**SH_{31}:** There is a significant relationship between perceiving benefits at the ***Promising level of SaaS maturity model*** and achieving an *increased of ROI* within an enterprise who adopts SaaS applications
			increased of federation	**SH_{32}:** There is a significant relationship between perceiving benefits at the ***Promising level of SaaS maturity model*** and achieving an *increased of federation* within an enterprise who adopts SaaS applications
			increased alignment of business and technology domains	**SH_{33}:** There is a significant relationship between perceiving benefits at the ***Promising level of SaaS maturity model*** and achieving an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
4.	• **reliability and fault tolerance** • **flexible and scalable**	*Level 3: Achieving*	*increased of ROI*	**SH_{41}:** There is a significant relationship between perceiving benefits at the ***Achieving level of SaaS maturity model*** and achieving an *increased of ROI* within an enterprise who adopts SaaS applications
			increased of vendor diversification options	**SH_{42}:** There is a significant relationship between perceiving benefits at the ***Achieving level of SaaS maturity model*** and achieving an *increased of vendor diversification options* within an enterprise who adopts SaaS applications
			increased of federation	**SH_{43}:** There is a significant relationship between perceiving benefits at the ***Achieving level of SaaS maturity model*** and achieving an *increased of federation* within an enterprise who adopts SaaS applications
			increased alignment of business and technology domains	**SH_{44}:** There is a significant relationship between perceiving benefits at the ***Achieving level of SaaS maturity model*** and achieving an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
5.	• **collaborative and smart** • **credible and accountable**	*Level 4: Stabilizing*	*increased of vendor diversification options*	**SH_{51}:** There is a significant relationship between perceiving benefits at the ***Stabilizing level of SaaS maturity model*** and achieving an *increased of vendor diversification options* within an enterprise who adopts SaaS applications
			increased of federation	**SH_{52}:** There is a significant relationship between perceiving benefits at the ***Stabilizing level of SaaS maturity model*** and achieving an *increased of federation* within an enterprise who adopts SaaS applications
			increased of organizational agility	**SH_{53}:** There is a significant relationship between perceiving benefits at the ***Stabilizing level of SaaS maturity model*** and achieving an *increased of organizational agility* within an enterprise who adopts SaaS applications
			increased alignment of business and technology domains	**SH_{54}:** There is a significant relationship between perceiving benefits at the ***Stabilizing level of SaaS maturity model*** and achieving an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
6.	• **nimblenes** • **sustainable and successful**	*Level 5: Optimizing*	*increased of inherent interoperability*	**SH_{61}:** There is a significant relationship between perceiving benefits at the ***Optimizing level of SaaS maturity model*** and achieving an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
			increased of organizational agility	**SH_{62}:** There is a significant relationship between perceiving benefits at the ***Optimizing level of SaaS maturity model*** and achieving an *increased of organizational agility* within an enterprise who adopts SaaS applications
			increased alignment of business and technology domains	**SH_{63}:** There is a significant relationship between perceiving benefits at the ***Optimizing level of SaaS maturity model*** and achieving an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications

Table C. 3 The third hypothesis (H_3) in the research can be translated into 44 (initial) sub-hypotheses

No	The design principles of SOA	The strategic goals and benefits of SOC	Sub-hypotheses (SH)
1.	**standardized service contract**	*increased of inherent interoperability*	**SH_{11}:** There is a significant relationship between implementing ***standardized service contract*** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased of federation	**SH_{12}:** There is a significant relationship between implementing ***standardized service contract*** and expecting an *increased of federation* within an enterprise who adopts SaaS applications
		increased of vendor diversification options	**SH_{13}:** There is a significant relationship between implementing ***standardized service contract*** and expecting an *increased of vendor diversification options* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{14}:** There is a significant relationship between implementing ***standardized service contract*** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
		increased of ROI	**SH_{15}:** There is a significant relationship between implementing ***standardized service contract*** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{16}:** There is a significant relationship between implementing ***standardized service contract*** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{17}:** There is a significant relationship between implementing ***standardized service contract*** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications
2.	**service loose coupling**	*increased of inherent interoperability*	**SH_{21}:** There is a significant relationship between implementing **service loose coupling** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased of federation	**SH_{22}:** There is a significant relationship between implementing **service loose coupling** and expecting an *increased of federation* within an enterprise who adopts SaaS applications
		increased of vendor diversification options	**SH_{23}:** There is a significant relationship between implementing **service loose coupling** and expecting an *increased of vendor diversification options* within an enterprise who adopts SaaS applications
		increased of ROI	**SH_{24}:** There is a significant relationship between implementing **service loose coupling** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{25}:** There is a significant relationship between implementing **service loose coupling** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{26}:** There is a significant relationship between implementing **service loose coupling** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications
3.	**service abstraction**	*increased of inherent interoperability*	**SH_{31}:** There is a significant relationship between implementing **service abstraction** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased of federation	**SH_{32}:** There is a significant relationship between implementing **service abstraction** and expecting an *increased of federation* within an enterprise who adopts SaaS applications
		increased of vendor diversification options	**SH_{33}:** There is a significant relationship between implementing **service abstraction** and expecting an *increased of vendor diversification options* within an enterprise who adopts SaaS applications
		increased of ROI	**SH_{34}:** There is a significant relationship between implementing **service abstraction** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{35}:** There is a significant relationship between implementing **service abstraction** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{36}:** There is a significant relationship between implementing **service abstraction** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications

Table C. 3 The third hypothesis (H_3) in the research can be translated into 44 (initial) sub-hypotheses – *cont'd*

No	The design principles of SOA	The strategic goals and benefits of SOC	Sub-hypotheses (SH)
4.	**service reusability**	*increased of inherent interoperability*	**SH_{41}:** There is a significant relationship between implementing **service reusability** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{42}:** There is a significant relationship between implementing **service reusability** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
		increased of ROI	**SH_{43}:** There is a significant relationship between implementing **service reusability** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{44}:** There is a significant relationship between implementing **service reusability** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{45}:** There is a significant relationship between implementing **service reusability** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications
5.	**service autonomy**	*increased of inherent interoperability*	**SH_{51}:** There is a significant relationship between implementing **service autonomy** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased of vendor diversification options	**SH_{52}:** There is a significant relationship between implementing **service autonomy** and expecting an *increased of vendor diversification options* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{53}:** There is a significant relationship between implementing **service autonomy** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
		increased of ROI	**SH_{54}:** There is a significant relationship between implementing **service autonomy** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{55}:** There is a significant relationship between implementing **service autonomy** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{56}:** There is a significant relationship between implementing **service autonomy** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications
6.	**service statelessness**	*increased of inherent interoperability*	**SH_{61}:** There is a significant relationship between implementing **service statelessness** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased of ROI	**SH_{62}:** There is a significant relationship between implementing **service statelessness** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{63}:** There is a significant relationship between implementing **service statelessness** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{64}:** There is a significant relationship between implementing **service statelessness** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications
7.	**service discoverability**	*increased of inherent interoperability*	**SH_{71}:** There is a significant relationship between implementing **service discoverability** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{72}:** There is a significant relationship between implementing **service discoverability** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
		increased of ROI	**SH_{73}:** There is a significant relationship between implementing **service discoverability** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{74}:** There is a significant relationship between implementing **service discoverability** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{75}:** There is a significant relationship between implementing **service discoverability** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications

Table C. 3 The third hypothesis (H_3) in the research can be translated into 44 (initial) sub-hypotheses – *cont'd*

No	The design principles of SOA	The strategic goals and benefits of SOC	Sub-hypotheses (SH)
8.	**service composability**	*increased of inherent interoperability*	**SH_{81}:** There is a significant relationship between implementing **service discoverability** and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications
		increased alignment of business and technology domains	**SH_{82}:** There is a significant relationship between implementing **service discoverability** and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications
		increased of ROI	**SH_{83}:** There is a significant relationship between implementing **service discoverability** and expecting an *increased of ROI* within an enterprise who adopts SaaS applications
		increased of organizational agility	**SH_{84}:** There is a significant relationship between implementing **service discoverability** and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications
		reduced of IT burden	**SH_{85}:** There is a significant relationship between implementing **service discoverability** and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications

II. Model of the promised benefits

We have presented our first hypothesis in the research presented in this thesis, which is "*Benefits of SaaS which are promised by providers enable the achievement of strategic goals and benefits of Service Oriented Computing (SOC)*". In order to answer this hypothesis, we would like to elaborate (initial) sub-hypotheses for the first hypothesis which have been presented in Table C.1. This elaboration is needed in order to be able to operationalize the promised benefits and the benefits of SOC in order to provide a clear research design to assess the benefits by utilizing PLS Path modeling. Furthermore, we only present key characteristics of the promised benefits, instead of presenting the promised benefits of SaaS in Table C.1. For this reason, we re-design sub-hypotheses related to the first hypothesis by defining and operationalizing the promised benefits from their key characteristics, instead of incorporating the sub-hypotheses in Table C.1 immediately to structure the promised benefit model.

According to the structural (model) development of the promised benefits which are discussed in detail in Chapter 4.1, we present the (developed) sub-hypotheses that should be designated in order to study the relationships between the (exogenous or endogenous) variables and the associated indicators, and between exogenous and endogenous variables within the first model. Therefore, we present the (developed) sub-hypotheses to study these relationships as depicted in Table C.4.

Table C. 4 The (developed) sub-hypotheses to structure the promised benefits can be presented after the promised benefits are operationalized

Path coefficient	The developed sub-hypotheses to structure the promised benefits
λ_{xa11}	There is a significant relationship between operationalizing *resource efficiency* by the providers and delivering a promised of *technology-enabled business support benefits* to the adopters during SaaS adoptions.
λ_{xa12}	There is a significant relationship between operationalizing *process effectiveness* by the providers and delivering a promised of *technology-enabled business support benefits* to the adopters during SaaS adoptions.
γ_{a15}	There is a significant relationship between delivering a promised of *technology-enabled business support benefits* and expecting an *increased of ROI* within an enterprise who adopts SaaS applications.
λ_{ya51}	There is a significant relationship between expecting an *increased of ROI* and increasing *ability to incorporate multi-purpose* during SaaS adoptions.
λ_{ya52}	There is a significant relationship between expecting an *increased of ROI* and increasing *ability to provide cost-effective solution* during SaaS adoptions.

Table C. 4 The (developed) sub-hypotheses to structure the promised benefits can be presented after the promised benefits are operationalized – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the promised benefits
γ_{a17}	There is a significant relationship between delivering a promised of *technology-enabled business support benefits* and expecting a *reduced of IT burden* within an enterprise who adopts SaaS applications.
λ_{ya71}	There is a significant relationship between expecting a *reduced of IT burden* and increasing *scalability of IT products* pertaining to SaaS applications.
λ_{ya72}	There is a significant relationship between expecting a *reduced of IT burden* and increasing *value of business by leveraging IT products* pertaining to SaaS applications.
γ_{a14}	There is a significant relationship between delivering a promised of *technology-enabled business support benefits* and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications.
λ_{ya41}	There is a significant relationship between expecting an *increased alignment of business and technology domains* and increasing *automation of technology innovation* during SaaS adoptions.
λ_{ya42}	There is a significant relationship between expecting an *increased alignment of business and technology domains* and increasing *capability of addressing immediate business changes* during SaaS adoptions.
λ_{xa21}	There is a significant relationship between operationalizing *service availability* by the providers and delivering a promised of *interactive support benefits* to the adopters during SaaS adoptions.
λ_{xa22}	There is a significant relationship between operationalizing *service reliability* by the providers and delivering a promised of *interactive support benefits* to the adopters during SaaS adoptions.
λ_{xa23}	There is a significant relationship between operationalizing *data confidentiality* by the providers and delivering a promised of *interactive support benefits* by the adopters during SaaS adoptions.
γ_{a21}	There is a significant relationship between delivering a promised of *interactive support benefits* and expecting an *increased of inherent interoperability* within an enterprise who adopts SaaS applications.
λ_{ya11}	There is a significant relationship between expecting an *increased of inherent interoperability* and increasing *ease-of-access* during SaaS adoptions.
λ_{ya12}	There is a significant relationship between expecting an *increased of inherent interoperability* and increasing *ease-of-information exchange* during SaaS adoptions.
λ_{ya13}	There is a significant relationship between expecting an *increased of inherent interoperability* and increasing *community collaboration* during SaaS adoptions.
γ_{a26}	There is a significant relationship between delivering a promised of *interactive support benefits* and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications.
λ_{ya61}	There is a significant relationship between expecting an *increased of organizational agility* and increasing *capability of responding to business changes* during SaaS adoptions.
λ_{ya62}	There is a significant relationship between expecting an *increased of organizational agility* and increasing *strategic solution in establishing an agile organization* during SaaS adoptions.
γ_{a24}	There is a significant relationship between delivering a promised of *interactive support benefits* and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications.
λ_{xa31}	There is a significant relationship between operationalizing *integrated information* by the providers and delivering a promised of *comprehensive support benefits* to the adopters during SaaS adoptions.
λ_{xa32}	There is a significant relationship between operationalizing *regulatory compliance* by the providers and delivering a promised of *comprehensive support benefits* to the adopters during SaaS adoptions.
γ_{a33}	There is a significant relationship between delivering a promised of *comprehensive support benefits* and expecting an *increased of vendor diversification options* within an enterprise who adopts SaaS applications.
λ_{ya31}	There is a significant relationship between expecting an *increased of vendor diversification options* and increasing *ability to choose "best-of-breed" of IT products* during SaaS adoptions.
λ_{ya32}	There is a significant relationship between expecting an *increased of vendor diversification options* and increasing *free of vendor lock-in* during SaaS adoptions.

Table C. 4 The (developed) sub-hypotheses to structure the promised benefits can be presented after the promised benefits are operationalized – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the promised benefits
γ_{a32}	There is a significant relationship between delivering a promised of *comprehensive support benefits* and expecting an *increased of federation* within an enterprise who adopts SaaS applications.
λ_{ya21}	There is a significant relationship between expecting an *increased of federation* and increasing *standardization of IT environment* during SaaS adoptions.
λ_{ya22}	There is a significant relationship between expecting an *increased of federation* and increasing *protection of implementation details* during SaaS adoptions.
γ_{a36}	There is a significant relationship between delivering a promised of *comprehensive support benefits* and expecting an *increased of organizational agility* within an enterprise who adopts SaaS applications.
γ_{a34}	There is a significant relationship between delivering a promised of *comprehensive support benefits* and expecting an *increased alignment of business and technology domains* within an enterprise who adopts SaaS applications.

According to Table C.4, there are 32 sub-hypotheses in total, within which 22 *correspondence rules* relationship are structured to build the *outer model (measurement model),* and 10 *non-observational hypotheses* and *theoretical definitions* relationship are structured to build the *inner model (structural model)*. Among those correspondence rules relationship, there are seven correspondence rules relationship within the outer model (measurement model) of the exogenous variables whereas the rest 15 correspondence rules are incorporated within the outer model (measurement model) of the endogenous variables.

III. Model of the perceived benefits

The second hypothesis in the research presented in this thesis aims at answering the following premise: "*Benefits of SaaS which are perceived by adopters can be directed to the achievement of strategic goals and benefits of Service Oriented Computing (SOC)*". In order to answer this hypothesis, we would like to elaborate our sub-hypotheses which have been presented in Table C.2 by incorporating the PLS Path modeling method in order to answer the second hypothesis. For this reason, a measurable model to assess SaaS benefits needs to propose by operationalizing the promised benefits based on modeling standard which is specified in the method. This model specification results in re-designing the (initial) sub-hypotheses in order to provide a clear research design by utilizing PLS Path modeling. The rest of this appendix will discuss about how the developed sub-hypotheses are built in order to build a model of the perceived benefit by utilizing the PLS Path modeling.

Based on the structural (model) development of the perceived benefits which are discussed in detail in Chapter 4.2, the operationalization of the perceived benefits results in different sub-hypotheses that should be developed in order to study the relationships between the (exogenous or endogenous) variables and the associated indicators, and between exogenous and endogenous variables within the second model. Therefore, we present the (developed) sub-hypotheses to study these relationships as depicted in Table C.5.

According to Table C.5, there are 42 sub-hypotheses in total, within which 25 *correspondence rules* relationship are structured to build the *outer model (measurement model),* and 17 *non-observational hypotheses* and *theoretical definitions* relationship are structured to build the *inner model (structural model)*. Among those correspondence rules relationship, there are 10 correspondence rules relationship within the outer model (measurement model) for the exogenous variables whereas the rest 15 correspondence rules are incorporated within the outer model (measurement model) for the endogenous variables.

Table C. 5 The (developed) sub-hypotheses to structure the perceived benefits can be presented after the benefits are operationalized

Path coefficient	The developed sub-hypotheses to structure the perceived benefits
λ_{xb11}	There is a significant relationship between operationalizing *utility based* and perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model during SaaS adoption.
γ_{b17}	There is a significant relationship between perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model and expecting a *reduced of IT burden* by the adopters.
γ_{b14}	There is a significant relationship between perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model expecting an *increased alignment of business and technology domains* by the adopters.
λ_{yb71}	There is a significant relationship between expecting a *reduced of IT burden* and increasing *scalability of IT products* pertaining to SaaS applications.
λ_{yb72}	There is a significant relationship between expecting a *reduced of IT burden* and increasing *value of business by leveraging IT products* pertaining to SaaS applications.
λ_{xb21}	There is a significant relationship between operationalizing *SLA driven* and perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model during SaaS adoption.
γ_{b24}	There is a significant relationship between perceiving benefits of SaaS at *Level 0- Potential* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.
λ_{yb41}	There is a significant relationship between expecting an *increased alignment of business and technology domains* and increasing *automation of technology innovation* during SaaS adoptions.
λ_{yb42}	There is a significant relationship between expecting an *increased alignment of business and technology domains* and increasing *capability of addressing immediate business changes* during SaaS adoptions.
λ_{xb31}	There is a significant relationship between operationalizing *shared multitenant efficient* and perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model during SaaS adoption.
λ_{xb32}	There is a significant relationship between operationalizing *community contribution* and perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model during SaaS adoption.
γ_{b35}	There is a significant relationship between perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model and expecting an *increased of ROI* by the adopters
λ_{yb51}	There is a significant relationship between expecting an *increased of ROI* and increasing *ability to incorporate multi-purpose* during SaaS adoptions.
λ_{yb52}	There is a significant relationship between expecting an *increased of ROI* and increasing *ability to provide cost-effective solution* during SaaS adoptions.
γ_{b32}	There is a significant relationship between perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model and expecting an *increased of federation* by the adopters
λ_{yb21}	There is a significant relationship between expecting an *increased of federation* and increasing *standardization of IT environment* during SaaS adoptions.
λ_{yb22}	There is a significant relationship between expecting an *increased of federation* and increasing *protection of implementation details* during SaaS adoptions.
γ_{b34}	There is a significant relationship between perceiving benefits of SaaS at *Level 2- Promising* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.
λ_{xb41}	There is a significant relationship between operationalizing *reliability and fault tolerance* and perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model during SaaS adoption.
λ_{xb42}	There is a significant relationship between operationalizing *flexible and scalable* and perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model during SaaS adoption.
γ_{b45}	There is a significant relationship between perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model and expecting an *increased of ROI* by the adopters
γ_{b43}	There is a significant relationship between perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model and expecting an *increased of vendor diversification options* by the adopters

Table C. 5 The developed sub-hypotheses to structure the perceived benefits can be presented after the benefits are operationalized – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the perceived benefits
λ_{yb31}	There is a significant relationship between expecting an *increased of vendor diversification options* and increasing *ability to choose "best-of-breed" of IT products* during SaaS adoptions.
λ_{yb32}	There is a significant relationship between expecting an *increased of vendor diversification options* and increasing *free of vendor lock-in* during SaaS adoptions.
γ_{b42}	There is a significant relationship between perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model and expecting an *increased of federation* by the adopters
γ_{b44}	There is a significant relationship between perceiving benefits of SaaS at *Level 3: Achieving* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.
λ_{xb51}	There is a significant relationship between operationalizing *collaborative and smart* and perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model during SaaS adoption.
λ_{xb52}	There is a significant relationship between operationalizing *credible and accountable* and perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model during SaaS adoption.
γ_{b53}	There is a significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased of vendor diversification options* by the adopters
γ_{b52}	There is a significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased of federation* by the adopters
γ_{b56}	There is a significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased of organizational agility* by the adopters
λ_{yb61}	There is a significant relationship between expecting an *increased of organizational agility* and increasing *capability of responding to business changes* during SaaS adoptions.
λ_{yb62}	There is a significant relationship between expecting an *increased of organizational agility* and increasing *strategic solution in establishing an agile organization* during SaaS adoptions.
γ_{b54}	There is a significant relationship between perceiving benefits of SaaS at *Level 4: Stabilizing* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.
λ_{xb61}	There is a significant relationship between operationalizing *nimbleness* and perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model during SaaS adoption.
λ_{xb62}	There is a significant relationship between operationalizing *sustainable and successful* and perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model during SaaS adoption.
γ_{b61}	There is a significant relationship between perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model and expecting an *increased of inherent interoperability* by the adopters
λ_{yb11}	There is a significant relationship between expecting an *increased of inherent interoperability* and increasing *ease-of-access* during SaaS adoptions.
λ_{yb12}	There is a significant relationship between expecting an *increased of inherent interoperability* and increasing *ease-of-information exchange* during SaaS adoptions.
λ_{yb13}	There is a significant relationship between expecting an *increased of inherent interoperability* and increasing *community collaboration* during SaaS adoptions.
γ_{b66}	There is a significant relationship between perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model and expecting an *increased of organizational agility* by the adopters
γ_{b64}	There is a significant relationship between perceiving benefits of SaaS at *Level 5: Optimizing* of SaaS maturity model and expecting an *increased alignment of business and technology domains* by the adopters.

IV. Model of the process benefits

We present the third hypothesis in the research as: "*Benefits of SaaS can be appreciated during the whole lifecycle of SaaS by incorporating the design principles of SOA.*" In order to answer this hypothesis, we would like to develop a measurable model which aims at assessing the benefits of SaaS by considering the design principles of Service Oriented Architecture (SOA) during the whole lifecycle of SaaS. In order to develop this model, we would like to elaborate the sub-hypotheses which have been presented in Table C.3 by incorporating the PLS Path modeling method into a model of the design benefit. Therefore, a set of measurable indicators to assess the design principles is needed in order to understand the underlying relationship between the design principles of SOA and the benefits of SaaS which will be represented as the strategic goals and benefits of Service Oriented Computing (SOC). The rest of this appendix will discuss about how the developed sub-hypotheses are developed in order to build a model of SaaS benefits from the perspective of the lifecycle process of SaaS which underlies three concepts, which are SaaS lifecycle, the design principles of SOA, and the strategic goals and benefits of SOC.

The operationalization of the process benefits which are discussed further in Subchapter 4.3 aims at providing a clear structure of the process benefits. Following this, we elaborate the (initial) sub-hypotheses which have been presented in Table C.3 by considering the structure of the third model which utilizes the PLS Path modeling method. For this reason, we present Table C.6 in order to study the relationship between the (exogenous or endogenous) variables and the associated indicators, and between exogenous and endogenous variables within the third model. There are 75 sub-hypotheses in total, within which 31 *correspondence rules* relationship are structured to build the *outer model (measurement model),* and 44 *non-observational hypotheses* and *theoretical definitions* relationship are structured to build the *inner model (structural model)*. Among those correspondence rules relationship, there are 16 correspondence rules relationship within the outer model (measurement model) for the exogenous variables whereas the rest 15 correspondence rules are incorporated within the outer model (measurement model) for the endogenous variables.

Table C. 6 The (developed) sub-hypotheses to structure the process benefits can be presented after the benefits are operationalized

Path coefficient	The developed sub-hypotheses to structure the process benefits
λ_{xc11}	There is a significant relationship between ensuring that *consistency of information about services (related to the delivery of SaaS applications) which is published by the providers* is considered during the lifecycle of SaaS and employing the design principle of *standardized service contract* during SaaS adoptions.
λ_{xc12}	There is a significant relationship between ensuring that *description level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *standardized service contract* during SaaS adoptions.
γ_{c11}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
λ_{yc11}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of inherent interoperability* and increasing *ease-of-access* during SaaS adoptions.
λ_{yc12}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of inherent interoperability* and increasing *ease-of-information exchange* during SaaS adoptions.
λ_{yc13}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of inherent interoperability* and increasing *community collaboration* during SaaS adoptions.
γ_{c12}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of federation.*

Table C. 6 The (developed) sub-hypotheses to structure the process benefits can be presented after the benefits are operationalized – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the process benefits
λ_{yc21}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of federation* and increasing *standardization of IT environment* during SaaS adoptions.
λ_{yc22}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of federation* and increasing *protection of implementation details* during SaaS adoptions.
γ_{c13}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.
λ_{yc31}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of vendor diversification options* and increasing *ability to choose "best-of-breed" of IT products* during SaaS adoptions.
λ_{yc32}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of vendor diversification options* and increasing *free of vendor lock-in* during SaaS adoptions.
γ_{c14}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.
λ_{yc41}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased alignment of business and technology domains* and increasing *automation of technology innovation* during SaaS adoptions.
λ_{yc42}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased alignment of business and technology domains* and increasing *capability of addressing immediate business changes* during SaaS adoptions.
γ_{c15}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
λ_{yc51}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of ROI* and increasing *ability to incorporate multi-purpose* during SaaS adoptions.
λ_{yc52}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of ROI* and increasing *ability to provide cost-effective solution* during SaaS adoptions.
γ_{c16}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
λ_{yc61}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of organizational agility* and increasing *capability of responding to business changes* during SaaS adoptions.
λ_{yc62}	There is a significant relationship between accomplishing the strategic goal and benefit of *increased of organizational agility* and increasing *strategic solution in establishing an agile organization* during SaaS adoptions.
γ_{c17}	There is a significant relationship between employing the design principle of *standardized service contract* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
λ_{yc71}	There is a significant relationship between accomplishing the strategic goal and benefit of *reduced of IT burden* and increasing *scalability of IT products* pertaining to SaaS applications.
λ_{yc72}	There is a significant relationship between accomplishing the strategic goal and benefit of *reduced of IT burden* and increasing *value of business by leveraging IT products* pertaining to SaaS applications.
λ_{xc21}	There is a significant relationship between ensuring that *availability of configuration options for services (related to the delivery of SaaS applications) which are specified by both the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service loose coupling* during SaaS adoptions.
λ_{xc22}	There is a significant relationship between ensuring that *granularity level of services (related to the delivery of SaaS applications) which incorporate both perspective of the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service loose coupling* during SaaS adoptions.

Table C. 6 The (developed) sub-hypotheses to structure the process benefits can be presented after the benefits are operationalized – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the process benefits
γ_{c21}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
γ_{c22}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of federation.*
γ_{c23}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.
γ_{c25}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
γ_{c26}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
γ_{c27}	There is a significant relationship between employing the design principle of *service loose coupling* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden.*
λ_{xc31}	There is a significant relationship between ensuring that *generality level of information about services (related to the delivery of SaaS applications) which are published by the providers* is considered during the lifecycle of SaaS and employing the design principle of *service abstraction* during SaaS adoptions.
λ_{xc32}	There is a significant relationship between ensuring that *the depth information about service implementations (related to the delivery of SaaS applications) which satisfy both requirements of the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service abstraction* during SaaS adoptions.
γ_{c31}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
γ_{c32}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of federation.*
γ_{c33}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.
γ_{c35}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
γ_{c36}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
γ_{c37}	There is a significant relationship between employing the design principle of *service abstraction* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden.*
λ_{xc41}	There is a significant relationship between ensuring that *multipurpose level of services (related to the delivery of SaaS applications) which are expected by the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service reusability* during SaaS adoptions.
λ_{xc42}	There is a significant relationship between ensuring that *frequency of reusable services (related to the delivery of SaaS applications) which are developed by the providers in meeting the demand of the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service reusability* during SaaS adoptions.
γ_{c41}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
γ_{c44}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.
γ_{c45}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
γ_{c46}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
γ_{c47}	There is a significant relationship between employing the design principle of *service reusability* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden.*

Table C. 6 The developed sub-hypotheses to structure the process benefits can be presented after the benefits are operationalized – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the process benefits
λ_{xc51}	There is a significant relationship between ensuring that *governance level of services (related to the delivery of SaaS applications) which are defined by the providers* is considered during the lifecycle of SaaS and employing the design principle of *service autonomy* during SaaS adoptions.
λ_{xc52}	There is a significant relationship between ensuring that *capability of autonomous services (related to the delivery of SaaS applications) in meeting business changes from the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service autonomy* during SaaS adoptions.
γ_{c51}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
γ_{c53}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of vendor diversification options*.
γ_{c54}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.
γ_{c55}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
γ_{c56}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
γ_{c57}	There is a significant relationship between employing the design principle of *service autonomy* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
λ_{xc61}	There is a significant relationship between ensuring that *availability level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service autonomy* during SaaS adoptions.
λ_{xc62}	There is a significant relationship between ensuring that *possibility of scaling application and data (related to the delivery of SaaS applications) in accommodating business changes from the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service stateless* during SaaS adoptions.
γ_{c61}	There is a significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
γ_{c65}	There is a significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
γ_{c66}	There is a significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
γ_{c67}	There is a significant relationship between employing the design principle of *service stateless* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.
λ_{xc71}	There is a significant relationship between ensuring that *accessibility level of services (related to the delivery of SaaS applications) which are developed by the providers* is considered during the lifecycle of SaaS and employing the design principle of *service discoverability* during SaaS adoptions.
λ_{xc72}	There is a significant relationship between ensuring that *availability of mechanisms of discovering services (related to the delivery of SaaS applications) which are developed by the providers* is considered during the lifecycle of SaaS and employing the design principle of *service discoverability* during SaaS adoptions.
γ_{c71}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
γ_{c74}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.
γ_{c75}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
γ_{c76}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
γ_{c77}	There is a significant relationship between employing the design principle of *service discoverability* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.

Table C. 6 The developed sub-hypotheses to structure the process benefits can be presented after the benefits are operationalized – *cont'd*

Path coefficient	The developed sub-hypotheses to structure the process benefits
λ_{xc81}	There is a significant relationship between ensuring that *custom option level of services (related to the delivery of SaaS applications) in meeting business changes from the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service composability* during SaaS adoptions.
λ_{xc82}	There is a significant relationship between ensuring that *flexibility of custom options for services (related to the delivery of SaaS applications) which are expected by the adopters* is considered during the lifecycle of SaaS and employing the design principle of *service composability* during SaaS adoptions.
γ_{c81}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of inherent interoperability*.
γ_{c84}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased alignment of business and technology domains*.
γ_{c85}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of ROI*.
γ_{c86}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *increased of organizational agility*.
γ_{c87}	There is a significant relationship between employing the design principle of *service composability* during SaaS adoptions and accomplishing the strategic goal and benefit of *reduced of IT burden*.

Appendix D: Developing Usecase

This appendix contains information about business-usecase diagrams based on business case which has been presented in Subchapter 5.2. The business usecase diagrams will be developed according to a standardized- general purpose modeling language, which is known as Unified Modeling Language (UML). By having these business-usecase diagrams, general features of Software as a Service (SaaS)-based application can be captured. These diagrams also incorporate important functionalities and the related actors who are involved within the application.

We develop five usecase models each of which represents different subscriptions which are offered within the Exact Online and Exact Online Accounting Software. Exact Online software has three types of subscriptions, which are Basis, Advanced, and Premium. The usecase diagrams for these subscriptions are presented in Figure D.1, Figure D.2, and Figure D.3, subsequently.

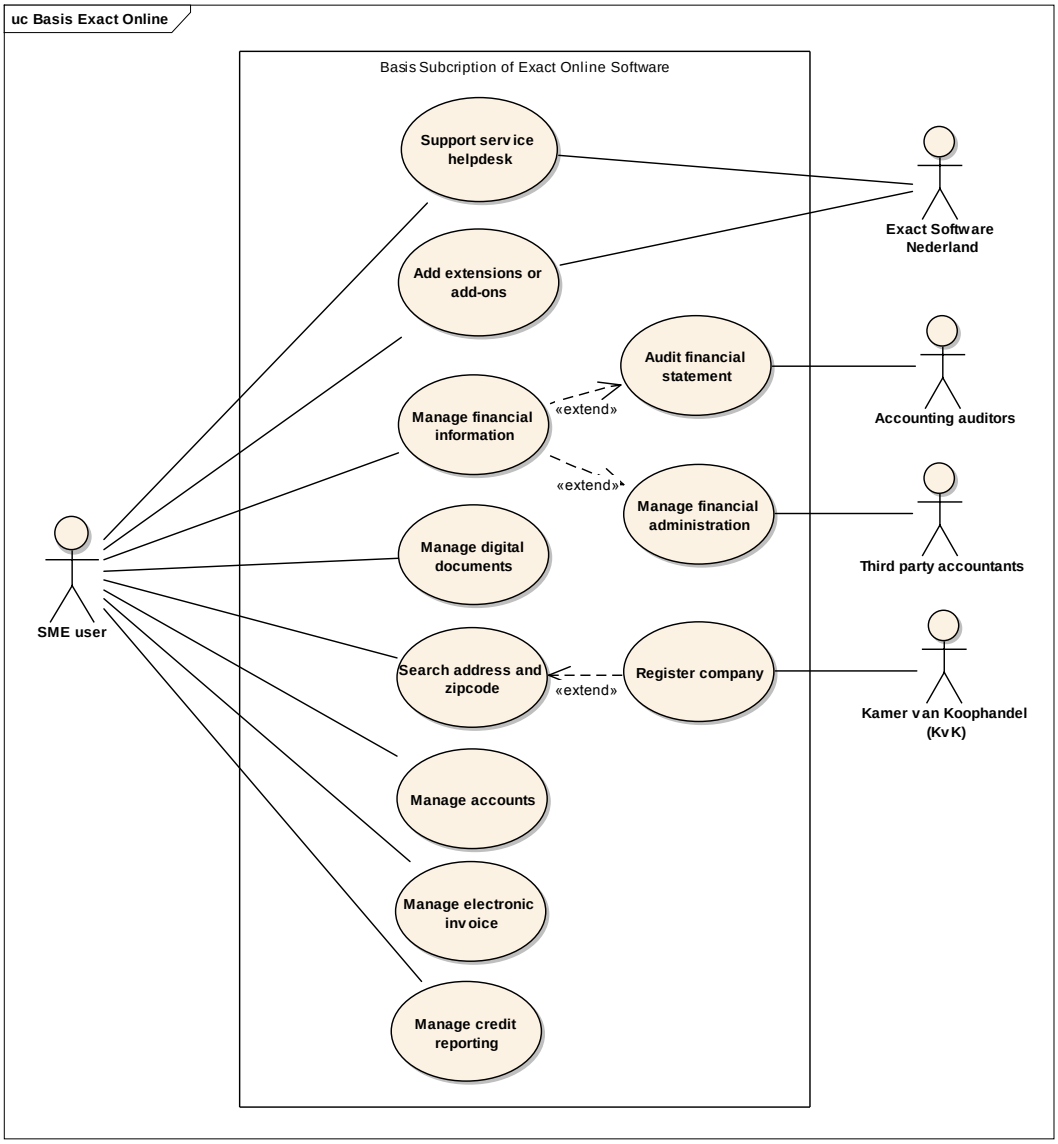

Figure D. 1 Basis subscription of Exact Online software provides a set of basic functionalities to clients

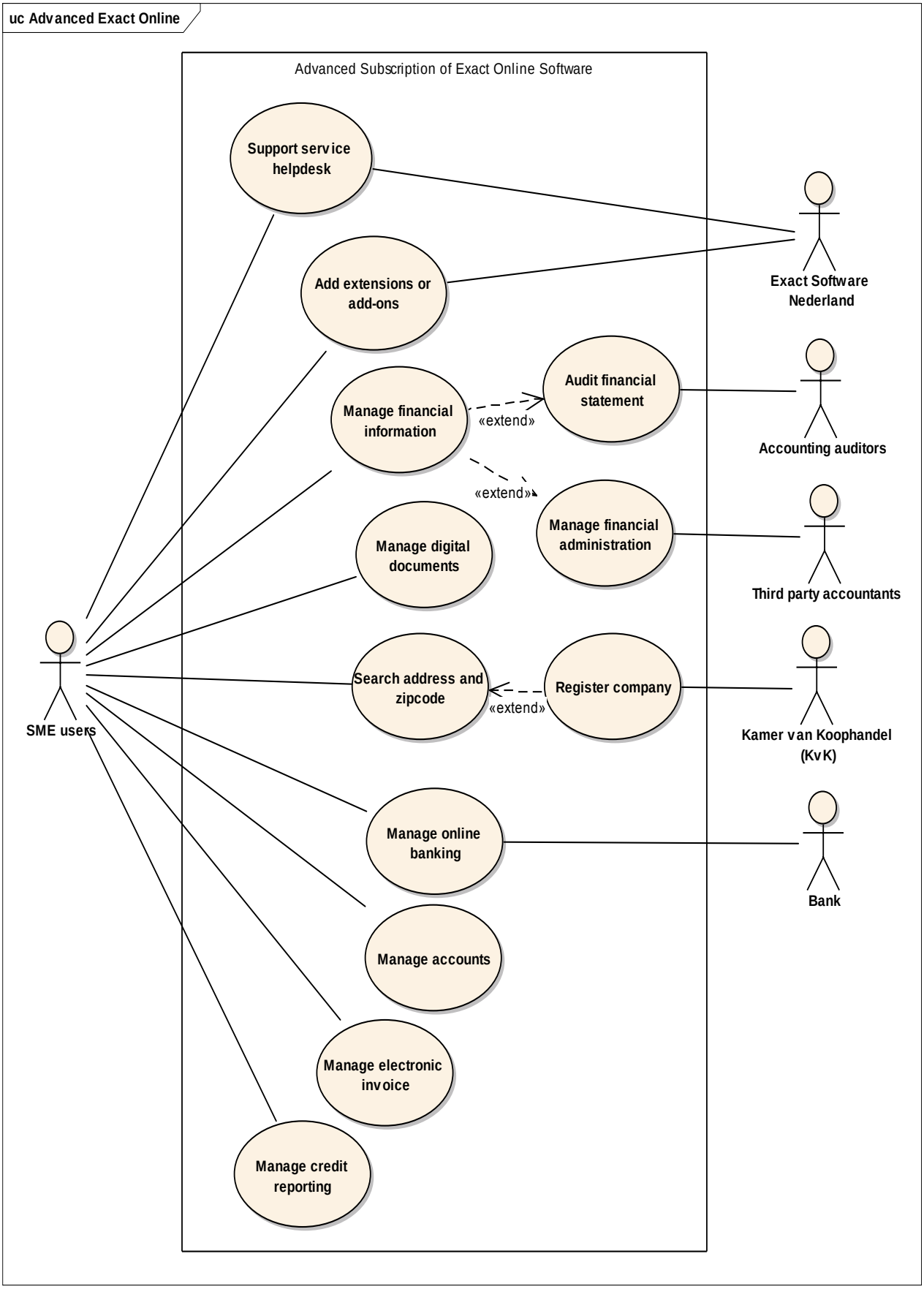

Figure D. 2 Advanced subscription of Exact Online software extends basic functionalities from Basis Subscription

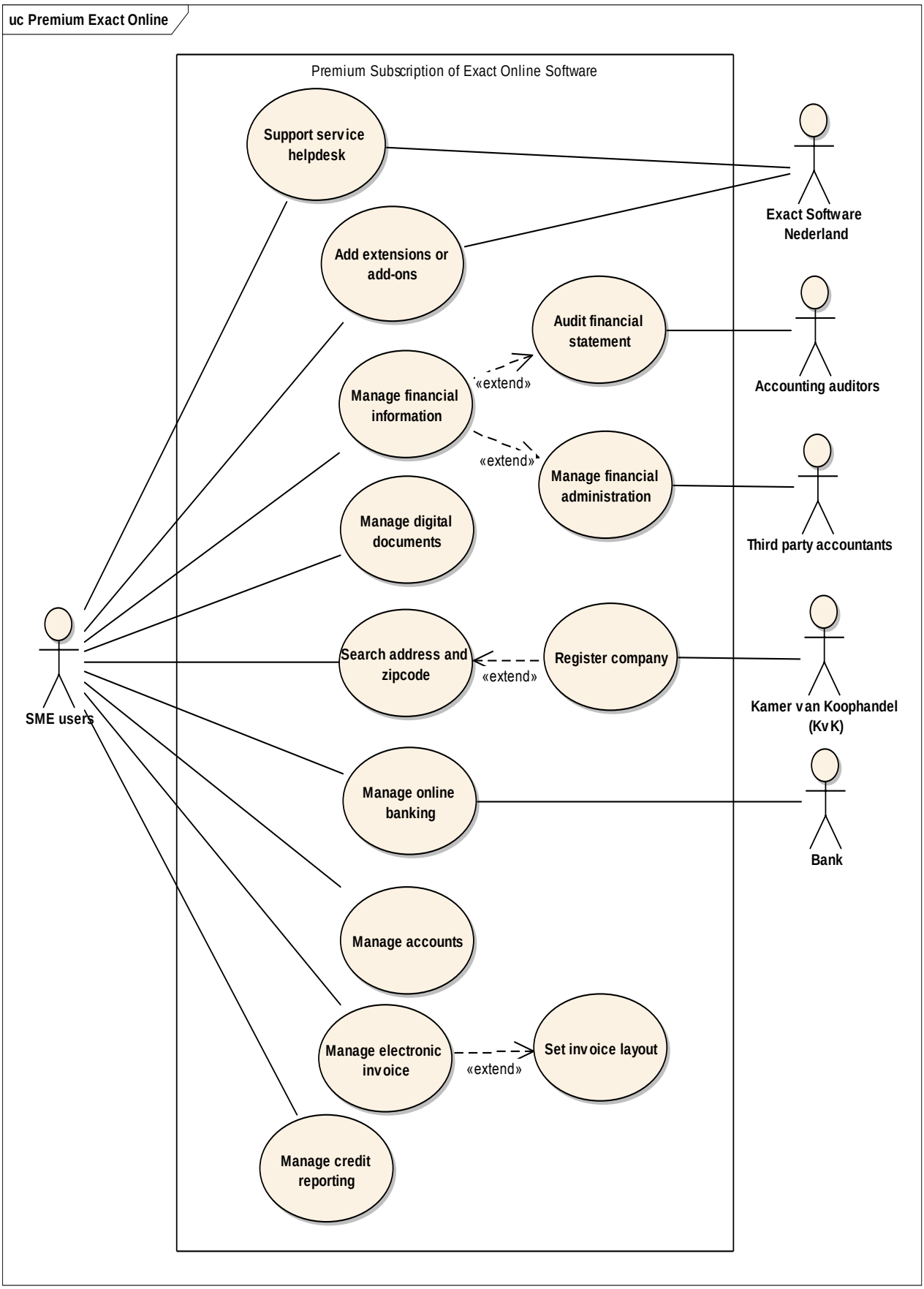

Figure D. 3 Premium subscription of Exact Online software offers a complete package of the software

Figure D. 4 Basis subscription of Exact Online Accounting software provides limited functionalities of the software

The Exact Online Accounting software basically has the same features with Exact Online software, but the former software is targeted for accountants and accounting firms. The Basis subscription is provided free for any accountants and accounting firms while this subscription can be upgraded into advanced subscriptions which enable accountants and accounting firms to manage multiple clients. We develop usecase diagrams for these subscriptions in Figure D.4 and Figure D.5, subsequently.

Figure D. 5 Advanced subscription of Exact Online Accounting software offers a complete package toward the software

Appendix E: Identifying research data

This appendix contains information about how research data is identified from data collection that applies two data gathering methods, which are interviews and questionnaires. The result from applying the first method will be addressed in Part I while the result from applying the latter method will be addressed in Part II. The rest of this appendix will discuss about main findings from research data in order to serve input for the models of benefit structures of Software as a Service (SaaS).

I. Identifying interview results

We conducted two interviews with the representatives of Exact Software Nederland regarding Exact Online application. The first interview was conducted with Miss Kim ten Brink, who is a Senior Proposition Manager who is responsible of conducting research marketing and proposing new development toward the application for certain target market; while the second interview was conducted with Mr. Werner van der Meer who is a Software Engineering Manager who is in charge of developing, and maintaining the application. The rest of this part will discuss about important findings from the results of the interviews which are presented further as followings.

General Information

The research is equipped with interview transcript which is not included within this thesis, but it is possible to contact the author by email (A.AnisahHerdiyantiPrabowo@student.tudelft.nl). We found several important findings during the interview regarding Exact Online application. They include the same basic application for Exact Online and Exact Online Accounting software; new packages of an ERP system which is developed from Exact Online; different management of extensions and add-ons; and important actors who are involved during the whole lifecycle process of delivering Exact Online [see Subchapter 5.3 for more details]. Overall, the interview gives depth insights toward the application and how it is delivered to clients, i.e. the users of the application. Yet, it provides limited information about benefits which can be gained from adopting the application since the interview was focusing more on the delivery of the application, including software features, and software user and management.

Key Results

We asked both interviewees about the benefits from adopting Exact Online during the interviews. From interview with the Senior Proposition Manager, we found that the benefits from adopting Exact Online which is provided in the official website of the application [http://www.exactonline.nl/] are rather generic for many types of enterprises. This is intentionally dedicated to address larger target markets apart from specific features that are offered within Exact Online to help managing financial issues which is the core process of any enterprises. Furthermore, there are several benefits which are particularly unique to the application that are found during the interviews. The name of Exact as a prominent player in software industry in the Netherland provides strategic position for Exact Online to enter the market of financial management software. Following this, trustworthy services are also of important benefits which differentiate the application with other vendors who provide similar application. Moreover, highly secured access is guaranteed by a certified security procedure which is implemented within the application. Yet, there is slightly awareness from the clients of the application regarding to what extent these benefits can be achieved which might be caused by limited information

about benefits from adopting the application, lack of understanding about SaaS contract which is provided in Terms and Conditions before subscribing to the application, and too high expectation toward services provided by the application due to the well-known name of Exact.

In the light of having better understanding toward benefits from adopting the application, we define three aspects of benefits which can represent common benefits that are usually promised by the providers. They are *technology-enabled business support benefits*, *interactive support benefits,* and *comprehensive support benefits*. The *technology-enabled business support benefits* can be indicated by efficient use of resources and effective management of process; while the *interactive support benefits* can be indicated by available and reliable services, and secured data. The *comprehensive support benefits* can be indicated by integrated information and compliance to regulatory and laws. According to indicators which are identified to indicate these benefits, we ask several questions during the two interviews with the Senior Proposition Manager and the Software Engineering Manager (Development Manager) of Exact Online software. We provide Table E.1 to present responses toward the technology-enabled business support benefits, Table E.2 to present responses toward the interactive support benefits, and Table E.3 to present responses toward the comprehensive support benefits. It is important to note that during the interview the questions might not be posed as 'it-is' to interviewees and the order might not be the same with the actual implementation during the interviews. Therefore, the responses toward these questions are generated by the interviewer from the all of the responses which are received during the interviews.

Table E. 1 Exact Online software address technology-enabled business support benefits to some extent

Questions	Senior Proposition Manager	Software Engineering Manager
Would you consider that the model which is offered by your organization is efficient at transferring risks from clients to your organization as a vendor?	Conducting financial management via online can hinder the risk of loss of critical data which might happen if financial issues are managed via manual bookkeeping. Therefore, online financial management software provides good solution to this issue. Exact Online enables users to manage their financial issues instantly via web-based application which is hosted centrally in Exact.	SaaS-based application can help to reduce the possibility of data lost by performing periodical data backup. Therefore, clients are not necessarily required to perform their own data backups. Exact Online also provides additional service for clients who are unsubscribed to the application, but they want to have all of their data when subscription to Exact. This service is performed by on-request.
Would you agree that the SaaS model is efficient at saving costs and at optimizing enterprise resources?	Clients can use the application instantly after they registered for annual subscription for Exact Online. Since the price for the subscriptions are known beforehand, and possible extensions are provided, clients are able to allocate their IT-related cost investment during the suscription.	The fact that clients do not need to perform prior installation to access the application, and invest server hardware for the application can be seen as potential cost-savings.
Do you think that the model can be effectively delivered within a shorter implementation time?	Clients only need to subscribe to the application via online and they can use the application instantly after that. However, in some cases, there might be possibilites that clients need assistances from the Support teams regarding the use of the application.	SaaS-based application provides instant access and online supports to clients. Exact Online adopters have been progressing tremendously since it was published in 2005. Since we regard accounting and accounting firms as the ambassadors of the application, they contribute to reducing implementation time since they have been familiar in managing financial issues of their clients by using the application.

Table E. 1 Exact Online software address technology-enabled business support benefits to some extent – *cont'd*

Questions	Senior Proposition Manager	Software Engineering Manager
Would you agree that SaaS model is effective in improving business process management within the client's enterprise?	Performing bookkeeping manually can be of burdens to enterprises. By performing financial management via online can help to enhance business performance since enterprises can be provided with real time information about their stocks and financial issues.	Any updates toward the application are published within the application. This is part of Exact's concern to improve its services toward the clients of Exact Online.
Could you think of any trade-off that may incur due to the adoption of SaaS model?	Clients sometimes have difficulties on using the application due to less human intervention for a SaaS-based application.	There might be possibilites that extensions and add-ons are similar one to another. Exact are now work with certain third-parties to introduce a complete package for specific clients which is developed by integrating features of Exact Online with important features to support busienss process of those specific clients.
Is there any challenge that might be faced during the delivery of services, e.g. limited number of highly skilled expertise?	There are possibilities for business reengineering, particularly for enterprises who have been doing their bookkeeping manually on papers. There might be mind-shifting needed to change how financial issues are managed.	There might be challenges when performing data backups, including when moving to bigger capacity of servers.

Table E. 2 Exact Online software address interactive support benefits to some extent

Questions	Senior Proposition Manager	Software Engineering Manager
How would the availability of services related to the SaaS applications be defined? Is the service availability defined formally in a contract?	There are such descriptions in Terms and Conditions, but the clients might not be aware of it. Although it might look silly for not reading such contract, the clients usually do not read the contract carefully before they subscribe to Exact Online.	Limited supports toward the application are only available during working hours within working days.
Is there any possibility to scale up and scale out the applications? If it is possible, is the procedure of scaling the applications defined in a (formal) contract?	Terms and Conditions are the only SaaS contract which is available. The application is not equipped with paper-based contract.	There is possibility to move database into bigger capacity of servers and to multiplicate database to many servers.
Are the applications deployed and tested before they are implemented? Is there any possibility that the applications would be deployed and tested when they are implemented? Is there any (formal) procedure in doing so?	Clients can access the application instantly after they are subscribed to the application. Any updates toward the application would not affect on its performance when users access the application.	There is a procedure to updates and fixing bugs toward the application periodically. Periodic maintenance should be informed to users at least a week before it is conducted.

Table E. 2 Exact Online software address interactive support benefits to some extent – *cont'd*

Questions	Senior Proposition Manager	Software Engineering Manager
How would the reliability of services be defined? Is the service reliability defined formally in a contract?	The application only has Terms and Conditions which can represent a (formal) SaaS contract.	SaaS-based application only provides Terms and Conditions as its (formal) contract.
Would you think that the personal data and enterprise data of your clients are secured enough by considering the current data security procedure? Would your clients think so?	Clients might not aware of data security procedure which is perfomed within Exact Online. However, some clients do ask about this because they want to ensure whether or not their data is safely secured.	By working together with a secured third party provider, Exact Online guarantees secured acess within the application.

Table E. 3 Exact Online software address comprehensive support benefits to some extent

Questions	Senior Proposition Manager	Software Engineering Manager
How would multi-tenant data management be performed during the delivery of SaaS applications? Could you refer to a specific data management approach?	*The interviewers couldn't manage to ask this question to both interviewees*	
Do you provide your clients with a centralized-network based applications or a locally-installed application supported with infrastructures?	Exact Online is provided via internet which can be accessed simultanously by users who subscribe to the application.	Exact Online is hosted in Exact and the servers are multiplicated in other countries for backups.
How would new laws and regulatory procedures be incorporated within the current applications? Is there any (formal) procedure in doing so? How frequent do you think that this process might happen?	Proposition of new extensions or any other developments toward the application can be done via the Proposition team who conducts research markets to address new requirements toward the application, or via Support team who receives feedbacks and suggestions toward the application. This proposition is handed over to Development team.	Any proposition toward product development can be directed to Development team who will discuss with Product Owner. They will decide whether certain extensions need to be added within the application. However, updates and bug-fixing are still performed periodically.

Other important Results

In order to have better understanding toward benefits of SaaS from the perspective of process during the lifecycle of SaaS, we also asked technical questions about services which are delivered during the adoption of Exact Online. We employed the design principles of Service Oriented Architecture (SOA) to understand the whole process of delivering these services. During the interviews, we expect the interviewees to indicate situation within which the principles might be applied when services related to Gmail application are specified at different processes of SaaS lifecycle. We will discuss further responses from the interviews as followings. It is important to note that the interviewers might not pose the questions as 'it-is' to interviewees and the order might not be the same with the actual implementation during the interviews. Furthermore, the responses toward these questions are generated by the interviewer from the all of the responses which are received during the interviews.

STANDARDIZED SERVICE CONTRACT

This principle is indicated by the following situation:

- consistency of information about services (related to the delivery of SaaS applications) which is published by the providers
- description level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters

We developed some questions to indicate the situation under which these indicators might be found. Table E.4 is provided to present responses from both interviewees.

Table E. 4 Exact should consider collaboration with clients when conceptualizing SaaS contract

Questions	Senior Proposition Manager	Software Engineering Manager
Do you think that every contract for any subscriptions of Exact Online and Exact Online Accounting software is conceptualized by both providers and adopters?	*The interviewers didn't ask this question because SaaS contract is not conceptualized by both parties, which are Exact as the provider of Exact Online and clients as the adopters of Exact Online. The SaaS contract is represented as Terms and Conditions which are structured by Exact and should be agreed by clients before adopting the application.*	
What does the contract cover?	Service availability and periodical services are available within the Terms and Conditions that represent a SaaS contract.	Technical descriptions toward services related to Exact Online are included within the Terms and Conditions although not many clients read this contract before they susbcribed to the application.

SERVICE LOOSE COUPLING

This principle is indicated by the following situation:

- availability of configuration options for services (related to the delivery of SaaS applications) which are specified by both the providers and the adopters
- granularity level of services (related to the delivery of SaaS applications) which incorporate both perspective of the providers and the adopters

We developed some questions to indicate the situation under which these indicators might be found. Table E.5 is provided to present responses from both interviewees.

Table E. 5 Exact should consider possible accommodation of business changes within Exact Online

Questions	Senior Proposition Manager	Software Engineering Manager
What types of services do Exact Online and Exact Online Accounting software provide?	Configuration options are limited to the look-and-feel of the application because the clients use the same application through the internet.	Configuration options are provided for changing layout of the applications, choosing what financial information to present, setting layouts for an invoice.
Are there any significant impacts which might affect business process within client's enterprise during the implementation of services, e.g. maintaining synchronization?	Reengineering business process might be due to happen if clients were perfoming their bookkeeping manually on paper.	Extensions can be instantly added through application wizard. For add-ons, clients can contact third-parties who provide those features. Any updates and scheduled backups toward the application will be informed to clients via the application.

SERVICE ABSTRACTION

This principle is indicated by the following situation:

- generality level of information about services (related to the delivery of SaaS applications) which are published by the providers
- the depth information about service implementations (related to the delivery of SaaS applications) which satisfy both requirements of the providers and the adopters

We developed some questions to indicate the situation under which these indicators might be found. Table E.6 is provided to present responses from both interviewees.

Table E. 6 Exact should provide sufficient information regarding services related to Exact Online

Questions	Senior Proposition Manager	Software Engineering Manager
Do you think that (the published) information about services related to Exact Online and Exact Online Accounting is sufficient to represent the main feature of the applications? Could you think of any other information which should be published as well?	The information about benefits of adopting Exact Online is limited in the official website of the application. However, this information is intended to be general in order to address larger target markets of any sizes of enterprises. Specific benefits, i.e. focusing on their busines processes, should be made known to clients.	The benefits of secured data access should be emphasized more since Exact Online application is provided with a certified data security standard from *e-sure*.
To what extent the detail of service implementation pertaining to the applications is made available to customers (in order to prepare for future provider diversification)?	Clients are not aware of the underlying implementation details about extensions and add-ons. They just want their issues solved by subscribing to more extensions and add-ons.	Any updates toward extensions and add-ons are provided in the official websites of Exact Online. Furthermore, any updates toward the application is available within the application.

Table E. 6 Exact should provide sufficient information regarding services related to Exact Online – *cont'd*

Questions	Senior Proposition Manager	Software Engineering Manager
Do you think that (the published) information about services related to Exact Online and Exact Online Accounting is sufficient to represent the main feature of the applications? Could you think of any other information which should be published as well?	The information about benefits of adopting Exact Online is limited in the official website of the application. However, this information is intended to be general in order to address larger target markets of any sizes of enterprises. Specific benefits, i.e. focusing on their busines processes, should be made known to clients.	The benefits of secured data access should be emphasized more since Exact Online application is provided with a certified data security standard from *e-sure*.
To what extent the detail of service implementation pertaining to the applications is made available to customers (in order to prepare for future provider diversification)?	Clients are not aware of the underlying implementation details about extensions and add-ons. They just want their issues solved by subscribing to more extensions and add-ons.	Any updates toward extensions and add-ons are provided in the official websites of Exact Online. Furthermore, any updates toward the application is available within the application.
Are the details of service governance made available by providers and accessible by customers?	Terms and Conditions are accessible to clients, although they cannot be able to change the content of Terms and Conditions.	Terms and Conditions can represent SaaS contract within which clients are locked in to access certain levels of services which can be provided through the application.
Is all necessary (and additional) information about a service defined within a formal contract?	Terms and Conditions are the only available (formal) contract that incorporates Service Level Agreements (SLAs). Yet, they do not provide sufficient information about service descriptions. Instead they focus on SLAs, including service levels, periodical service charge, and termination and the related consequences.	

SERVICE REUSABILITY

This principle is indicated by the following situation:

- multipurpose level of services (related to the delivery of SaaS applications) which are expected by the adopters
- frequency of reusable services (related to the delivery of SaaS applications) which are developed by the providers in meeting the demand of the adopters

We developed some questions to indicate the situation under which these indicators might be found. Table E.7 is provided to present responses from both interviewees.

Table E. 7 Exact should accommodate possibilities to change services related to Exact Online

Questions	Senior Proposition Manager	Software Engineering Manager
To what extent, the services related to Exact Online and Exact Online Accounting software can accommodate business changes?	Exact Online provides base for other applications, i.e. Exact Handel, and Exact Time and Billing in order to provide a complete solution for specific users. The existing Exact Online application can be extended by incorporating available modules and extensions, and add-ons.	To some degree, Exact Online can be extended via extensions and add-ons. However, new extensions are developed only if they are requested from the Product Owner as a result of discussion with the Development team.
To what extent, the services related to Exact Online and Exact Online Accounting software are reusable?	Some propositions, i.e. Exact Handel, and Exact Time and Billing, have been developed by keeping the idea of providing a complete package for specific clients. These propositions are developed from the existing Exact Online application.	

SERVICE AUTONOMY

This principle is indicated by the following situation:

- governance level of services (related to the delivery of SaaS applications) which are defined by the providers
- capability of autonomous services (related to the delivery of SaaS applications) in meeting business changes from the adopters

We developed some questions to indicate the situation under which these indicators might be found. Table E.8 is provided to present responses from both interviewees.

Table E. 8 Exact should provide information about how to govern services to clients related to Exact Online

Questions	Senior Proposition Manager	Software Engineering Manager
To what extent, service governance is defined? Is it defined in a formal contract?	Terms and Conditions provide information about period of contracts, service level, and data protections.	Terms and Conditions do not provide information about service descriptions in detail.
Are the services related to Exact Online and Exact Online Accounting software designed autonomously in meeting the demand of business changes?	Three types of subscriptions in Exact Online provide possibilities for a client to extend the features of the application in meeting the demand of their business. Additional add-ons are also available which is provided by third-parties.	Clients are able to add more modules or extensions within Exact Online through wizard. Additional add-ons can also be accessed via third-parties which includes link of Exact Online within their developed applications.
To what extent, a service can share its resources with other services?	The newly developed propositions, i.e. Exact Handel, make use of financial management features which are available in Exact Online.	

SERVICE STATELESSNESS

This principle is indicated by the following situation:

- availability level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters

– possibility of scaling application and data (related to the delivery of SaaS applications) in accommodating business changes from the adopters

We developed some questions to indicate the situation under which these indicators might be found. Table E.9 is provided to present responses from both interviewees.

Table E. 9 Exact Online software should provide continuous services related to Exact Online

Questions	Senior Proposition Manager	Software Engineering Manager
To what extent, the services related to Exact Online and Exact Online Accounting software are available?	Services related to Exact Online are available during the period of contract which is renewed annually. However, help desk and supports are only available real-time during working days.	Services provided by the Support team is limited to working hours during working days. However, clients are able to access the applicationa at anytime and anywhere during the period of contract.
Is there any possibility to increase the scalability of applications and data? If it is possible, is there any formal procedure to do so?	The database of clients are backed up into multiple servers although there is limited information whether or not any formal procedure about this back-up is available to clients. They just want to have their data secured regardless any peculiarities behind data management procudure.	It is possible to scale up data to bigger server and to scale out data to many servers. There is procedure to do so, but it is not yet formalized.

SERVICE DISCOVERABILITY

This principle is indicated by the following situation:

– accessibility level of services (related to the delivery of SaaS applications) which are developed by the providers
– availability of mechanisms of discovering services (related to the delivery of SaaS applications) which are developed by the providers

We developed some questions to indicate the situation under which these indicators might be found. Table E.10 is provided to present responses from both interviewees.

Table E. 10 Exact Online software should facilitate accessible services to clients pertaining to Exact Online

Questions	Senior Proposition Manager	Software Engineering Manager
To what extent, the services related to Exact Online and Exact Online Accounting software can be accessed?	Services within Exact Online application are available at anytime. However, there might be possibilities that clients find difficulties when using the application, or when they would like to find available extensions and add-ons that can satisfy their requirements. For this matter, they can contact the Support team who is available in working hours during the working days.	Limited availability of the Support team does not affect the accessibility toward the application. Clients are able to accessed the application at anytime and anywhere, and are able to add new extensions and add-ons through the wizard.
How are these services communicated to clients (SaaS adopters)?	All information about services are available through the official website of Exact Online. However, it is possible for clients to contact the Support team for further assistances and ask for consultancy for individual assistaances or training on-site in the clients' enterprises.	All updates regarding Exact Online are provided within the application.

SERVICE COMPOSABILITY

This principle is indicated by the following situation:

- custom option level of services (related to the delivery of SaaS applications) in meeting business changes from the adopters
- flexibility of custom options for services (related to the delivery of SaaS applications) which are expected by the adopters

We developed some questions to indicate the situation under which these indicators might be found. Table E.11 is provided to present responses from both interviewees.

Table E. 11 Exact Online software should consider providing composable services related to Exact Online

Questions	Senior Proposition Manager	Software Engineering Manager
Are the services related to Exact Online and Exact Online Accounting software can be adjusted continually in order to accommodate business changes?	For the new propositions, i.e. Exact Handle, some features are adopted from Exact online software.	Any updates toward Exact Online are communicated within the application. However, the development of new extensions from the existing available extensions should be discussed with the Development team and the Product Owner of the application.

II. Identifying questionnaire results from SaaS adopters

We delivered questionnaire to the users of Gmail application which is part of Google apps that are introduced by Google. This SaaS-based email application has gained its prominence for its free-email account with large storage capacity for a hosted mail. Regardless limited access of a web-based application, Gmail offers significant benefits for a SaaS-based application, e.g. easy access anytime, anywhere through Single-Sign On (SSO) which is integrated with other applications, e.g. myERP as a SaaS ERP system. The rest of this part will discuss about important findings from the results of delivering the questionnaires which are presented as followings.

General Information

We received responses from 44 anonymous users who have ever experienced with Gmail application for more than two years on average. Most of users (almost 50%) are student academic and researchers, while the rest are mainly from practitioners who are working in various sectors, including information, services, and manufacturing. Regardless significant benefits from subscribing to Gmail, more than half or respondents are aware of Gmail as one of SaaS-based email application. Most of the respondents (around 75%) experience that Gmail is quite simple, while it is considered (by more than 85%) to bring a better off performance comparing to a locally-installed email application. Moreover, various benefits are experienced by users, including cost-savings, reliable services, and painless upgrades and updates of infrastructures. Additional questions about SaaS-based application which employs Service Oriented Architecture (SOA) concept shows that there is very limited awareness of such application in practices apart from quite moderate awareness (more than 50%) of the respondents' view toward the emerging concept of SOA.

Key Results

Each of the statement in the questioners which are delivered to the user of Gmail application can be categorized into six levels of maturity within which benefits of delivering Software as a Service (SaaS) applications can be appreciated. They are *utility based* at Level 0 (Potential)*; SLA driven* at Level 1

(Prospective); *shared multitenant efficient*, and *community contribution* at Level 2 (Promising); *reliability and fault tolerance* and *flexible and scalable* at Level 3 (Achieving); *collaborative and smart* and *credible and accountable* at Level 4 (Stabilizing); and *nimbleness* and *sustainable and successful* at Level 5 (Optimizing). In order to provide better insight toward the result from the questionnaires, we map the questionnaire questions into each level of the developed SaaS maturity model which will be discussed further as followings.

Level 0 (Potential)

We present Table E.12 in order to show questionnaire questions which can help to indicate potential benefits from adopting Gmail as a SaaS-based email application. The benefits at this level are indicated by *utility-based* concept by which vendors deliver service-oriented applications based on pay-per-use or pay-per-period. Since Gmail is offered freely to its subscribers, there is strong indication that users would perceive benefits from adopting this application more than those benefits which can be appreciated at Level 0 according to the developed SaaS maturity model.

Table E. 12 Most of respondents see potential benefits from adopting Gmail as SaaS-based email application by answering the following questions

Question No	Questionnaire Questions
Q2	Based on your experience in using Gmail as a SaaS-based email application, how successful would you think this application in delivering services according to its intended features, e.g. email, messaging?
Q4	Would you agree that Gmail as a SaaS-based email application can help to improve the management of your resources effectively and efficiently, e.g. accessible at anytime and anywhere, saving storage in a hosted server?
Q5	Would you agree that SaaS-based application provided by Google, e.g. Google apps, can help to improve IT engagement in a human's daily life?
Q6	How convenient would you think the services provided by a SaaS-based e-mail application, e.g. Gmail, with other services provided by a locally-installed email application, e.g. Microsoft Outlook?
Q8	According to you, how important is pricing in subscribing to a SaaS-based application, e.g. SaaS-based email application such as Gmail?

More than half of respondents consider that Gmail is very successful in delivering free services for a hosted-mail application, including email and messaging. The free services are likely to bring the successful adoption of this SaaS-based email application which is indicated by most of respondents (more than 70%) who regard that pricing is of important consideration when subscribing to Gmail. Moreover, the respondents are mostly convenient with the services of hosted-email application provided by Gmail comparing to a local-installed email application, e.g. Microsoft Outlook. There are only few respondents who consider that Gmail cannot help to manage enterprise resources efficiently and effectively. The fact some respondents (more than 15%) choose not to give their opinions may indicate that they are not yet aware of the benefits of adopting Gmail as a SaaS-based email application.

Level 1 (Prospective)

We present Table E.13 in order to show questionnaire questions which can help to indicate benefits from adopting Gmail as a SaaS-based email application at prospective level of the developed SaaS maturity model. The benefits at this level are indicated by *SLA-driven* concept by which vendors and clients agree upon a certain level of services which should be delivered for a service-oriented application. Since Google offers ready-to-click Terms and Conditions as other SaaS-based providers, this SaaS contract can be used to standardize its services to multiple clients, i.e. users of Gmail application. Thus, benefits at Level 1 might be expected from delivering Gmail based application.

Table E. 13 Most of respondents see prosepective benefits from adopting Gmail as SaaS-based email application by answering the following questions

Question No	Questionnaire Questions
Q7	How likely would you think that both SaaS-based email application and locally-installed email application can collaborate to provide integrated offline and online email services in the future?
Q9	How important is to read Terms and Conditions before subscribing to a SaaS-based application, i.e. Gmail?
Q10	In your opinion, how likely would you find that descriptions of services which are offered in a SaaS-based email application, i.e. Gmail, are stated within Terms and Conditions before agreeing to subscribe to the application?
Q11	Based on your experience when using a SaaS-based application, i.e. Gmail, how likely would you move to other applications?

More than 75% of the respondents see potential collaboration between Gmail as SaaS-based email application and locally-installed email application in the future. This may indicate that users are likely to see opportunities of having more benefits from integrated offline and online email services instead of indicating this trend as a threat for complex hosted-mail management. Meanwhile, more than 40% of the respondents consider that reading Terms and Conditions before subscribing to Gmail is not important. Since this SaaS contract is structured by Google who provides Gmail, service descriptions could not address balanced conceptualization of service descriptions from both vendors and clients. Following this, more than half of respondents experienced that such descriptions do not exist in the Terms and Conditions due to either lack of information or lack of participation during the conceptualization of service descriptions. However, the users of Gmail might not see this as critical problem since more than 60% of respondents do not consider moving to other hosted-mail applications.

Level 2 (Promising)

We present Table E.14 in order to show questionnaire questions which can help to indicate promising benefits from adopting Gmail as a SaaS-based email application. The benefits at this level are indicated by *shared resources efficient* concept within which vendors provide the related infrastructures to support their services while maintaining standardized services to clients; and *community contribution* concept within which clients are able to share experiences, challenges, and feedback regarding the adoption of SaaS-based application. By providing standardized services, users of Gmail application can expect promising benefits from adopting the application. However, Gmail community is not yet well established to the users of the application and therefore might limit users in experiencing benefits from sharing experiences and feedbacks from the community.

Table E. 14 Most of respondents see promising benefits from adopting Gmail as SaaS-based email application by answering the following questions

Question No	Questionnaire Questions
Q12	As a user of SaaS-based application, e.g. Gmail, how easy is it to change the look-and-feel of the application, e.g. application interface?
Q13	How confident are you to let SaaS-based provider, i.e. Google, manage all critical information of your personal data within SaaS application, i.e. Gmail?
Q14	How aware are you of any procedure to manage your data that is described by Google who provides Gmail, e.g. within Terms and Conditions of services?
Q15	Would you agree if a community whose community member uses the identical SaaS application, e.g. SaaS-based email application, is created in order to share experiences, challenges, and feedback when using the application?

Most of the respondents (more than 80%) experienced that they can change the look-and-feel of the application easily, e.g. application interface. This may indicate that Google as Gmail provider allow configurations while keeping each of its user data separated. Meanwhile, only 7% of the respondents are very confident that Google can manage all critical information of their personal data within Gmail. This may indicate hesitancy to what extent data privacy has been safely secured. Moreover, almost all of the respondents (95%) are not aware of any procedure to manage data which might be included within Terms and Conditions. Regardless vast adoption of Gmail application, 95% of the respondents expect to have a community within which its members are able to share experiences, challenges and feedbacks when using the application. This may indicate that the users of Gmail are neither aware of such community nor informed that such community exists.

Level 3 (Achieving)

We present Table E.15 in order to show questionnaire questions which can help to indicate benefits from adopting Gmail as a SaaS-based email application at Level 3 of the developed SaaS maturity model. The benefits at this level are indicated by *reliability and fault tolerance* concept within which vendors provide cost efficient and effective IT supports; and *flexible and scalable* concept within which business changes for specific clients are accommodated but only to the extent of configuring the application. It is challenging that users of Gmail application can expect benefits of SaaS at this level considering that there is limited information about business continuity procedure that is provided for the application and limited configuration options to change the application in order to satisfy changes in user requirements.

Table E. 15 Achieving benefits from adopting Gmail as SaaS-based email application are realized by the respondents by answering the following questions

Question No	Questionnaire Questions
Q17	How aware are you of any procedure to ensure business continuity, e.g. disaster recovery plan, which is provided by Google to keep personal data safe for its email product, namely Gmail?
Q18	Would you think that configuration options which are provided by Google within its email product, namely Gmail, are flexible in order to meet changes in user requirements?

There is limited awareness from the respondents (less than 50%) about any procedure that can ensure business continuity provided for Gmail application. Meanwhile, most of respondents (more than 85%) consider that configuration options within Gmail are flexible in meeting changes in business requirements. However, this fact is not necessarily applied to all cases since there is limitation in configuring Gmail application which is commonly found in other SaaS applications.

Level 4 (Stabilizing)

We present Table E.16 in order to show questionnaire questions which can help to indicate benefits from adopting Gmail as a SaaS-based email application at Level 4 of the developed SaaS maturity model. The benefits at this level are indicated by *collaborative and smart* concept within which configuration options are still of importance consideration to accommodate changes in business requirements and technology; and *credible and accountable* concept within which reliable and available services are ensured formally within Service Level Agreements (SLAs). Although many respondents (more than 70%) confirmed that help desk supports are continuously available and reputably reliable, we found that the help desks are limited to the help features which are provided within the Gmail application. Since Google provides limited configuration options toward the application and limited supports toward its help features, it is unlikely that users can expect benefits of SaaS at Level 4 based on the developed SaaS maturity model which is presented in the research.

Table E. 16 The need to maintain the benefits from adopting Gmail are realized by the respondents by answering the following questions

Question No	Questionnaire Questions
Q19	Would you regard services and help desk supports from Google who provides a SaaS-based email application, namely Gmail, are continuously available and reputably reliable?

Level 5 (Optimizing)

We present Table E.17 in order to show questionnaire questions which can help to indicate benefits from adopting Gmail as a SaaS-based email application which can be optimized at Level 5 of the developed SaaS maturity model. The benefits at this level are indicated by *nimbleness* concept within which shared infrastructure can help to optimize enterprise resources while preserving highly secured data for each client; and *sustainable and successful* concept within which continuous supports and services can help to deliver values to clients. Since customizing application is still very limited, e.g. adding application extensions, users are likely to achieve few benefits at Level 5 from adopting the application. However, it is likely for users to achieve more benefits from continuous services which are provided by providing pace and stability toward the application, e.g. less frequent server breakdowns.

Table E. 17 The need to optimize the benefits from adopting Gmail are realized by the respondents by answering the following questions

Question No	Questionnaire Questions
Q20	To what extent Google as a SaaS-based email provider allows you as a user to customize Gmail which is a SaaS-based email application?
Q21	How aware are you of an emerging concept of Service Oriented Architecture (SOA)?
Q22	Would you regard Gmail as a SaaS-based email application as a SOA application?
Q24	Do you have any idea whether or not Google as a SaaS-based email vendor provides a shared database and infrastructure to support Gmail as a SaaS-based email application?
Q25	Would you agree upon this statement: "Google as a SaaS-based application vendor delivers services and help desk supports continuously while fostering pace and stability of the applications".

The fact that more than 80% of the respondents agree toward flexible customization within Gmail application, this is not necessarily true since Google provides limited configuration options for users in the application, i.e. application interface. However, at least half of the respondents are aware of shared database and infrastructures to support the application. This positive awareness might lead to the fact many respondents (almost 60%) consider that the application is supported with continuous services and stable application. Regardless little awareness toward the emerging service concept within Service Oriented Architecture (SOA) approach, more than half of the respondents have no or little information whether or not this application employs SOA approach.

Other Important Results

We also delivered questions in order to have a better understanding toward the processes of SaaS lifecycle related to the delivery of Gmail as a SaaS-based email application. For this reason, we posed questions related to the discovery, selection, engaging and delivery of services related to Gmail application during the lifecycle of SaaS. We employed design principles of SOA during the whole lifecycle from which respondents are expected to indicate situation within which the principles might be applied when services related to Gmail application are specified at different processes of SaaS lifecycle. We will discuss further responses from the respondents in order to address this expectation

in the early phase and later phase of SaaS lifecycle. It is important to note that only 22 out of 44 responses who are received for this part of questionnaires. This might be due to relatively more complex questions for sophisticated users who have backgrounds about information and the related technology.

Service discovery, and service selection and engagement

There are four design principles which are appreciated during this early phase of SaaS lifecycle. They are standardized service contract, service loose coupling, service abstraction, and service discoverability which will be discussed as following.

STANDARDIZED SERVICE CONTRACT

There are two characteristics which indicate this principle, which are *consistency of information about services*, and *description level of services*. In order to understand under which circumstances the characteristic might be applied, we posed eight statements as depicted within Table E.18, to the respondents from whom the following main question can be addressed: *would you agree upon the following situation that might occur during the agreement of services within Terms and Conditions before subscribing to a SaaS-based application, e.g. Gmail?*

Table E. 18 Users should pay more attentions when agreeing Terms and Conditions before subscribing to Gmail application

No	Statement	Responses
1)	Both of you as the user of SaaS application, e.g. Gmail, and vendor of SaaS application, e.g. Google who provide Gmail, contribute to the conceptualization service descriptions within Terms and Conditions.	Almost half of respondents agree that Terms and Conditions for subscribing to Gmail application are conceptualized by both Google as vendors of the application, and users as subscribers. This result pays our attention since it might be biased because the Terms and Conditions are structured by Google itself in order to provide standard services to its clients.
2)	Service descriptions within Terms and Conditions are signed formally using a specific authorization procedure.	More than 40% of respondents consider accepting Terms and Conditions as a formal SaaS contract. However, the fact that around the same amount of respondents choose to provide neutral responses may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware what service descriptions are • they are not aware of such descriptions are provided within Terms and Conditions • they do not read the Terms and Conditions
3)	SaaS application, e.g. Gmail, can be used directly after a user is subscribed to the application.	Most of the respondents (around 60%) agree strongly that Gmail can be used directly after they are subscribed to the application.
4)	Technical descriptions, including basic cost, periodical service charge, and Service Level Agreements, are provided in detail in service descriptions within Terms and Conditions of services.	Approximately 6 out of 10 people (around 60%) agree that technical descriptions over Gmail services are provided within the Terms and Conditions. However, there is considerable amount of respondents (approximately 30%) choose to provide neutral responses may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of how technical descriptions look like within Terms and Conditions • they do not read the Terms and Conditions

Table E. 18 Users should pay more attentions when agreeing Terms and Conditions before subscribing to Gmail application – *cont'd*

No	Statement	Responses
5)	Service descriptions within Terms and Conditions of services contains information about the availability of services and data, including service levels, business continuity protection, termination and the related consequences.	More than 3 out ouf 10 people agree (around 30%) that service and data availability is incorporated within the Terms and Conditions. However, there is considerable amount of respondents (approximately 40%) choose to provide neutral responses may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of the descriptions about availability of services • they are hesistant whether such descriptions are available within the Terms and Conditions • they do not read the Terms and Conditions
6)	Service descriptions within Terms and Conditions of services contains information about how to perform data management and authorization, including data privacy and security, e.g. information security.	Approximately 3 out of 10 people (around 30%) agree that data management and authorization are provided within the Terms and Conditions. However, there is considerable amount of respondents (approximately 30%) choose to provide neutral responses while there is few respondents quite disagree about this statement. This situation may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of how data management and authorization might look like within Terms and Conditions • they are hesistant whether such procedure are available within the Terms and Conditions • they do not read the Terms and Conditions
7)	Service descriptions within Terms and Conditions of services incorporates information about additional services and fees, including up-time guaranties and penalties, escalating discounts for incremental spending.	Approximately 3 out of 10 people (around 30%) agree that information about additional services and the related fees are provided within the Terms and Conditions. However, there is considerable amount of respondents (approximately 40%) choose to provide neutral responses while there is few respondents quite disagree about this statement. This situation may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of what additional services and fees are • they are hesistant whether such information are available within the Terms and Conditions • they do not read the Terms and Conditions
8)	Service descriptions within Terms and Conditions of services provides sufficient information about technical descriptions of services.	More than 3 out ouf 10 people agree (around 30%) that the Terms and Conditions are sufficient. However, there is considerable amount of respondents (approximately 40%) choose to provide neutral responses may indicate any of the following possibilities: • the respondents might not fully understand the questions • they do not read the Terms and Conditions

SERVICE LOOSE COUPLING

There are two characteristics which indicate this principle, which are *availability of configuration options for services*, and *granularity level of services*. In order to understand under which circumstances the characteristic might be applied, we posed four statements as depicted within Table E.19, to the respondents from whom the following main question can be addressed: *would you agree upon the following statements with regard to SaaS applications, e.g. Gmail?*

Table E. 19 Users should be able to optimize the use of Gmail application by being aware of types of services in the application

No	Statement	Responses
9)	You are provided with the capability to configure services related to Gmail application, e.g. configure security and privacy level.	Almost half of respondents agree that Gmail application provides capability to configure services, e.g. security and privacy level. This result pays our attention since it might be biased because there are limited configurations options within the application. This is also confirmed by few respondents (less than 20%) who quite disagree that Gmail provides such capability.
10)	You are provided with the capability to change scope of services related to Gmail application which have been described by Google, e.g. request other data security methods.	There are quite same amount of responses from respondents who agree strongly and agree to some degree, and who are neutral (each less than 30%) pertaining to the capability to change scope of services within Gmail. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of what scope of services are.
11)	It is possible for other SaaS providers (vendors) to provide similar services which are currently available within Gmail application.	There are quite same amount of responses from respondents who agree strongly and agree to some degree, and who are neutral (30% on average) pertaining to the possibilities of other hosted-mail providers to provide similar services like those are provided in Gmail. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of other vendors who provides similar services like those are provided in Gmail • they have limited information about what services can be provided within hosted email applications.
12)	There is significant impact in the performance of mail management during the implementation of new services in Gmail, e.g. updates of application lay-outs and features.	Half of the respondents agree (strongly and to some degree) that there is significant impact on Gmail performance when new updates are implemented. However, there are quite amount of responses (approximately 30%) who are neither agree nor disagree that such impact is significant. Moreover, some respondents (less than 20%) quite disagree toward this statement. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of what kind of impacts might be experienced during the implementation of new services in Gmail • they have ever experienced such impacts, but they are not sure to what extent the significancy of the impacts can be defined

SERVICE ABSTRACTION

There are two characteristics which indicate this principle, which are *generality level of (published) information about services*, and *the depth information about service implementations*. In order to understand under which circumstances the characteristic might be applied, we posed four statements as depicted within Table E.20, to the respondents from whom the following main question can be addressed: *would you agree upon the following statements with regard to information about services within Gmail application which is provided by Google as the provider of this SaaS-based email application?*

Table E. 20 Users should be aware of any information about services which are provided within Gmail application in order to optimize its use

No	Statement	Responses
13)	The information about services related to Gmail application, which are published by Google is sufficient to represent main features of the application.	More than half of the respondents agree that information about Gmail features is sufficient to represent the real features which can be found within the application. Regardless few respondents (about 10%) who disagree toward this statement, there are respondents who choose to provide neutral responses. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they have limited information about Gmail features • they are hesistant whether or not they have ever compared the published features and the real features
14)	Google who develops Gmail application, provides information regarding the detail implementation of services related to the application, e.g. the underlying business logic that is used to manage the setting of mail server.	There are some respondents (about 24%) who disagree that Google provides the detail implementation of services within Gmail. The main responses (about 38%) are neutral which may indicate any of the following possibilities: • the respondents might not fully understand the questions • they have limited information about service implementation
15)	Governance of services related to SaaS application is made available by Google who provides Gmail application and is accessible by users of the application.	There are some respondents (about 19%) who disagree that Google provides governance of services which are accessible by the users. The majority of the respondents (about 40%) agree toward this statement. However, quite similar amount of responses are found to be neutral which may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of what service governance are • they are not sure whether or not such governance is accessible to the users.
16)	Additional information about services related to Gmail application is provided within Terms and Conditions of services.	The majority of responses (around 50%) indicate that additional information about services is provided within Terms and Conditions. This result pays our attention since it might be biased because the Terms and Conditions are hardly read by the users before they subscribe to the application. Quite moderate amount of responses (almost 40%) are also found to be neutral which may indicate that either the questions are not comprehensible, or there is no such information available.

SERVICE DISCOVERABILITY

There are two characteristics which indicate this principle, which are *accessibility level of services*, and *availability of mechanisms of discovering services*. In order to understand under which circumstances the characteristic might be applied, we posed three statements as depicted within Table E.21, to the respondents from whom the following main question can be addressed: *would you agree upon the following statements with regard to information about services within Gmail application which is provided by Google as the provider of this SaaS-based email application?*

Table E. 21 Users should be able to locate services easily within Gmail application

No	Statement	Responses
17)	Services related to Gmail application can be located easily.	The majority of responses (about 68%) indicate that services within Gmail application can be easily located. However, there is considerably number of responses (about 25%) who disagree toward this statement which may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of how to locate services in Gmail • they have limited information about services in Gmail
18)	Discovering mechanisms of services related to Gmail application are published to users through an accessible media.	The majority of responses (about 54%) indicate that there are discovery mechanisms to locate services within Gmail application and such mechanisms are published to users. However, there is considerably number of responses (about 25%) who disagree toward this statement while similar amount of responses (about 23%) are neutral. This situation may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of any discovery mechanisms to locate services • they are hesitant whether or not such mechanisms are provided to users
19)	Discovering mechanisms of services related to Gmail application are communicated to users.	The majority of responses (about 68%) indicate that services within Gmail application can be easily located. However, there is considerably number of responses (25%) who disagree toward this statement which may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of what mechanisms to communicate • this statement is quite similar with the previous statement (S18)

Service selection and engagement, and service enactment

There are four design principles which are appreciated during this early phase of SaaS lifecycle. They are service reusability, service autonomy, service statelessness, and service composability which will be discussed as following.

SERVICE REUSABILITY

There are two characteristics which indicate this principle, which are *multipurpose level of services*, and *frequency of reusable services*. In order to understand under which circumstances the characteristic might be applied, we posed four statements as depicted within Table E.22, to the respondents from whom the following main question can be addressed: *would you agree upon the following statements with regard to reusability aspect of services pertaining to Gmail application which is provided by Google as the vendor of this SaaS-based email application?*

Table E. 22 Users should be provided with services which can accommodate changes in user requirements related to Gmail application

No	Statement	Responses
20)	It is possible to change services related to Gmail application via a community-based sharing in order to accommodate changes in user requirements.	Half of respondents agree upon the possibility to change services within Gmail application via community-based sharing. However, quite moderate amount of responses (about 35%) are also found to be neutral and some responses indicate disagreement toward this statement. These results may indicate that either the questions are not comprehensible, or users have limited information about such community for the application.
21)	Services related to Gmail application is designed for multipurpose in order to accommodate changes in user requirements.	The majority of responses (about 62%) indicate that services in Gmail application are able to accommodate changes in user requirements. However, quite moderate amount of responses (about 29%) are also found to be neutral which may indicate that either the questions are not comprehensible, or users are not aware of multipurpose services.
22)	Services related to Gmail application can be reused to serve various user requirements.	The majority of responses (about 61%) indicate that services in Gmail application can be reused for multipurpose. However, quite moderate amount of responses (about 29%) are also found to be neutral which may indicate that either the questions are not comprehensible, or users are not aware of reusable services.
23)	Services related to Gmail application can be redundant with other services in Google apps.	The majority of responses (about 48%) are also found to be neutral which may indicate that either the questions are not comprehensible, or users are not aware of redundant services. However, moderate number of respondents (around 40%) indicates agreement upon the possibility of having redundant services within Gmail application.

SERVICE AUTONOMY

There are two characteristics which indicate this principle, which are *governance level of services*, and *capability of autonomous services*. In order to understand under which circumstances the characteristic might be applied, we posed four statements as depicted within Table E.23, in order to the respondents from whom the following main question can be addressed: *would you agree upon the following statements with regard to governance aspect of services pertaining to Gmail application?*

Table E. 23 Users should be provided with service governance regarding Gmail application

No	Statement	Responses
24)	Governance of services related to Gmail application, e.g. periodical updates and maintenance, is published periodically through user account in Gmail.	The majority of the responses (about 55%) indicate that periodical updates are informed to the users periodically through their Gmail account. However, there are still respondents (less than 20%) who do not agree toward this statement. The number of neutral responses is also not a few (about 27%) and so as disagreement responses (about 18%) which may indicate that either the questions are not comprehensible, or users have limited information about service governance.
25)	Performance of Gmail application can be improved if services related to this application are autonomous in satisfying changes in user requirements, e.g. a service to send an email would be independent from a service to send an offline message of messenger within Gmail.	Almost half of the respondents (about 48%) agree that services within Gmail can be improved by performing autonomous services; while moderate amount of responses (about 43%) are neutral. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of autonomous services • they are hesitant whether or not such improvement can be achieved while satisfying changes in user requirements
26)	Services related to Gmail application have controls toward their underlying (business or application) logic.	Almost half of the respondents (about 46%) agree that services within Gmail have controls toward their underlying logic; while the majority of the responses (about 50%) are neutral. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of what the underlying logic is
27)	Services related to Gmail applications can share their resources with other services although they remain independent toward each other.	More than half of the respondents (about 55%) agree that shared resources are possible amongst services; while many responses (about 45%) are neutral. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of either shared resources or independence services

SERVICE STATELESSNESS

There are two characteristics which indicate this principle, which are *availability level of services*, and *possibility of scaling application and data*. In order to understand under which circumstances the characteristic might be applied, we posed four statements as depicted within Table E.24, in order to the respondents from whom the following main question can be addressed: *would you agree upon the following statements with regard to availability aspect of services pertaining to Gmail application?*

Table E. 24 Users should be provided with continuous services related to Gmail application

No	Statement	Responses
28)	Services related to Gmail application are always available as long as user can have access to the application.	The majority of responses (about 80%) agree that services related to Gmail application are available as long as user has a Gmail account. However, there are few respondents who do not agree upon this statement, but the number of these respondents is not significant (about 10%).
29)	Services related to Gmail application remain stateful unless they are needed as long as user can have access to the application.	Many respondents (about 64%) agree that services related to Gmail application remain stateful unless they are needed. However, there is quite moderate amount of responses which are neutral that may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of what a stateful service is
30)	I would agree if Gmail application and Gmail data can be scaled up to bigger capacity of server.	The majority of responses (about 86%) agree if Gmail application and data can be scaled up to bigger server capacity. Yet, there are few responses (about 14%) which are neutral due to any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of scaling up application and data
31)	I would agree if Gmail application dan data can be scaled out to many servers.	The majority of responses (about 73%) agree if Gmail application and data can be scaled out to many servers. Meanwhile, there are quite moderate amount of responses which are neutral (about 27%) due to any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of scaling out application and data

SERVICE COMPOSABILITY

There are two characteristics which indicate this principle, which are *custom option level of services*, and *flexibility of custom options for services*. In order to understand under which circumstances the characteristic might be applied, we posed three statements as depicted within Table E.25, in order to the respondents from whom the following main question can be addressed: *would you agree upon the following statements with regard to customization upon services related to Gmail application which is provided by Google?*

Table E. 25 Users should be able to customize services related to Gmail application in certain cases

No	Statement	Responses
32)	It is possible to customize services related to Gmail application, e.g. changing business logic or changing layouts within Gmail application.	The majority of responses (about 63%) agree upon the possibility to customize services related to Gmail application. However, there are quite moderate amount of responses (about 32%) which are neutral. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of service customization • they have limited information about the examples of customizing services related to Gmail application, e.g. changing business logic.
33)	Services related to Gmail application can be reused and recomposed to accommodate changes in user requirements.	Half of the respondents agree that services related to Gmail application can be reused and recomposed. However, half of the other respondents choose not to agree (about 9%) or choose to be neutral (about 41%) upon this statement. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of service reusability and recompsability • they have limited information about changes in user requirements.
34)	Capability of services related to Gmail application is communicated effectively by Google who provides the application.	The majority of responses (about 62%) agree to some degree that capability of services related to Gmail application is communicated effectively. However, there are quite moderate amount of responses (about 24%) which are neutral while there are few responses (about 14%) which disagree upon this statement. This may indicate any of the following possibilities: • the respondents might not fully understand the questions • they are not aware of what capability of services is about • they have limited information about how Google communicate to users related to Gmail services • they are hesistant about the term effectiveness.

Appendix F: Preparing inputs for the models of SaaS benefits

Research data which has been collected when conducting interviews and delivering questionnaires should be prepared before the data are inputted to the models of SaaS benefits. The models of SaaS benefits include the promised benefit model, the perceived benefit model, and the process benefit model. In this appendix we will present the data which is inputted to these three models.

I. Inputs for the promised benefit model

We present Table F.1 in order to provide inputs for the promised benefit model. These inputs are derived from interview results which have been identified in *Appendix E, Part I.*

Table F. 1 Quantifying the result from the interviews serves input for the model of the promised benefits

Indicators of the promised benefits	Interviewee 1	Interviewee 2
resource efficiency	4	4.5
process effectiveness	4.5	3.5
service availability	4.5	4.5
service reliability	4.5	4.5
data confidentiality	4	5
integrated information	5	5
regulatory compliance	3	4
ability to incorporate multipurpose	3	4
ability to provide cost effective solution	4	4
scalability of IT products	3	4
value of business by leveraging IT products	5	3
automation of technology innovation	4	3
capability of addressing immediate business changes	3	4
ease of access	4	5
ease of information exchange	3	3
community collaboration	3	4
capability of responding to business changes	3	4
strategic solution in establishing an agile organization	3	4
ability to choose best of breed of IT products	3	2
free of vendor lock in	1	2
standardization of IT environment	2	2
protection of implementation details	1	2

II. Inputs for the perceived benefit model

We present Table F.2 in order to provide inputs for the perceived benefit model. These inputs are derived from 44 responses which have been identified in *Appendix E, Part II.*

Table F. 2 Quantifying the responses from the questionnaires serves input for the model of the perceived benefits

Indicators of the perceived benefits	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11
utility based	4.40	4.40	3.20	4.00	3.80	3.60	3.80	4.60	5.00	3.40	4.20
SLA driven	3.25	2.75	3.00	3.75	4.25	4.25	2.25	3.50	3.50	3.25	4.25
shared multitenant efficient	3.33	3.33	3.33	3.67	3.67	3.00	3.33	3.00	2.67	3.67	2.67
community contribution	3.00	5.00	4.00	3.00	4.00	3.00	3.00	3.00	5.00	5.00	4.00
reliability&fault tolerance	3.00	5.00	2.00	4.00	4.00	3.00	2.00	4.00	2.00	2.00	2.00
flexible&scalable	3.00	5.00	3.00	2.00	4.00	4.00	4.00	3.00	2.00	4.00	4.00
collaborative&smart	2.00	4.50	3.50	3.50	4.00	4.50	2.50	4.00	3.00	2.50	2.50
credible&accountable	1.00	4.00	4.00	5.00	4.00	5.00	1.00	5.00	4.00	1.00	1.00
nimbleness	2.00	5.00	2.00	2.50	2.50	3.50	2.50	4.00	4.00	4.50	2.50
sustainable&successful	3.67	4.33	2.00	4.33	2.67	3.67	2.33	3.67	4.00	4.00	2.67
scalability of IT products	2.67	4.67	3.00	3.00	3.00	3.33	2.33	4.00	4.00	3.33	3.00
value of business by leveraging IT products	3.89	4.11	3.00	4.78	3.22	3.89	3.44	4.56	4.67	3.67	3.89
automation of technology innovation	2.75	4.38	2.63	4.13	4.00	3.38	2.38	3.75	3.25	3.63	3.38
capability of addressing immediate business changes	3.00	4.67	3.33	3.17	3.50	3.50	2.83	4.00	3.67	3.50	3.50
ability to incorporate multipurpose	2.83	4.08	3.08	3.92	3.92	3.75	3.33	3.75	3.42	2.92	2.92
ability to provide cost effective solution	3.50	4.00	2.75	4.00	4.25	3.75	3.75	4.25	4.25	3.50	3.50
standardization of IT environment	2.75	3.25	2.67	3.58	3.75	3.75	2.08	3.50	2.50	2.42	3.42
protection of implementation details	2.75	2.75	3.00	3.00	3.25	4.25	2.00	3.50	3.50	3.00	3.25
ability to choose best of breed of IT products	3.00	3.38	3.63	4.63	3.75	4.38	2.63	4.00	3.00	2.63	3.13
free of vendor lock in	2.58	4.58	2.33	3.42	3.42	3.00	2.33	3.50	4.42	4.42	3.17
capability of responding to business changes	2.50	5.00	2.50	2.25	3.25	3.75	3.25	3.50	3.00	4.25	3.25
strategic solution in establishing an agile organization	2.83	4.67	2.00	3.42	2.58	3.58	2.42	3.83	4.00	4.25	2.58
ease of access	3.67	4.33	3.67	4.00	3.33	3.00	2.00	4.00	3.33	3.00	3.00
ease of information exchange	4.00	4.33	4.00	4.67	3.67	3.33	3.00	4.67	4.00	3.00	3.33
community collaboration	2.00	5.00	2.50	2.50	2.50	3.00	2.00	3.50	5.00	4.50	2.50

Table F. 2 Quantifying the responses from the questionnaires serves input for the model of the perceived benefits – *cont'd*

Indicators of the perceived benefits	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22
utility based	3.60	4.80	3.80	2.60	4.00	3.40	3.80	3.00	4.60	4.00	4.60
SLA driven	3.00	4.00	3.50	2.50	3.25	3.75	2.50	2.75	3.50	3.00	3.25
shared multitenant efficient	2.67	3.67	3.67	1.67	3.00	3.67	3.67	2.33	4.00	3.67	3.67
community contribution	4.00	4.00	4.00	3.00	5.00	4.00	5.00	2.00	4.00	4.00	4.00
reliability&fault tolerance	3.00	2.00	3.00	1.00	2.00	4.00	2.00	2.00	3.00	3.00	5.00
flexible&scalable	2.00	4.00	4.00	3.00	3.00	5.00	4.00	4.00	5.00	3.00	4.00
collaborative&smart	3.00	4.00	4.00	4.00	3.50	3.00	4.00	4.00	3.50	4.00	4.50
credible&accountable	4.00	4.00	4.00	5.00	4.00	1.00	4.00	4.00	2.00	5.00	5.00
nimbleness	4.00	2.50	4.50	3.00	4.00	4.50	4.00	2.00	3.50	4.00	4.00
sustainable&successful	2.33	4.00	4.00	2.33	2.33	3.67	2.00	2.00	3.00	3.00	4.00
scalability of IT products	3.67	3.00	4.00	3.67	3.67	4.33	3.67	2.00	4.67	3.67	4.33
value of business by leveraging IT products	3.11	4.67	4.00	2.11	4.11	3.89	3.67	3.33	4.00	4.00	4.67
automation of technology innovation	2.75	3.50	3.75	2.25	3.63	4.00	4.25	3.50	4.13	3.75	3.88
capability of addressing immediate business changes	3.33	3.50	3.83	3.00	3.67	4.17	4.00	2.33	4.50	3.67	4.33
ability to incorporate multipurpose	3.17	4.17	3.92	3.17	3.75	3.17	4.17	3.58	4.00	3.92	4.17
ability to provide cost effective solution	4.00	4.25	3.75	4.00	3.75	2.50	3.50	3.25	3.50	4.00	4.75
standardization of IT environment	3.00	3.33	3.17	1.50	3.08	3.58	2.17	2.25	3.17	3.00	3.75
protection of implementation details	3.00	3.25	3.75	3.50	3.25	3.75	2.25	1.75	3.25	3.00	3.00
ability to choose best of breed of IT products	3.75	4.00	3.75	3.75	3.63	2.75	3.00	3.25	3.38	4.00	4.63
free of vendor lock in	4.17	3.17	4.17	2.67	4.00	4.42	3.92	2.58	4.25	3.92	4.17
capability of responding to business changes	3.00	3.25	4.25	3.00	3.50	4.75	4.00	3.00	4.25	3.50	4.00
strategic solution in establishing an agile organization	3.17	3.25	4.25	2.67	3.17	4.08	3.00	2.00	3.25	3.50	4.00
ease of access	2.00	3.67	3.67	1.67	3.33	4.00	4.00	2.00	4.33	3.67	3.33
ease of information exchange	3.67	4.33	3.67	3.00	4.00	4.00	4.33	2.67	5.00	4.00	4.33
community collaboration	4.50	2.50	4.50	4.00	4.50	4.50	4.00	1.50	4.00	4.00	4.00

Table F. 2 Quantifying the responses from the questionnaires serves input for the model of the perceived benefits – *cont'd*

Indicators of the perceived benefits	R23	R24	R25	R26	R27	R28	R29	R30	R31	R32	R33
utility based	1.40	4.20	4.20	3.20	3.40	3.80	2.40	4.00	3.80	3.80	4.20
SLA driven	1.00	3.75	3.50	3.50	2.50	3.00	3.75	3.75	4.25	4.25	2.50
shared multitenant efficient	1.00	3.67	4.00	2.67	2.67	3.67	2.67	3.00	3.67	3.67	3.33
community contribution	1.00	4.00	4.00	3.00	4.00	3.00	5.00	3.00	5.00	4.00	4.00
reliability&fault tolerance	1.00	4.00	3.00	4.00	5.00	2.00	2.00	5.00	5.00	5.00	2.00
flexible&scalable	1.00	4.00	4.00	3.00	4.00	3.00	4.00	4.00	4.00	3.00	4.00
collaborative&smart	1.00	4.50	4.00	3.50	4.00	3.50	4.00	2.50	4.50	4.00	4.50
credible&accountable	1.00	5.00	4.00	4.00	4.00	4.00	4.00	1.00	5.00	5.00	5.00
nimbleness	1.00	3.50	4.00	3.00	3.00	2.50	2.50	4.50	4.50	3.50	3.00
sustainable&successful	1.67	3.33	3.33	3.33	2.33	2.00	3.67	4.00	4.00	4.67	3.67
scalability of IT products	1.00	4.00	4.00	3.33	4.00	2.33	3.00	3.67	4.33	3.67	3.33
value of business by leveraging IT products	1.89	4.11	4.11	3.44	3.78	3.33	3.89	4.33	3.67	3.89	3.89
automation of technology innovation	1.00	3.88	4.25	3.38	4.00	3.38	3.75	3.88	4.13	4.00	4.38
capability of addressing immediate business changes	1.00	4.17	4.00	3.33	4.00	2.83	3.50	3.50	4.17	3.50	4.00
ability to incorporate multipurpose	1.00	3.92	4.00	2.92	3.67	3.42	3.67	3.25	4.42	3.92	4.33
ability to provide cost effective solution	1.50	4.25	3.75	3.00	4.00	3.25	3.00	3.00	4.25	4.50	5.00
standardization of IT environment	1.00	3.92	3.50	3.17	3.17	2.67	2.58	3.58	4.42	4.42	2.17
protection of implementation details	1.00	3.75	3.25	3.00	2.25	2.50	3.00	3.75	4.25	4.00	1.50
ability to choose best of breed of IT products	1.50	4.38	3.50	3.13	3.50	3.38	3.50	3.13	4.63	4.50	3.88
free of vendor lock in	1.00	3.42	4.25	3.42	3.42	2.67	3.17	4.00	4.67	4.17	3.33
capability of responding to business changes	1.00	3.75	4.00	3.00	3.50	2.75	3.25	4.25	4.25	3.25	3.50
strategic solution in establishing an agile organization	1.33	3.42	3.67	3.17	2.67	2.25	3.08	4.25	4.25	4.08	3.33
ease of access	1.00	4.00	4.00	2.67	2.67	4.00	2.33	4.00	3.67	3.33	3.67
ease of information exchange	1.67	4.67	4.00	3.33	4.33	3.67	4.00	3.33	4.33	4.00	4.33
community collaboration	1.00	3.50	4.00	3.00	3.50	2.00	3.00	4.00	5.00	4.00	2.50

Table F. 2 Quantifying the responses from the questionnaires serves input for the model of the perceived benefits – *cont'd*

Indicators of the perceived benefits	R34	R35	R36	R37	R38	R39	R40	R41	R42	R43	R44
utility based	4.20	4.20	5.00	3.80	3.20	3.40	4.40	4.40	3.60	5.00	4.80
SLA driven	3.75	3.25	3.50	3.25	3.75	2.50	3.00	3.00	3.00	3.00	3.00
shared multitenant efficient	3.00	2.67	3.33	2.33	1.67	2.33	3.33	3.67	3.67	3.33	2.33
community contribution	4.00	3.00	4.00	5.00	3.00	3.00	4.00	3.00	3.00	3.00	3.00
reliability&fault tolerance	3.00	4.00	4.00	2.00	2.00	2.00	2.00	3.00	2.00	2.00	2.00
flexible&scalable	4.00	4.00	3.00	3.00	5.00	3.00	2.00	4.00	4.00	4.00	3.00
collaborative&smart	4.50	2.50	4.00	3.50	3.00	3.00	3.00	4.00	4.00	4.00	3.50
credible&accountable	5.00	1.00	5.00	4.00	1.00	3.00	4.00	4.00	4.00	4.00	4.00
nimbleness	3.00	3.50	4.50	3.00	1.00	3.00	4.50	2.50	4.00	1.50	2.50
sustainable&successful	4.00	4.67	4.67	3.33	4.00	3.33	2.33	4.00	3.00	1.67	3.00
scalability of IT products	4.00	4.67	4.00	2.67	3.00	3.00	3.67	2.67	3.67	3.33	3.67
value of business by leveraging IT products	4.33	3.89	4.89	3.78	4.00	4.11	3.78	4.33	4.00	3.89	4.33
automation of technology innovation	3.88	3.38	3.50	2.63	2.50	2.50	3.75	3.75	4.00	4.00	2.88
capability of addressing immediate business changes	4.00	4.17	3.83	2.67	3.00	3.00	3.50	3.17	3.67	3.50	3.17
ability to incorporate multipurpose	4.25	3.17	4.08	3.33	2.67	3.08	3.58	3.92	3.92	4.08	3.58
ability to provide cost effective solution	4.25	3.75	4.75	4.00	2.25	3.25	4.50	4.00	3.50	4.25	4.25
standardization of IT environment	3.58	3.08	3.50	2.42	2.58	2.17	2.33	3.00	2.33	2.67	2.67
protection of implementation details	3.25	3.25	3.50	3.50	3.00	2.75	3.00	2.50	3.00	2.00	3.00
ability to choose best of breed of IT products	4.88	2.13	3.75	3.38	2.50	2.50	3.00	3.50	3.25	3.00	3.63
free of vendor lock in	3.75	3.92	4.33	3.08	2.42	2.58	4.33	2.67	3.67	3.08	3.33
capability of responding to business changes	3.50	3.75	3.75	3.00	3.00	3.00	3.25	3.25	4.00	2.75	2.75
strategic solution in establishing an agile organization	3.50	4.08	4.58	3.17	2.50	3.17	3.42	3.25	3.50	1.58	2.75
ease of access	3.67	3.33	3.33	2.33	2.00	2.00	3.33	4.00	3.67	4.00	3.00
ease of information exchange	4.00	3.00	4.00	2.67	2.67	3.00	4.33	3.67	4.00	4.67	3.33
community collaboration	3.50	4.00	4.50	4.00	2.00	3.00	4.50	2.00	3.50	2.00	3.50

III. Inputs for the process benefit model

We present Table F.3 in order to provide inputs for the process benefit model. These inputs are derived from interview results and questionnaire responses which have been identified in *Appendix E, Part III.*

Table F. 3 The process benefits are indicated from the interview results and questionnaire responses

Indicators of the process benefits	IR1	IR2	IR3	IR4	IR5	IR6	IR7	IR8	IR9	IR10	IR11	IR12
consistency of information about services	4.33	5.00	5.00	2.33	2.33	4.67	3.67	2.67	3.67	3.67	4.67	5.00
description level of services	3.60	4.20	5.00	2.80	3.00	3.40	4.40	4.20	3.40	3.20	5.00	3.00
availability of configuration options for services	4.50	5.00	4.00	2.50	4.50	3.50	4.00	4.50	4.00	3.50	5.00	3.00
granularity level of services	4.00	3.00	3.00	2.50	2.50	3.50	4.00	5.00	3.00	2.50	5.00	3.00
generality level of information about services	3.67	4.00	2.33	3.33	3.00	4.33	4.00	4.33	3.33	3.00	4.33	3.67
the depth information about service implementations	4.00	3.00	2.00	3.00	3.00	2.00	4.00	3.00	4.00	3.00	4.00	4.00
multipurpose level of services	4.00	3.50	4.00	3.50	3.00	2.00	4.00	4.50	4.00	3.50	4.00	3.00
frequency of reusable services	3.00	5.00	3.00	3.50	3.00	2.50	4.00	4.00	4.50	3.00	3.50	4.00
governance level of services	3.50	3.50	2.00	3.50	3.00	3.00	4.00	3.00	4.00	3.00	5.00	2.50
capability of autonomous services	4.00	4.50	2.50	3.50	3.00	4.00	4.00	3.50	4.50	3.00	4.00	2.50
availability level of services	4.00	4.50	3.00	3.50	5.00	1.50	4.00	4.00	4.00	4.00	4.00	3.50
possibility of scaling application&data	5.00	4.50	4.00	4.00	5.00	4.50	4.00	4.00	5.00	4.00	4.50	3.00
accessibility level of services	4.00	1.00	2.00	2.00	5.00	2.00	4.00	5.00	4.00	4.00	5.00	4.00
availability of mechanisms of discovering services	3.50	1.50	3.00	3.50	3.00	2.00	4.00	4.50	4.50	3.00	5.00	3.50
custom option level of services	3.00	4.00	3.00	4.00	5.00	2.00	4.00	4.00	4.00	3.00	5.00	3.00
flexibility of custom options for services	4.00	4.00	3.00	4.00	3.00	2.00	4.00	4.50	4.00	4.00	4.00	3.50
ease of access	3.50	1.00	2.50	3.00	4.00	2.00	4.00	4.50	4.50	3.50	5.00	3.50
ease of information exchange	3.67	2.00	2.33	3.00	3.67	2.33	4.00	4.17	4.17	3.33	5.00	3.33
community collaboration	4.00	4.00	3.50	3.00	4.00	2.50	4.00	4.50	4.00	4.50	4.50	3.00
standardization of IT environment	3.98	3.73	4.33	2.71	2.78	3.36	4.02	3.96	3.69	3.29	4.89	4.00
protection of implementation details	3.92	3.25	3.08	2.71	2.88	3.46	4.00	4.33	3.33	3.13	4.58	3.42
ability to choose best of breed of IT products	3.52	3.64	3.00	3.96	3.00	3.08	4.08	3.64	4.08	3.24	4.60	3.40
free of vendor lock in	3.88	4.13	3.50	3.50	3.88	2.38	4.00	4.38	4.00	3.50	4.50	3.13
automation of technology innovation	4.00	4.25	2.75	3.75	3.00	3.00	4.00	4.00	4.25	3.50	4.00	3.00
capability of addressing immediate business changes	3.75	4.25	3.17	3.67	3.58	2.58	4.00	4.50	4.33	3.33	4.33	3.00
capability of responding to business changes	4.00	4.17	4.00	3.17	4.00	2.67	4.00	4.50	4.00	2.83	4.67	3.00
strategic solution in establishing an agile organization	4.33	4.67	4.33	3.33	3.67	3.33	4.00	3.00	4.00	4.00	4.33	4.67
ability to incorporate multipurpose	3.83	4.17	3.67	3.33	4.17	2.50	4.00	4.33	4.00	3.33	4.67	3.00
ability to provide cost effective solution	3.75	4.25	3.13	3.63	3.00	2.63	4.00	4.13	4.25	3.38	3.88	3.25
scalability of IT products	4.50	3.75	4.00	3.50	4.00	3.25	4.00	4.50	4.50	4.00	4.25	3.00
value of business by leveraging IT products	3.98	4.43	4.13	3.16	2.83	3.52	4.02	3.59	3.89	3.22	4.42	3.38

Table F. 3 The process benefits are indicated from the interview results and questionnaire responses – *cont'd*

Indicators of the process benefits	IR13	IR14	IR15	IR16	IR17	IR18	IR19	IR20	IR21	IR22	IR23	IR24
consistency of information about services	3.00	3.00	4.33	4.33	3.33	5.00	5.00	3.33	3.33	4.00	2.33	2.00
description level of services	3.00	3.40	4.60	4.00	2.80	5.00	1.80	3.60	4.60	2.80	3.60	3.80
availability of configuration options for services	3.00	3.50	4.50	4.00	4.50	5.00	3.00	2.50	5.00	4.00	1.50	2.50
granularity level of services	3.00	3.50	4.00	4.00	4.50	5.00	1.50	3.00	4.00	3.00	4.00	3.50
generality level of information about services	3.00	3.00	4.67	4.00	3.33	5.00	4.00	2.67	3.00	4.00	3.00	3.00
the depth information about service implementations	3.00	3.00	5.00	4.00	3.00	4.00	2.00	1.00	2.00	4.00	1.00	2.00
multipurpose level of services	3.00	3.00	5.00	4.00	4.00	5.00	3.00	2.00	3.00	2.00	3.00	4.00
frequency of reusable services	3.00	3.00	5.00	4.00	3.50	5.00	4.00	2.00	3.00	4.00	3.50	3.50
governance level of services	3.00	3.00	3.50	4.00	3.00	5.00	5.00	3.50	3.00	4.00	2.50	3.00
capability of autonomous services	3.00	3.00	3.50	4.00	3.50	2.50	5.00	3.00	3.00	4.00	3.00	3.50
availability level of services	3.00	3.50	5.00	4.00	4.00	5.00	5.00	4.50	4.00	3.50	2.00	2.00
possibility of scaling application&data	3.00	4.00	4.00	4.00	4.00	5.00	4.50	4.00	4.00	5.00	3.00	4.00
accessibility level of services	3.00	4.00	4.00	4.00	4.00	5.00	1.00	5.00	4.00	4.00	4.00	5.00
availability of mechanisms of discovering services	3.00	4.00	5.00	4.00	4.00	5.00	1.50	3.50	3.00	1.00	3.00	3.00
custom option level of services	3.00	3.00	5.00	4.00	4.00	5.00	4.00	3.00	4.00	3.00	3.00	4.00
flexibility of custom options for services	3.00	3.00	2.50	4.00	3.50	4.50	4.00	2.00	2.50	3.00	3.00	4.00
ease of access	3.00	4.00	4.50	4.00	4.00	5.00	1.50	4.00	3.50	2.50	3.50	4.00
ease of information exchange	3.00	3.67	4.17	4.00	3.67	5.00	2.50	4.00	3.33	3.00	3.17	3.67
community collaboration	3.00	3.00	4.50	4.00	4.00	5.00	3.00	2.50	4.00	2.50	2.00	3.00
standardization of IT environment	3.00	3.47	4.64	4.11	3.38	5.00	2.60	3.64	3.64	2.60	2.98	2.93
protection of implementation details	3.00	3.13	4.67	4.00	3.21	4.75	2.38	2.67	3.50	3.50	3.00	3.13
ability to choose best of breed of IT products	3.00	3.28	3.52	4.00	3.16	4.80	2.96	3.32	3.32	2.96	3.12	3.56
free of vendor lock in	3.00	3.13	4.25	4.00	4.00	4.88	3.50	2.38	3.63	3.00	2.63	3.63
automation of technology innovation	3.00	3.00	3.00	4.00	3.50	3.50	4.50	2.50	2.75	3.50	3.00	3.75
capability of addressing immediate business changes	3.00	3.08	4.58	4.00	3.75	4.17	3.83	2.42	3.50	3.33	2.75	3.58
capability of responding to business changes	3.00	3.33	5.00	4.00	4.33	5.00	3.00	2.33	4.00	2.67	2.67	3.67
strategic solution in establishing an agile organization	3.00	3.33	4.67	4.00	3.67	5.00	5.00	4.00	3.67	4.33	3.33	3.00
ability to incorporate multipurpose	3.00	3.17	4.83	4.00	4.17	5.00	3.33	2.50	4.00	3.00	2.50	3.50
ability to provide cost effective solution	3.00	3.00	4.00	4.00	3.63	4.25	4.00	2.25	2.88	3.25	3.13	3.75
scalability of IT products	3.00	3.50	4.50	4.00	4.00	5.00	3.25	3.00	3.50	2.50	3.00	4.00
value of business by leveraging IT products	3.00	3.10	4.36	4.08	3.41	4.38	3.95	2.98	3.48	3.70	2.98	3.33

Appendix G: Providing useful reference for collecting data in further research

We have presented data gathering methods which are used in the research in *Appendix B*. A list of interview questions has been developed in *Appendix B* through which data from vendors who offer Software as a Service (SaaS)-based applications can be collected in order to understand the benefits of SaaS from the perspective of SaaS providers. Furthermore, a list of questionnaire questions has also been developed through which data from clients who subscribe to SaaS applications can be collected in order to understand the benefits of SaaS from the perspective of SaaS adopters. However, applying differences in data collection methods which are applied for each perspective when realizing SaaS benefits, can lead to difficulties in comparing data. In the light of providing more reliable research data for further research in the future, we develop possible interview questions to understand SaaS benefits from the perspective of SaaS adopters in Part I of the appendix and possible questionnaire questions to understand SaaS benefits from the perspective of SaaS providers in Part II of the appendix. In addition, we also develop possible questionnaire questions to understand SaaS benefits from clients of SaaS providers in particular within Part III of the appendix.

I. Interview Guide to gather information from SaaS adopters

In this interview guide, understanding SaaS benefits from the perspective from SaaS adopters will be addressed. For this reason, SaaS benefits are approached by developing a SaaS maturity model which can incorporate key characteristics of the perceived benefits, key benefits of SaaS from the perspective of adopters, and the related key attributes of SaaS applications in each of the maturity level.

The key characteristics of the perceived benefits of SaaS are incorporated within different levels of SaaS maturity as depicted in Table G.1. The key characteristic of *utility based* is incorporated within *Level 0 (Potential)* while the key characteristic of *SLA driven* is incorporated within *Level 1 (Prospective)*. The key characteristic of *shared resources efficient* and *community contribution* are included within *Level 2 (Promising)* whereas the key characteristic of *reliability and fault tolerance* and *flexible and scalable* are included within *Level 3 (Achieving)*. The level maturity of *Stabilizing (Level 4)* includes the key characteristic of *collaborative and smart*, and *credible and accountable* while the level maturity of *Optimizing (Level 5)* includes the key characteristic of *nimbleness* and *sustainable and successful*. Moreover, each level of maturity can be associated with the key attributes of SaaS applications according to literatures [Carraro & Chong, 2006a; Ried et al., 2008; Kang et al., 2010] while the key characteristics of the perceived benefits of SaaS can be associated with the key benefits of SaaS from the perspective of adopters which are identified according to the former SaaS maturity models by Microsoft [Carraro & Chong, 2006a], Forrester [Ried et al., 2008], and Kang [Kang et al., 2010]. The interview questions will be driven from the description on each level of maturity which may cover the key characteristics, the key benefits, and the key attributes.

In order to have a better understanding toward the process of delivering SaaS applications from clients' perspectives, we elaborate the interview questions by considering the design principles of SOA which can be appreciated during the lifecycle of SaaS. The aim of this elaboration is more on understanding the process of delivering SaaS applications from the perspective of SaaS adopters during the lifecycle of SaaS, which includes three processes of *service discovery, service selection and engagement,* and *service enactment*.

Table G. 1 The developed SaaS maturity model characterizes benefits of SaaS which are commonly perceived by SaaS adopters

Maturity Level	Key characteristics of the perceived benefits of SaaS	Key benefits of SaaS from the perspective of the adopters			The related key attributes of SaaS applications
		Microsoft [Carraro & Chong, 2006a]	Forrester [Ried et al., 2008]	Kang et al. [2010]	
0 (Potential)	*Utility based*: only pay per use or pay per user	*efficient and effective services*	*business and IT alignment*	*effective and efficient services*	Market
1 (Prospective)	*SLA driven*: define policy and delivery parameters to measure performance				- Standard Support - Market
2 (Promising)	- *Shared resources efficient*: allow configurations while keeping each tenant data separated - *Community contribution*: perform strategic corporate social responsibility		*business and community engagement*		- Standard Support - Configurability - Market
3 (Achieving)	- *Reliability and fault tolerance*: ensure continuous service delivery while eliminating disruption to business - *Flexible and scalable*: be elastic but scalable in order to meet business changes	*interoper-ability of services*		*integrated services*	- Standard Support - Configurability - Multi-tenant efficiency - Integration - Scalability - Market
4 (Stabilizing)	- *Collaborative and smart*: maintain flexibility of configuring applications equipped with continuous support and services - *Credible and accountable*: maintain reliability and availability of services		*dynamic and interoperable services*	*SOA benefits*	- Standard Support - Configurability - Multi-Tenant efficiency - Scalability - Integration - Market - Development - Scalability (of business)
5 (Optimizing)	- *Nimbleness*: optimize enterprise resources through infrastructure sharing while ensuring data confidentiality - *Sustainable and successful*: continuously improve services while fostering pace and stability of delivering value to tenants	*integrated and secured services*	*agile delivery*		- Standard Support - Configurability - Multi-Tenant efficiency - Scalability - Integration - Security - Market - Development - Scalability (of business) - Communication

The first process includes the design principles of *standardized service contract, service loose coupling, service abstraction,* and *service discoverability*; while the second process includes all of the design principles, which are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability,* and *service composability*. The third process includes the design principles of *service reusability, service autonomy, service statelessness,* and *service composability*.

The interview questions will be provided to clients who subscribe to a SaaS-based application from vendors. The interview starts with general questions related to specific role of the clients' representatives which are chosen as an interview target. Following this, specific questions pertaining to the adoption of the SaaS applications are presented. These questions are grouped into two themes, which are related to the benefits from the adoptions and the lifecycle process of SaaS during the delivery of SaaS applications. Please note that this guide is only a reference during the interview since it aims at eliciting information by performing a semi-structured interview. Thus, it is possible to interviewees to ask further information about the questions to the interviewers during the interview and it is also possible that the interview might stray from this interview guide.

General questions

Name of interviewee: Click here to enter text.

This question is not relevant for analyzing the results from interviews. However, it is possible if the interviewee does not wish his/her name to be exposed.

Gender: ◉ Female ○ Male

This is a general question.

Job title of interviewee: Choose an item.

This is relevant to analyze the reliability of information that is provided by the interviewee. The job titles can be chosen from the following list:

- Accountant
- Administrator
- Auditor
- Business Analyst
- CEO
- CFO
- Consultant
- Director
- Engineer
- Finance Analyst
- Help desk
- Instructor
- Manager
- Officer
- Operator
- Production Supervisor
- Project Manager
- Sales rep
- Scientist
- Senior Accountant
- Specialist
- Software Developer
- Student
- Supervisor
- Systems Analyst
- Technician
- Vice president/executive
- Other

Business sector of organization: Choose an item.

This is a general question about organization based on business sector. The business sector can be chosen from the following list:

- Accommodation and Food Services
- Administrative and Support, Waste Management and Remediation Services
- Agriculture, Forestry, Fishing and Hunting
- Arts, Entertainment and Recreation
- Construction
- Finance and Insurance
- Information
- Management of Companies and Enterprises
- Manufacturing
- Mining, Quarrying, and Oil and Gas Extraction
- Public Administration
- Real Estate and Rental and Leasing
- Retail Trade
- Transportation and Warehousing
- Utilities
- Other

Number of employees: Choose an item.

This question can indicate the size of the organization.

Year started with service-orientation and SaaS thinking in the organization: Choose an item.

This question can indicate the degree of innovation within the organization.

Specific questions

These interview questions are structured within two general themes, which are related to the benefits of SaaS which are perceived by clients and the lifecycle process of SaaS during the delivery of SaaS applications. The first theme covers a list of questions which aims at understanding to what extent the adoption of SaaS applications can be associated with benefits of SaaS within the developed SaaS maturity model. By referring to this maturity model, the benefits from adopting SaaS applications can be appreciated according to benefit levels of the maturity model. For this reason, the interview questions are divided into two sections, which represent general questions about the adoption of the applications and specific questions about benefits from the adoptions, respectively. The latter section is also divided into six groups each of which incorporates questions related to each levels of SaaS maturity model.

The second theme includes a list of questions aims at understanding benefits of SaaS which can be appreciated from the perspective of the lifecycle process of SaaS during the delivery of SaaS applications. For this reason, the design principles of SOA will be appreciated during different process within the SaaS lifecycle. Following this, two consecutive sections are presented within which the process within SaaS lifecycle are included, which are *service discovery, service selection and engagement,* and *service enactment*. The sections represent the early process (service discovery, and service selection and engagement) and the tail process (service selection and engagement and service enactment), subsequently. They aim at understanding to what extent the design principles of SOA can be employed during SaaS lifecycle.

The interview duration for each theme is approximately 30'-45'; thus the interview is approximately conducted within 60'-90'. Please record the interview and make notes of important points from the interviewees' answers during the interview.

The perceived benefits from SaaS adopters

:: <u>The adoptions of SaaS applications</u> ::

- **Key Questions :**
  - Type of subscription
  - Functionalities, extensions, and/or add-ons
  - Help desk support
  - Data confidentiality
- **Specific Questions :**
  1) Which (SaaS) applications did your enterprise choose to help managing financial issues within the enterprise?
     a. What type of subscriptions did the enterprise choose?
     b. How long has the enterprise subscribed to the applications?
     c. Did you notice any challenges during the adoption of the applications?
  2) Which functionalities do you think helpful to improve the performance of business process in the enterprise?
     a. Have you ever log-on into the SaaS applications?
     b. Did you experience any difficulties in using the applications?
     c. What functionalities did you find the most important?
     d. Is the enterprise subscribed to any extensions or add-ons?
     e. Could you think of any (other) functionality which should have existed in the applications?

3) How do you think about help desk support which is provided by vendors?
   a. Did you find that the help desk supports from vendors are useful?
   b. Are the help desk supports always available when they are needed?
   c. Could you suggest any improvements toward the help desk supports?
   d. Would you agree that IT-sourcing model would increase the dependency with vendors, especially related to transfer of knowledge and maintenance of the applications?
4) How do you think about management of data by vendors?
   a. Do you think that the current user management is secured?
   b. Would you entrust the vendors to manage personal and organizational data of your enterprise? Do you think that data management should be in the hand of organization itself internally?
   c. Could you think of any drawbacks in transferring the risk of managing enterprise critical data to vendors?

:: The benefits from adopting SaaS applications ::

LEVEL 0: POTENTIAL

- **Key Questions :**

  Utility based: only pay per use or pay per user

- **Specific Questions :**

5) Is the application which is outsourced from vendor specifically developed according to requirements from business? Can it be categorized as on-demand software?
6) What type of payment mechanism does the enterprise subscribe to in conjunction with the adoption of the application? Is it based on pay-per-usage (period of use) or pay-per-user (number of users)?
   a. What services are included within the chosen subscription?
   b. Do the services cover IT infrastructures to support the application?
7) How do you think about the benefits of this outsourcing model?
   a. Would you agree that the outsourcing model can help to improve the management of enterprise resources effectively and efficiently?
   b. Would you agree that the outsourcing model can contribute to business and IT alignment within the enterprise?

LEVEL 1: PROSPECTIVE

- **Key Questions :**

  SLA driven: define policy and delivery parameters to measure performance

- **Specific Questions :**

8) Do you think it is possible for vendors to offer the similar application as the one that you subscribed, to other clients, e.g. competitors in the same business sector with the enterprise? Would you think this identical application as a threat or an opportunity for collaboration?
9) How would your enterprise differentiate itself with other enterprises that also provide identical applications?
   a. Is the description of services incorporated within Service Level Agreements (SLAs) in a formal contract?
   b. Would you think of changing your contract with vendors and further changing service descriptions, or even moving to other different applications?

LEVEL 2: PROMISING

- **Key Questions :**
  - *Shared resources efficient*: allow configurations while keeping each tenant data separated

  - *Community contribution*: perform strategic corporate social responsibility

- **Specific Questions :**

10) Does the vendor provide the enterprise with an option to change the look-and-feel of the application, e.g. interface and rules? To what extent, this option is allowed?
11) Would you think that the vendor is capable of managing confidentiality of personal and enterprise data for multiple clients?
    a. Would you agree if critical data of the enterprise is managed by the vendor?
    b. How would you ensure that your data is kept separated from other clients in vendor's server? Did you ask the vendor to specify this requirement in a formal procedure?
12) Would you agree if a community whose member adopts identical applications is created in order to share experiences, challenges, and feedback from the adoption of the applications?
    a. Would you be interested in contributing within this community?
    b. What benefits would you expect by joining this community?

LEVEL 3: ACHIEVING

- **Key Questions :**
  - *Reliability and fault tolerance*: ensure continuous service delivery while eliminating disruption to business
  - *Flexible and scalable*: be elastic but scalable in order to meet business changes

- **Specific Questions :**

13) Are you provided with an integrated database in vendor's server?
    a. Did you find that this integration is useful?
    b. Would you think that this integration can improve application's performance?
    c. Would you think that this integration may result in cost efficient and effective IT support?
    d. Could you think of any challenges which might happen due to this integration?
14) Is the enterprise provided with a formal procedure to ensure business continuity, e.g. disaster recovery plan?
15) Is the enterprise allowed to configure the application in order to incorporate changes in technology and business requirements? To what extent this configuration is possible?

LEVEL 4: STABILIZING

- **Key Questions :**
  - *Collaborative and smart*: maintain flexibility of configuring applications equipped with continuous support and services
  - *Credible and accountable*: maintain reliability and availability of services

- **Specific Questions :**

16) Would you agree if the vendor provides continuous services and help desk supports during the adoption of the applications?
    a. If yes, could you indicate why do you think so?
    b. To what extent, do you think that the services and help desk supports are available? Do you think that they are reliable?
17) Do you think that the vendor provides a flexible option for the enterprise to configure the application?

LEVEL 5: OPTIMIZING

- **Key Questions :**
  - *Nimbleness*: optimize enterprise resources through infrastructure sharing while ensuring data confidentiality

- *Sustainable and successful*: continuously improve services while fostering pace and stability of delivering value to tenants

- **Specific Questions :**

18) Do you think that the vendor allows the enterprise to customize the application?
    a. Are you allowed to customize the business rules and workflows of the application, instead only configuring user interface of the application?
    b. Are you provided with a good design interface to customize the application?
19) Have you ever heard about Service Oriented Architecture (SOA)? Do you think that the vendor implement this concept within the application?
20) Are you provided with a shared database and infrastructure to support the application?
21) Would you agree that the provider is capable of providing reliable and seemingly supports toward the application?
22) Would you agree that the provider delivers services continuously in satisfying the demand from business while fostering pace and stability of the applications?

The lifecycle process of SaaS during the delivery of SaaS applications

:: Service discovery, and service selection and engagement ::

STANDARDIZED SERVICE CONTRACT

- **Key Questions :**
  - consistency of information about services (related to the delivery of SaaS applications) which is published by the providers
  - description level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters

- **Specific Questions :**

1) Have you ever been involved during the agreement of service level in a contract meeting?
    a. Could you help me to remember, who were involved during the meeting?
    b. When did the meeting take place, before or after the project was started?
    c. Was the contract conceptualized by both enterprise and vendor?
    d. Was it formally signed during a contract meeting?
    e. How long did usually it take before the contract was signed?
    f. Did you find any challenges (issues) during the meeting?
2) Could you briefly describe the content of the contract?
    a. Does the contract contain information about technical descriptions[8] of services?
    b. Does the contract contain information about availability of services and data[9]?
    c. Does the contract contain information about how to manage and authorize data[10]?
    d. Does the contract explain about additional services and fees[11] toward the application?

[8] Technical descriptions include:
- *Basic cost*, including setup costs and storage fees
- *Periodical service charge*, including pilot periods
- *Service Level Agreement*

[9] Availability of services and data include:
- *Service levels and service credits*, e.g. business continuity protection, Disaster Recovery & Business Continuity, Site and Network security
- *Termination and the related consequences*, and exit strategy

[10] Data management and authorization include: *security and privacy of data*, e.g. information security, customer data, personal data

[11] Additional services and fees include:
- *Locked in or escalating discounts* for incremental spending
- *Additional services*, e.g. uptime guarantees and penalties
- *Integration* with existing system

e. Are there any other specifications which are not technically described within the contract?

SERVICE LOOSE COUPLING

- **Key Questions :**
  - availability of configuration options for services (related to the delivery of SaaS applications) which are specified by both the providers and the adopters
  - granularity level of services (related to the delivery of SaaS applications) which incorporate both perspective of the providers and the adopters
- **Specific Questions :**

3) Is the enterprise provided with the capability to configure services related to the applications, e.g. service to determine periodical service charge, service to calculate discounts for incremental spending, service to provide extra security and privacy toward critical financial data?
   a. To what extent, configuration options are available toward these services?
   b. To what level, (the granularity levels of) these services are determined, e.g. fixed discounts for incremental spending, standardized data security methods?
   c. Are there any possibilities to diversify vendors which can provide similar services in different applications, e.g. service to secure critical financial data?
4) Do you think that any configuration toward these services might affect enterprise business performance?

SERVICE ABSTRACTION

- **Key Questions :**
  - generality level of information about services (related to the delivery of SaaS applications) which are published by the providers
  - the depth information about service implementations (related to the delivery of SaaS applications) which satisfy both requirements of the providers and the adopters
- **Specific Questions :**

5) Did you find that information about services related to the application which had been published by the vendor was sufficient enough, e.g. through the descriptions of functionalities of the application? Did you find it too general?
6) Is the enterprise provided with the detail of implementation of all of services related to the application (in order to prepare for future provider diversification), e.g. the underlying business logic which is used to perform financial management within the application?
7) Is the enterprise provided with the detail of service governance, e.g. the detail of updates and maintenance of services?
8) Is all necessary (and additional) information about services defined within a formal contract? Do you think that, the contracts always need to be updated?

SERVICE DISCOVERABILITY

- **Key Questions :**
  - accessibility level of services (related to the delivery of SaaS applications) which are developed by the providers
  - availability of mechanisms of discovering services (related to the delivery of SaaS applications) which are developed by the providers
- **Specific Questions :**

9) To what extent, services related to the application are accessible through a (secured) network which is provided by the vendor?
   a. Do you think that the services can be easily accessed?

b. Do you think that the services can be located efficiently?
c. Are you provided with any formal mechanism to discover the services?

10) Is the enterprise provided with any information related to the services, e.g. what functionality can be served by the services, how to access and how to use the services?

:: Service selection and engagement, and service enactment ::

SERVICE REUSABILITY

- **Key Questions :**
  - multipurpose level of services (related to the delivery of SaaS applications) which are expected by the adopters
  - frequency of reusable services (related to the delivery of SaaS applications) which are developed by the providers in meeting the demand of the adopters
- **Specific Questions :**

11) Do you think that the services related to the application are able to accommodate business changes?
   a. Is there any possibility to refine service descriptions which have been agreed a formal contract in order to incorporate business changes in requirements and technology? If it is possible, is there any formal procedure to do so?
   b. Do you think that the services are designed for multi-purposes, e.g. to accommodate changes in technology and business requirements?

12) To what extent, do you think that the services are reusable?
   a. Do you think that a service can be reused to serve various business processes?
   b. Could you think of any redundant services, e.g. within extensions and add-ons?

SERVICE AUTONOMY

- **Key Questions :**
  - governance level of services (related to the delivery of SaaS applications) which are defined by the providers
  - capability of autonomous services (related to the delivery of SaaS applications) in meeting business changes from the adopters
- **Specific Questions :**

13) Is the governance of services defined within a formal contract, e.g. periodical updates and maintenance?

14) Do you think that business performance would be improved if the services are autonomous in satisfying business changes, e.g. a service to calculate discounts on incremental spending would be independent from a service to determine periodical service charge?

15) Could you think of any services which are closely related to other services?
   a. Do you think that by being autonomous, a service can help to optimize enterprise resources since they are relatively independent?
   b. Do you think that business performance could be improved by employing autonomous services?

SERVICE STATELESSNESS

- **Key Questions :**
  - availability level of services (related to the delivery of SaaS applications) which are agreed by both the providers and the adopters
  - possibility of scaling application and data (related to the delivery of SaaS applications) in accommodating business changes from the adopters

- **Specific Questions :**

  16) To what extent, the services are available for the enterprise?
      a. Are the services always available during the whole period of contract?
      b. Is there any possibility for service to remain stateful during the period of contract?
  17) Would you agree if the applications and or data are scaled up to bigger capacity of server? Would you agree if they are scaled out to many servers?

SERVICE COMPOSABILITY

- **Key Questions :**
  - custom option level of services (related to the delivery of SaaS applications) in meeting business changes from the adopters
  - flexibility of custom options for services (related to the delivery of SaaS applications) which are expected by the adopters
- **Specific Questions :**

  18) Do you think that it is possible to customize services related to the application, e.g. changing business logic to calculate the service to calculate discounts on incremental spending?
      a. Would you suggest that all of the services are capable of being composed to serve different business purposes?
      b. Would you suggest that the services are capable of being repeatedly reused and recomposed?
      c. Would you agree that it is important to communicate the possibility of customizing the services effectively?

II. Questionnaire Guide for SaaS providers

This questionnaire is a part of a master thesis project which is written as a partial fulfillment to accomplish a degree of Master of Science in Engineering and Policy Analysis at Delft University of Technology. The goal of the project is to provide methodology for assessing benefits of adopting Enterprise Resource Planning (ERP) system which is delivered through Software as a Service (SaaS) model within Small Medium Sized Enterprises (SMEs). The benefits of SaaS are conceptualized from the perspectives of important actors, which are vendors as SaaS providers and clients as SaaS adopters, and from the perspective of the lifecycle process of SaaS during the delivery of SaaS applications. In order to accommodate these different perspectives, SaaS benefits are directed to the achievement of an established concept about benefits which was proposed by Erl [2007]. These benefits are referred as the strategic goals and benefits of Service Oriented Computing (SOC).

In this questionnaire guide, the perspective of SaaS providers will be addressed by conceptualizing SaaS benefits which can be promised by the providers. The promised benefits are approached by operationalizing Service Level Agreements (SLAs) within a formal SaaS contract. For this reason, three main aspects of benefits which are usually promised by the providers can be identified, which are *technology-enabled business support benefits*, *interactive support benefits,* and *comprehensive support benefits*. According to indicators which are identified to indicate the benefits, a list of questions is structured within three sections each of which represents different aspects of the promised benefits.

Furthermore, in order to have a better understanding toward the lifecycle process of SaaS related to the delivery of the system, the questionnaire is also equipped with questions that aim at appreciating the design principles of Services Oriented Architecture (SOA) during the lifecycle of SaaS. Therefore, eight sections follow each of which represents the principles, which are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability,* and *service composability*. According to these design principles, a list of statements is structured in each section that indicates situation within which the principles might be applied when services related to the system are specified at different processes of SaaS lifecycle.

You have been selected to fulfil this questionnaire because you are involved during the development of SaaS ERP system in your organization. The questionnaire starts with general questions about you and your organization. Then, two themes follows, each of which aims at understanding the benefits of SaaS from the perspective of the providers, and the perspective of the lifecycle process of SaaS, sequentially. The total number of questions related to the promised benefits is 16 questions while the total number of questions related to the lifecycle process of SaaS is 32 questions. The questionnaire ends with an open field that is provided to accommodate your comment.

General questions

Name of respondent: Click here to enter text.

This question is not relevant for analyzing the results from questionnaire. However, it might be possible that the respondent leave this question blank as anonymous.

Age: Choose an item.

The age of the respondent may be relevant by indicating the interest in new innovations. However, it might be possible that the respondent leave this question blank.

Gender: ◉ Female ○ Male

This is a general question. Respondent should choose either male or female.

Job title of respondent: Choose an item.
This is relevant to analyze the reliability of information that is provided by the respondent. This question will be represented as a drop-down menu that presents a list of job titles which should be chosen by the respondent. The job titles include:

- Accountant
- Administrator
- Auditor
- Business Analyst
- CEO
- CFO
- Consultant
- Director
- Engineer
- Finance Analyst
- Help desk
- Instructor
- Manager
- Officer
- Operator
- Production Supervisor
- Project Manager
- Sales rep
- Scientist
- Senior Accountant
- Specialist
- Software Developer
- Student
- Supervisor
- Systems Analyst
- Technician
- Vice president/executive
- Other

Organization sector: Choose an item.
This is a general question about organization based on business sector, which includes:

- Accommodation and Food Services
- Administrative and Support, Waste Management and Remediation Services
- Agriculture, Forestry, Fishing and Hunting
- Arts, Entertainment and Recreation
- Construction
- Finance and Insurance
- Information
- Management of Companies and Enterprises
- Manufacturing
- Mining, Quarrying, and Oil and Gas Extraction
- Public Administration
- Real Estate and Rental and Leasing
- Retail Trade
- Transportation and Warehousing
- Utilities
- Other

Number of employees: Choose an item.
This question can indicate the size of the organization.

Year started with service-orientation and SaaS thinking in the organization: Choose an item.
This question can indicate the degree of innovation within the organization

Specific questions

These questions are structured within two general themes, which are related to the promised benefits from the perspective of SaaS providers, and the lifecycle process of SaaS that can lead to appreciating benefits of SaaS from the perspective of process during the lifecycle of SaaS. The former theme will be divided into three sections while the latter theme will be divided into eight sections.

The promised benefits from the perspective of SaaS providers

A general question about benefits from adopting SaaS applications will be presented first. Then, three sections will be presented in conjunction with the promised benefits. In each number, please choose the description that represents to what extent you would agree upon the current situation of delivering SaaS applications by your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

1) Would you agree upon the following benefits in Table G.2 which can be expected by your clients who subscribe a SaaS application from your organization?

Table G. 2 The promised benefits include technilogy-enabled business support, interactive support, and comprehensive support benefits

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
a)	Technology-enabled business support benefits, which include cost savings, efficient resource management, faster implementation time, and effective business operations.	○	○	○	○	○
b)	Interactive support benefits, which include providing continuous services, reliable supports, and securing enterprise data.	○	○	○	○	○
c)	Comprehensive support Benefits, which include facilitating information integration, and enabling regulatory compliance.	○	○	○	○	○

2) In your opinion, do you think that the identified benefits which are presented in Question 1, are sufficient and complete?

- ○ Yes, I think they are sufficient and complete.
- ○ Yes, I think they are sufficient, but incomplete.
- ○ Yes, I think they are complete, but insufficient.
- ○ No, I do not think so. I think they are lacking.
- ○ No, I do not think so. I think they are both insufficient and incomplete.
- ○ No opinion.

3) Do you have any idea which benefits of SaaS that have not been included in Question 1?

Click here to enter text.

4) According to your experience, how likely are you to find the following key characteristics of SaaS benefits in Table G.3 during the delivery of SaaS applications by your organization to your clients?

Table G. 3 There are seven characteristics that can indicate the promised benefits of SaaS

No	Key characteristics of the promised benefits of SaaS	Do you agree?				
		Very likely	Moderately likely	Slightly likely	Not at all likely	No opinion
a)	resource efficiency	○	○	○	○	○
b)	process effectiveness	○	○	○	○	○
c)	data confidentiality	○	○	○	○	○
d)	integrated information	○	○	○	○	○
e)	service availability	○	○	○	○	○
f)	service reliability	○	○	○	○	○
g)	regulatory compliance	○	○	○	○	○

TECHNOLOGY-ENABLED BUSINESS SUPPORT BENEFITS

This section describes the benefits of SaaS which can help to improve management of resources efficiently and management of business process effectively. This improvement includes cost savings, efficient resource management, faster implementation time, and effective business operations. In each number, please choose the description that represents to what extent you would agree upon the current situation of delivering SaaS applications by your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "no opinion".

5) As one of an outsourcing (software) company which aims at delivering software products through a SaaS model, would you consider that the model which is offered by your organization is efficient at transferring risks from clients to your organization as a vendor?
   - (●) Yes, I definitely think that the SaaS model can efficiently transfer risks from clients to vendor.
   - ( ) Yes, I think that the SaaS model is a good way to transfer risks, but only to some degree that there is still few issues, e.g. maintaining critical data.
   - ( ) Yes, I think that the SaaS model can help to transfer some risks, but they are not significant in reducing the possibility of risk occurrence.
   - ( ) No, I do not consider that the SaaS model is efficient at transferring risks from clients to vendor.
   - ( ) No opinion.

6) Would you agree that the SaaS model is efficient at saving costs and at optimizing enterprise resources?
   - ( ) Yes, I would surely agree that the SaaS model is efficient at saving costs and optimal for managing enterprise resources.
   - (●) Yes, I would agree that the SaaS model is efficient at saving costs, but not optimal for managing enterprise resources.
   - ( ) Yes, I would agree that the SaaS model is optimal for managing enterprise resources, but not efficient in saving costs.
   - ( ) Yes, I would agree that the SaaS model results in little efficiency either at saving cost or at optimizing enterprise resource.
   - ( ) No, I disagree entirely. I think that the SaaS model is not efficient in saving costs and not optimal in managing enterprise resources.
   - ( ) No opinion.

7) Do you think that your organization can deliver SaaS application efficiently according to business requirements and delivered effectively within a shorter implementation time?
   - ( ) Yes, I think the application can be delivered efficiently according to requirements and delivered effectively within a shorter implementation time.
   - ( ) Yes, I think the application can be delivered efficiently according to requirements, but the implementation time may take longer.
   - ( ) Yes, I think the application cannot be delivered efficiently according to requirements, but can be delivered effectively within a relatively shorter implementation time.
   - ( ) No, I think the application cannot be delivered in the most efficient and effective manner.
   - ( ) No opinion.

8) Would you believe that your organization can help to improve business process management within the client's enterprise by delivering SaaS-based application?
   - ○ Yes, I would certainly believe that the application is effective in improving business process management the client's enterprise.
   - ○ Yes, I believe that the application is effective in improving business process management, but only to some degree that I can give an example of this improvement.
   - ○ Yes, I would agree that the application is effective in improving business process management, but I cannot give any example of this improvement.
   - ○ No, I do not think this newly developed application is effective in improving business process management within the client's enterprise.
   - ○ No opinion.

9) Are you aware of any significant issues which might be faced by your organization during the delivery of SaaS applications to the clients?
   - ○ Yes, I am aware that the enterprise faced significant issues during the delivery of SaaS applications to clients.
   - ○ Yes, I am aware that the enterprise faced some issues during the delivery of SaaS applications to clients, but I think that the issues are not significant.
   - ○ Yes, I am aware that the enterprise faced few insignificant issues during the delivery of SaaS applications to clients.
   - ○ No, I am not aware if the enterprise might face any issues.
   - ○ No opinion.

INTERACTIVE SUPPORT BENEFITS

This section describes the benefits of SaaS which include providing continuous services, reliable supports, and securing enterprise data. In each number, please choose the description that represents to what extent you would agree upon the current situation of delivering SaaS applications by your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "no opinion".

10) Do you think it is important to define level of service availability within a formal contract?
   - ○ Yes, I think it is important to define level of service availability within a formal contract.
   - ○ Yes, I think it is important to define level of service availability, but I do not think it should be defined formally in a contract.
   - ○ No, I do not think it is necessary to define level of service availability in a formal contract since it might be changed frequently due to business changes.
   - ○ No, I do not think it is necessary to define level of service availability.
   - ○ No opinion.

11) Do you have any idea how important is to scale up and scale out[12] application and data for a SaaS-based application?
   - ○ I would think the possibility to scale application and data is very important for a SaaS-based application.

[12] The scalling out technique means partitioning and replicating a database into multiple servers while the scaling up means moving to a larger server which has more powerful processors and quicker disk drives.

- I would think the possibility to scale application and data is not so important for a SaaS-based application.
- I would think it is a little bit unnecessary to scale application and data.
- I would think scaling application and data is not necessary at all.
- No opinion.

12) Would you think it is important to define level of service reliability within a formal contract?
- Yes, I think it is important to define level of service reliability within a formal contract.
- Yes, I think it is important to define level of service reliability, but I do not think it should be defined formally in a contract.
- No, I do not think it is important to define level of service reliability in a formal contract.
- No, I do not think it is necessary to define level of service reliability since it is hard to measure.
- No opinion.

13) In your opinion, how confident are your organization can protect personal and enterprise data of your clients?
- I am certainly sure that the personal and enterprise data are safely secured.
- I think only to some degree that the personal and enterprise data are safely secured.
- It is hard to say whether or not the personal and enterprise data are safely secured.
- No, I do not think the personal and enterprise data are safely secured since I hardly find any procedure for data security.
- No opinion.

COMPREHENSIVE SUPPORT BENEFITS

This section describes the benefits of SaaS which include facilitating information integration, and enabling regulatory compliance. In each number, please choose the description that represents to what extent you would agree upon the current situation of delivering SaaS applications by your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "no opinion".

14) How likely do you think your organization manage databases according to data management approach[13]?
- It is very likely that multiple clients' databases are managed according to data management approach.
- It is moderately likely that multiple clients' database is managed according to data management approach.
- It is slightly likely that multiple clients' database is managed according to data management approach.
- No, I do not think the enterprise perform any data management according to data management approach for any clients.
- No opinion.

[13] Depending on technical and business considerations, multi-tenant data management can be distinguish into separate database, shared database with different schema, and shared database with the same database schema.

15) In your opinion, would you categorize the SaaS application which is provided by your organization as a centralized-network based application or a locally-installed application?

- ○ I would certainly think that the application can be categorized into a centralized-network based application.
- ○ I would think that the application can be categorized into a centralized-network based application, but some services within the application are also performed locally.
- ○ I would think that the application can be categorized into a locally-installed application, but some services within the application are also performed centrally.
- ○ I would certainly think that the application can be categorized into a locally-installed application.
- ○ No, I do not think that the application can be categorized into either a centralized-network based application or a locally-installed application
- ○ No opinion

16) Would you think it is possible for the application to accommodate new laws and regulations?

- ◉ Yes, I would think that it is certainly possible for the application to accommodate new laws and regulations.
- ○ Yes, I would think that it is possible, but only to some degree that new laws and regulations can be accommodated within business logic of applications.
- ○ Yes, I would think that it is probably possible in limited circumstances.
- ○ No, I do not think that it is possible.
- ○ No opinion.

The benefits of SaaS from the perspective of the lifecycle process of SaaS

STANDARDIZED SERVICE CONTRACT

This section describes how the design principle of standardized service contract can be appreciated during the lifecycle of SaaS. This principle is an essential part of service design since it aims at defining services as clearly as possible in order to reduce future issues which might be faced during the delivery of SaaS applications. In order to accommodate this principle, two characteristics should exist, which are *consistency of information about services*, and *description level of services*. These characteristics will be represented as eight statements in Table G.4 with five different answer options, which are ”completely agree”, “agree to some degree”, “neutral”, “quite disagree”, and “strongly disagree”. In each statement, please choose one option that represents to what extent you would agree upon the current situation of process in designing services within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose “neutral”.

Table G. 4 The principle of standardized service contracts can be indicated by consistency information and description level of services

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
1)	Both of your organization as a SaaS provider and your clients as SaaS adopters contribute to the conceptualization of SaaS contract during contract meeting.	○	○	○	○	○
2)	Representatives from both parties agree to sign the contract during the first contract meeting.	○	○	○	○	○

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
3)	The project of adopting SaaS application is officially started after the contract is signed.	○	○	○	○	○
4)	Technical descriptions, including *basic cost, periodical service charge, and Service Level Agreements*, are provided in detail in the contract.	○	○	○	○	○
5)	The contract contains information about the availability of services and data, including *service levels, business continuity protection, termination and the related consequences*.	○	○	○	○	○
6)	The contract contains information about how to perform data management and authorization, including *data privacy and security*, e.g. information security.	○	○	○	○	○
7)	The contract incorporates information about additional services and fees, including *uptime guaranties and penalties, escalating discounts for incremental spending*.	○	○	○	○	○
8)	The contract provides sufficient information about technical descriptions of services.	○	○	○	○	○

SERVICE LOOSE COUPLING

This section describes how the design principle of service loose coupling can be appreciated during the lifecycle of SaaS. This principle promotes an interoperable service which is independent with other services but may require information from other services in order to optimize enterprise resources and business performance. In order to accommodate this principle, two characteristics should exist, which are *availability of configuration options for services*, and *granularity level of services*. These characteristics will be represented as five statements in Table G.5 with five different answer options, which are ”completely agree”, “agree to some degree”, “neutral”, “quite disagree”, and “strongly disagree”. In each statement, please choose one option that represents to what extent you would agree upon the current situation of process in designing services within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose “neutral”.

Table G. 5 The principle of service loose coupling can be indicated by availability of configuration options and granularity level of services

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
9)	SaaS application is provided with configuration options toward the same scope of services which have been described in the contract.	○	○	○	○	○
10)	SaaS application is provided with capability to change scope of services which have been described in the contract.	○	○	○	○	○

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
11)	Services related to SaaS application are loosely-coupled[14] with other services.	○	○	○	○	○
12)	It is possible for other providers to provide similar services related to SaaS application which are currently available.	○	○	○	○	○
13)	There is significant impact in business performance within client's enterprise during the implementation of services related to SaaS application.	○	○	○	○	○

SERVICE ABSTRACTION

This section describes how the design principle of service abstraction can be appreciated during the lifecycle of SaaS. This principle aims at providing necessary information for service communication. In order to accommodate this principle, two characteristics should exist, which are *generality level of (published) information about services*, and *the depth information about service implementations*. These characteristics will be represented as four statements in Table G.6 with five different answer options, which are ""completely agree", "agree to some degree", "neutral", "quite disagree", and "strongly disagree". In each statement, please choose one option that represents to what extent you would agree upon the current situation of process in designing services within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

Table G. 6 The principle of service abstraction can be indicated by generality level of information and depth information about service implementations

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
14)	The information about services related to SaaS application which are published by your organization is sufficient to represent main feature of the application.	○	○	○	○	○
15)	Your organization provides information regarding the detail implementation of services related to SaaS application.	○	○	○	○	○
16)	Governance of services related to SaaS application is made available by your organization and is accessible by clients.	○	○	○	○	○
17)	Additional information about services related to SaaS application is stated in a formal contract.	○	○	○	○	○

SERVICE REUSABILITY

This section describes how the design principle of service reusability can be appreciated during the lifecycle of SaaS. This principle is the core of delivering a service-oriented application which aims at

[14] Basic pattern in loose-coupling: *location independence* through dynamic discovery, *communication independence* through web service standard, *security independence* through a federated security standard, and *instance independence* through a synchronous and asynchronous model [Linthicum, 2007]

designing multipurpose services which can be reused for different purposes. In order to accommodate this principle, two characteristics should exist, which are *multipurpose level of services*, and *frequency of reusable services*. These characteristics will be represented as four statements in Table G.7 with five different answer options, which are "completely agree", "agree to some degree", "neutral", "quite disagree", and "strongly disagree". In each statement, please choose one option that represents to what extent you would agree upon the current situation of process in designing services within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

Table G. 7 The principle of service reusability can be indicated by multipurpose level of services and frequencey of reusable services

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
18)	It is possible to change service descriptions which have been described in the contract in order to accommodate business changes.	○	○	○	○	○
19)	Services related to SaaS application is designed for multipurpose in order to accommodate business changes.	○	○	○	○	○
20)	Services related to SaaS application can be reused to serve various business processes.	○	○	○	○	○
21)	Services related to SaaS application can be redundant with other services.	○	○	○	○	○

SERVICE AUTONOMY

This section describes how the design principle of service autonomy can be appreciated during the lifecycle of SaaS. This principle aims at designing reliable services which have self-governance to their logic while being capable of sharing their resources. In order to accommodate this principle, two characteristics should exist, which are *governance level of services*, and *capability of autonomous services*. These characteristics will be represented as three statements in Table G.8 with five different answer options, which are "completely agree", "agree to some degree", "neutral", "quite disagree", and "strongly disagree". In each statement, please choose one option that represents to what extent you would agree upon the current situation of process in designing services within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

Table G. 8 The principle of service autonomy can be indicated by governance level of services and capability of autonomous services

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
22)	Governance of services related to SaaS application is defined in detail in a formal contract.	○	○	○	○	○
23)	Services related to SaaS application have controls toward their underlying (business or application) logic.	○	○	○	○	○
24)	Services related to SaaS applications can share their resources with other services although they remain independent toward each other.	○	○	○	○	○

SERVICE STATELESSNESS

This section describes how the design principle of service statelessness can be appreciated during the lifecycle of SaaS. This principle supports effective process and efficient resources by providing information if it is necessary. In order to accommodate this principle, two characteristics should exist, which are *availability level of services*, and *possibility of scaling application and data*. These characteristics will be represented as three statements in Table G.9 with five different answer options, which are "completely agree", "agree to some degree", "neutral", "quite disagree", and "strongly disagree". In each statement, please choose one option that represents to what extent you would agree upon the current situation of process in designing services within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

Table G. 9 The principle of service statelessness can be indicated by availability level of services and possibility of scaling application and data

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
25)	Services related to SaaS application are always available during the period of contract.	○	○	○	○	○
26)	It is possible to increase scalability[15] of the application and data.	○	○	○	○	○
27)	Procedure to scaling the application and data is defined in a formal contract.	○	○	○	○	○

SERVICE DISCOVERABILITY

This section describes how the design principle of service discoverability can be appreciated during the lifecycle of SaaS. This principle promotes an easy access toward capabilities of services which are related to SaaS application. In order to accommodate this principle, two characteristics should exist, which are *accessibility level of services*, and *availability of mechanisms of discovering services*. These characteristics will be represented as three statements in Table G.10 with five different answer options, which are "completely agree", "agree to some degree", "neutral", "quite disagree", and "strongly disagree". In each statement, please choose one option that represents to what extent you would agree upon the current situation of process in designing services within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

Table G. 10 The principle of service discoverability can be indicated by accessibility level of services and availability of service discovery mechanism

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
28)	Services related to SaaS application can be accessed easily.	○	○	○	○	○
29)	Discovery mechanisms of services related to SaaS application are formalized in a procedure to discover services.	○	○	○	○	○
30)	Discovery mechanisms of services related to SaaS application are communicated with clients.	○	○	○	○	○

[15] Scalability can refer to the ability to increase volume without impacting costs.

SERVICE COMPOSABILITY

This section describes how the design principle of service composability can be appreciated during the lifecycle of SaaS. This principle enables complex customs options toward SaaS application and the related services. In order to accommodate this principle, two characteristics should exist, which are *custom option level of services*, and *flexibility of custom options for services*. These characteristics will be represented as two statements in Table G.11 with five different answer options, which are "completely agree", "agree to some degree", "neutral", "quite disagree", and "strongly disagree". In each statement, please choose one option that represents to what extent you would agree upon the current situation of process in designing services within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

Table G. 11 The principle of service composability can be indicated by custom option level and flexibility of custom options

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
31)	Services related to SaaS application can be reused and recomposed to accommodate changes in business requirements and technology.	○	○	○	○	○
32)	Capability of services is communicated effectively to clients.	○	○	○	○	○

III. Questionnaire Guide for SaaS adopters

In this questionnaire guide, the perspective of SaaS adopters will be addressed by conceptualizing SaaS benefits which are perceived by clients who adopt a SaaS application. The perceived benefits are approached by developing a SaaS maturity model which incorporates key characteristics of the benefits at different levels. The key characteristic of *utility based* is incorporated within *Level 0 (Potential)* while the key characteristic of *SLA driven* is incorporated within *Level 1 (Prospective)*. The key characteristic of *shared resources efficient* and *community contribution* are included within *Level 2 (Promising)* whereas the key characteristic of *reliability and fault tolerance* and *flexible and scalable* are included within *Level 3 (Achieving)*. The level maturity of *Stabilizing (Level 4)* includes the key characteristic of *collaborative and smart*, and *credible and accountable* while the level maturity of *Optimizing (Level 5)* includes the key characteristic of *nimbleness* and *sustainable and successful*. According to these key characteristics, a list of questions is structured in order to understand to what extent a client may perceive benefits from adopting SaaS within his/her organization and to what extent the perceived benefits can be associated with different benefits which are commonly perceived by SaaS adopters within the levels of SaaS maturity.

Furthermore, in order to have a better understanding toward the lifecycle process of SaaS related to the delivery of the system from clients' perspectives, the questionnaire is also equipped with questions that aim at understanding the process of delivering SaaS applications from the perspective of SaaS adopters during the lifecycle of SaaS within which the principles might be applied when services related to the system are specified at different processes of SaaS lifecycle. The lifecycle includes three processes of *service discovery, service selection and engagement,* and *service enactment*. The first process includes the design principles of *standardized service contract, service loose coupling, service abstraction,* and *service discoverability*; while the second process includes all of the design principles, which are *standardized service contract, service loose coupling, service abstraction, service reusability, service autonomy, service statelessness, service discoverability,* and *service composability*. The third process includes the design principles of *service reusability, service autonomy, service statelessness,* and *service composability*. According to these design principles which are appreciated in the respective processes, a list of questions is structured in two different sections each of which represent earlier and latter processes of SaaS lifecycle, respectively.

You have been selected to fulfil this questionnaire because you are involved during the adoption of SaaS ERP system, which is later referred as SaaS application, in your organization. The questionnaire starts with general questions about you and your organization. Then, two themes follows each of which aims at understanding the benefits of SaaS from the perspective of the adopters, and the perspective of the lifecycle process of SaaS, consecutively. The total number of questions related to the perceived benefits from the perspective of the adopters is 20 questions while the total number of questions related to the lifecycle process of SaaS is 34 questions. The questionnaire ends with an open field that is provided to accommodate your comment.

General questions

Name of respondent: Click here to enter text.

This question is not relevant for analyzing the results from questionnaire. However, it might be possible that the respondent leave this question blank as anonymous.

Age: Choose an item.

The age of the respondent may be relevant by indicating the interest in new innovations. However, it might be possible that the respondent leave this question blank.

Gender: ◉ Female ○ Male

This is a general question. Respondent should choose either male or female.

Job title of respondent: Choose an item.
This is relevant to analyze the reliability of information that is provided by the respondent. This question will be represented as a drop-down menu that presents a list of job titles which should be chosen by the respondent. The job titles include:

- Accountant
- Administrator
- Auditor
- Business Analyst
- CEO
- CFO
- Consultant
- Director
- Engineer
- Finance Analyst
- Help desk
- Instructor
- Manager
- Officer
- Operator
- Production Supervisor
- Project Manager
- Sales rep
- Scientist
- Senior Accountant
- Specialist
- Software Developer
- Student
- Supervisor
- Systems Analyst
- Technician
- Vice president/executive
- Other

- Accountant
- Administrator
- Auditor
- Business Analyst
- CEO
- CFO
- Consultant
- Director
- Engineer
- Finance Analyst
- Help desk
- Instructor
- Manager
- Officer
- Operator
- Production
- Supervisor
- Project Manager
- Sales rep
- Scientist
- Senior Accountant
- Specialist
- Software Developer
- Student
- Supervisor
- Systems Analyst
- Technician
- Vice president/executive
- Other

Organization sector: Choose an item.
This is a general question about organization based on business sector, which includes:

- Accommodation and Food Services
- Administrative and Support, Waste Management and Remediation Services
- Agriculture, Forestry, Fishing and Hunting
- Arts, Entertainment and Recreation
- Construction
- Finance and Insurance
- Information
- Management of Companies and Enterprises
- Manufacturing
- Mining, Quarrying, and Oil and Gas Extraction
- Public Administration
- Real Estate and Rental and Leasing
- Retail Trade
- Transportation and Warehousing
- Utilities
- Other

Number of employees: Choose an item.
This question can indicate the size of the organization.

Year started with service-orientation and SaaS thinking in the organization: Choose an item.
This question can indicate the degree of innovation within the organization

Specific questions

These questions are structured within two general themes. They are related to the benefits of SaaS that are perceived by the clients, and the benefits of SaaS from the perspective of the lifecycle process of

SaaS which are perceived by clients who are involved during lifecycle of SaaS. In addition, the latter theme will be divided into two sections each of which represent earlier and latter processes of SaaS lifecycle, respectively, within which the design principles of SOA can be appreciated during the lifecycle process of SaaS related to delivery of SaaS application.

The perceived benefits from the perspective of SaaS adopters

This section includes a number of questions about benefits of adopting SaaS applications within your organization. In each number, please choose the description that represents to what extent you would agree upon the current adoption of SaaS applications within your organization. If there is no description that can represent this adoption, or if you have no information about this, please choose "no opinion".

1) Based on your experience in the project of implementing a SaaS-based outsourcing application, how successful would you think the application in performing its intended tasks in order to fulfill business requirements over IT?
   - ○ I would think that the application is very successful in performing its intended tasks in order to fulfill requirements from business management of organization.
   - ○ I would think that to some degree the application is successful in performing its intended tasks in order to fulfill requirements from business management of organization.
   - ○ I would think that the application is of a slightly successful adoption in performing its intended tasks to fulfill business requirements.
   - ○ I would think that the application is not successful at all in performing its intended tasks.
   - ○ No opinion.

2) In your opinion, do you think subscription type for a SaaS application which is chosen by your organization is too complex, quite simple, or about right to support business process?
   - ○ I would think that the chosen subscription is too complex.
   - ○ I would think that the chosen subscription is somewhat complex.
   - ○ I would think that the chosen subscription is quite simple.
   - ○ I would think that the chosen subscription is about right.
   - ○ No opinion.

3) In your opinion, would you agree that the current outsourcing model that is adopted by your organization can help to improve the management of organization resources effectively and efficiently?
   - ○ Yes, I would completely agree that the current outsourcing model can help to improve the management of organization resources effectively and efficiently.
   - ○ Yes, I would agree but only to some degree that the current outsourcing model can help to improve the management of organization resources effectively and efficiently.
   - ○ I am afraid I could not either agree or disagree upon this question.
   - ○ No, I quite disagree that the current outsourcing model can help to improve the management of organization resources.

- ○ No, I strongly disagree that the current outsourcing model can help to improve the management of organization resources.

4) Would you agree that the current outsourcing model in your organization can contribute to business and IT alignment within the organization?
   - ○ Yes, I would agree entirely that the current outsourcing model can contribute to business and IT alignment within the organization.
   - ○ Yes, I would agree but only to some degree that the current outsourcing model can contribute to business and IT alignment within the organization.
   - ○ I am afraid I could not either agree or disagree upon this question.
   - ○ No, I quite disagree that the current outsourcing model can contribute to business and IT alignment within the organization.
   - ○ No, I strongly disagree that the current outsourcing model can contribute to business and IT alignment within the organization.

5) How convenient would you think if a vendor to whom you subscribe your SaaS application, offers similar applications to your competitors in the same business sector?
   - ○ I would feel very convenient since this situation may increase collaboration.
   - ○ I would feel moderately convenient since this situation may become an organization threat.
   - ○ I would feel slightly convenient even though it is very rare for vendors to offer the similar application to other enterprises by keeping the idea that the application which is provided by vendor is unique to each enterprise.
   - ○ I would not feel convenient at all.
   - ○ No opinion.

6) How likely would you think that identical applications can be of opportunity for collaboration?
   - ○ It is very likely that identical applications can be of an opportunity for collaboration.
   - ○ It is moderately likely that identical applications can be of an opportunity for collaboration, but only to some degree.
   - ○ It is slightly likely that little collaboration can be initiated through the identical applications.
   - ○ I do not think that that the identical applications can be of an opportunity for collaboration. I regard them as a threat.
   - ○ No opinion.

7) In your opinion, how likely would you find service descriptions within Service Level Agreements (SLAs) in a formal contract related to a SaaS application which is adopted by your organization?
   - ○ It is very likely that the description of services related to SaaS application is incorporated in a formal contract.
   - ○ It is moderately likely that the description of services related to SaaS application is incorporated in a formal contract, but only to some degree.
   - ○ It is slightly likely that the description of services related to SaaS application is incorporated in a formal contract, but only for few services.
   - ○ I do not think that there is such description in a formal contract.
   - ○ No opinion.

8) Based on your experience during the adoption of SaaS application, how likely would you be to change a SaaS contract after the application is implemented, e.g. changing service descriptions, or even moving to other different applications?
   - ○ It is very likely that a SaaS contract is changed during the delivery of the application since business requirements change frequently.
   - ○ It is moderately likely that a SaaS contract is changed to some degree during the delivery of the application, although we do understand changing contract would affect business performance.
   - ○ It is slightly likely that a SaaS contract is changed during the delivery of the application, because changing the contract would be similar with making a new contract.
   - ○ I do not think that we would be interested in changing a SaaS contract. Changing the vendor would be better off than changing the contract.
   - ○ No opinion.

9) As a user of SaaS application in your organization, how easy is it to change the look-and-feel of the application, e.g. application interface?
   - ○ I found that it is very easy to change the look-and-feel of the application.
   - ○ I found that it is moderately easy to change the look-and-feel of the application.
   - ○ I found that it is slightly easy to change the look-and-feel of the application.
   - ○ I found that it is not easy at all to change the look-and-feel of the application.
   - ○ No opinion.

10) How confident are your organization to let vendor of SaaS application manage all critical information of personal and enterprise data?
   - ○ I am certainly sure that the personal and enterprise data are safely secured by vendor.
   - ○ I think only to some degree that the personal and enterprise data are safely secured by vendor.
   - ○ It is hard to say whether or not the personal and enterprise data are safely secured by vendor.
   - ○ No, I do not think the personal and enterprise data are safely secured since I hardly find any procedure for data security which is described by vendor.
   - ○ No opinion.

11) How aware are you of any procedure to manage enterprise data that is included within a formal procedure in a contract?
   - ○ I am fully aware that there is such a detailed formal procedure in a contract.
   - ○ I am aware that there is such a formal procedure in a formal contract, but I think it is only a general procedure.
   - ○ I am aware that there is such a formal procedure, but I am not sure whether it is incorporated within a contract.
   - ○ I do not think there is such a formal procedure.
   - ○ No opinion.

12) Would you agree if a community whose community member adopts identical applications of SaaS is created in order to share experiences, challenges, and feedback from the adoption of the applications?
   - ○ Yes, I would definitely agree that such community should be created and I would be very interested in contributing within the community.

- Yes, I would agree if such community is created and I might be interested in joining the community.
- I am afraid I could not either agree or disagree to join such community.
- No, I would not agree if such community is created.
- No, I strongly disagree if such community is created.

13) In your opinion, how likely would you think that an integrated database in vendor's server can improve business performance in your organization?

- I think it is very likely that an integrated database in vendor's server can improve business performance through an efficient and effective IT support.
- I think it is moderately likely that an integrated database in vendor's server can improve business performance to some degree since an integrated database might be difficult to maintain.
- I think that it is slightly likely an integrated database in vendor's server can help to improve business performance since an integrated database might be possible to escalate data management conflict.
- I do not think business performance would be improved through an integrated database.
- No opinion.

14) How aware are you of any procedure to ensure business continuity, e.g. disaster recovery plan that is included in a formal contract?

- I am fully aware that there is a detailed procedure to ensure business continuity which is incorporated in a formal contract.
- I am aware that there is a procedure to ensure business continuity, but only a general procedure which is stated in a formal contract.
- I am aware that there is a procedure to ensure business continuity, but I am not sure whether it is incorporated within a formal contract.
- I do not think there is such a formal procedure.
- No opinion.

15) Would you think that configuration options which are provided by the vendor are flexible in order to meet business changes?

- Yes, I would certainly think the configuration options are flexible in order to satisfy changes in business requirements.
- Yes, I would think that the configuration options are flexible but only to some extent these options can accommodate changes in business requirements.
- Yes, I would think that only few configuration options are provided to satisfy changes in business requirements.
- No, I do not think that the configuration options are provided in order to satisfy changes in business requirements.
- No opinion.

16) Would you regard services and help desk supports from vendor who deliver SaaS application, are continuously available and reputably reliable?

- Yes, I would surely regard its services and supports are continuously available and reputably reliable.

- Yes, I would regard its services and supports are available but only to some degree they are available and thus only to some degree they can provide reliable services and supports.
- Yes, I would regard its services and supports are available but not reliable.
- No, I do not think its services and supports are reliable.
- No opinion.

17) Do you think that vendor who delivers a SaaS application in your organization allows users of the application to customize the application?
- Yes, we are allowed to customize the business rules and workflows of the application and provided with a good design interface to customize the application.
- Yes, we are allowed to customize the business rules and workflows of the application and but we are not provided with a good design interface to customize the application.
- Yes, but we are only allowed to configure user interface of the application.
- No, I do not think customizing the application would be possible.
- No opinion.

18) Would you regard the application which is outsourced from the vendor is a service-oriented application which is developed according to an established concept, namely Service Oriented Architecture (SOA)?
- Yes, I would definitely think so.
- Yes, I would think the application is delivered as a service, but I do not have any information whether it is developed according to SOA concept.
- Yes, I would think the application is delivered as a service, but I do think that it is a SOA-based application.
- No, I would not think that the application represents a service-oriented application.
- No opinion.

19) Do you have any idea whether or not vendor of SaaS application provides a shared database and infrastructure to support the application?
- Yes, I am certain that vendor of SaaS application provides a shared database and infrastructure to support the application.
- Yes, it is true that vendor of SaaS application provides an integrated database, but I am not sure whether the database is shared with other clients.
- Yes, it is true that vendor of SaaS application provides a shared infrastructure to support the application, but I am not sure whether it also provides a shared database.
- No, I do not think that it provides neither a shared database nor a shared infrastructure.
- No opinion.

20) Would you agree upon this statement: "vendor of SaaS application delivers services and help desk supports continuously while fostering pace and stability of the applications".
- Yes, I would definitely agree upon this statement
- Yes, I would agree upon this statement but only to some degree.
- I am neutral upon this statement.
- No, I quite disagree upon this statement.
- No, I strongly disagree upon this statement.

:: Service discovery, and service selection and engagement ::

In this section, four design principles of Service Oriented Architecture (SOA) will be appreciated during an earlier phase of SaaS lifecycle which includes two processes, which are discovering services, and selecting and engaging services. In each of the principle, several statements are provided with five different answer options, which are "completely agree", "agree to some degree", "neutral", "quite disagree", and "strongly disagree". In each statement, please choose one option that represents to what extent you would agree upon the current situation pertaining to services related to the delivery of SaaS application within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

STANDARDIZED SERVICE CONTRACT

This principle is an essential part of service design since it aims at defining services as clearly as possible in order to reduce future issues which might be faced during the delivery of SaaS applications. In order to accommodate this principle, two characteristics should exist, which are *consistency of information about services*, and *description level of services*. These characteristics are broken down into eight statements as depicted in Table G.12.

Table G. 12 Eight statements are derived from two charateristics that indicate the principle of standardized service contract

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
1)	Both vendor of SaaS application as a SaaS provider, and your organization as SaaS adopters contribute to the conceptualization of SaaS contract during contract meeting.	○	○	○	○	○
2)	Representatives from both parties agree to sign a SaaS contract during the first contract meeting.	○	○	○	○	○
3)	The project of adopting SaaS application is officially started after a SaaS contract is signed.	○	○	○	○	○
4)	Technical descriptions, including *basic cost, periodical service charge, and Service Level Agreements*, are provided in detail in a SaaS contract.	○	○	○	○	○
5)	A SaaS contract contains information about the availability of services and data, including *service levels, business continuity protection, termination and the related consequences*.	○	○	○	○	○
6)	A SaaS contract contains information about how to perform data management and authorization, including *data privacy and security*, e.g. information security.	○	○	○	○	○
7)	A SaaS contract incorporates information about additional services and fees, including *uptime guaranties and penalties, escalating discounts for incremental spending.*	○	○	○	○	○
8)	A SaaS contract provides sufficient information about technical descriptions of services.	○	○	○	○	○

SERVICE LOOSE COUPLING

This principle promotes an interoperable service which is independent with other services but may require information from other services in order to optimize enterprise resources and business performance. In order to accommodate this principle, two characteristics should exist, which are *availability of configuration options for services*, and *granularity level of services*. These characteristics are broken down into four statements as depicted in Table G.13.

Table G. 13 Four statements are derived from two charateristics that indicate the principle of service loose coupling

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
9)	Your organization is provided with the capability to configure services related to SaaS application, e.g. service to determine periodical service charge, service to calculate discounts for incremental spending, service to provide extra security and privacy toward critical financial data.	○	○	○	○	○
10)	Your organization is provided with the capability to change scope of services which have been described in a SaaS contract, e.g. fixed discounts for incremental spending, standardized data security methods.	○	○	○	○	○
11)	It is possible for other SaaS providers (vendors) to provide similar services related to SaaS application which are currently available.	○	○	○	○	○
12)	There is significant impact in business performance within your organization during the implementation of services related to SaaS application.	○	○	○	○	○

SERVICE ABSTRACTION

This principle aims at providing necessary information for service communication. In order to accommodate this principle, two characteristics should exist, which are *generality level of (published) information about services*, and *the depth information about service implementations*. These characteristics are broken down into four statements as depicted in Table G.14.

Table G. 14 Four statements are derived from two charateristics that indicate the principle of service abstraction

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
13)	The information about services related to SaaS application which are published by vendor that provide the application is sufficient to represent main feature of the application.	○	○	○	○	○
14)	The vendor who delivers a SaaS application provides information regarding the detail implementation of services related to the application, e.g. the underlying business logic which is used to perform financial management within the application.	○	○	○	○	○

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
15)	Governance of services related to SaaS application is made available by vendors who provide the application and is accessible by your organization.	○	○	○	○	○
16)	Additional information about services related to SaaS application is stated in a formal contract.	○	○	○	○	○

SERVICE DISCOVERABILITY

This principle promotes an easy access toward capabilities of services which are related to SaaS application. In order to accommodate this principle, two characteristics should exist, which are *accessibility level of services*, and *availability of mechanisms of discovering services*. These characteristics are broken down into three statements as depicted in Table G.15.

Table G. 15 Three statements are derived from two charateristics that indicate the principle of service discoverability

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
17)	Services related to SaaS application can be accessed easily.	○	○	○	○	○
18)	Discovering services related to SaaS application are formalized in a procedure.	○	○	○	○	○
19)	Discovery mechanisms of services related to SaaS application which are developed by vendor are communicated your organization.	○	○	○	○	○

:: Service selection and engagement, and service enactment ::

In this section, four design principles of Service Oriented Architecture (SOA) will be appreciated during the later phase of SaaS lifecycle which includes two processes, which are service selection and engagement, and service enactment. In each of the principle, several statements are provided with five different answer options, which are "completely agree", "agree to some degree", "neutral", "quite disagree", and "strongly disagree". In each statement, please choose one option that represents to what extent you would agree upon the current situation pertaining to services related to the delivery of SaaS application within your organization. If there is no description that can represent the situation, or if you have no information about the situation, please choose "neutral".

SERVICE REUSABILITY

This principle is the core of delivering a service-oriented application which aims at designing multipurpose services which can be reused for different purposes. In order to accommodate this principle, two characteristics should exist, which are *multipurpose level of services*, and *frequency of reusable services*. These characteristics are broken down into four statements as depicted in Table G.16.

Table G. 16 Four statements are derived from two charateristics that indicate the principle of service reusability

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
20)	It is possible to change service descriptions which have been described in a SaaS contract in order to accommodate business changes.	○	○	○	○	○
21)	Services related to SaaS application is designed for multipurpose in order to accommodate business changes.	○	○	○	○	○
22)	Services related to SaaS application can be reused to serve various business processes.	○	○	○	○	○
23)	Services related to SaaS application can be redundant with other services, e.g. within extensions and add-ons.	○	○	○	○	○

SERVICE AUTONOMY

This principle aims at designing reliable services which have self-governance to their logic while being capable of sharing their resources. In order to accommodate this principle, two characteristics should exist, which are *governance level of services*, and *capability of autonomous services*. These characteristics are broken down into four statements as depicted in Table G.17.

Table G. 17 Four statements are derived from two charateristics that indicate the principle of service autonomy

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
24)	Governance of services related to SaaS application, e.g. periodical updates and maintenance, is defined in detail in a formal contract.	○	○	○	○	○
25)	Business performance can be improved if services related to SaaS application are autonomous in satisfying business changes, e.g. a service to calculate discounts on incremental spending would be independent from a service to determine periodical service charge	○	○	○	○	○
26)	Services related to SaaS application have controls toward their underlying (business or application) logic.	○	○	○	○	○
27)	Services related to SaaS applications can share their resources with other services although they remain independent toward each other.	○	○	○	○	○

SERVICE STATELESSNESS

This principle supports effective process and efficient resources by providing information if it is necessary. In order to accommodate this principle, two characteristics should exist, which are *availability level of services*, and *possibility of scaling application and data*. These characteristics are broken down into four statements as depicted in Table G.18.

Table G. 18 Four statements are derived from two charateristics that indicate the principle of service statelessness

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
28)	Services related to SaaS application are always available during the period of SaaS contract.	○	○	○	○	○
29)	Services related to SaaS application remain stateful unless they are needed during the period of SaaS contract.	○	○	○	○	○
30)	I would agree if SaaS application and or data are scaled up to bigger capacity of server.	○	○	○	○	○
31)	I would agree if SaaS application and or data are scaled out to many servers.	○	○	○	○	○

SERVICE COMPOSABILITY

This principle enables complex customs options toward SaaS application and the related services. In order to accommodate this principle, two characteristics should exist, which are *custom option level of services*, and *flexibility of custom options for services*. These characteristics are broken down into three statements as depicted in Table G.19.

Table G. 19 Three statements are derived from two charateristics that indicate the principle of service composability

No	Statement	Do you agree?				
		Completely agree	Agree to some degree	Neutral	Quite disagree	Strongly disagree
32)	It is possible to customize services related to SaaS application, e.g. changing business logic to calculate the service to calculate discounts on incremental spending.	○	○	○	○	○
33)	Services related to SaaS application can be reused and recomposed to accommodate changes in business requirements and technology	○	○	○	○	○
34)	Capability of services is communicated effectively by vendor who provides SaaS application.	○	○	○	○	○

Curriculum Vitae

Anisah Herdiyanti was born in Surabaya in January 1987. The author's educational background is S.Kom (Computer Engineering) degree in Information Systems from Institut Teknology Sepuluh Nopember (ITS), Surabaya, Indonesia, 2008. She loves to travel and practice new food recipes. She also loves kids, origami, and books.

She is currently a junior lecturer in ITS within which she joins the Laboratory of Strategic Planning of Information Systems. She also became an editor of some IT related books, and collaborated with Professor Sarno to publish a book about framework writing, entitled "Metode Framework Writing; Kiat Sukses Menulis" [ISBN: 978-979-756-678-4]. Her research interests include IT Audit, IT Policy and Governance, Strategic Planning for Information System, and service-oriented concept.