PREDICTING THE PERFORMANCE OF ERP IN A CHANGING AND CHALLENGING ENERGY MARKET

MASTER THESIS

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PREFACE

This thesis is the result of six months hard work and concludes my life as a student at the University of Twente and as an intern at Avanade. The last six months have been an exciting journey, which were devoted to reading interesting papers, speaking to experienced people and writing about ERP, the energy market, and non-commodity products and services. In this journey, I have learned a lot about the potential of ERP and the energy transition to non-commodity products and services. I received help from many people regarding various topics, for which I am very grateful. Thank you all! A few of them I would like to mention here explicitly.

Numerous meetings with Richard van Os and Jeroen van de Beek have helped me to find my way in the world of ERP and the energy market. Many thanks to Richard and Jeroen for their help, support and for challenging me to go outside my comfort zone during this research.

I also would like to thank my supervisors Klaas Sikkel and Jos van Hillegersberg from the University of Twente for their guidance and valuable insights throughout this research. Their feedback, whether it was enthusiastic or critical, helped me to structure and improve my research.

A special thanks goes to the organisations that helped me to explore the changing and challenging world of generating and selling energy and helped me to validate and complete the findings of this research. These organisations contributed to bring this research to a higher level.

Finally, I would like to thank my friends and family for their feedback and help throughout the last six months and all the years before. A specials thanks goes to Ursula Wegmann for always listening to me and supporting me in this journey.

For now, I hope you will enjoy reading this thesis as much as I enjoyed writing it.

Regards,

Jonas van den Bogaard

EXECUTIVE SUMMARY

"*The energy supplier of today, which focuses on the production and sales of electricity (and gas), has no sustainable future. Energy suppliers have to redesign themselves to survive.*" All energy suppliers approached in this research confirmed this statement. All four energy suppliers are searching for new ways to position themselves in the future energy market. One thing is clear, in this new position non-commodity products and services (e.g., solar installations and energy management tools) are of great importance. New IT solutions are required to support (the sales and delivery of) non-commodity products and services. However, there is some ambiguity around which IT solution would fit best. This research, therefore, aims to provide insight into the expected performance of ERP as a solution for non-commodity products and services supplied by energy suppliers. The expected performance is the degree to which an ERP implementation provides the expected benefits for the organisation.

A literature review has been executed to determine a model and methodology to predict the performance of ERP. The developed model explains which constructs are important. The expected ERP performance depends on the fit and viability of the selected ERP. When an ERP has a good fit and is viable, the system can provide the expected benefits and users will be satisfied. The fit depends to which extent the business needs match with the ERP functionalities, moderated by resolution strategies. The business needs are assessed based on the current business situation (e.g., business processes) and organisational drivers (e.g., the current IT landscape is too expensive). The viability depends on the economic, the IT infrastructure, the organisation and the third party constructs. The economic construct determines whether the ERP system is economic feasible and justifiable. The IT infrastructure construct refers to which extent the selected ERP fits in the current IT infrastructure. The organisation construct refers to the extent the organisation is willing to implement the selected ERP and is ready for using this ERP. The third party construct refers to which extent third parties (that are involved) support the selected ERP.

Based on the model, a methodology has been introduced, tested and improved. This methodology consists of five steps: *Step 1: Assess the current business situation and drivers in the organisation, Step 2: Find business needs & assess the economic, IT infrastructure, organisation and third party constructs, Step 3: Analyse the ERP functionalities, Step 4: Assess the fit and viability, and Step 5: Determine the performance.*

The methodology (and model) has been demonstrated in the energy market to predict the performance of two versions of Microsoft Dynamics AX (Microsoft Dynamics AX 2012 and MECOMS 2012) as an ERP solution for non-commodity products and services. During this demonstration, literature reviews are conducted, and nine experts (primarily experts from energy suppliers and Avanade) are interviewed.

The demonstration resulted in the prediction of the performance of Microsoft Dynamics AX for four energy suppliers. For young energy suppliers (founded after 2000 and characterised by a "flexible and open-for-change" culture) Microsoft Dynamics AX 2012 is a good solution to consider. For traditional energy suppliers (founded before 2000 and characterised by a "rigid and change-resistant" culture) Microsoft Dynamics AX 2012 is a good solution to consider under the condition the organisation is first restructured. For traditional energy supplier MECOMS 2012 is a questionable solution to consider. There will be a need for organisational restructuring, but even then it will be questionable whether MECOMS 2012 is a good technology to consider if the solution is only used for non-commodity products and services. In that case, it would be better to consider another technology that better fits with the needs of the non-commodities.

The evaluation of the demonstration yields the conclusions that the predictions of the ERP performance are recognised and believed to give a fairly reliable overview of the reality and are considered to be relevant for each energy supplier considering ERP. Furthermore, this evaluation revealed that the introduced model and methodology is a relevant approach for any organisation in any particular market that is considering an ERP selection and implementation. Further research, however, is recommended.

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LIST OF ABBREVIATIONS

BPMN	Business Process Modelling Notation
CIGRE	International Council on Large Electricity Systems
CO2	Carbon dioxide
CRM	Customer Relation Management
DRG	Decentralised Renewable Energy Generation
DRGI	Decentralised Renewable Energy Generation Installation
DSRM	Design Science Research Methodology
ECN	Energy research Centre of the Netherland
ERP	Enterprise Resource Planning
HR	Human Resources
IEEE	Institute of Electrical and Electronics Engineers
IS	Information Systems
IT	Information Technology
MECOMS	Meter Data Management & Customer Information System
MRP	Manufacturing Resource Planning
MW	Megawatt
UML	Unified Modelling Language

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1 INTRODUCTION

Enterprise Resource Planning (ERP) is receiving significant attention in the literature. The performance (success or failure) of ERP depends on how ERP system is perceived. In this thesis, performance is defined as the degree to which an ERP implementation provides the expected benefits for the organisation. Up to today, ERP has been implemented at many organisations: both successfully and unsuccessfully. Several studies have identified which factors lead to successful implementations. However, very little research has been done in predicting the potential performance of an ERP implementation in a particular market. In this research, the performance of ERP is predicted for the market for non-commodity products and services. This introductory chapter gives an overview of the context, the research setting and problem motivation behind this research (1.1, 1.2, and 1.3) as well as the research goals and objectives, the research scope and the research questions (1.4, 1.5 and 1.6).

1.1 Context

The Dutch government has committed to reducing the greenhouse gas emissions, increase decentralised renewable energy generation (DRG) and stimulate low-energy homes and buildings [1]. DRG, such as residential solar and wind installations, are an alternative to the traditional centralized non-renewable energy sources such as gas and coal, which produce harmful emissions. These products related to DRG and low-energy homes and buildings are referred to as non-commodity products and services in this thesis. This transition to DRG and low-energy homes and buildings, will reduce the volume of demand for centralized energy production based on gas and coal, and increase the demand for non-commodity products such as solar installations and energy management tools. Several scholars argue that suppliers of energy have to rethink their business models to create and find new value propositions related to non-commodities to sustain their business and keep their customers [2]–[4]. In order to provide these new non-commodity products and services, new investments in IT capabilities need to be considered, including the (improved) use of ERP. This research anticipates on the above-mentioned developments in the energy market [2].

1.2 Research setting

This research is conducted at the ERP Service Line of Avanade in the Netherlands. Avanade is an international provider of Microsoft-focused consulting services. The company provides IT services focused on the Microsoft platform for mid-sized to large enterprise organisations [5]. The company was founded in 2000 as a joint venture between Accenture and Microsoft. Avanade has over 70 locations in 20 countries and has an office in the Netherlands since 2004. The company has seven services lines: *Application development, Collaboration, CRM, Data analytics, ERP, Infrastructure services, and Managed services.*

The mission and vision of Avanade are to help organisations to increase the value of IT for the business by both delivering innovations to lower costs by making IT part of the organisations strategic capability [5]. The ERP Service Line focuses on one ERP system: Microsoft Dynamics AX. At this moment, this solution is applied to three markets in the Netherlands: Retail, Health and Utilities. This research focuses on a new application of Microsoft Dynamics AX in the energy market, which are the utilities.

Energy sector. The energy sector is involved in producing, transporting and supplying electricity to customers. In this sector, several parties can be distinguished. Kok, Scheepers and Kamphuis [6] introduced a model to distinguish these parties:

1. The *Producer* handles the production of the electricity. This producer can both be a large power producer as a small DRG producer.
2. The *Transmission system operator* handles the operation and maintenance of the transmission system. Thus the interconnected system of delivering the electricity from the large producer to the distribution grid.

3. The *Distribution system operator* handles the operation and maintenance of the distribution system. This system is the interconnected system of the transmission grid and the customer.
4. The *Energy Supplier* handles the sale of commodity products (e.g., electricity and gas) and non-commodity products and services (e.g., DRG installations) to the customer. In this research two types of energy suppliers are considered: the traditional energy suppliers (founded before 2000) and the young energy suppliers (founded after 2000).
5. The *Final customer* is the person who purchases the commodity products or non-commodity products and services for his use.

Traditionally energy suppliers were purely focused on buying and selling commodity products (e.g., electricity and gas). However, the deregulation of the energy market has increased the competition in the energy market (especially for energy suppliers), placing more stress on their margins and financial performance. Energy suppliers have to search for new ways to differentiate from another. Focusing on non-commodity products such as DRG installations and energy saving services can provide new sources of revenue and profit.

Microsoft Dynamics AX. Avanade's ERP offerings are based on the Microsoft Dynamics AX platform. Microsoft Dynamics AX is Microsoft's enterprise resource planning software for enterprises [5]. This systems includes all functionalities you would normally expect in an ERP system: *Financial Management, Procurement Management, Project Management and Project Accounting, Supply Chain Management, Inventory Management and Warehousing, Sales Orders, Production and Manufacturing, Service Management, HR Management and Payroll, Fixed Assets, CRM and Sales and Marketing, Web Portals, Workflow and Alerts, Reporting and Business Intelligence, as well as Development and Integration.*

MECOMS. Avanade's ERP offering for energy and utility providers [5]. MECOMS is built on the Microsoft Dynamics AX platform. MECOMS has four major business domains: *Customer Care & Billing, Meter Data Management, Market Interaction, and Operations.*

1.3 Problem statement

Avanade's ERP Service Line frequently reviews new opportunities in the energy market. The previous introduced transition in the energy market towards non-commodity products, such as DRG and energy-saving products, is showing a new promising opportunity for the application of ERP. However, because of the lack of insight into the needs of energy suppliers regarding non-commodity products, Avanade has no clear understanding of how to react to this new opportunity, which version of their ERP solutions would fit best in this market and is therefore not sure if it is viable to invest in this opportunity.

Therefore, Avanade approached me with the request to help define and evaluate a new proposition of using ERP for energy suppliers focused on non-commodity products. This request fits my research objective: to develop an information system (IS) proposition to support innovation and to provide knowledge about the impact of the IS on achieving the firm's strategic goals. Because there is little to no research on the use of ERP for non-commodity products, this is a good moment to study the potential value of ERP for non-commodity products.

1.4 Research goals and objectives

There is a lack of insight into the potential of ERP as a solution for non-commodity products in the changing and challenging energy market. Therefore, the goal of this research is: **To study the potential of ERP as a solution for non-commodity products and services**

The following objectives are set to accomplish this goal:

- *Understand how to predict the performance of ERP in a new market*
- *Understand the developments and needs of energy suppliers regarding non-commodity products and services*
- *Explain the match between ERP and these developments and needs*

The practical relevance of this research is the insight Avanade gains on the potential of their ERP offerings as a solution for non-commodity products and services in this changing energy market. This insight helps Avanade to decide on how to react on this new opportunity. The scientific relevance of this research is researchers getting insights into the gaps of ERP and into predicting the performance of an ERP in a niche markets.

1.5 Research scope and focus

The scope of this research encompasses the development of a model and methodology to predict the performance of ERP in the changing and challenging energy market. It should be noted that not all available ERP systems and the viewpoints of each party in the energy market are considered to be part of the scope due to the limitations of time. This research focuses on Microsoft's ERP system and the viewpoint from the energy supplier.

1.6 Research questions

To achieve the previous set of research goals and objectives the following main research question were answered in this thesis:

Main research question: **What is the expected performance of ERP as a solution for non-commodity products and services?**

The following six sub-questions will be answered to address answer the main research question:

1. *What are the factors that enable a good ERP performance?*

Various frameworks for predicting ERP performance are identified, which are subsequently synthesized into a single model to answer the first question.

2. *What methodology can be used to predict ERP performance?*

The second question is included for providing a methodology to apply the previously introduced model in a particular market.

3. *What are the needs of energy suppliers related to non-commodity products and services?*

The third question is included to understand the needs of energy suppliers about the non-commodities, such as DRG and energy saving products and services. In order to understand these needs, deeper knowledge is required on the current business situation of energy suppliers (including the relevant processes and requirements), how this situation is expected to change in the near future, and what impact this has on the energy suppliers and their IT.

4. *How do these needs of energy suppliers relate to ERP?*

The fourth question is included to understand how the non-commodity developments and needs relate to ERP. To predict the ERP performance, deeper knowledge is required on how the development and needs of the energy market match the ERP functionalities.

5. *To what extent are energy suppliers ready for ERP?*

The fifth question is included to understand if ERP is a viable solution for energy suppliers to consider.

6. *To what extent can the developed model and methodology be used to predict the performance of ERP?*

The sixth and last question is included to understand whether the developed model and methodology is useful for predicting the performance of ERP.

2 INTRODUCING THE TRANSITION TO DECENTRALISED RENEWABLE ENERGY GENERATION AND LOW-ENERGY HOMES

This chapter explores the context of the research in more detail and reveals the current developments and trends regarding the changing and challenging energy market. In the past few years, much has been written about the energy transition to DRG and low-energy homes. This chapter informs the reader about developments affecting the energy market and what this means for the transition towards non-commodity product and services (e.g., solar installation and energy management tools). First, the changing nature of electricity generation and usage is explained (2.1 and 2.2), followed by the discussion on the effects of this transition towards the (future) role of energy suppliers (2.4).

2.1 Literature review methodology overview

By conducting a preparatory literature review, the developments in the energy sector are explored for a better understanding of the research problem. For this literature review to be thorough and reliable, a structured search approach is used to perform this review. The search approach used in this study is based on the 'Grounded Theory Literature-Review Method' by Wolfswinkel, Furtmueller, & Wilderom [7]. For more details about this literature review refer to Appendix A.

2.2 The changing nature of electricity generation

According to Kok, Scheepers & Kamphuis [6] from Energy Research Centre of the Netherlands, there are two movements happening in the energy market. First there is the move towards more sustainable energy sources, and secondly there is the shift from central energy generation towards decentralised energy generation.

2.2.1 The increasing demand for sustainable energy sources.

The world is facing many challenges about energy supply, sustainability, and climate change [8]. As a sector, the energy sector has the highest production of CO2 in comparison to other sectors [9], [10]. This high production is due to the large demand for energy and the over-dependence on fossil fuels (oil, coal, and natural gas), which are the main contributors to CO2 emissions. In the Netherlands alone, fossil fuels generate over 85% of the total energy generation [11].

Energy generation mix					
2012			2020		
1.	Gas	22.000 MW	1.	Gas	16.000 MW (- 6.000 MW)
2.	Coal	4.200 MW	2.	Wind	5.600 MW **(+ 3.177 MW)**
3.	Wind	2.433 MW	3.	Coal	4.600 MW (+ 400 MW)
4.	Nuclear	510 MW	4.	Solar	4.000 MW **(+ 3.635 MW)**
5.	Solar	365 MW	5.	Nuclear	510 MW (+ 0 MW)

TABLE 1: PREDICTED ENERGY GENERATION MIX IN 2012 AND 2020 [11]

According to Kok, Scheepers & Kamphuis [6], there are two important drives to reduce the fossil fuel dependency:

- *Environmental concerns,* such as concerns about pollution and climate change.
- *Diversification of energy sources*. In most Western economies, energy is imported from elsewhere. With a never ending (and most probably increasing) demand for energy, these Western economies want to depend less on other countries and increase production in their countries.

Given this scenario, the challenge is to drastically decrease the dependency on fossil fuels

In September 2013, the Dutch government signed an energy agreement with 40 major players in the energy market to set targets for low-carbon and renewable energy generation [1]. Table 1 provides an overview of these targets. The advantages of using renewable energy generation are the elimination of harmful emissions and a decrease of the dependence on exhaustible resources of fossil energy. With these targets set, the prognosis is a reduction of the energy generation by fossil fuels from over 85% (of the total energy production) in 2012 to less than 70% by 2020, which means that the renewable generation capacity has to be tripled at the least. To achieve these objectives, the energy sector has to change and include more renewable sources.

2.2.2 Decentralization of electricity generation.

The renewable sources come in various shapes and sizes. This research distinguishes between central – and often large – generation installations (e.g., wind parks on-shore or offshore) and decentralised – small and plentiful – generation installations (e.g., residential solar panels or wind turbines). These decentralised renewable energy sources differ from the traditional sources. Traditionally the electricity was generated by (a few) large power plants and delivered via a high-voltage network to the local electric distribution systems serving the individual consumers [12]. With the development of decentralised renewable energy generation (DRG), the consumer of tomorrow (and today) may not only consume but also produce energy.

Definitions of decentralised renewable generation. In the introduction (section 1.1), decentralised renewable generation (DRG) has been loosely defined as small-scale electricity generation from a renewable source. Decentralised generation is also commonly called distributed generation, embedded generation or small-scale generation. However, when do we consider it small-scale? Is a wind park with only five wind turbines still considered as small-scale? A short survey of the literature shows there is some ambiguity in the exact definition.

Pepermans et al. [13] concluded there is as yet no universal agreement on the definition of decentralised generation. Some define decentralised generation based on the voltage level, where others base it on where the generation units connect to the grid. IEEE defines decentralised generation as the generation of electricity that is significantly smaller than central generation's plants[1]. The working group of CIGRE defines distributed generation as generation units with a maximum capacity of 50MW to 100MW and not centrally planned or dispatched[2]. Also, researchers came up with different definitions, Chambers [14] defined decentralised generation as generation units smaller than 30MW and sited at or near customer sites. Pepermans et al. [13] reviewed all different definitions and defined a decentralised generation as an electric power generation source connected directly to the distribution network or on the customer's side of the meter. This particular definition is used in this thesis.

Next question to answer: when do we consider a power source renewable? The term "renewable" is defined as naturally replenishable on a human timescale [10]. A generation unit is considered renewable when it comes from energy source which is naturally replenished on a human timescale.

Combining these two definitions: a DRG product is a small electric power generation unit connected directly to the distribution network or on the customer's side of the meter, which uses a replenishable energy source.

Classification of decentralised renewable generation. According to Pepermans et al. [13] and ECN[3] [10], there are five different types of DRG technologies: hydro, wind, photovoltaic, geothermal and thermal power. Table 2 provides an overview.

[1] IEEE stands for the Institute of Electrical and Electronics Engineers and the definition is taken from [84].
[2] CIGRE stands for the International Council on Large Electricity Systems and the definition is take from [84]
[3] ECN stands for the Energy research Centre of the Netherlands and the definition is taken from [10]

Name	Fuel	Description
Photovoltaic systems	Solar energy	Photovoltaic systems convert solar energy directly into electricity. These Photovoltaic units are commonly known as solar panels.
Wind systems	Wind energy	Wind systems, such as micro wind turbines, convert the kinetic energy of streaming air to electricity.
Solar Thermal systems	Solar energy	Solar thermal systems convert solar energy to heat. This heat is used to generate electricity.
Geothermal systems	Geothermal heat	Geothermal systems used geothermal heat from the earth to generate electricity.
Small Hydro systems	Water energy	Small hydro systems convert the kinetic energy of streaming water to electricity.

TABLE 2: OVERVIEW DRG TECHNOLOGIES

This research focuses mainly on photovoltaic systems and wind systems because these systems are by far the most widely available and used DRG products [15]. In Appendix B these two technologies have been discussed in more detail, the other technologies have not been discussed in detail in this thesis.

2.3 The changing electricity consumption

Also to the changing nature of electricity generation, the energy consumption is changing too. According to Busnelli, Shantaram and Vatta [4], the energy consumption is nowadays growing more slowly in Europe than before, and this trend is expected to continue in the future. One of the reasons for this changing energy consumption is that energy-efficiency measures begin to take hold.

The previous introduced drivers and energy agreement also stimulate a lower energy consumption [1]. Many new technologies, such as smart energy management tools, energy-efficient boilers and energy-efficient lighting, are introduced to decrease the energy consumption of homes and buildings [3], [4].

Definition of energy saving products and services. In contrast to the definition of decentralised renewable generation, the definition of energy saving products is clear. In this thesis, energy saving products and services refer to all products and services that contribute to a lower energy consumption.

2.4 The effects on the energy supplier's role

The continuing transformation towards more DRG and low-energy homes and building is seen as a serious threat to energy suppliers' business models [2], [4], [16], [17]. Traditionally the energy suppliers covered and focused on the value chain of power generation by large power plants through the transmission to distribution. The production and delivery of electricity for a fixed price is seen as their main value proposition, and competition is mostly based on this fixed price strategy [2], [17]. In this model, low prices for customers are achieved by serving more customer from the same "system". Therefore, the energy suppliers mainly focus on economies of scale to reduce production costs. In this traditional model, the energy suppliers were able to prosper and achieve high generation margins on the back of rapid economic growth and soaring commodity and energy prices. However, this model is no longer sustainable according to Klose et al. [3]. The political drive to stimulate cleaner energy production and the slow economic recovery (after the economic crisis in 2008) decreases the demand for energy from the traditional large power (mostly fossil fuel based) plants.

Furthermore, customers are moving from passive payers of monthly bills to being more proactive and engaged in energy consumption and production. The increasing electricity generation by customers and the increasing usage of energy saving products also decrease the demand for electricity from energy suppliers.

At the same time, the increasing electricity generation by DRG requires a large investment in the power grid. The intermittent nature of both wind and solar energy creates imbalances in the transmission and distribution grids [3], [18]. These imbalances threaten the reliability of the power grid. The energy suppliers and other parties in the sector are required to invest and introduce balancing mechanisms to manage the fluctuating demand and supply of energy. Summarizing all the above-mentioned developments one can say that the rising fixed costs for generation, transmission and distribution will have to be spread over declining energy volumes, leading to increased pressure on energy suppliers' profit margins. Energy suppliers have to adapt their business models to react to this trend [2], [16], [17].

Since DRG is not yet cost-competitive with large-scale power plants or large-scale renewable energy projects, it is one of the least attractive forms of electricity generation [13]. Several energy suppliers have started with pilot projects to offer DRG products to its customers [19][20]. However those who offer DRG services today, do not see DRG as a serious source of income and, therefore, do not heavily promote it. DRG services are mostly introduced to create political and customer goodwill, not for economical purposes. This barrier caused by a lack of profitability is the main reason DRG is not yet considered as an attractive market for energy suppliers [17]. To overcome this barrier, energy suppliers have to develop a new value proposition for DRG beyond the delivery of electricity only, and focus on new customer needs such as: price stability, energy independence and/or eco-friendly lifestyle [2]. By not developing such a new proposition, energy suppliers will fail to cope with tomorrow's changing demand.

The energy value chain	Generation	Transmission	Distribution	Consumption
Current value propositions in the energy sector	✓ Operation of large-scale power plants	✓ Operation of transmission grids	✓ Operation of distribution grid	✗ No value proposition
Potential value propositions in the energy sector	✓ Operation of large-scale power plants	✓ Operation of transmission grids	✓ Operation of distribution grid	✓ DRG and energy saving products and services

TABLE 3: VALUE CHAIN IN ENERGY SECTOR [17]

The challenge for energy suppliers is to change from a commodity (energy) provider to a comprehensive energy service provider. However, what does this change mean? Various studies have suggested potential new products and services: sale and delivery of DRG and energy saving products, installation services, operation and maintenance services, financial options and consulting services [3], [4], [17]. These services have to be seen as a strategic gateway into new revenue streams, such as the DRG (service) market and energy saving (service) market. These are two promising growth markets, considering the expected growth of DRG in the next few years [3], [21], [22]. However these are markets on the consumption side of the value chain and, therefore, are markets that are not yet or hardly been covered by the energy suppliers so far (see Table 3). Energy suppliers will face stiff competition in these markets [4]. Today, these markets are mostly harvested by companies outside the energy sector and are not yet adequately seized by energy suppliers. Energy suppliers need to have a better approach than the current companies in serving these

markets today. These markets require a pro-active approach to convince customers that the suppliers' new products and services add value to these markets.

To realize such a business model, the energy suppliers have to invest in and explore new capabilities to deliver these new services. Current pilot projects for DRG products and other non-commodity products have to be further developed and improved for mass production. These improvements require reviewing and changing current business processes. Also new IT capabilities (e.g., ERP) have to be explored and implemented. However, research on the contributions of these IT capabilities to these changing business processes is scarce. Therefore, this thesis research is initiated by Avanade and forms an attempt to close this knowledge gap.

3 RESEARCH PROCESS AND METHODOLOGY

This chapter describes the research outline. First, the research methodology is described (3.1). Secondly, the research model and document structure is presented (3.2 and 3.3), followed by a description of the used model languages and notations (3.4).

3.1 Research methodology

The Design Science Research Methodology (DSRM) has been applied to structure the research. Peffers et al. [23] introduced DSRM; DSRM provides an aligned methodology about how to conduct a design science research. Figure 1 presents an overview of the DSRM.

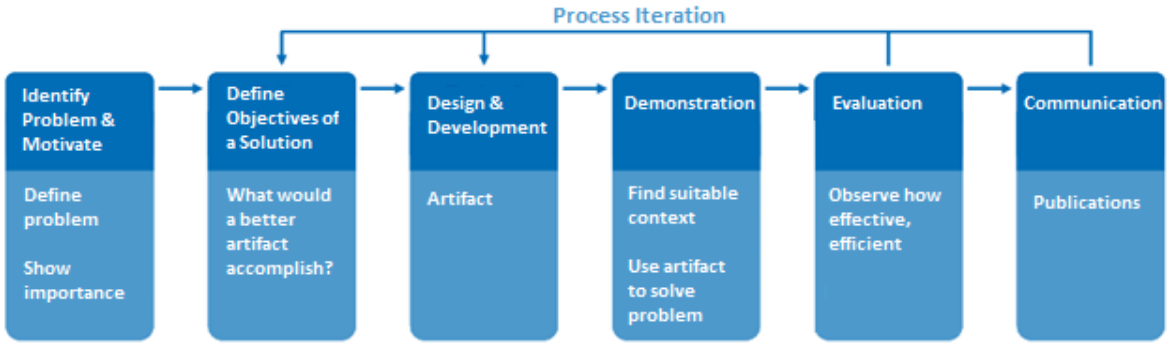

FIGURE 1: OVERVIEW OF THE RESEARCH METHODOLOGY (DSRM)

Based on the DSRM, the following five phases have been distinguished in this research study.

Problem identification and motivation. In this first step, the research problem has been defined, and the need for a solution has been justified (During the design study an artefact will be developed to provide a solution to the identified research problem).

Defining the objectives. The second step specifies the objectives of the (to be developed) solution based on the previous defined problem specification.

Design and development. The next step is related to the creating of the artefact. Artefacts can be potential constructs, models, methods, instantiations or new properties of technical, social and/or informational resources. In this step, the research determines the functionality of the artefact and defines its architecture.

Demonstration. The 'Demonstration' step is used to apply the created artefact and describes how and to which extent the artefact solves an instance of the problem. Several methods (e.g., case study, experimentation, simulation) are available to discuss the outcome.

Evaluation. In the 'Evaluation' step, the results of the demonstration are evaluated by screening the artefact against the original set of objectives. The researcher can decide to go back to the step "Design and development" to improve the artefact at the end of this step if needed.

Communication. The last phase concerns the communication about the research. This step brings together the results from all the previous steps and communicates these results to a relevant audience, in an appropriate form.

3.2 Research model

Due to a lack of research into this specific ERP field, an exploratory design research is conducted to predict the performance of ERP as a solution for non-commodity products and services. The research methodology, as stated in the previous section, in combination with the questions as stated in 1.6 Research questions leads to the research model as shown in Figure 2. This model helps to perform the research to answer the research questions. The model is explained in this section.

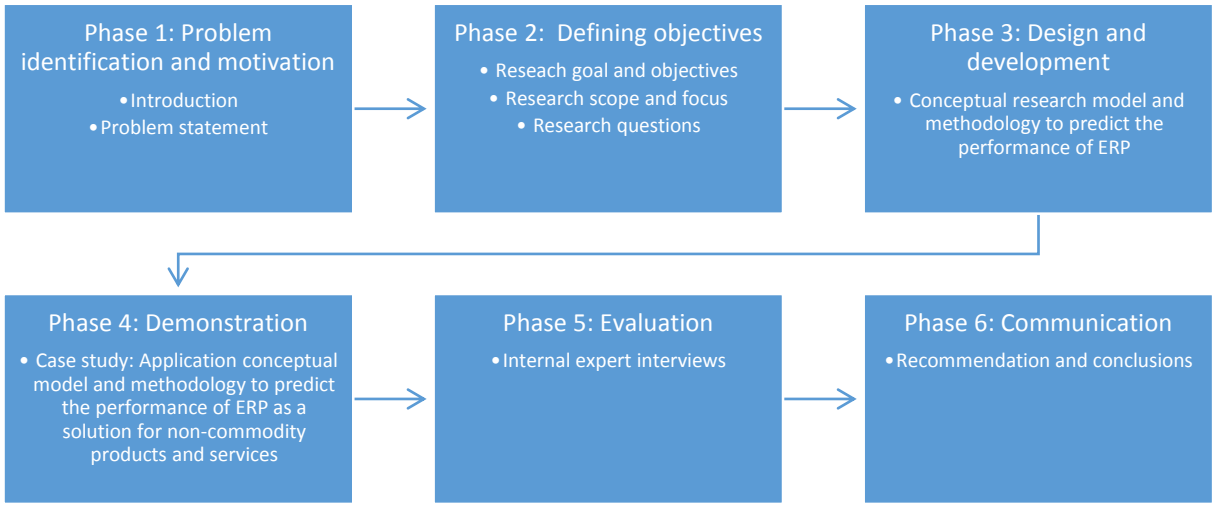

FIGURE 2: RESEARCH MODEL

Phase 1: In the first phase the problem, as well as the type of solution and motivation of it, are introduced.

Phase 2: In the second phase the problem is translated to set goals and objectives. Based on these goals and objectives a set of research questions is introduced. In this phase also the research scope and focus, process and methodology are selected.

Phase 3: To be able to create a conceptual model and methodology to predict the performance ERP, further insight into the predicting ERP performance is needed. Therefore, a literature review is conducted. In this literature review, the enablers of ERP performance and which techniques are available to predict ERP performance are studied in general,. This literature review helps to define a conceptual model to tackle down the identified problem and to answer the main research question. The literature review partly addresses the first two sub-question (sub-questions one and two as listed in section 1.6).

Phase 4: Next, the demonstration phase applies the previously introduced conceptual model and methodology in the energy market to predict the performance of ERP as a solution for non-commodity products and services. During the application of this methodology, the needs related to non-commodity and the readiness for ERP are described and discussed. Eight interviews with experts and a literature review are the basis of the needs and the readiness for ERP. These results will provide an answer to the third research sub-question. Then the ERP functionalities are formulated. Based on the needs and ERP functionalities, the relation to ERP (fit) and readiness for ERP (viability) are determined through two interviews with an ERP expert. This will answer sub-question four and five. The results of the fit and viability form the basis for the prediction of the performance of ERP in changing and challenging energy market.

Phase 5: During this phase, the results of the demonstration phase are evaluated. Both the conceptual model and the methodology itself and the results of the application of this conceptual model and methodology have been discussed with two ERP experts. Based on these results, the conceptual model, methodology and the credibility of the prediction are updated accordingly. This answers sub-question one, two and six.

Phase 6: Finally, in the communication phase recommendations and conclusions have been synthesized and the main research question is answered.

3.3 Document structure

This thesis document is structured as follows: Chapter 1 introduces the research object. Chapter 2 introduces the topic of changing and challenging energy market. Chapter 3 describes the research design, process, methodology and model as well as the document structure. Chapter 4 describes the conceptual model and methodology to predict the ERP performance that resulted from the literature review. Chapter 5 - 9 present the results of applying the previous conceptual model and methodology to predict the performance of ERP as a solution for non-commodity products and services. Chapter 10 describes the evaluation of the developed conceptual model and methodology. Chapter 11 presents the final conclusions and recommendations and answers the main research question. Table 4 provides an overview of the document structure and research topics.

Chapter	Research question	Research goal	Method
1. Introduction	-	-	-
2. Introducing the transition to decentralised renewable energy generation and low-energy homes	-	-	Preparatory literature review
3. Research process and methodology	-	-	-
4. Theoretical model and methodology for the prediction of ERP performance	1. What are the factors that enable a good ERP performance?	Understand how to predict the performance of ERP in a new market	Literature review
	2. What methodology can be used to predict ERP performance?		
5 – 9. Step 1 – 5 (Demonstration of the methodology)	3. What are the needs of energy suppliers related to non-commodity products and services?	Understand the developments and needs of energy suppliers regarding non-commodity products and services	Literature review
	4. How do these needs of energy suppliers relate to ERP?	Explain the match between ERP and these developments and needs	Expert opinions
	5. To what extent are energy suppliers ready for ERP?		
10. Evaluation	6. To what extent can the developed model and methodology be used to predict the performance of ERP?	Understand how to predict the performance of ERP in a new market	
11. Conclusion	Main research question: What is the expected performance of ERP as a solution for non-commodity products and services?	To study the potential of ERP as solution for non-commodity products and services	-

TABLE 4: DOCUMENT AND RESEARCH OVERVIEW

3.4 Model language and notation

In this research, various process models are presented. For these process models, one modelling language is used: the Business Process Modelling Notation. Next this notation is shortly introduced.

The Business Process Modelling Notation (BPMN) is a language for business process modelling that provides a graphical notation for specifying business processes in a Business Process Diagram [24]. BPMN is based on a flowcharting technique similar to the activity diagram of the Unified Modelling Language (UML).

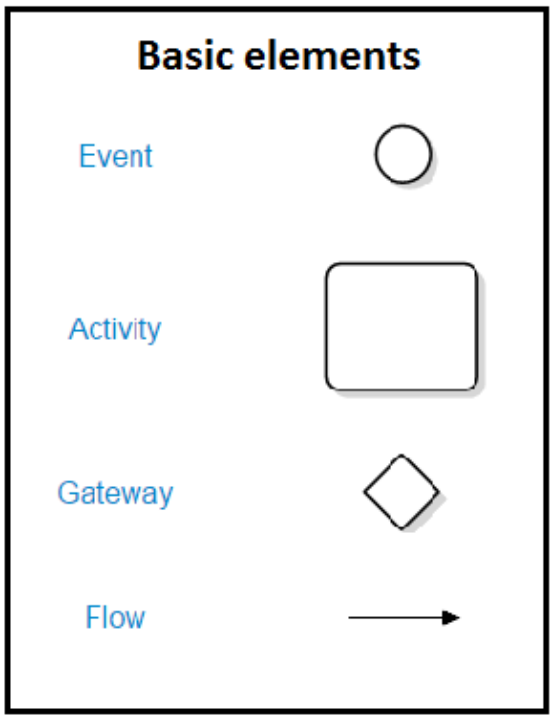

FIGURE 3: OVERVIEW BASIC ELEMENTS OF BPMN

The BPMN language consists of various elements. Figure 3 presents an overview of the relevant concepts of BPMN language which are applied in this research. Next, each element is briefly explained.

An *event* represents something that happens during the business processes. This event can be the occurrences in the real world that are relevant to the business processes.

An *activity* represents an exertion that must be done during the business processes. This activity can be for example, a task, sub-process or transaction.

A *gateway* is used to represent the join and split of the behaviour of the flow of control between two objects (e.g., activities, events and gateways). Join gateway has at least two incoming flows and one outgoing flow. Split gateway has at least one incoming flow and two outgoing flows. These gateways determine the flow depending on the conditions expressed.

A *flow* represents a connection between two objects (e.g., activities, events and gateways).

4 THEORETICAL MODEL AND METHODOLOGY FOR THE PREDICTION OF ERP PERFORMANCE

This chapter describes a theoretical model and methodology to predict the performance of ERP adoption in a particular market. Over the years, a number of studies have been published on the concepts of enterprise resource planning, successful ERP adoption and predicting the performance of IT. The beginning of this chapter (4.1) provides the reader an overview of the literature review methodology, followed by the introduction of the relevant concepts. First an explanation and definition of ERP is given (section 4.2). Subsequently, the success factors of ERP are discussed (section 4.3). Next, attention is paid to the concept of predicting ERP performance (section 4.4 and section 4.5). The remainder of this chapter (section 4.6 and 4.7) elaborates on the definition of a conceptual model and methodology. This model and methodology provides a representation of the approach used during this thesis research to predict the performance of ERP in a particular market. This model and methodology have been empirically tested during the demonstration phase of this research using a test case concerning the energy market.

4.1 Literature review methodology overview

This section introduces the methodology for the literature review.

By conducting a literature review, a solid understanding with regards to predicting ERP performance is constructed. For this literature review to be thorough and reliable, a structured search approach is selected. Similar to the previous literature review (see Chapter 2), the search approach used in this part of the study is based on the 'Grounded Theory Literature-Review Method ' by Wolfswinkel, Furtmueller, & Wilderom [7]. The concept-centric approach by Webster and Watson [25] is applied to structure the results of this search. For more details of this literature review refer to Appendix A.

4.2 Introducing the concept of Enterprise Resource Planning

This section introduces the concept of ERP.

In today's competitive business environment, organisations have to search for new ways to deliver new services to customers faster, better and cheaper than their competitors. Often, the key to success, besides a good product and/or service is an efficient integrated information system [26]. Using information systems efficiently can result in a successful management of business processes. ERP is one of these integrated information systems.

The term enterprise resource planning (ERP) has first been mentioned in the early 1990s by the Gartner Group [27]. This definition originated from manufacturing resource planning (MRP). ERP systems' functionality normally covers finance and accounting, purchasing, HR management, sales or customer order management, and operations management. Today, ERP is often considered in an even broader sense. Most scholars and professionals see ERP as a business management system to integrate business processes across business functions, using a common database and shared interfaces [26], [28], [29]. These common database and shared interfaces allow ERP to deliver consistent data to all business functions in real time. Real time refers to data and processes that are always up-to-date. Where some see ERP purely as a solution to integrated business processes within an organisation [28], others also recognize the opportunity to integrate business processes across organisations [29]. Taken this into account, ERP in this thesis is defined as follows:

"ERP is an information system consisting of integrated sets of software that can be used to manage and integrate all business processes and functions within an organisation and across organisations."

ERP has the ability to automate and integrate business processes across functions and locations of an organisation with the potential benefits of drastic declines in inventory, reductions in working capital, extensive information about customers' wishes and needs, and managerial insights in the (functioning of the) organisation. When implemented successfully, an ERP system has a large and sometimes even critical effect on the organisational performance and survival [30]. This makes the ERP market as one of the fastest growing and most profitable areas in the software industry. However, despite the tremendous popularity of ERP the market is littered with remarkable failures [30]–[32]. ERP implementations are well-known to be overtime, over-budget and less profitable than anticipated [30].

An ERP implementation is more than just installing software, it is much more about change management and (new) technology adoption [28]. This makes an ERP implementation process difficult and complex. Hence, much research has been conducted about why ERP implementations fail or succeed.

4.3 Introducing the concept of successful ERP implementation

This section introduces the concept of ERP success.

The link between ERP and successful implementation is deeply studied. A review of the literature with regards to ERP success results in multiple explanations for success. Kamhawi [33] for example related the success to time, budget and predetermined goals. Other studies tried to explain ERP success based on organisational fit [34]–[37]. Law and Ngai [38] explained ERP success based on strategic alignment and managerial support. And there are also researchers [39]–[41] who tried to explain the success of ERP by adapting existing information systems (IS) success models, such as the success models by DeLone and McLean's [42], the Technology Acceptance Model developed by Davis [43] and the Ives, Hamilton and Davis IS model [44]. Some researchers like Stemberg et al. [30] purely focused on the link between business process modelling and ERP success, and Wang and Wu [45] focused on user satisfaction and ERP success. Then finally, there is a large group of researchers who combined different factors to explain ERP success [28], [39], [46]. Table 5 presents an overview of all the above-mentioned types of explanations.

ERP success	Scope explanations	Sources
	Time, budget, and predetermined goals	[33]
	Strategic alignment and managerial support	[38]
	Organisational fit	[34]–[37]
	DeLone and McLean's success model, Technology Acceptance Model, and/or Ives, Hamilton and Davis IS model	[39]–[41]
	Business process modelling	[30]
	User satisfaction	[45]
	Combination of these factors	[28], [39], [46].

TABLE 5: ERP SUCCESS OVERVIEW

4.4 Concept of predicting the successful adoption of ERP

This section introduces the concept of predicting ERP success.

As indicated in the previous section, there are many explanations for the performance (success or failure) of ERP. However, there is hardly any research done about how to predict the performance of an ERP implementation [47]. A prediction of ERP implementation performance upfront enables organisations to decide whether it makes sense to initiate or not an ERP implementation or whether corrective and/or preventive actions are needed to increase the feasibility of a successful ERP. Samuel and Kumar [47] and

Lim [48] are one of the few researchers who studied the prediction of ERP performance before the implementation started. Samuel and Kumar [47] developed a predicting model based on seven critical success factors (vendor transparency, top management priority, positional power user involvement, knowledge power user sharing, project team dedication, transaction user change and consultant customer focus). Lim [48] suggest Case-based reasoning (CBR) to forecast the performance of an ERP implementation. CBR is a learning algorithm used for business forecasting.

Another interesting approach to predict the performance in advance comes from researchers who worked with models to predict the successful implementation of other technologies (e.g., e-commerce). They developed the Fit-Viability Theory.

The Fit-Viability Theory is developed to predict the successful adoption of the mobile technologies, e-commerce initiative or/and group discussion tools in a particular organisation [49]–[52]. While this theory was originally developed purely for these technologies, it has been successfully applied in other technologies such as big data [53] too, which makes it an interesting theory for predicting ERP performance. However, it has never been empirically tested and applied to predict the successful adoption of ERP.

In order to bridge the research gap of understanding how to predict ERP performance before implementation, it is interesting to develop and test a prediction model based on the Fit-Viability Theory in combination with the theory of ERP fit. In the next two sub-sections, both theories are discussed in more detail.

4.4.1 Fit-Viability Theory

Several researchers have proposed (and used) the fit-viability model to predict a successful adoption of technology.

In 1995, Goodhue and Thompson [54] argued that the fit between the task characteristics and technology characteristics affects the individual performance of that technology. This concept is among others applied by Zigurs and Buckland [55] to assess group support decision tools. However, these studies lack what is (later) called “viability”.

As a result, the fit-viability model was proposed by Tjan [50] for evaluating organisational adoption of e-commerce initiatives. This model consists of two dimensions to evaluate internet initiative projects. The first dimension is *viability* and the second is *fit*. Viability measures to what extent the technology meets the organisation IT-infrastructure, capital needs, human resources, etc. Fit measures to what extent the technology is consistent with the organisation culture, structure and core competencies. Figure 4 presents the proposed fit-viability model of Tjan [50].

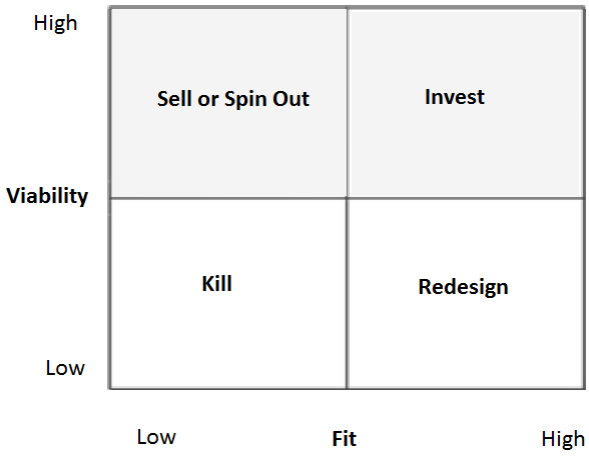

FIGURE 4: FIT-VIABILITY MODEL BY TJAN [50]

Later Liang and Wei [51] adapted the model of Tjan [50] to develop their Fit-Viability Framework to assess the adoption of mobile commerce technology. In the revised model, they defined fit as to what extent the capabilities of the mobile technology meet the requirements of the task. The viability has been defined as to what extent the organisational environment is ready for the technology. The readiness depends on economic, social and organisational requirements. Economic requirements relate to costs and financial benefits. Social requirements relate to user readiness, and organisational requirements relate to the maturity and composition of the organisation infrastructure. Both dimensions (fit and viability) create a simple matrix with the fit on the horizontal axis and viability on the vertical axis (shown in Figure 5). The four categories in the matrix show what the best strategy would be for the application of the technology. When the application has both a good fit and a high viability, it is likely to succeed.

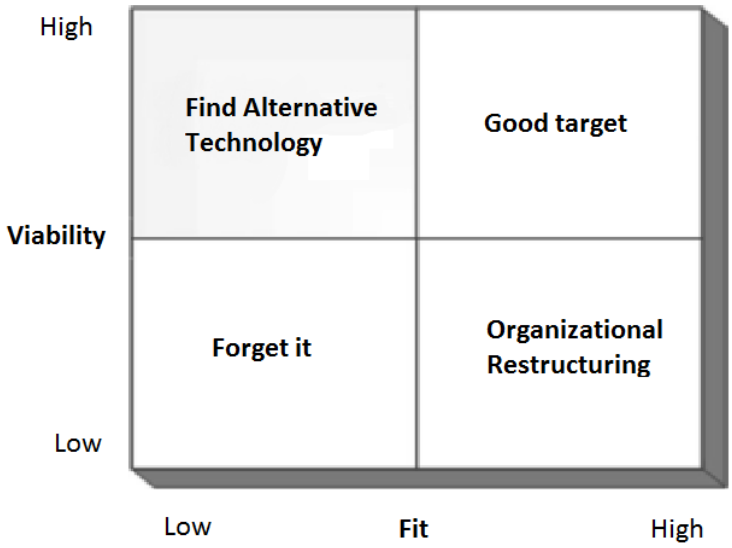

FIGURE 5: FIT-VIABILITY MODEL BY LIANG AND WEI [51]

In 2007, Liang et al. [49] further improved the framework introduced by Liang and Wei [51] by introducing a set of measurement instruments to assess the fit and viability to predict the success of mobile technologies. In their renewed research model, they measure the fit by "calculating" the match between the task and the technology. Viability was measured by "calculating" the readiness of the organisation for the technology. Within the viability, they consider three aspects: economic feasibility, IT infrastructure and organisational readiness. Economic feasibility is determined by two aspects: the cost benefits and the effect on the competitive advantages of the organisation. The technical infrastructure depends on current IT infrastructure and the IT strategy. Organisational readiness is based on the organisation's willingness and ability to use the technology. All items for measuring the fit and viability a seven-point Likert-scale (1 = strongly disagree and 7 = strongly agree) is used. Figure 6 presents this framework.

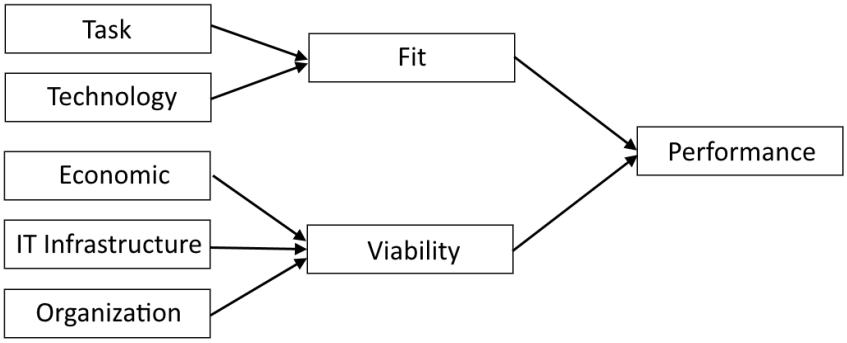

FIGURE 6: FIT-VIABILITY MODEL BY LIANG ET AL. [49]

In 2011, Turban, Liang and Wu [52] proposed a modified fit-viability based framework regarding the adoption and use of social software for group decision support (shown in Figure 7). In this model the fit is defined by the match between the intended "decision-making tasks" and the available "social software tools". The viability is defined by the implementation factors and constraints which need to be considered to assess the project viability. These implementation factors and constraints consist of the economic factors (e.g., economic feasibility, justification etc.), IT infrastructure factors (e.g., readiness, security, risks etc,) and organisation (e.g., readiness, privacy, management support, organisational culture, resistance to change, legal, copyright, etc.). The organisation should deploy those projects which are most fit and viable. Turban et al. suggest a six step procedure to determine the performance: *Determine the fit between a technology and a decision task, Analyse economic viability of the technology, Identify necessary infrastructure, Examine human factors and organizational issues associated with the application, Choose a deployment strategy, and Measure performance.*

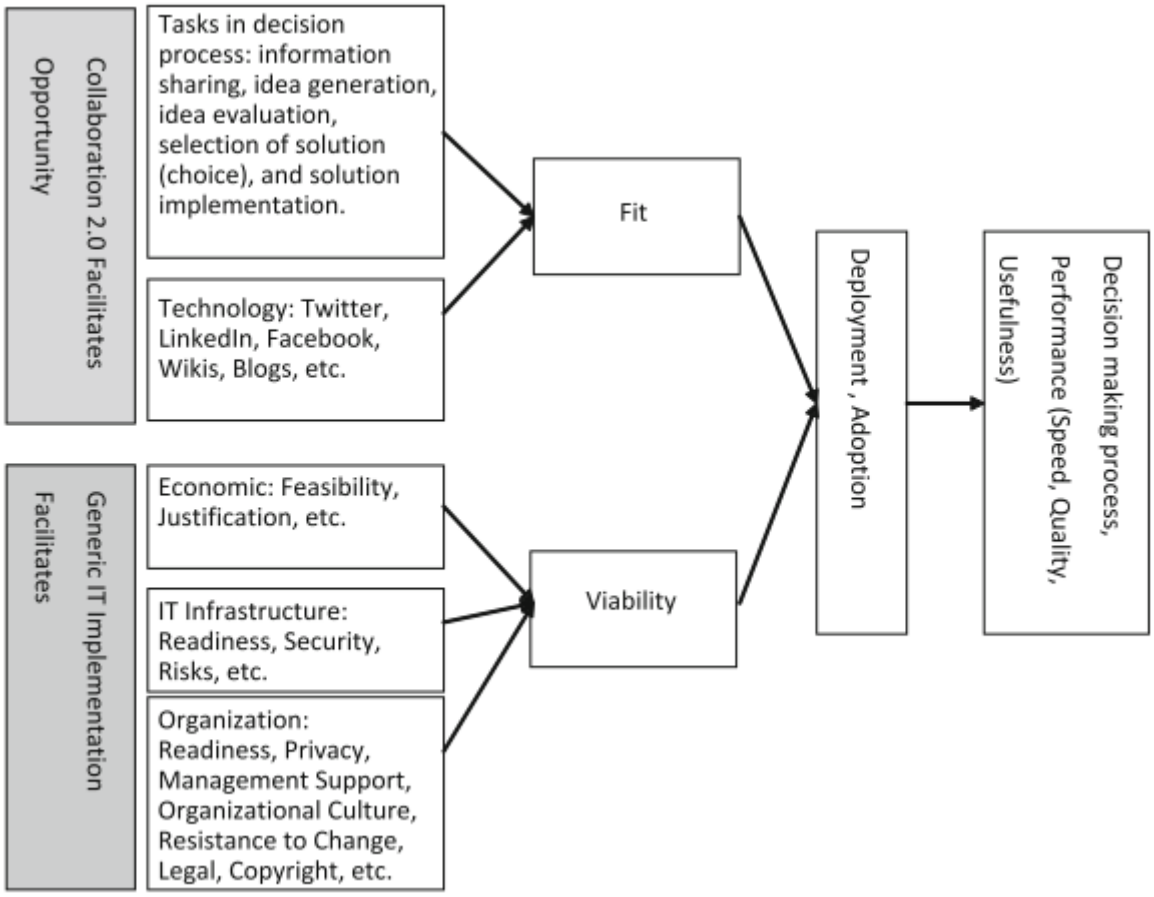

FIGURE 7: FIT-VIABILITY MODEL BY TURBAN, LIANG AND WU [52]

4.4.2 ERP FIT Theory

In the theory of ERP, a lot is written about the importance of the match between the organisational needs and the ERP's functionalities, to be considered as the fit [34]–[36]. In this paper the concept "ERP fit" represents the 'fit between ERP and organisation requirements' and "ERP gap" represents the 'misfit between ERP and organisational requirements'. Gaps can lead to ERP implementations with undesirable design and reality gaps, which consequently could lead to underperforming systems.

Already in 1993, Brynjolfsson & Mendelson [37] recognised that these failures were often not the results of incorrectly coded software, but rather the results of not being able to match the system with the true organisational needs. It is widely confirmed by other researchers that the degree of gaps between ERP

systems and the organisational needs is one of the main reasons determining the failure of ERP implementation [30], [34]–[36].

In the literature one source of gaps is particularly often mentioned: the one-size-fits-all solution. ERP systems are 'standard software packages' developed to fulfil the common requirements of organisations of different sizes and from different industries [36]. However, each organisation has its unique character/set of characteristics. Therefore, organisations can have company-specific, sector specific or country-specific requirements that may do not match the standard capabilities of ERP [35]. Company-specific requirements represent differences in organisational structure; for example, utility companies have a different organisational structure than a financial institution. Sector-specific requirements represent for example, the different requirements between private and public sector. Within public companies information is handled differently, and has to be more accessible to the public. Country-specific requirements are often caused by differences in financial regulations, such as the VAT, etc. Research shows that even the best ERP package can only meet 70% of the organisational requirements [56].

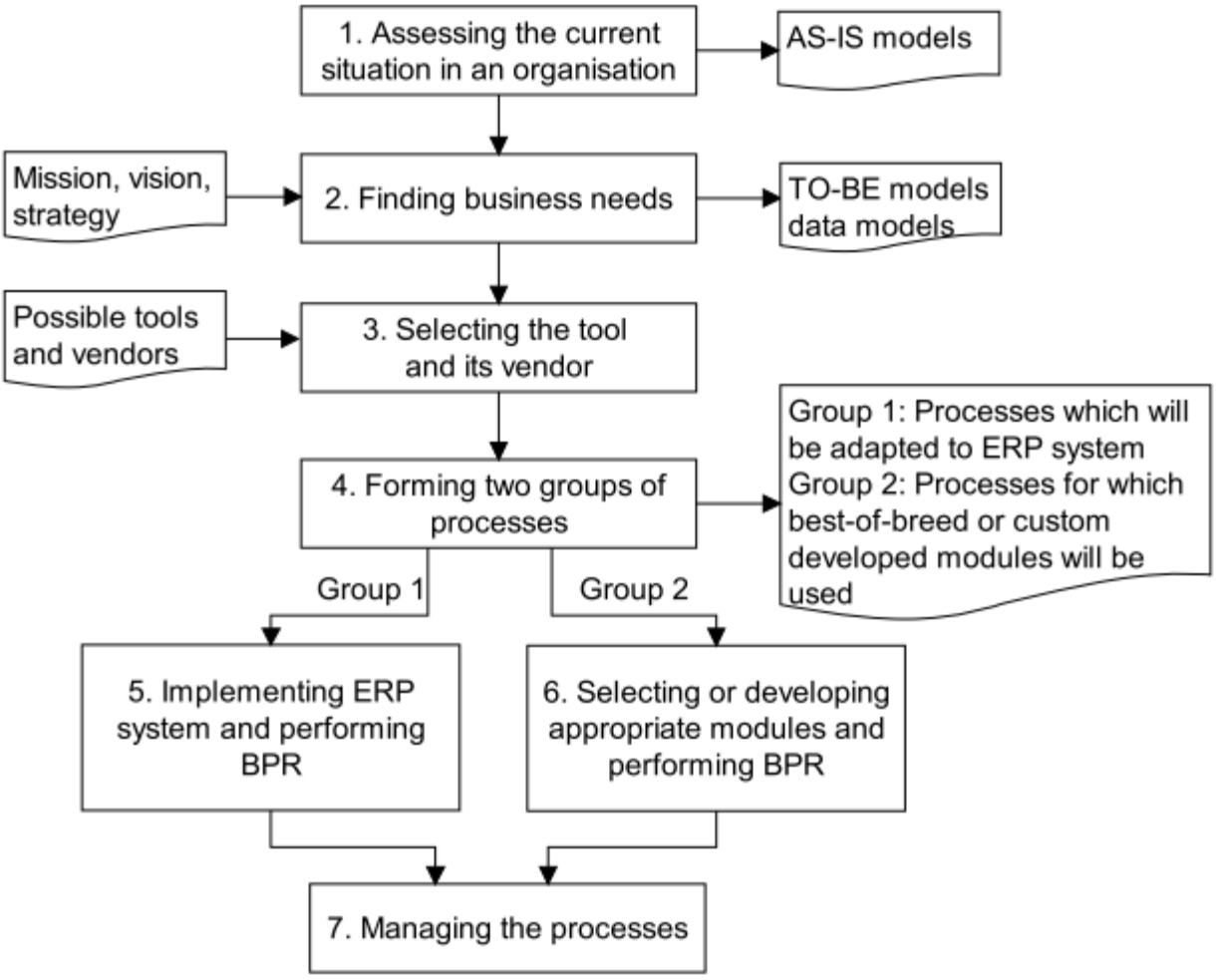

FIGURE 8: FRAMEWORK ŠTEMBERGER ET AL. [30]

Soh et al. [35] suggested an effective fit analysis requires both comprehensive understandings of the organisation as well as of the complex software. Štemberger et al. [30] proposed a framework to implement an ERP successfully (see Figure 8). For a successful implementation, they suggest a seven stages methodology. To predict the ERP fit however only the first three stages that focus on selecting an ERP system that fits the organisation (fit analysis) are of most interest. Stage 1 "*Assessing the current situation in an organisation*" focuses on modelling the current business processes. The result of this stage is an AS-

IS model of the business processes. Stage 2 "*Find business needs*" is related to determining the TO-BE situation. The strategy, vision and mission is often used as input for this stage. Stage 3 "*Selecting the tool and its vendor*" is about matching the business needs and ERP system functionalities. This stage determines the ERP fit with the organisation.

After the determination of the fit, Soh et al. [35] suggested that "resolution strategies" can help to reduce the chances of any misfits and increase the overall fit of the ERP solution. When a misfit is identified, a resolution strategy can be applied. There are two spectrums of resolution strategies: organisational change and ERP customization. By the modification of the ERP system, ERP should be able to cope with the organisation's unique characters. By its modification, the organisation should be able to cope with the ERP unique characters. These findings are supported by Hong & Kim [34], who suggest that the resolution strategy moderates the negative impact of misfits on the chance of ERP implementation success.

4.5 Summarizing the concepts of predicting successful ERP adoption

This section provides a summary of the results of the literature review on predicting ERP success.

The literature review resulted in the identification of various concepts and two key theories: the Fit-Viability Theory and the ERP fit theory. To summarize the concepts related to these two theories, Webster and Watson [25] suggest to present the concepts in a matrix. In this matrix, the identified concepts are listed together. In this way, the matrix provides an effective way to present and summarize the various findings and insights. Table 6 presents the results of the literature review and is called the concepts matrix.

Sources	Concepts								
	Performance	Fit	Viability	ERP functionalities	Business needs	Economic	IT Infrastructure	Organisation	Resolution strategies
Goodhue and Thompson [54]	X	X							
Zigurs and Buckland [55]	X	X							
Tjan [50]	X	X	X			X	X	X	
Liang and Wei [51]	X	X	X			X	X	X	
Liang et al. [49]	X	X	X			X	X	X	
Turban et al. [52]	X	X	X			X	X	X	
Brynjolfsson and Mendelson [37]		X		X	X				
Soh et al. [35]		X		X	X				X
Shiang-Yen et al. [36]		X		X	X				
Hong and Kim [34]		X		X	X				X
Štemberger et al. [30]		X		X	X				

TABLE 6: CONCEPT MATRIX

4.6 Conceptual research model to predict the performance of ERP

This section introduces the research model, which is composed on the basis of the results of the literature review.

Based on the results of the literature review, which assessed the current status of research literature about predicting ERP performance (degree of success), a conceptual research model is developed. Figure 9 presents this research model. This conceptual model is a combination of a measurement model and a structural model. A structural model shows the relationships between constructs; a measurement model explains how the constructs are measured (indirectly only). First, the definitions of constructs and measures are given, after which the relationships are explained.

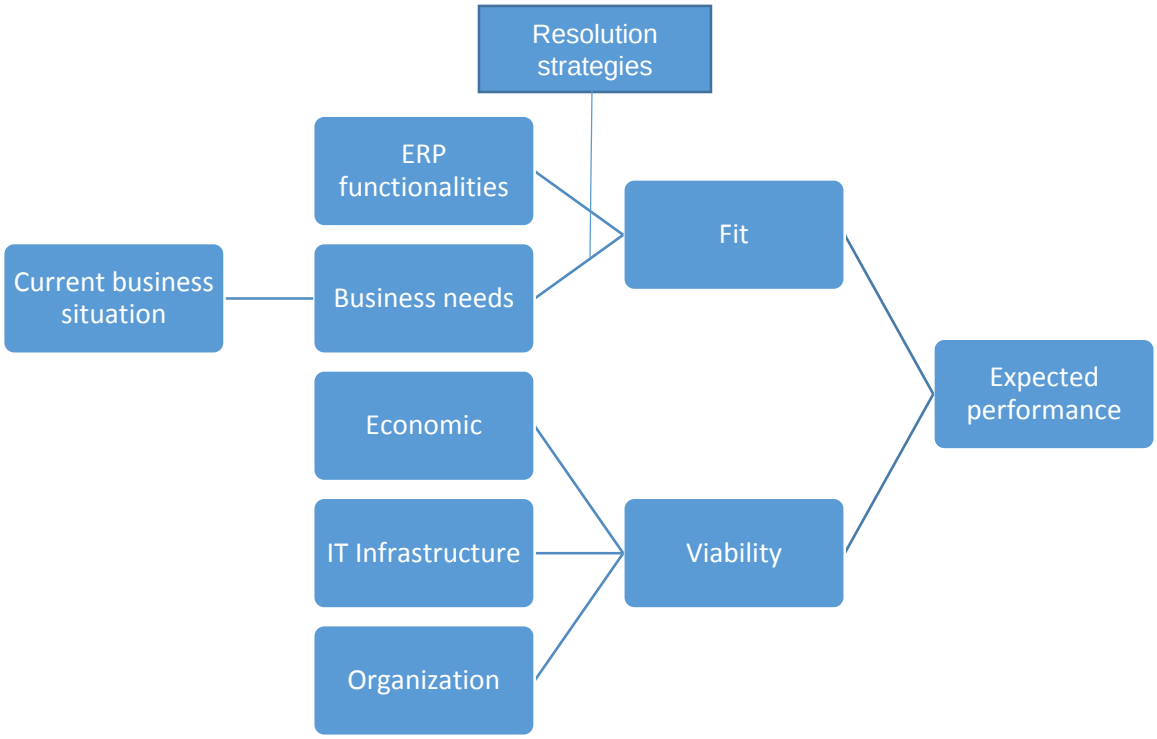

FIGURE 9: CONCEPTUAL RESEARCH MODEL

4.6.1 Constructs and Measures

The constructs are the variables to explain an actual phenomenon [57]. In this case, the phenomenon explained is the potential performance of ERP. A characteristic of constructs is that they are unobservable by definition, which means they cannot be measured directly. In contrast to constructs, measures/measurements can be valued directly and help qualifying and/or quantifying a construct indirectly [57]. Measures help a researcher to observe a construct indirectly and, therefore, are also known as indicators or observed variables.

The measurement instruments (tools) used in this thesis are interviews. The first set of interviews are used to collect the actual values of the indicators (measured data). The second set of interviews consists of a fit analysis and viability analysis. During the second set, the results of the interviews are analysed, and the fit and viability constructs are scored, based on the data collected. For both the fit and viability construct a seven-point Likert-scale (1 = very low and 7 = very high) is used.

The rest of this section introduces all constructs that are part of the approach model and their indicators (measures). Note that the theoretical foundation of all constructs can be found in Sections 4.4 and 4.5 and is not explained here.

Expected performance is the first (main) construct in the model. In this study, the expected performance construct is considered as the degree to which an ERP implementation provides the expected benefits for the organisation. The expected ERP performance depends on the fit and viability. When a system has a good fit and is viable, the system will provide the expected benefits and users will be satisfied and be using the system the way it is supposed to [51]. The performance construct is (indirectly) measured based on the score of the fit and viability constructs, and positioned in the research framework introduced by Liang and Wei [51]. In this framework four scenarios of performance are considered: a high fit and high viability suggest that the selected ERP system is a good target (high performance): a high fit and low viability suggest to restructure the organisation first (medium performance): a low fit and high viability suggest to find an alternative technology (medium performance): and a low fit and low viability suggest to refrain from using this ERP system or to find another ERP system (low performance).

Fit is the second construct. The fit construct concerns the extent to which the business needs match with the ERP functionalities moderated by the resolution strategies. The fit construct is measured based on a fit analysis, during which the match between the business needs and the ERP functionalities and the moderation effect of the available resolution strategies is rated.

Viability is the third construct**.** The viability construct concerns the extent to which the ERP is economically feasible, and to what degree the IT infrastructure and organisation are ready for the ERP. The viability construct is scored based on the viability analysis. During this analysis, the economic feasibility, IT infrastructure readiness and social readiness of the organisation are scored.

Business needs is the fourth construct. The business needs are best described as detailed knowledge about the desired business processes and their context (value propositions and market actors). Understanding the desired business processes and context is essential to describe how the business needs to operate and how its current operations can be improved [24], [30]. The business needs construct is based on the current business situation and influenced by the future developments, the organisations mission, vision and strategy.

Current business situation is the fifth construct. The current business situation is best described as detailed knowledge about the current business processes and its context (value propositions and market actors). In this research the following indicators (measurements) determine the current business situation construct:

- Value propositions
- Market actors
- Processes

ERP functionalities is the sixth construct. Data to score this construct are derived from ERP consultants, users and training materials and/or reference models [58]. Reference models are used by ERP vendors to describe their ERP generic functionalities in a universally understood form. In this research, the following indicators (measurements) determine the ERP functionalities:

- ERP training materials and/or reference models
- Expert knowledge of ERP consultants

Resolution strategies are the seventh construct. As can be seen in section 4.4, the resolution strategies refer to the moderations strategies that can be used to reduce the number of misfits between the business needs and ERP functionalities. In this research, the following indicators (measurements) determine the resolution strategies:

- Suitable resolution strategies

Economic is the eighth construct. As can be seen in section 4.4, the economic construct refers to the extent the technology is considered to be cost-beneficial (feasible) and the effect on the competitive advantages of the organisation (justifiable). In relation with ERP, this research considers the following indicators (measurements) to determine this economic construct:

- Feasibility
- Justification

IT Infrastructure is the ninth construct. As can be seen in section 4.4, the IT infrastructure construct refers to the extent the selected technology can be integrated easily into the current IT infrastructure and architecture (readiness). In relation with ERP, the following indicator (measurement) influencing the IT infrastructure construct is considered:

- Readiness

Organisation is the tenth and last construct. As can be seen in section 4.4, the organisation construct refers to the extent the organisation is willing to implement the selected technology (organisational support) and is ready for using this technology (organisational culture and resistance to change). In relation with ERP the following major indicators (measurements) are considered in determining the organisation construct:

- Organisational support
- Organisational culture
- Resistance to change

4.6.2 Structural relations

The following five construct relationships in this conceptual model are based on the fit-viability theory as previously introduced (see 4.4.1).

The Fit influences the Expected performance. As can be seen in section 4.4, a good technology fit has a positive influence on the expected performance of that system. This fit relationship is both proven for new technologies as well as for ERP systems. (But a good fit is not enough. The technology should also be viable too, see below).

The Business needs and the ERP functionalities influence the Fit and is moderated by the Resolution strategies. As can be seen in section 4.4 the fit is determined by the match between the business needs and the ERP functionalities and is moderated by resolution strategies. This relationship is proven for ERP systems.

The Current business situation influences the Business needs. As can be seen in section 4.4 the business needs are determined based on the current business situation. This relation is proven for ERP systems.

The Viability influences the Expected performance. As can be seen in section 4.4.1, a viable technology has a positive influence on the expected performance of the technology. This specific relation is proven for several technologies, but not yet for ERP systems. For ERP, however, there are many success factors that relate to viability, and thus the relationship between performance and viability is very likely to exist and therefore part of the conceptual model.

Economic, IT Infrastructure and Organisation influence the Viability. As can be seen in section 4.4.1, viability is determined by economic, IT infrastructure and organisation constructs. This relationship is proven for several technologies, but not yet for ERP systems. However, many ERP success factors can be related to the economic, IT infrastructure and organisation constructs and thus this relationship is very likely to exist and therefore part of the conceptual model.

4.7 Conceptual methodology to predict the performance of ERP

This section introduces the methodology to predict the performance of ERP within a specific market, based on the previously introduced model.

Based on the previously introduced conceptual model to predict the performance of ERP and the results of the literature review, a conceptual methodology is developed (see Figure 10). The methodology is inspired

by frameworks of Štemberger et al. [30], Liang et al. [49], and Turban et al. [52]. This methodology will serve as a guideline for predicting the performance of ERP in a particular market. In the next sections, the steps of the methodology are described and explained.

FIGURE 10: CONCEPTUAL METHODOLOGY

4.7.1 Step 1: Assess the current business situation in the organisation

The first step aims at assessing the current business situation in the organisation. The current situation is best described as the current value propositions, market actors and business processes. The knowledge of value propositions provides insights into the business model. Furthermore, the understanding of the market actors and business processes help understanding how these value propositions are realized. Business processes can be quite complex [26]. Individuals with different backgrounds and skills are responsible for executing the business processes. The differences between individuals can affect how well a business process is executed. A good understanding of each of his or her role in a process and how the process should be executed is important to make processes more efficient and effective. An organisation can conduct a business process analysis to acquire this knowledge. This analysis helps to create a process model, which is an abstract presentation of the processes [26].

Several organisations have already some kind of model. However, in practice these model are often not up-to-date. Nevertheless, Štemberger et al. [30] suggest there is no need to developed high-detailed models because such a model can be very time-consuming and costly. A high-level process model is in most cases sufficient. The process model, together with the descriptions of the value propositions and actors, helps to describe the current business situation in a universally understood format [26], [30].

4.7.2 Step 2: Find business needs & assess the economic, IT infrastructure and organisation constructs

The second step aims at finding the business needs and at assessing the economic, IT infrastructure, organisation and third party constructs. During this step, the business needs are determined in the form of a list of needs, which represents the desired business processes and its desired context (value proposition and market actors). This research recommends using the current business situation, future developments, the organisation's mission, vision and strategy, and expert knowledge as input for this step. Štemberger et

al. [30] suggest for some organisation the business needs will require major changes in the current business situation, but for other only small changes are necessary.

The economic, IT infrastructure and organization constructs can best be assessed in the form of an expert perception. Expert interviews or a questionnaire can be best used as input for this step. The economic construct is measured based on economic feasibility and justification of the selected ERP. The IT infrastructure construct is measured based on the extent to which the selected ERP fits in the current IT infrastructure, and the organization construct is measured based on the extent the organisation is willing to implement the selected ERP and is ready for using this ERP.

4.7.3 Step 3: Understand the ERP functionalities

In the third step, the selected ERP system(s) have to be analysed. An ERP system can be quite complex. This research recommends to involve ERP experts, or to analyse the functionalities of the selected ERP system(s) by studying the reference models or any other training materials on the selected ERP system.

4.7.4 Step 4: Assess the fit and viability

During step one, two and three all the necessary data are collected for a comparison between the selected ERP system(s) and the organisation. The fourth step is extremely important, the fit and viability for the selected ERP system have to be assessed. The fit is assessed based on analysing the match between the business needs and ERP functionalities, and analysing the moderation effect of the available resolution strategies. The business needs are divided into two groups: the first group consist of the business needs that will fit with the ERP system while the second group of business needs are those for which a resolution strategy is needed (e.g., custom work) or cannot be supported.

The viability is assessed based on analysing the economic, IT infrastructure and organisation constructs. To score both the fit and viability construct, Liang et al. [49] suggest using a seven-point Likert-scale (1 = very low and 7 = very high). Both the fit and viability analysis requires a good understanding of the selected ERP system. Therefore, this research recommends (if possible) involving ERP experts of the selected ERP system to assess the fit and viability.

4.7.5 Step 5: Determine the expected performance

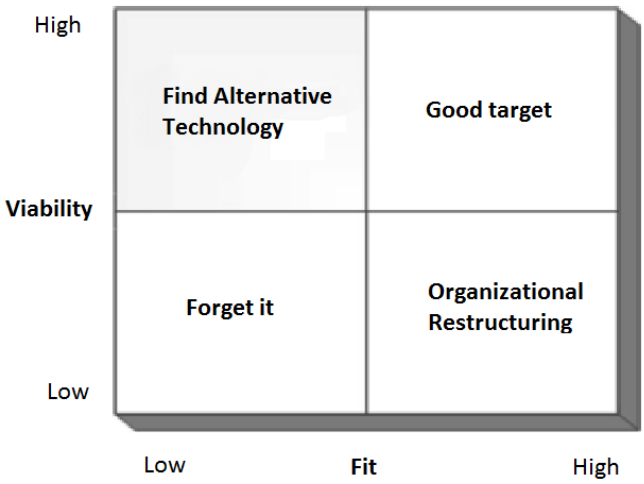

FIGURE 11: FIT-VIABILITY MODEL BY LIANG ET AL. [51]

Finally, the last step aims at determining the expected performance of the selected ERP system(s). The expected performance is determined based on the scores of the fit and viability. These scores help to position the expected performance of the selected ERP system(s) in the Fit-Viability model by Liang et al.

[51] (see Figure 11): a high fit and high viability suggest a good target (high preformance). A high fit and low viability suggest an organisational restructuring is required to have a good opportunity of success (medium performance); a low fit and high viability suggest to find an alternative ERP system (medium performance); and a low fit and low viability suggest to forget the whole idea of using such kind of ERP system (low performance). Organisational restructuring refers to the need for an organisational change project. In such cases, all the constituent parts of an organisational change project, like change management, changes in the organisational structures and changes in the organisational culture, have to take place. This kind of change projects can be very complex and time consuming but will be needed to get the right mind setting within the organisation. After positioning the performance of the selected ERP system(s), the organisation can consider to (not) implement the selected ERP system(s), and/or to start a restructuring of the organization if needed.

5 STEP 1: ASSESS CURRENT BUSINESS SITUATION

This chapter presents the results of the first step of the previously introduced methodology. Step 1 is the assessment of the current business situation. First, the assessment procedure is explained (5.1), and next, the results of the assessment are presented (5.2 and 5.3).

5.1 Assessment procedure

Data for defining the current business situation are collected by two unstructured interviews and two semi-structured interviews. Both the semi-structured and unstructured interviews are typical and useful qualitative research method to understand what is happening and to search for new insights [59]. Due to time-constraints, the identification of the current situation regarding the non-commodity products and services is based on the processes and market actors for solar installations and related services. Section 5.1.1 briefly introduces the procedure for the unstructured interviews, followed by section 5.1.2 which introduces the procedure for a semi-structured interview. Section 5.1.3 elaborates on the data analysis.

5.1.1 Unstructured interviews 1 and 2, and its procedure

DATA COLLECTION

An unstructured interview is an informal method to acquire knowledge, and no question list is prepared beforehand.

These unstructured interviews 1 and 2 are exploratory interviews to interview 3 and 4.

EXPERT OPINIONS EXECUTION

In total two internal persons are interviewed by unstructured interviews. The two respondents of Avanade were approached by email for a face-to-face unstructured interview. Following a positive reaction of the respondents, a 60-minute interview was planned and executed. The interviews were conducted face-to-face at the respondent location of choice.

PARTICIPANT OF INTERVIEW 1

Respondent 1 is ”Business development executive for energy & utilities” at Avanade. In his function, he handles finding new channels and markets for distribution, and for selling more services and products to existing customers in the energy & utilities sector. Avanade is a global company for Microsoft-focused consulting services (see also 1.2). Respondent 1 was selected for his experience in the energy market. The goal of respondent 1 is to understand which part of the energy market is involved in solar installation.

PARTICIPANT OF INTERVIEW 2

Respondent 2 is EALA (Europe, Africa, and Latin America) Solution lead for energy & utilities industry based on Microsoft Dynamics AX as well as a senior manager for Dynamics AX service line for Avanade. He handles managing and developing the Dynamics AX based energy & utilities solution. He has experiences with international ERP implementations and a good understanding of the Energy & Utility market. (Avanade is a global company for Microsoft-focused consulting services, see also 1.2). Respondent 1 was selected for his experience of the transition in the energy sector.

5.1.2 Semi-structured interviews 3 and 5, and its procedure

DATA COLLECTION

A semi-structured interview is less informal and more structured. In the semi-structured interview, a list of themes and questions will be used to steer the interview in the correct direction. However, during the interview deviation from this list is allowed.

The questions prepared for the interview and questionnaire can be found in Appendix C.2.

EXPERT OPINIONS EXECUTION

In total two external persons were interviewed through a semi-structured interview. The two respondents of Energy Supplier A were approached to conduct a semi-structured interview by email. Following a positive reaction of the respondents, a 90-minute interview was planned and executed. The interviews were conducted face-to-face at the respondent location of choice.

Interviews 1 and 2 were exploratory interviews to interviews 3 and 4. Therefore, interviews 1 and 2 were executed first and unstructured, and interviews 3 and 4 were subsequently executed in a semi-structured manner.

PARTICIPANT OF INTERVIEW 3

Respondent 3 is the ”Domain Architect for the lead to contract” at Energy Supplier A. Energy Supplier A is (large) traditional energy supplier in the Netherlands (founded before 2000). He has experience in bridging the gap between the business and technical implementation. He handles understanding the business concerns and assists improvements.

PARTICIPANT OF INTERVIEW 4

Respondent 4 is the ”Manager process innovation (in the Netherlands)” at the installation partner of Energy Supplier A. He handles improving efficiency, customer intimacy and safety by process improvements and innovations. The installation partner handles installing and maintaining non-commodity products. Respondent 4 was selected for his experience in the sales of non-commodity products and related services.

5.1.3 Data analysis

The collected interview data can be considered as qualitative data. One of the characteristics of qualitative data is that the data are non-standardized and complex. They need to be summarized, categorized and/or restructured to support meaningful support to the study [59].

With the permission of the participants, all collected data of the interviews are summarized. After summarization, the data of four interviews are compared, categorized and synthesized to create a clear and comprehensive understanding of the current situation regarding the market focus, market size, value proposition, market actors and processes.

5.2 Results

This section presents the results of the interviews.

5.2.1 Results of interview 1

Interview 1 focused on the energy market. Respondent 1 confirmed that there are 49 companies licensed to supply energy to Dutch customers of which a few of them are involved in solar installations.

5.2.2 Results of interview 2

During the interview 2 the processes regarding the solar installations and related services were discussed. Although the respondent did not yet implement a solution for these processes, he provided interesting new

insights into what sub-processes could be part of these processes and what further developments may have an impact on these processes. These insights formed a good basis and background knowledge for interview 3 and 4.

Respondent 2 indicated that the processes of solar installations show much resemblance to the processes of other non-commodity products, such as boilers and car charging stations. Both processes consist of processes for installing the products and processes for after-sales services, such as maintenance.

Respondent 2 also mentioned there are multiple financial structures (e.g., leasing) available for pricing products requiring a large upfront investment. Although these financial structures are commonly used in other industries, it is not certain what their role is or can be in the market for solar installations and other non-commodity products.

Another important note of attention by respondent 2 concerns the role of partners for solar installations. Acquiring the needed skills and the expertise, partnerships with other companies can support the Energy supplier.

5.2.3 Results of interview 3

When discussing the current and future business models, respondent 3 indicates there is almost nothing to earn with the sales of gas and electricity anymore. The margins on these products are very low, and therefore he argues that a business model purely focused on commodity products is no longer sustainable. Energy suppliers are required to search for new business models. He mentions that Energy supplier A is trying to become more service oriented. To accomplish this, he indicates that Energy supplier A is adapting its business models to include new value propositions consisting of new (non-commodity) DRG and energy saving products and services. Besides the standard commodity products, such as gas and electricity, Energy supplier A is now focussing on non-commodity products and services, such as energy management tools, solar installations and cv-boilers. Energy Supplier A actively pursues more involvement of their section of DRG (related) products and services in this segment in the future.

Due to time constraints the rest of this interview focuses in depth on the value proposition, business processes and market actors of solar installations.

During the further discussion of the value proposition of solar installations, respondent 3 indicates the sales of solar installations are still small. He argued the monthly sales of solar installations reached only two digits numbers. On the other hand, the sales of the energy management tools, such as the energy management tool, is growing much faster.

Next the business processes and market actors are discussed. Respondent 3 indicates that the processes of solar installations are not yet fully optimized and automated. He mentions there are several parties involved: the customer, Energy supplier A itself, an installation partner and a supplier of materials. He discussed the business processes of solar installation in detail. To summarize this discussion: The sales process starts when the customer shows interest. Then, a personal business proposition is offered. After the acceptance of the propsoition, the installation partner is made aware of the order and handles its further arrangement. Finally, the customer and all other parties are billed and invoiced. A more detailed summary of the processes is presented in section 5.3.

Lastly, how the processes of solar installation could be improved was briefly discussed. Respondent 3 mentions a few improvements. First, he argues that the bundling of a solar installation with other products and services is not yet possible. Secondly, in the current processes no other financial structures other than full payment are available. Thirdly, the after-sales services for solar installations purely consists of reactive maintenance services which are paid on a pay-per-fault basis. For all these three points, he points out that there is room for improvement.

5.2.4 Results of interview 4

During the interview, the value propositions regarding (non-commodity) DRG and energy saving products and services were discussed from the viewpoint of the installation partner. Respondent 4 confirmed the three value propositions of Energy supplier A: energy management tools, solar installations and cv-boilers. He described their company role as the provider of installation and maintenance services.

Due to time constraints the rest of this interview focuses in depth on the value proposition, business processes and market actors of solar installations.

The discussion of respondent 3 has been mostly focused on the marketing and sales processes of solar installations, and the discussion of respondent 4 has been focused on the delivery and billing processes of solar installations.

During the discussion on the delivery and billing processes of solar installations, respondent 4 indicates there are three departments involved: the department for installation and service maintenance, intake & planning, and IT support & planning. The processes are arranged to deliver large volumes of products and services. To summarize the further discussion on the processes on solar installation, the processes start after receiving an order from Energy Suppler A. This order contains all the details of the products and the customer. Next, the required materials are ordered, and the required people and equipment is planned. After the materials arrive, the order is executed and, subsequently, the hours and materials are reported. Finally, the order is closed, and the customer and other parties are invoiced and billed. A more detailed summary of the processes is presented in section 5.3.

Respondent 4 agreed with both remarks of respondent 3 that the sales of solar installations is still considered to be very low, but that the sales of DRG related products such as the energy management tools are much higher.

An interesting remark of respondent 4 is that their organisation is not managed per product group, but rather by process group. This process focus is due to the similarity between their process approach of the delivery of solar installations and that of other energy products (e.g., smart meters, energy management tools or boilers).

5.3 The current business situation

This section presents the analysis that has been done to describe the current business situation.

5.3.1 Assessed market focus

During interview 1, the market focus is discussed. The concept of “market focus” refers to the energy suppliers who are considered potential customers for an ERP solution that supports non-commodity products and services. In this discussion, respondent 1 defines the potential customer as follows: *The potential customer is an energy supplier, active in the Dutch energy market and offering or is planning to offer, to its customers, products and services related to non-commodity.*

5.3.2 Assessed market size

Next, in interview 1 the actual active energy suppliers in the Dutch market are identified. A total of 49 companies is licensed to supply energy to Dutch customers. Currently, 18 of 49 are selling solar installations to customers. An overview of these 18 energy suppliers can be found in Market analysis results.

5.3.3 Assessed value propositions

During the interviews 2, 3 and 4, three value propositions related to non-commodity and offered by Energy Supplier A are identified: Solar installations, CV-boilers and Energy management tools. Although the CV-boilers and Energy management tools are not considered DRG products, these are products that save energy and contribute to low-energy home or building. Respondent 3 mentioned that all three products are

important in the current energy transition (see Chapter 2). Table 7 provides an overview of these value propositions.

Value proposition of DRG products	Value proposition of energy saving products	
Solar installations	Energy management tool	
	CV-Boilers	

TABLE 7: OVERVIEW VALUE PROPOSITION RELATED TO NON-COMMODITY

Due to time constraints, this research only concentrated in-depth into the processes related to the value proposition for solar installations. The value proposition for solar installations involves the advisory services for the most optimal solar installation construction, the installation service and the maintenance services after installation.

5.3.4 Assessed market actors.

During the three interviews, four actors were identified who are involved in the value proposition for solar installations. Table 8 provides an overview of the involved actors.

Actors involved in the value proposition for solar installations
Customer
Energy Supplier A
Energy Supplier A installation partner
Supplier

TABLE 8: OVERVIEW MARKET ACTORS

For each actor, the following descriptions are used:

Customer. The entity of persons that buys or has bought a solar installation. Energy Supplier A focuses both on the B2B (Business to Business) market as B2C (Business to Customer) market.

Energy Supplier A. The seller of energy and solar installations and related services. Energy Supplier A is also the central contact point for the customer.

Energy Supplier A installation partner. The partner of Energy Supplier A to provide installation and maintenance services for solar installation.

Supplier. The supplier is the organisation that delivers the materials required for a solar installation.

5.3.5 Assessed processes

In the interview 2, 3 and 4 the processes related to solar installations are discussed. As a result of this discussion, two main processes are identified:

1. The process related to the sales of solar installation (e.g., solar product and the advisory and installation services) .
2. The process related to after-sales services (e.g., maintenance services). In the next sections, these processes are described in more detail.

PROCESSES FOR SALES OF SOLAR INSTALLATIONS (PROCESS 1)

During the interviews 3 and 4 the business process related to the sales of solar installations were best described as the processes regarding the Marketing, Sales, Delivery and Billing of solar installation. As shown in Figure 12, the sales process consists of these four parts (sub-processes).

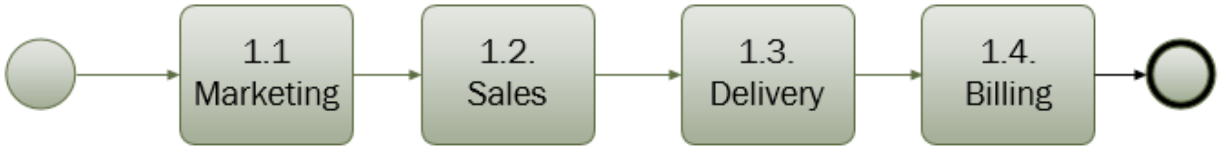

FIGURE 12: HIGH-LEVEL OVERVIEW INSTALLATION BUSINESS PROCESS

The '**marketing'** process is related to preparing, creating, launching and monitoring a campaign which creates awareness among the customers of the option to buy a solar installation (see Figure 13). In the process, two parties are involved: the marketing department of Energy Supplier A and the intake & planning department of the installation partner. To prepare a campaign, the installation partner establishes the cost prices and analyses the services capacity. After this preparation, the marketing department of Energy Supplier A sets the sales prices for solar installations and creates a campaign to promote the solar installations. When the campaign is started, the marketing department monitors the campaign by tracking the actions of prospects which will be considered as leads.

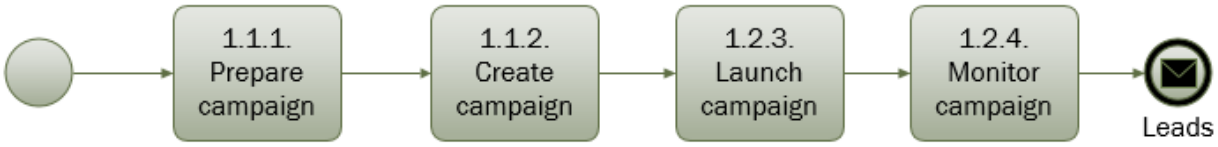

FIGURE 13: OVERVIEW MARKETING PROCESS

The '**sales'** process is related to sales of a solar installation to a customer (see Figure 14). In this process, both the customer and sales department of Energy Supplier A are involved. There are two ways the sales department becomes aware of an interested customer. The first way is through the leads created during the campaign by the marketing department. These leads are followed up by the sales department through a phone call or email. The second route goes via the website, telephone, face-to-face or social media where the customer can directly contact the sales department. After a customer has shown interest, the sales department creates a personal and customized offering for the structure of the solar installation. Each roof is different, and the shadow, angle or position towards the sun can significantly affect the performance of the solar installation. Energy Supplier A uses advanced software to analyse what would be recommended in each case. Potential obstructions (such as trees and other buildings) are also assessed and modelled. The roof parts which are dark red are estimated to receive the most sun during the year and thus most suitable for a solar installation. The software also calculates the expected solar electricity generation. The results of this analysis and the Energy Supplier A solar solution form the basis of Energy Supplier A solar proposition offer. This proposition is then sent to the prospect in the form of an indication offer. When the prospect is convinced of Energy Supplier A solar proposition, a final offer is constructed and signed by both parties.

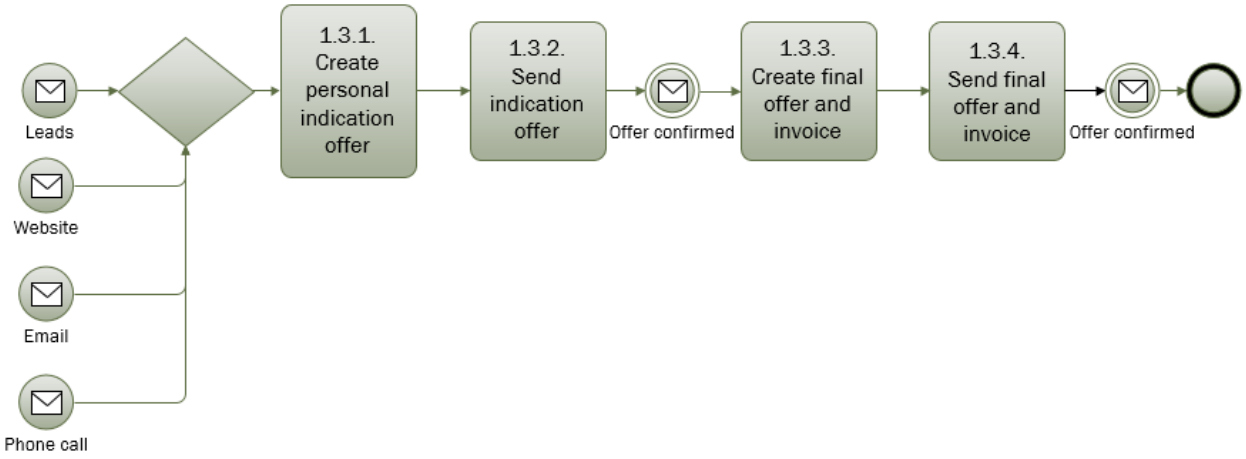

FIGURE 14: OVERVIEW SALES PROCESS

The '**dilivery'** process involves the procurement of materials, planning of people and equipment, executing the installation itself and reporting the used materials, hours and equipment (see Figure 15). In this process, four parties are involved: Energy Supplier A, the installation partner, the wholesaler (= Supplier of materials) and the customer. Based on the signed offer, the marketing department of Energy Supplier A creates a work order for the installation partner. This work order provides information on the type of service (installation or maintenance), product details, service tasks, customer details and period of delivery. Based on this work order the intake & planning department of the installation partner plans a delivery date and time with the customer, orders the required materials, and plans the required hours and equipment for the installation. Next, a service engineer of the installation and service maintenance department of the installation partner signs in on the work order. When the materials arrive at the installation company, they will be checked. If the order materials are endorsed, the installation can be executed by the service engineer. When finished they, report the hours and materials used and sign-off the work order. The sales department will then close the work order, and the service department of Energy Supplier A will add the installation to its asset management tool.

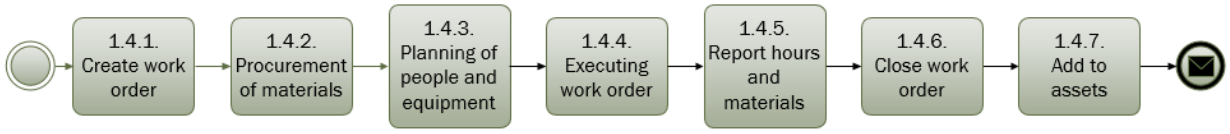

FIGURE 15: OVERVIEW DELIVERY PROCESS

The '**billing'** process takes care of sending a bill to the customer for the solar installation services he will receive as well as to pay the installation partner and supplier(s) (see Figure 16). The customer has to pay for the solar installation in three steps during a predefined period: 10%, 60% and 30%. The first 10% is paid after the final offer is signed. This 10% is considered as a deposit. Next payment takes place at least one day before the installation; here the customer has to pay the next 60%. After the installation is done, the customer is required to pay the final 30%. Both the installation partner and wholesaler are paid once a month by the sales department.

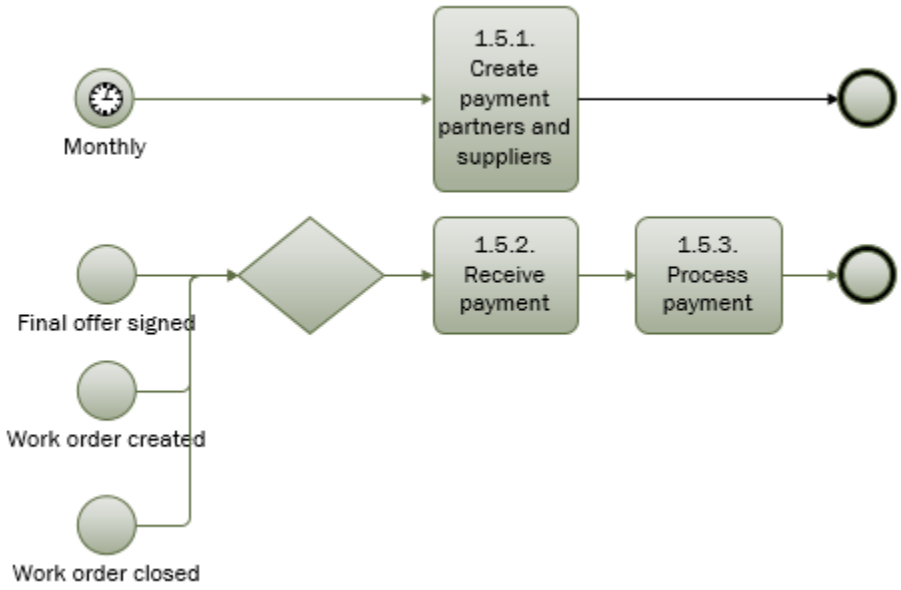

FIGURE 16: OVERVIEW BILLING PROCESS

PROCESS OF AFTER-SALES SERVICES (PROCESS 2)

Resulting from the interviews the business process related to the after-sales services can best be described as the processes regarding the reactive maintenance services. This process takes place when a defect or malfunction of a solar installation is reported. Reactive maintenance services are often referred to as the fire-fighting approach where the equipment is repaired or replaced after it has failed [60]. For Energy Supplier A this means that they repair only after the customer requested such. As shown in Figure 17 the installation process consists of three parts (sub-processes).

FIGURE 17: HIGH-LEVEL OVERVIEW OF MAINTENANCE BUSINESS PROCESS

The '**Receiving service request'** process is related to become aware of the malfunctioning of a solar installation and to plan the period within it needs to be fixed (see Figure 18). In this process, two parties are involved: the service department of Energy Supplier A and the customer. The service department of the energy supplier receives a service request via telephone or another source from a customer who bought a solar installation before, and is having a problem later. To identify the defect, the customer needs to provide information about him- or herself, the solar installation and the type of the defect or malfunction. The service department checks this information with the stored data on the customer and his installation and plans a preferred time-slot with the customer.

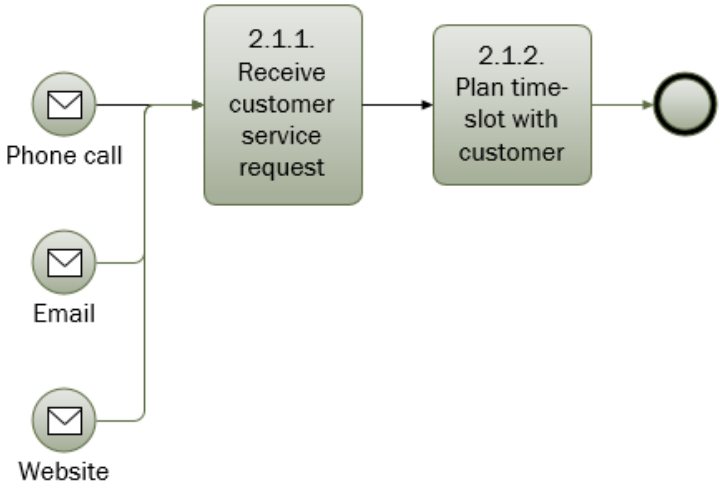

FIGURE 18: OVERVIEW RECEIVING SERVICE REQUEST PROCESS

The '**Dilivery'** process is related to executing the service maintenance (see Figure 19). In this process, four parties are involved: Service Department of Energy Supplier A, Intake & planning department of installation partner, Installation & service maintenance department of installation partner and the customer. Based on the provided information by the customer and the stored information in the system, a work order is generated by the service department of Energy Supplier A. When the intake & planning department of the installation company receives the work order, it will plan the hours and materials prospected, and purchase, if needed, the materials to fix the defect. Next, a service engineer of the installation & service maintenance department signs in on the work order and provides the service maintenance to address the defect at the customer site. He or she reports the hours spent and equipment and materials used, to the service department of Energy Supplier A, which updates the asset tool if needed.

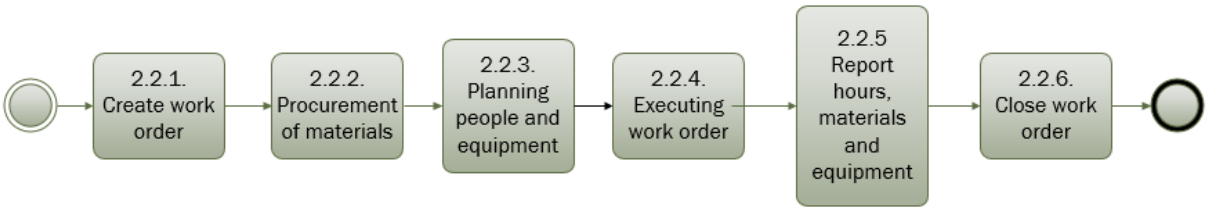

FIGURE 19: OVERVIEW DELIVERY PROCESS

The '**Billing'** process takes care of sending the bill to the customer for the solar maintenance services (if the defect or malfunctioning is not covered by any guarantee anymore), as well as paying the installation partner and supplier if necessary (see Figure 20). In this process, four parties are involved: Service department of Energy Supplier A, intake and planning department of the installation partner, the supplier and the customer. After malfunction is properly addressed, the customer is invoiced for the tasks and materials used. The customer is to respect a fixed period to pay the invoice. The installation partner is paid once a month by the sales department. The installation partner pays the supplier.

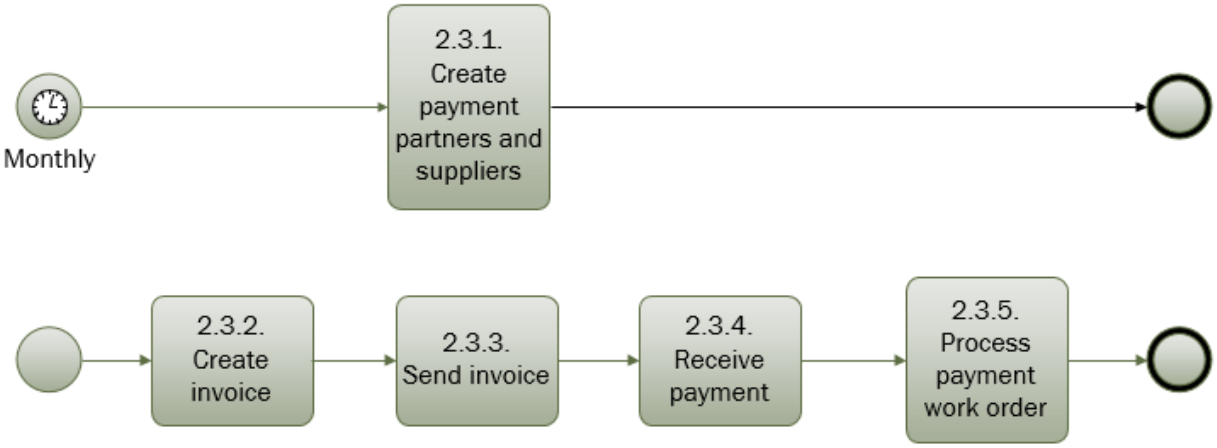

FIGURE 20: OVERVIEW BILLING PROCESS

6 STEP 2: FIND BUSINESS NEEDS AND ASSESS THE ECONOMIC, IT INFRASTRUCTURE AND ORGANISATION CONSTRUCTS

This section presents the results of the second step of the methodology. Step 2 focuses on the identification of the business needs and the assessment of the economic, IT infrastructure and organisation constructs. Fristly, the suggestions for the business needs of previous research, and the current business situation are discussed (6.1 and 6.2). Secondly the assessed business needs are validated and complemented, and the economic, IT infrastructure and organisation constructs are assessed. (6.3, 6.4 and 6.5).

6.1 Assessment procedure of business needs

Data for understanding and assessing the business needs have been collected by analysing the interview results concerning the current business situation (chapter 5) and by performing a literature review of the developments regarding non-commodity in the utility sector. This literature review is based on (and is a indepth of) the literature review conducted in section 2.1. By conducting this deepening literature review - in combination with the interview data - a solid understanding of the business needs is constructed. The search approach used in this study is based on the 'Grounded Theory Literature-Review Method' by Wolfswinkel, Furtmueller, & Wilderom [7]. For more details about this literature review refer to Appendix A.

6.2 Business needs

6.2.1 Introducing a future scenario of non-commodity market

As is shown in Chapter 2, the current model (where the energy suppliers achieve high margins caused by rapid economic growth and soaring commodity and energy prices) is no longer sustainable today because of political/environmental and economic circumstances. To keep their business profitable, energy suppliers have to change the way they do their business by focusing on sustainable energy production and energy-savings products and services such as solar installations. For energy suppliers (like Energy Supplier A) to establish a successful position in the future market, it is necessary to understand how this market is expected to develop in the next coming years. Both Boston Consulting Group and McKinsey defined the future for the energy market as one of great opportunities and uncertainties [4][3]. Based on these papers and other publications, a scenario is developed that illustrates a possible evolution of the energy market in this uncertain and dynamic period that lays ahead of us. This scenario is based on five assumptions regarding the drivers of the future energy market: demand for traditional energy, technological development, regulation, consumer behaviour and competition.

Demand for traditional energy. Klose et al. [3] enticipate, due to the political drive towards cleaner energy generation and the slow economic recovery, decreasing demand for energy from traditional energy plants. These findings are supported by Busnelli et al. [4]. This trend requires energy suppliers to search for new sources of income.

Technology development. Based on the findings of Sinke [18], Frantzis et al. [16] and Klose et al. [3], the costs of solar and wind technology are expected to drop in the future due to promising developments in DRG technologies and the transformation of the electricity grid. These promising developments are extra stimulated because the prices of exhaustible commodities are on the other hand expected to rise because of a diminishing availability of these commodities in the future. Because of these developments in pricing and technology it is expected that DRG and energy savings products become a more economically viable solution than it is today.

Regulations. Frantzis et al. [16] expects policy trends for Renewable Portfolio Standard and/or greenhouse gas emission cap to gain momentum at state and local levels, and to stimulate the adoption of DRG products [16]. These findings are supported by the expectations of Klose et al. [3], who expect that DRG and energy saving products will be backed by strong regulatory support in the form of for example fixed feed-in tariffs and subsidies. Feed-in tariffs are a fee above the rate of electricity to provide long-term security for DRG producers.

Customer behaviour. Businelli et al. [4] and Frantzis et al. [16] identified customers as being positive about saving energy. But where today DRG and energy saving products are mostly adopted by early adopters, who are mostly driven by environmental incentives ("being green") rather than economic incentives, future DRG and energy saving products will be interesting for the mass markets only when these products are economically viable solutions, because the mass is driven by economic incentives. Also Sinke [18] recognised the importance of economic viability for DRG and energy saving products to move mass markets.

Competition. Both Richter et al. [2] and Frantzis et al. [16] define the non-commodity market and in particular the solar installation market as very competitive, and they expect that the competitiveness will only grow further in the future due to the other developments described above.

Drivers	Scenario	Source
Demand for traditional energy	Decreasing demand for traditional energy	[3], [4]
Technology development	Improving DRG Technology resulting in costs decrease	[3], [16], [18]
Regulation	Regulators push for meeting CO2 targets	[3], [16]
Consumer behaviour	Customers adopt economically viable initiatives	[4], [16], [18]
Competition	Very competitive	[2], [16]

TABLE 9: FUTURE SCENARIO

Summarizing, the following scenario is expected: a reduction in demand for energy from traditional energy plants, lower production costs because of improved technologies, new regulation to push for meeting CO2 targets, adoption by customers of technologies that offer attractive (financial) returns, and a competitive market that keeps prices for customers low.

6.2.2 Introducing the conceptual business needs

The previously introduced scenario makes DRG and energy saving products interesting for Energy Supplier A in the future. However, for Energy Supplier A to position itself successfully in this future market, it has to understand where the money will be, what customers want, which products and services the organisation will be best positioned to deliver, and how this affects Energy Supplier A 's current business situation in terms of its value propositions, market actors and processes. This section describes and discusses how Energy Supplier A business situation is expected to change. Therefore, eleven emerging trends are identified which summarize this change and reflect the needs of the business. These are trends which cannot be ignored because they are at the heart of the ongoing transformation of the energy business towards a greener and on energy services oriented market. They will make an impact on the future energy business and it should be taken into account in both short-term and long-term planning.

Based on the literature review, three main trends are identified: energy suppliers are changing towards an energy service provider, energy suppliers are trying to focus on after-sales services too, and energy suppliers are investing in new capabilities to realize such. Table 10 visualizes these trends. Next, these trends are discussed in detail.

Business needs			Source
Energy service specialist	1	Support for multiple non-commodity products	[3], [4], [61]
	2	Support for bundling of non-commodity products and services with commodity products	[2], [3], [17], [62]–[64], Respondent 3
	3	Support for service and product unbundling	-
	4	Support for products, services and packages customization	[63], [65], [66]
After sales specialist	5	Support for multiple types of maintenance	[60]
	6	Support for full-life cycle support	[18], [67], [68]
New capabilities	7	Support for multiple financial options	[3], [4], [63], [66], Respondent 2
	8	Support for service contracts	[3], Respondent 3
	9	Support collective buying and sharing	[11], [63], [69], [70]
	10	Support for multiple partnerships	[3], [4], [17], Respondent 3
	11	Support for outsourcing and acquisitions	[2], [17]

TABLE 10: OVERVIEW CONCEPTUAL BUSINESS NEEDS

Energy service specialist. As various studies have suggested [3], [4], [17] energy suppliers are changing from a commodity provider to a comprehensive energy service provider. Energy suppliers are becoming the central point of contact for the customer with any energy-related question or need. This change starts with offering non-commodity products such as solar installations, what Energy Supplier A is doing now. However, for Energy Supplier A to move from an Energy provider to an Energy service specialist to stay ahead of its competitors, Energy Supplier A has to further develop and improve its product and service portfolio in order to achieve an advantage in the competition. According to Barney [71], organisations have two strategies to create competitive advantage: either by creating a better cost position or by being able to differentiate. Because several reports have mentioned that the profits and costs in the energy are under pressure [3], [4], this implies that a differentiation strategy is a preferred alternative to seeking new value and revenue. Next is suggested how Energy Supplier A could differentiate and improve its product and service portfolio.

The first improvement is the introduction of new non-commodity products. At present, Energy Supplier A's non-commodity product portfolio consists of three non-commodity products: solar installations, energy management tools and cv-boilers. In the future, it would be interesting to focus on a wider range of non-commodity products. Solar is only one of five DRG technologies [13] (see also Table 2 in 2.2.2) and the potential of other decentralised energy products, such as wind or hydro, is growing. Where Energy Supplier A does not recognize the potential of other DRG technologies yet, they may do so in the future. According to Peacock [61], developments in micro wind installation, are very promising and have the potential for urban application. In the future, micro wind installations can be an interesting alternative for (or addition to) Energy Supplier A solar installations. Also the developments for plug-in electricity vehicles are promising and will impact the energy sector as well, according to Klose et al. [3] and Busnelli et al. [4]. Offering charging stations to customers can be a new product for energy suppliers to deliver to their customers. These are only two examples of new products that could be interesting for Energy Supplier A in the future. By introducing new services and products, Energy Supplier A could differentiate its product and service portfolio from the portfolio of its competitors.

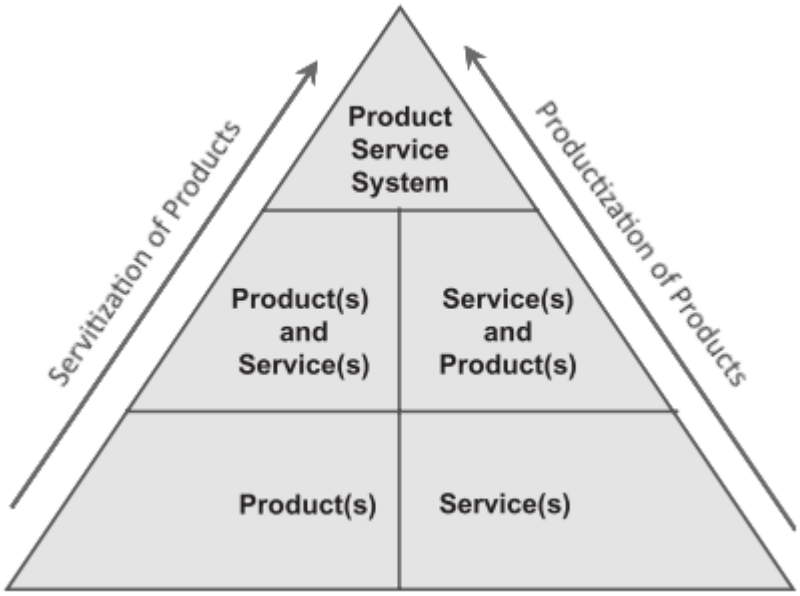

FIGURE 21: THE PRODUCT SERVICE-SYSTEM CONCEPT [63]

The second improvement is the bundling of non-commodity products and services with commodity products. Traditionally, people considered products separately from services. However, according to Baines et al. [63] recent years have been characterised by the 'servitization' of products and the 'productization' of services (Figure 21). The 'servitization' is seen when the material products become inseparable from the services component. Similarly 'productization' is when the service becomes inseparable from a product component. In other words, the product and service are seen as a single offering. This single offering is often referred to as the product-service system. There are many examples of product-service systems, as shown in publications. Goedkoop et al. [64] already provide 150 examples of product-service systems. One particular interesting example Goedkoop et al. [64] mentioned is *the mobile phone set by Libertel.* Libertel (today Vodafone) saw the high prices of mobile phones as the main drawback for private end-users to subscribe to the telecom network of Libertel. To stimulate the market penetration of mobile phones and increase sales of their telecom services, Libertel decided to provide a mobile phone for free in combination with a service contract. This bundling of product and services created a unique position for Libertel and competitive advantages to its competitors. The bundling of products and services is not yet standard practice in the energy sector [62], but today's market for non-commodity products such as solar installation is showing a similar trend. The high price of a solar installation is seen as a main drawback, but there is an enormous potential for growth [18]. Richter et al. [2], [17] already commented that the bundling of products and services can give energy suppliers a unique position in comparison to other suppliers of solar installations or other non-commodity products, especially when these non-commodity products are bundled with the traditional commodity products and services such as (the supply of) gas and electricity. At present, Energy Supplier A sells multiple non-commodity products, such as solar installations, energy management tools and boilers, as separate products, and commodity services, such as gas and electricity contract, as separate services. According to Richters [2], [17], the energy sector will benefit when they consider selling non-commodity products together with commodity products/services. The energy sector will be able to create a new value proposition for its customer, increase customer profits, and protect market share. An example of a new value proposition would be a package deal where a solar installation is bundled with a long-term electricity contract. The customer pays a fixed electricity price for a particular period and receives the solar installation with no prior investment costs for the solar installation. These findings are supported by Baines et al. [63] and Goedkoop et al. [64] who see product and service bundling as the means to create an unique selling point with extra value for the customer. It will protect the company's market share, increase the ability to extend services and lower the financial entrance threshold for new clients. The need to bundle energy products is acknowledged and mentioned by Energy Supplier A and is listed high on its priority list. However,

as noted by Baines et al. [63], this bundling of products and services will require a cultural shift as well as a modification of the relationship between the customer and the company.

The third improvement is much related to the second and concerns the unbundling of products and services. Unbundling could also be referred to as the “deservitization” or “deproductization”. The unbundling of packages concerns the breaking up of packages once they are sold as separate products and services. Once a customer buys a package deal (e.g., an electricity contract including a solar installation), he or she may want to cancel one of the (singled out) services (e.g., electricity contract) in the package deal, but keep the rest of the package deal (e.g., solar installation) intact. To support this, Energy Supplier A needs to support the unbundling of packages into separate products and services after a bundled sale is completed. Although Richter et al. [2], [17], Baines et al. [63], or Goedkoop et al. [64] did not acknowlegde this need. The need for unbundling of package deals will require reconsideration of Energy Supplier A termination processes.

The fourth improvement is products, services and packages customization. Baines et al. [63] identified that product customization is a way to differentiate and therefore to provide more customer value. When the product is flexible it will better suit the customer needs. Today customers only have a few options to customize their solar installation. They can choose the number of solar panels they want, and they can choose between two types of solar panels to compose their solar installation. In the future, it is interesting to increase the number of types of solar panels and to allow a combination of different types of panels to better suit the needs of the customer. Innovations in the solar generation sector are already showing promising new solar panel products. One example is the integration of solar panels into roof tiles and see-through solar panels [65]. These innovations allow Energy Supplier A to offer multiple solar products and thus customize the solar installation to the specific customer wishes. Also to the customization of solar installations, the introduction of packages may require customization too. In the telecom sector, for example, customers have the option to compose their package deal (e.g., which mobile with which type of phone contract) [66]. For Energy Supplier A to provide customization, the processes have to be designed in such a way that it allows further customization of products and packages.

After-sales specialist. Also after-sales services, such as Energy Supplier A ’s reactive maintenance services, have shown promise for the energy sector and can provide new means to differentiate from the competition [4], [17]. However to become an after-sales specialist Energy Supplier A has to further develop and improve its current portfolio of after-sales services.

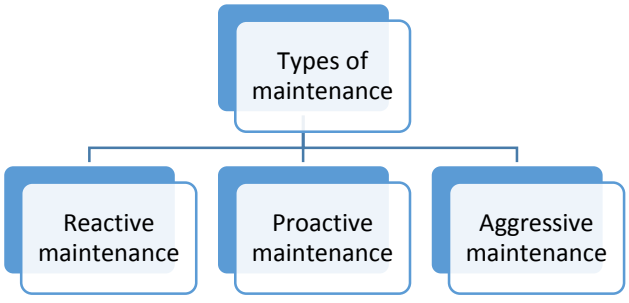

FIGURE 22: OVERVIEW MAINTENANCE TYPES

The first improvement is the introduction of varied types of maintenance. Today Energy Supplier A only provides maintenance services based on reactive maintenance. Reactive maintenance is often referred to as the fire-fighting approach and means the equipment is repaired or replaced after it has failed [60]. Energy Supplier A recognised the need for more advanced maintenance services. According to Swanson et al. [60] there are two other types of maintenance to consider: proactive maintenance and aggressive maintenance (see Figure 22). Proactive maintenance is a strategy to avoid failure by monitoring the equipment regularly and by undertaking preventive maintenance actions (to prevent future failures) based on actual performance and time in use. Aggressive maintenance goes even further and goes beyond the effort to prevent failures

only. It aspires to improve the performance of the equipment structurally by upgrading parts of the equipment or design.

The second improvement in the After-Sales is the introduction of full-life cycle support for non-commodity products. Full-life cycle support consists of the return flow or disposal flow of the products at the end of their economic life cycle [67], [68]. Solar panels are expected to have a life-cycle up to 25 years. The question is, however, what to do after these 25 years passed. Today the disposal of solar installations is a task of the customer. However with the transformation of the asset ownership from the customer to the energy supplier (as part of the package deal), the carrying out of the disposal is a new responsibility of the energy supplier. This new responsibility requires the energy supplier to consider full-life cycle support. Also for customer-owned assets, it could be interesting for the energy supplier to consider the disposal flow as an extra service to the customer. Due to depletion of natural resources, it might be a necessity to reuse materials or parts of the products. The findings of Sinke [18] support this; he expects that the availability of sufficient and cheap materials for the production of solar panels may be a problem in the future. Also, the government may require organisations to reusing materials. According to Hillegersberg et al. [67] and Sundin [68], full-fife cycle support is emerging in other sectors such as the logistics and manufacturing sector.

New capabilities. For Energy Supplier A to increase its sales of non-commodity products and/or services, it not only has to improve its product and service portfolio, but also has to consider investing in capabilities.

The first improvement is the introduction of multiple financial options. Today, solar installations are invoiced based on a full payment. However with the introduction of package deals, where the ownership of the asset is transferred from the customer to the energy supplier, new pricing structures and, thereby, financial options are required [63]. There are multiple financial options to consider (see Figure 23): hire purchase, a lease, and paying in terms. A hire purchase is an alternative way to finance the acquisition of an asset. The customer hires the asset from the energy supplier, and so he does not have to pay to energy supplier in full [72]. During the hiring period the customer pays the energy supplier in terms, and can use the asset. However, the ownership of the asset remains with the energy supplier until the asset is fully paid. A lease is an agreement between the person or company who owns the asset, known as the lessor, and the person who uses the asset, known as the lessee [72]. The lessee can use the asset for a fixed period of time in exchange for regular payments. The major difference with a hire purchase is that the ownership is not transferred at the end of the leasing period. The pay-in-terms is a loan agreement where the customer pays for the asset in multiple payments over a fixed period [72]. The main difference between a hire purchase and a lease is that the customer is immediately the owner of the asset in case of a hire purchase.

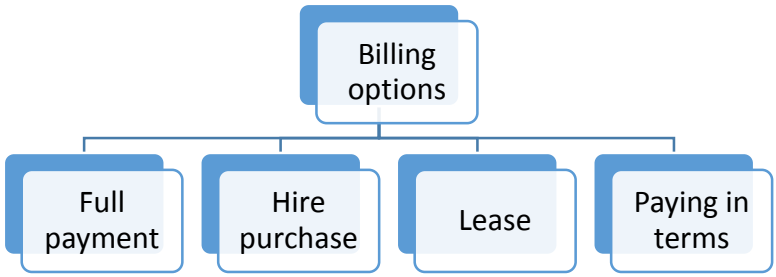

FIGURE 23: OVERVIEW BILLING OPTIONS

Respondent 2 argues there is a need for more financial options as extra means to differentiate and increase the sales of non-commodity products and services. This need is supported by Klose et al. [3] and Busnelli et al. [4]. A similar trend showed in the telecom sector, where the telecom sector was used to focus purely on phone contracts. At present, they also offer all sorts of telephones with multiple paying plans [66]. For example, now they sell mobile telephones through a full payment or a lease.

The second improvement is the support for service contracts regarding the maintenance of non-commodity products. Today Energy Supplier A provides maintenance services purely on a pay-per-fault basis. Energy

Supplier A acknowledges the need for service contracts. Also Klose et al. [3] recognizes the potential of service maintenance contracts for energy suppliers. With a service contract, the customers pay a fixed fee per year to cover any maintenance costs. This contract prevents that the customer has to pay for any unexpected costs related to failure or malfunctions of the installation. Also with the introduction of full-life cycle support, a full-life cycle support service contract could be an interesting option to consider.

The third improvement is the closer collaboration with other companies (see Figure 24). For energy suppliers to deliver the wide range of new non-commodity products and service, they need to engage with other companies to provide the required expertise or capacity. Richter et al. [17] suggest that energy suppliers could benefit from the existing know-how of small installation and essembling companies who are specialized in decentralised energy generation. These companies have the expertise, means and contacts, and the energy suppliers can provide the funds and its customers. A partnership with a financial institution may be required to offer the (previously) newly introduced billing plans. Also Busnelli et al. [4] suggest that energy suppliers should establish partnerships with financial institutes for extra financial expertise and sources. The non-traditional financial options may require extra financial expertise and investments, which Energy Supplier A may not have in-house. According to Klose et al. [3], partnerships with the automotive sector can be interesting as well, giving to the growing market for charging stations of electric vehicles. Lastly, respondent 2 sees possibilities for data partnerships, to exchange data which could help create leads or sales for example.

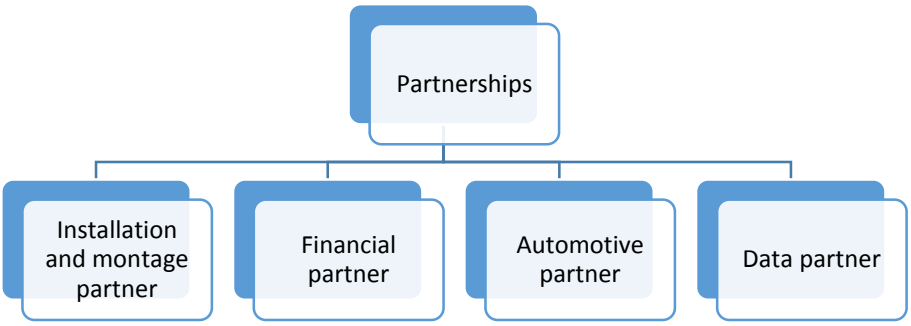

FIGURE 24: OVERVIEW PARTNERSHIPS

The fourth improvement is the consideration of outsourcing and acquisitions. This improvement is linked to the need for closer collaboration: Energy Supplier A may need more sources and expertise. Today Energy Supplier A already outsources a part of its business process to its installation partner. More and more organisations outsource processes that, in their opinion, do not belong to the core processes. A trend in the energy sector is that energy suppliers work together with solar expert companies to advance their position in the market [17]. Another option for Energy Supplier A to increase its knowledge about solar installations is through acquisition.

The fifth improvement is the support of collective buying and sharing. Collective buying (or group buying) is considered a strategic form of product acquisition that is employed by groups of customers to obtain volume discount on desired products and services [73]. Collective sharing (or group sharing) is considered a form of ownership, in which not one individual, but the whole group is the owner of the asset [70]. Where collective buying has been widely adopted in other industries (e.g., car sharing) [63], [70], it has not yet been introduced in the energy sector for non-commodity products. However, several studies are showing there is a growing interest in collective energy projects. Energytrends 2014 [11] is describing an increase of collective solar projects, in which customers unite to buy non-commodity products together on a collective basis and share the ownership of the non-commodity products collectively. An example is a collective project in Goirle [69]. A group of residents invested collectively in 214 solar panels, which were placed at ten different buildings. For Energy Supplier A to take advantage of the growing market for collective buying and sharing, they should consider improving their processes to be able to serve groups in the sales process.

6.3 Validation procedure of business needs and assessment procedure of economic, IT infrastructure and organisation constructs

This section describes the validation of the future business situation and the assessment of the economic, IT infrastructure and organisation constructs of a new ERP solution. Section 6.3.1 briefly introduces the procedure, followed by section 6.3.2 which elaborates on the data analysis.

6.3.1 Validation and assessment procedure

DATA COLLECTION

In this validation, a qualitative approach is applied. Data for the validation is collected by four semi-structured interviews (interview 5 till 8) and a short questionnaire. A semi-structured interview is a typical and useful qualitative research method to understand what is happening and to seek for new insights [59]. The goal of the interview is two-fold. Firstly, in these interviews the identified business needs are validated, ranked and if possible expanded. Secondly, the position of the organisations regarding the constructs influencing the viability of Dynamics AX are identified. A questionnaire is a technique of data collection in which each person is asked the same set of questions in a predetermined order [59]. The goal of the questionnaire is to introduce the topic to the respondent and to already receive some general insights from the respondent to prepare and complete the follow-up interview accordingly.

The questions prepared for the interview and questionnaire can be found in Appendix C.3.

EXPERT OPINIONS EXECUTION

All respondents were contacted to invite them to participate in this research by email. After a positive reaction of the respondent, a 60-minute interview was planned (which both suited the respondent and interviewer) and the short questionnaire, as preparation for the interview, was sent. The interview was conducted face-to-face at the respondent location of choice.

PARTICIPANT OF INTERVIEW 5

Respondent 5 is the manager for product management and business development for Energy Supplier B. He is responsible for all energy-related products and services offered by Energy Supplier B at present and in the near future. Energy Supplier B is a (large) traditional energy supplier in the Netherlands (founded before 2000), which focusses both on production as on marketing and sales of electricity. Respondent 5 was selected for his experience in non-commodity products and related services.

PARTICIPANT OF INTERVIEW 6

Respondent 6 is manager marketing & sales and manager service management for Energy Supplier C. She handles the functional management of IT applications in its IT landscape. Energy Supplier C is a (large) traditional energy supplier in the Netherlands (founded before 2000), which focuses both on production and on marketing and sales of electricity. Respondent 6 was selected for her experience in developments regarding non-commodity products and related services and the impact it has on IT.

PARTICIPANT OF INTERVIEW 7

Respondent 7 is head of the customer service and back-office for Energy supplier D. He is responsible for the processes related to customer service. Energy supplier D is a (relative) young energy supplier in the Netherlands (founded after 2000), which focuses on marketing and sales of electricity. Respondent 7 was selected for his experience in non-commodity products and related services.

PARTICIPANT OF INTERVIEW 8

Respondent 8 is a business consultant for Energy Supplier C. She is responsible for supervision and development of new market models. Energy Supplier C is a (large) traditional energy supplier in the Netherlands (founded before 2000), which focuses both on production and on marketing and sales of electricity. Respondent 8 was selected for her experience in non-commodity products and related services.

6.3.2 Data analysis

The interview data and the questionnaire data can be considered as qualitative data. One of the characteristics of qualitative data is that these are non-standardized and complex. It needs to be summarized, categorized and/or restructured to meaningfully support the study [59].

With the permission of the participants, all interviews are recorded. Once the data are collected a qualitative data analysis is conducted. Only the sections relevant to the research are transcribed. After transcribing, the transcribed data and written notes are summarized. Next, the results of the summary are categorized and restructured so the data can be turned into concepts, which allow drawing meaningful conclusions. The categorization is based on the previously identified TO-BE business needs (see 6.2) and the three measurements of viability (the economic, IT infrastructure and organisation constructs). At the end, the data will be evaluated by alternative explanations and counter-arguments.

6.4 Results validation and assessment

This section presents the results of the questionnaire and interviews.

6.4.1 Results questionnaires

The results of the questionnaire can be found in Appendix E.

6.4.2 Results of interview 5

Respondent 5 confirms that the current business model (which is purely focussed on production and sales of commodity products) of energy suppliers is no longer sustainable in the future. Energy suppliers have to redesign themselves to survive. He describes the future of his company as*: A partner for the customer to assist in all its energy-related questions and needs.* The non-commodity products and services are crucial in providing answers to the requests and needs of customers and to create new sources of value for their company.

When discussing these new products and services, Respondent 5 indicates that he sees the energy management tools and car charging points as most potentail, followed by domotica products and smart home services (e.g., a service which regulates when to charge your car and to heat your boiler based on the fluctuations in the demand and supply of energy). To give an example of the growth potential of these products: he expects 70-80% of their current customers have an energy management tool installed within the next five years. On the other hand, he has lower expectations of solar installations and micro wind turbines. He argues the market is too saturated for their company to really make a difference in the market regarding these products.

When discussing the potential of the more promising new products, he indicates that the margins on these products and services are still small. Therefore they are not (yet) financially interesting, but they have a lot of strategic value. These new products and services show the customers that their company is providing new solutions for the energy transition, which help to increase customer comfort and customer value.

During the interview also the importance of bundling products and services is discussed. Respondent 5 indicates they are currently bundling non-commodity products through their Home Advice services. In this service, the customer is advised about a selection of products to lower CO2 emissions and to decrease his energy bill. In this discussion, the respondent indicates they provide discounts on telecom contracts if customers already have a gas and electricity contract with their company and vice versa. However, he sees

this rather as a marketing tool than as a bundling of products and services in one package. In other words, in his opinion the non-commodity products are not yet bundled with the traditional commodity products (e.g., electricity and gas). He argues that it is up to partners or third parties to offer bundled packages with the traditional commodity products and non-commodity products.

The next discussion focuses on the role of partners in this transition to non-commodity products. Respondent 5 agrees that the company has to work closely with other companies to successfully provide these products and services to customers. These partners help to deliver the products and services needed. Respondent 5 mentions four important partners: installation partner, financial partner, data partner, and IT partner. These partners help the company to focus on the core activities.

The change (from an energy provider to partnering up with the customer helping with all its energy questions and needs) will have a huge impact on their organisation, according to respondent 5. Both the processes and the IT infrastructure will be impacted.

When discussing this impact, respondent 5 mentions: *traditionally energy companies such as theirs, consider the processes as departments and templates, which are expected not to change much.* Respondent 5 agrees that the change from the energy provider to a partner of the customer requires a dynamic and integrated approach to their processes. For example, to provide the smart home services for flexibly managing the charging of the car and heating the boiler of a customer, an integration of the processes of the trading and sales department is required. These processes are as yet considered to be separated processes. He acknowledge this need for a change of culture and processes as a big and difficult challenge for their company and the energy sector in general.

Respondent 5 also expects changes in their IT environment. Their current IT architecture is also structured based on separate departments. To archive fully integrated processes, they need a more dynamic and integrated IT solution. This requires a new investment in IT. However, in a discussion on this investment, respondent 5 is worried about the rising upfront investments for new IT solutions and the increasing risks associated with these investments. He argues they have to search for new financial models to finance and set up these high risks investments, to be able to upgrade the current IT landscape.

Next, the organisation culture is discussed. Respondent 5 defines their current culture as traditional in which people are used to “doing the things in the way they have been done in the last fifteen years”. He indicates this mentality stimulates the resistance to change, which creates quite a few huge challenges for the switch to a more customer focused company. However, he argues that the internal support for this switch is growing. Both the higher management and the lower management are aware of the necessity of this switch and the impact this will have on both their processes and the IT environment.

To conclude the interview, respondent 5 argues that it is not a issue anymore that they have to change their business model; it rather is if they can and how fast they need have to change.

6.4.3 Results of interview 6

When discussing the future of energy suppliers, respondent 6 agrees there is no sustainable future for their company exclusively as producer and seller of electricity. Traditionally their company’s business model consists of investing money in new energy production capacity, which led to huge returns on investments. However, she argues this is no longer possible anymore. She argues that the focus on green energy and the cheap energy from Germany are resulting in an overproduction of electricity in the Netherlands. She mentions that she sees a trend of downscaling the production capacity of traditional energy plants rather than upscaling. This requires from their company and the energy sector in general, to search for new sources of income. She describes the future of their business as focusing on the customer instead of on production and in helping the customer with the energy transition.

To help the customer in the energy transition, respondent 6 agrees with the importance of non-commodity products and services. Although she mentions they currently do little with these products and services today,

they have big plans for the future. They have had a pilot project for solar installations and are planning to start with selling energy management tools. They also provide customers with the options to register for a solar park. For the B2B market, they have an interesting new service that flexibly manage the supply of energy by controlling the capacity of businesses to compensate a deviation between the demand and supply of energy. The businesses that apply for this service are financially compensated. This is a win-win for both the businesses and the energy supplier.

Respondent 6 argues that these products and services are considered a must have in the energy market, without lagging behind other energy suppliers, especially in the retail market.

In the discussion on the importance of bundling the products and services with the traditional commodity products, respondent 6 mentions she sees a lot of potential in this bundling. She argues that a combination of energy contracts and, for example, solar installations will be common in the future.

To accomplish these new products and services, respondent 6 agrees that partners are of great importance for their company. These partners have the skills and expertise needed. For example, the data partner can use the available data to predict the customer wishes and customer behaviour. Nowadays, their data is mostly used for analysing what happened in the past, rather than predicting what will happen in the future. Also to the installation, financial, data and automotive partner, she argues that a hardware or software partner can also be of importance for developing new products and services.

Respondent 6 also agrees that these partners can also help in outsourcing processes and functional management. However, this requires both new competencies of their company and from their partners to guarantee a successful outsourcing project.

When discussing the impact of these developments on the organisation, respondent 6 states: *it requires a lot to switch from a production company to a marketing and sales company with products and services which were not provided before.* In accomplishing this switch, she argues, their company is still searching. Traditionally, their company is risk-avoiding and has a slow decision process. The switch requires new competencies (e.g., entrepreneurship and risk-taking) and a different way of organizing the organisation. She argues this is a huge organisational challenge, which both impacts the organisational processes and the IT landscape.

When discussing this impact, respondent 6 mentions that the processes for sales and marketing are becoming much more important, and those of products are becoming less important.

In discussing the impact on their IT landscape, respondent 6 first describes their current IT architecture. They have a separate environment for B2B and B2C markets. For both environments, they have a solution that both integrates production and sales and marketing. She mentions that the big challenges are to include the new products and services in these environments and to improve the flexibility of these environments to react promptly on new developments. She argues they are currently not able to react quickly on changes, due to numerous government policy rules.

Next, the organisational culture is discussed. Respondent 6 describes their corporate culture as traditional in which people are focused on production rather than on the customer, and in which they are used to long decision processes and doing things the way they have been done for many years. She indicates this traditional culture is not best suited to change, even though everyone is aware of the necessity to change the processes and the IT solutions. A currently executed reorganisation aims at assisting this change by opening up the organisational culture to change.

To conclude the interview, respondent 6 mentions they have a lot of growth ambition both in the B2C and in the B2B market. In the B2B market, they want to differentiate by providing good administrative services. In the B2C market, they want to differentiate by focusing on customer comfort in the broadest sense and by relieving the customer with all this energy-related matters.

6.4.4 Results of interview 7

In the discussion on the future of energy suppliers, respondent 7 that mentions the environment in which Energy suppliers operate today will change. Newly entering competitors, such as Tesla, will have a large impact on the energy market. The current business model which is purely focused on production and sales of commodity products will not exist in the future in its current form. In order for energy suppliers to survive, respondent 7 that states the energy suppliers of today have to rethink their business operations. In his opinion, the future business model has to change its focus on data and technology, and combine these two into new products and services. He describes their future company as a data-hub for energy-related matters.

To accomplish this change to a data-hub, Respondent 7 that argues non-commodity products and services are very important. He sees a lot of potential products such as solar installations, energy management tools and other smart home services. However, he sees less potential in products such as micro wind turbines or car chargers.

The potential products are strategically important for the sales of gas and electricity. It helps to increase customer loyalty, and it creates new revenue streams by offering customers new products and services, which they can also buy when they do not have a gas or electricity contract. He also mentions that the financial contribution of these new products and services today (in comparison to the whole business) is still considered very low.

While discussing the bundling of new products with the traditional commodity products, respondent 7 mentions he sees no future in this bundling. He argues that customers prefer to buy products and the traditionally commodity products separately, so they know what they pay for.

In order to accomplish this change into a data-hub, respondent 7 mentions they have to rethink their current processes. Whereas the processes of sales and marketing are now focused on selling the tradition commodity products such as gas and electricity, the focus has to change to energy (related) products and services. This requires changes in both their processes as their IT environment.

Respondent 7 also agrees that increased collaboration with partners is of growing importance for energy suppliers. He agrees that an installation partner, financial partner and hardware or software partner can be helpful to acquire the skills and expertise needed for this change into a data-hub. Respondent 7 also agrees increased collaboration with and outsourcing to partners helps their company to focus on the core business.

To support the change, respondent 7 states that the energy supplier need to have an IT solution which is flexible and dynamic. He argues that their IT landscape has to be able to react promptly to on new developments in the environment and market to stay ahead of the competition. This requires a flexible, stable, scalable solution, which preferably is cheap as well. In his opinion, a good solution is a platform based on proven technology that can be customized easily by internal developers. Also, respondent 7 is open for solutions in the cloud.

When discussing the challenges in relation to their IT, respondent 7 mentions it is difficult to set the correct priorities, due to the ambiguity of future developments.

In the discussion on the support and resistance to change, respondent 7 mentions that their organisation is very open to change. He argues a new product or service can be launched within two months. He defines their organisational culture as innovative, focused and open to change, which allow their organisation to react fast on new developments. He sees this as one of their key competencies. To support the needed change, their organisation searches for IT solutions which can cope with these changes.

6.4.5 Results of interview 8

When discussing the past and future of energy suppliers, respondent 8 mentions they used to earn their money with the production of electricity. However, she agrees that this business model is no longer

sustainable, and they focus more and more on the customer. Today, she sees a shift from being a pure commodity provider to becoming an all-round commodity specialist to help with a customer with all his energy-related needs. To fulfil these needs they provide both commodity products as related energy products and services. The goal is to unburden the customer with all his energy-related matters by facilitating him with all the energy-related products and services.

In order to provide extra energy products and services, respondent 8 acknowledges the importance of (non-commodity) DRG and energy saving products and services. However, she indicates that their current non-commodity product and service portfolio is still very small. For now, they only offer customers solar installations and energy scans, and for the B2B market they have a service which flexibly manages the demand of energy. This service controls the energy capacity of businesses to compensate a deviation between the demand and supply of energy, for which the participating businesses are financially compensated. The energy scan is an advice service for customers on how they can save energy. At present, the financial contribution (less than 1% of the total revenue) of these new products and services to the total sales is considered still very small by Respondent 8.

Respondent 8 indicates they have ambiguous plans for more and new products and services in the future. She sees much potential in energy management tools, car charging points and in the long future a smart home service to control the moment of charging and discharging. Also she sees much potential in all-in packages wherein a car charging point in combination with an energy management tool and electricity contract is offered to the customer. This package has one contract and one price for the customer. The goal of this package is to free the customer from inconveniences and fulfil all his energy needs in one go.

When discussing the role of partners (and) outsourcing in this transition, respondent 8 confirms the importance of partners and outsourcing. She indicates it is impossible to insource all the required skills, resources and knowledge, and she argues that it is a wiser option to outsource non-core processes to partners who are specialized in that area. The installation partner, financial partner and big data partner are considered important. The installation partner helps with the delivery and maintenance of non-commodity products. The financial partner helps with financial matters, and the big data partner can help in the long run to do more with data.

In discussing about the impact of these developments on the organisation. Respondent 8 mentions it is difficult to provide customers with insights into simple things (e.g., what contract do I have) as well as in complex things (e.g., how many energy connections do I have, and how much electricity do I consume). Today, she comments, it is not possible to provide these insights. Further integration of both processes and IT systems is needed to accomplish this. However, she indicates this will be challenging. At present, the IT and business is seen as two separate things, rather than as enablers of one and the other. More cooperation between IT and the business is needed. This requires changes.

Due to the reorganisation, respondent 8 argues that their organisation is now semi-open to change (or at least the management is). However the organisation is considered to be very hierarchical, slow-moving and risk-avoiding, which characteristics still obstruct change. She argues it should be easier to purchase ideas that do not have a solid business case yet.

When discussing the impact on IT, respondent 8 mentions she would be very happy with one solution that integrates all business units, has all data, is accessible to everyone and is easy to use. She argues there is a high need for such a solution by sales and marketing. However, she sees many challenges in order to achieve such a solution, due to different interests, high costs and need for new training.

To conclude the interview, respondent 8 mentions the danger of new entrants in the energy product and services market. She argues organisations such as Tesla and Google may come with products and services focused on the energy market. She is concerned that top management might not acknowledge this danger yet.

6.5 Updated business needs and assessed economic, IT infrastructure and organisation construct

This section presents the results of the analysis of the interviews which have been conducted to update the business needs and to assess the economic, IT infrastructure and organisation construct.

All four respondents (number 5 till 8) confirmed that the current business model, which is exclusively focussed on production and/or sales of commodity products, is no longer sustainable in the future and has to be redesigned to survive. Each respondent is searching for new ways to position themselves in the future. However, there is some inconsistency among the respondents about what would be the right approach. Respondent 5 defines the future of the company as: *a partner of the customer to help with all his energy-related requests and needs.* Respondent 6 describes their future as: *an assistance for a customer in the energy transition.* Respondent 7 sees the future as: *a data-hub for energy-related matters*. Respondent 8 sees the future as: a*n all-round commodity specialist to help the customer with all his energy-related needs.* However, all four respondents agreed that non-commodity products and services will be of great importance to make this transition. These products and services empower customers to engage in energy consumption and production, and provide energy suppliers to deliver assets and drive optimal use of energy resources. During the discussions with all four respondents, they confirmed that the switch to non-commodity products and services will have an impact on their organisation and will create new needs for the business.

This section elaborates on the data collected by the interviews and questionnaire. First, the results towards the business needs are discussed (6.2), followed by the results of the economic, IT infrastructure and organisation factors (6.5.2, 6.5.3 and 6.5.4).

6.5.1 Updated business needs

This section visualizes the combined results of the interviews as presented in the previous section. The business needs that are acknowledged, revised and newly formulated, are shown in Table 11. A business need is acknowledged if at least ¾ of the respondents recognised its importance. A business need is new or revised, if at least ¾ of the respondents recognised the need to include or to revise this business need.

Updated Business needs		
Energy service specialist	1	Support for multiple non-commodity products
	2	Support for multiple non-commodity services
	3	Support for bundling of non-commodity products and services with commodity products
	4	Support for products, services and packages customization
After sales specialist	5	Support for multiple types of maintenance
	6	Support for full-life cycle support
New capabilities	7	Support for multiple financial options
	8	Support for service contracts
	9	Support for multiple partnerships
	10	Support for the outsourcing of processes
	11	Support for flexibility

TABLE 11: UPDATED BUSINESS NEEDS

As can be seen, there are a few differences between the introduced business needs in section 6.2 and the presented business needs in Table 11. The literature provided evidence for eleven business needs. However only seven of these are acknowledged by the respondents, one is revised and two are rejected. In addition, two business needs are added as a result of the interviews. Below, each of business need is discussed in detail.

SUPPORT FOR MULTIPLE NON-COMMODITY PRODUCTS

In all four interviews, the importance of non-commodity products is recognised. All four see the energy management tools as one of the most crucial products. However, there is some inconsistency among the respondents on the importance of the other products. Respondent 6, 7 and 8 has high expectations on solar installations, where respondent 5 expects less of it. A similar trend is seen for the expectations for domotica products and boilers, respondents 5 and 7 see high potential in these products where respondent 6 and 8 do not. Respondents 5 and 8 are the only ones who recognize the importance of car charging stations. Although the literature was suggesting a promise for micro wind turbines, none of the respondents confirmed this potential.

To conclude, non-commodity products are important just as previous research suggested. However, the type of products which are considered most important differ.

SUPPORT FOR MULTIPLE NON-COMMODITY SERVICES

Whereas the literature is focused on the potential of new products and after-sales services (e.g., maintenance), all four respondents also indicated the importance of new non-commodity services such as smart home services or smart business services. Respondent 5 provided one example of these smart home services: a service that regulates when to charge your car and/or heat your boiler based on the fluctuations in the demand and supply of energy. Respondents 6 and 8 also mentioned an example of such a smart business service. They described this service as a service for the B2B market that manages the energy capacity (demand) of the business to compensate deviation between the total demand and supply of energy. The business is financially compensated when applying for this service.

The importance of multiple non-commodity services was not suggested in the previous research and is, therefore, a new finding.

SUPPORT BUNDLING OF NON-COMMODITY PRODUCTS AND SERVICES WITH COMMODITY PRODUCTS

The importance bundling non-commodity services and products with traditional commodity products is only partially recognised. Respondents 5, 6 and 8 all confirmed the potential of bundling the non-commodity products and services with the traditional commodity products. They expect all-in packages, where a solar installation in combination with an energy management tool and energy contract is offered to the customer, to be common in the future. These packages involve one contract and one price. Respondent 8 argues that these packages fulfil all the customer's energy related needs at once and fully free the customer with all his energy bothers. Respondent 5 has a slightly different view on these packages, as he sees no direct role for them to offer these packages to customers. Instead, he expects partners or third parties to offer these packages to customers. They will only provide the required support in the background.

On the other hand, respondent 7 disagrees with the others. He sees no significant importance in this bundling at all. He argues that customers prefer to buy products and the traditional commodity products separately.

The bundling of services and products with traditional commodity products can be concluded to be less important than previous literature research suggested. Nevertheless, since it is acknowledged by ¾ of respondents, it is still considered to be semi-important.

SUPPORT FOR PRODUCTS, SERVICES AND PACKAGES CUSTOMIZATION

All four respondents confirmed the importance of customization. This implies that customization of products and packages (when available) is of importance for providing the customer with solutions they need. On the other hand, the customization of services was only confirmed by ¾ of the respondents. This implies there is less need for service customization than product customization.

The customization of products, service and packages are as important as previous research suggested.

SUPPORT FOR MULTIPLE TYPES OF MAINTENANCE

Three of four respondents confirmed the importance of multiple maintenance types. Only respondent 8 sees no need for maintenance services other than reactive maintenance. The other three respondents considered proactive maintenance as a good addition to reactive maintenance and respondents 5 and 7 even acknowledge the importance of aggressive maintenance.

The support for multiple types of maintenance can be concluded to be important as previous research suggested, since ¾ of respondents considered it as important.

SUPPORT FOR FULL-LIFE CYCLE SUPPORT

The importance of full-life cycle support is confirmed by ¾ of the respondents. Respondents 5 and 6 emphasized the importance of free the customer in his energy-related needs and questions. This implies that full-life cycle support can be an example of unburdening the customer. However, the full-life cycle support is not discussed in detail. More research is required to determine the exact composition of this support.

Nevertheless, the full-life cycle support is as important as previous research suggested.

SUPPORT FOR MULTIPLE FINANCIAL OPTIONS

All four respondents acknowledge the importance of multiple financial options. Energy supplier B from interview 5 already provides the option to rent a boiler, but this option is not available yet for other non-commodity products. All respondents recognised the importance of the leasing option. Respondent 8 argues a leasing construction helps to relieve the customer of its financial matters concerning, for example, the up-front investment in a solar installation. The renting and paying in terms, on the other hand, is only recognised as important by respondent 6, 7 and 8.

Multiple financial options are as important as previous research suggested.

SUPPORT FOR SERVICE CONTRACTS

The support for a service contract is partially recognised by ¾ of the respondents as important. Energy supplier B from interview 5 already provides service maintenance contracts for boilers, but not yet for the other non-commodity products. It offers two types of service contracts a basis-contract and an all-in-contract. On the other hand, respondent 7 sees no potential in service contracts.

The importance of service contracts is similar to what previous research suggested.

SUPPORT FOR MULTIPLE PARTNERSHIPS

In all four interviews, the importance of partnerships is confirmed. Respondent 6 mentions their organisation needs the skills, resources and expertise of their partners to deliver the products and services to the customers. This opinion is also supported by respondents 5, 7 and 8. However, there is some inconsistency among the respondents about the particular type of partners they consider most important. The installation / assembling partner and the financial partner are recognised as important by all four respondents. On the other hand, the hardware / software partner, who was not recognised in literature yet and helps to develop new products, services and/or IT platforms, is considered as important by respondents 5, 6 and 7. The (big) data partner is recognised as important by respondents 5, 6 and 8. They argued that their organisation do not have the correct skills, expertise and resources in-house to get the most out of their data. Respondent 7 argues that this is part of their core business, and therefore they have the required expertise and skills in-house instead of relying on a partner.

Multiple partnerships are more important as previous research suggested. The importance of the hardware / software partner was not recognised in the literature yet and is considered as a new finding.

SUPPORT FOR THE OUTSOURCING OF PROCESSES

Outsourcing was considered important in all four interviews. However, acquisitions were not. All four respondents indicate that outsourcing is an ideal solution to be able to focus on their core business. Respondent 5 sees their organisation as central point of contact for the customer for its energy-related questions and needs, and in order to serve this central point their organisation has a network of partners to help them provide the requested services and products. He argues that these partners have the expertise and resources to fulfil this need, which his company has not. Respondents 6, 7 and 8 confirm too that their organisation by itself is not able to provide all the products and services the customers are requesting for, and, therefore, need the help of partners. This help is provided through outsourcing of processes. Although the outsourced that they processes are not discussed in detail during the interviews, the importance of the installation and assembling partner implies that the processes around the delivery / installation and maintenance of non-commodity products and services are most likely to be outsourced. On the other hand, none of the respondents see a need for acquisitions. They argue their organisation prefers to outsource rather than to insource.

The results of these interviews provide a nuance to what is indicated in conceptual business needs. Outsourcing is more important and acquisition is less important than previous research suggested. Therefore, this business need is revised and renamed from support for outsourcing and acquisitions to support for outsourcing.

SUPPORT FOR FLEXIBILITY

In all four interviews, the importance of flexibility was considered a top priority. Flexible business and IT environment will allow them to react promptly to new developments, which is crucial to surviving this energy transition. Respondents 5, 6 and 8 mentioned that their organisation (due to its “rigid and change-resistant” organisational culture) has difficulties to quickly implement changes in the business and IT environment for a relative low price. They see their ability to implement changes as too slow and too expensive. On the other hand, respondent 7 mentioned that his organisation (due to its “flexible and open-for-change” organisational culture) is good at implementing changes quickly and relatively cheap. He argues his organisation benefits a lot from this ability and provides his organisation with a real advantage vis-à-vis the competition. This implies that the organisations which are able to react quickly and relatively cheap to new developments and therefore are flexible, will have a lead on towards the competition.

The importance of flexibility was not suggested in the previous research and is, therefore, a new finding.

SUPPORT FOR SERVICE AND PRODUCT UNBUNDLING

In the interviews, the importance of service and product unbundling was not confirmed. Only respondent 8 sees potential in unbundling, the others see none.

The service and product unbundling is therefore considered as less important, as respondent 2 suggested.

SUPPORT COLLECTIVE BUYING AND SHARING

Although previous research showed a promise for the collective buying of products and sharing of products, this is not confirmed by the interviews. Respondents 5 and 7 see no added value in supporting groups with their non-commodity products. The financial margins on these products are already considered very low, and therefore they see no financial benefit. On the other hand, respondent 6 does see potential in serving groups. The plan to allow the customer to register for a solar park implies a sort of group sharing.

The collective buying and sharing is considered less important than the previous literature suggested.

6.5.2 Assessed economic construct

Visualizing the results of the interviews, Table 12 shows the position towards the measures of the economic construct.

Construct	Measure	Position
Economic	Feasibility	A high feasible solution has clear and low-risk upfront costs and is preferably cheap.
	Justification	A high justifiable solution is suitable for non-commodity products and services, preferably also for commodity products and suitable for continuous improvement.

TABLE 12: OVERVIEW POSITION TOWARDS ECONOMIC CONSTRUCT

The economic justification is based on the expectation of the solution towards the effect on the competitive advantages of the organisation. All four respondents indicated that changes within their current IT landscape are unavoidable in the process of redesigning themselves in the energy market. Respondent 5 argued that the future developments require a more integrated IT solution to support the new non-commodity products and services. Respondents 6 and 8 that argued the growing importance of non-commodity products and services, requires an IT solution suitable for the sales of the new non-commodity products and services, and preferable as well for the sales of commodity products. Although respondent 7 did not mention the need for a new IT solution, he acknowledged the importance of continuous improvement of their current IT architecture to react to further developments. To summarize, a high justifiable solution is suitable for non-commodity products and services, preferably also for commodity products and suitable for continuous improvement.

The economic feasibility of the new IT solutions is based on the expectation towards the costs and benefits. All four respondents show concerns about the costs. Both respondent 5 and 6 mentioned problems with previous implementation of IT solutions. Respondent 5 emphasized the need for an IT solution with clear and low-risk upfront costs. This is confirmed by respondent 6, who mentioned that the total cost of ownership is seen as an important consideration for a new IT solution. Furthermore, respondents 7 and 8 indicated that a solution must preferable be cheap. To summarize, this implies that a highly feasible solution has clear and low-risk upfront costs and is preferably cheap.

6.5.3 Assessed IT infrastructure construct

Visualizing the results of the interviews, Table 13 shows the position towards the IT infrastructure construct.

Construct	Measure	Position
IT Infrastructure	Readiness	A ready solution integrates easily with SAP or Microsoft based IT solution as well as with multiple other applications.

TABLE 13: OVERVIEW POSITION TOWARDS THE IT INFRASTRUCTURE CONSTRUCT

The readiness of the current IT infrastructure and architecture is based on the smooth integration with the existing applications. Four respondents indicated they all have recently (in the last few years) invested in a new IT solution for the sales commodity products. In three of the four organisations, this is a single IT solution based on the Microsoft platform. In the other organisation, they have two IT solutions: one for the B2B market and one for the B2C market. The first solution is based on the SAP platform and the other on the Microsoft platform. In addition to these systems, the respondent indicated to have other systems to support the other processes such as trading and production. To summarize, this implies that a ready solution integrates easily with SAP or Microsoft based IT solution as well as with multiple other applications.

6.5.4 Assessed organisation construct

Visualizing the results of the interviews, Table 14 shows the position towards the organisation construct. In some cases, the position towards the measure is not considered the same for all interviewed companies and is depending on the type of company.

Construct	Measure	Position	Depended factor
Organisation	Organisational culture	A “rigid and change-resistant” organisational culture	A traditional energy supplier (Energy Suppliers A, B and C)
		A “flexible and open-for-change” organisational culture	A young energy supplier (Energy Suppliers D)
	Resistance to change	A high resistance to change of processes and IT	A traditional energy supplier (Energy Suppliers A, B and C)
		A low resistance to change of processes and IT	A young energy supplier (Energy Suppliers D)
	Organisational support	A strong support for new or improved IT solutions that support the realization of the redesign of their organisation.	

TABLE 14: POSITION TOWARDS ORGANISATION CONSTRUCT

The organisational culture represents the collective values, beliefs and principles of the people in the organisation. In all three interviews, the organisational culture is discussed. However, there is some inconsistency among the cultures at the three Energy suppliers. Respondents 5, 6 and 8 described their organisational culture as rigid; people are used to doing things the way they have been doing for many years, and it is difficult to introduce changes. Respondent 7, on the other hand, describes their culture as innovation focussed; people are used to continuous improvement, and it is easy to introduce changes. To summarize, there are two different descriptions of organisation culture. First, the organisation culture is “rigid and change-resistant”, and secondly, the organisational culture is “flexible and open-for-change”. This implies the its “rigid and change-resistant” culture is typical for a traditional energy supplier (e.g., energy supplier A, B and C), and the “flexible and open-for-change” culture is typical for a (relative) young energy supplier (e.g., energy supplier D).

The resistance to change is based on how easily business processes can be changed, and how smoothly new IT solutions in an organisation can be implemented. In all four interviews, the impact of the organisational culture on the resistance to change is discussed. Similar to the inconsistency among the organisational culture, there is the difference between the resistant forces to change. Respondents 5, 6 and 8 consider the relative high resistance to change as a serious challenge to their organisation. However in contrary, respondent 7 mentioned there is hardly any resistance to change, and he sees no direct challenges for their organisation in this area. To summarize, this implies that there are two different positions towards the resistance to change. First, the resistance to change is considered high and seen as a challenge for energy supplier A, B and C, and secondly, the resistance to change is considered low and not seen as a challenge for energy supplier D. This suggests that traditional energy suppliers (e.g., energy supplier A, B and C) have a high resistance to change and the (relatively) young energy suppliers (e.g., energy supplier D) have a low resistance to change.

The organisational support is based on the willingness of the organisation to consider new IT solutions. All four respondents are aware of the necessity to change processes and consider new or improved IT solutions. Respondent 8 argues that the support to change is mostly pushed by the management.

Respondents 5 and 6, on the other hand, both mentioned that the top management, as well as the lower management, are aware of the necessity of changing their organisation in a more customer service focused organisation which supports change. Furthermore, respondent 7 argues that everyone (both in the top management as lower management) is not only supporting the change of their organisation in a more data and technology focused organisation, but is also stimulating this change. He indicated that they continuously search for new or improved IT solutions to better support this change. To summarize, this implies there is a strong support for an IT solution that supports the realization of the redesign of their organisation by both the traditional energy suppliers (e.g., energy supplier A, B and C) and the (relatively) young energy suppliers (e.g., energy supplier D).

7 STEP 3: UNDERSTAND ERP FUNCTIONALITIES

This chapter presents the results of the third step of the methodology. Step 3 concerns the analysis of the ERP functionalities of the selected ERP system (and its derivate). Firstly, the procedure of the analysis is described (7.1) and secondly, the results of this analysis are presented (7.2).

7.1 Analysis procedure

Data for the identification of the ERP functionalities is collected by consulting an ERP Dynamics AX expert, studying the training materials on Microsoft Dynamics AX and MECOMS 2012. (MECOMS 2012 is a customized version of Microsoft Dynamics AX). One online course on Dynamics AX [74] has been conducted and the book 'Using Microsoft Dynamics AX 2012' by Luszcak [75] is used to understand the basic functionalities of Dynamics AX in this research.

7.2 ERP functionalities of Dynamics AX

Dynamics AX is Microsoft's core business management solution for both mid-sized companies and multinational organisations [5]. Dynamics is designed to support the complex requirements of today's businesses and is easy to use at the same time. Typical characteristics of Dynamics are the integration with other Microsoft technologies such as Microsoft SQL Server, SharePoint Services and Microsoft Azure.
First-time users feel comfortable from the beginning due to the typical Microsoft user interface, which is already known from Microsoft Windows and Microsoft Office. Dynamics AX has the basic ERP capability, which include the following areas [75] : Sales and marketing, Supply chain management, Production, Procurement and sourcing, Financial management, Project management and accounting, Human capital management, and Business intelligence and reporting. See Table 15 for explanatory notes on each capability.

Capability	Explanatory notes
Sales and marketing (CRM)	Manage sales, manage marketing and integrate customers.
Supply chain management	Connect sales and purchasing process with logistics, production and warehouse management, and manage distributed organisations.
Production	Minimize lead times, fulfil customer demand, manage your resources, and gain real-time insight into the production process, delivery process and costs process.
Procurement and sourcing	Direct and indirect procurement of good and services, and centralize buyer capabilities.
Service management	Plan, track and analyse service operations, and gain insight in costs and revenue.
Financial management	Register financial transactions, manage financial relationships, manage internal cost accounting, gain financial insights, help control expenditure and support accounting policies and rules.
Project management and accounting	Control schedules, resources and financials on short and long-term projects.
Human capital management	Store and manage employee records, employee recruitment and train, and support organisation management.
Business intelligence and reporting	Analyse factors that affect the organisation, create and share reports.

TABLE 15: EXPLANATORY NOTES OF DYNAMICS AX 2012 CAPABILITIES

In addition to the basic ERP capability, Microsoft and partners have developed industry-specific versions of Microsoft Dynamics with industry-specific capabilities. This study focuses on two versions of Dynamics AX: Microsoft Dynamics AX 2012 and MECOMS 2012.

7.2.1 Microsoft Dynamics AX 2012 (R3 CU8)

Microsoft Dynamics AX (R3 CU8) is the Microsoft standard and latest stable release version of Dynamics AX. This version contains all the basic capabilities of Dynamics AX.

7.2.2 MECOMS 2012 (R3)

MECOMS 2012 (R3) is the core business management solution for energy and utility companies [76]. MECOMS 2012 is built on Microsoft Dynamics AX. MECOMS 2012 has four major business domains that extend the standard capabilities of Microsoft Dynamics AX: Customer Care & Billing, Meter Data Management, Market Interaction, and Operations. Table 16 provides an overview of these additional business domains.

Business Domain	Explanatory notes
Customer Care & Billing	Product management, contract management, billing and credit management
Meter Data Management	Advanced metering interaction, manual meter reading, and validation & calculation
Market Interaction	Market communication, customer communication, and portfolio management
Operations	Inventory management, service management, and grid management

TABLE 16: OVERVIEW BUSINESS DOMAINS MECOMS 2012

8 STEP 4: ASSESS THE FIT AND VIABILITY

This chapter presents the results of the fourth step of the methodology. Step 4 is the assessment of the fit and viability of the ERP solution. To assess the fit and viability, two analyses have been performed. First, the assessment procedure is briefly explained (8.1), and secondly, the results of this assessment are presented (8.2).

8.1 Assessment procedure

The assessment of the fit and viability is a result of two analyses. The results of the previous two chapters are the input for these two analyses. Section 8.1.1 briefly introduces the fit analysis and its procedure, followed by section 8.1.2 which introduces the viability analysis and its procedure.

8.1.1 Fit analysis, its procedure and participant

DATA COLLECTION

The fit analysis is a technique used to predict the fit. The fit is rated on the basis of the match between the business needs regarding DRG (related) products and services and the ERP functionalities of the selected ERP systems, including the moderation effect of the available resolution strategies.

The fit is determined for two versions of Microsoft Dynamics AX: Microsoft Dynamics AX 2012 and MECOMS 2012 (see 7.2).

The data used to score the fit, are the updated business needs (6.5), ERP functionalities and ERP expert knowledge (7.2). Next, the procedure of the fit analysis is presented:

1. Match the business needs with the ERP functionalities
2. In case of a gap, identify what resolution strategy is suitable to avoid this gap.
3. Determine the overall fit

The fit analysis is performed by an ERP expert (respondent) during a semi-structured interview. The goal of this semi-structure interview is to assess the fit. The questions prepared for the interview can be found in Appendix C.4.

EXPERT OPINIONS EXECUTION

The respondent was contacted by email to invite him to participate in this fit analysis. For the interview, one 2-hour session was planned. The interview is conducted face-to-face at the Avanade's main office.

PARTICIPANT OF INTERVIEW 9

Respondent 9 is the EALA (Europe, Africa, and Latin America) solution lead for energy & utilities industry based on Microsoft Dynamics AX and senior manager for Dynamics AX service line for Avanade. (He is the same person as respondent 2 and respondent 10). He was selected for this fit analysis interview for his experience in Dynamics AX 2012 and MECOMS 2012.

DATA ANALYSIS

The interview data can be considered as qualitative data. These data are summarized, categorized and restructured to support the study.

8.1.2 Viability analysis, its procedure and participant

DATA COLLECTION

The viability analysis is a technique used to predict the viability of ERP as an IT solution to support DRG (related) products and services. The viability is rated on the basis of analysing the assessed economic, IT infrastructure and organisation constructs.

The viability is determined for two versions of Dynamics AX: Microsoft Dynamics AX 2012 and MECOMS 2012 (see 7.2) and for two types of Energy suppliers: the traditional energy suppliers (e.g., energy suppliers A, B and C founded before 2000) and the young energy suppliers D (e.g., energy supplier D founded after 2000). This differentiation is made because of the different position towards the organisational construct.

The data which are used to score the viability, are the assessed economic construct, assessed IT infrastructure construct, and the assessed organisation construct (see 6.5.2, 6.5.3 and 6.5.4). Next the procedure of the viability analysis is presented:

1. Identifying how the assessed economic construct relates to ERP
2. Identifying how the assessed IT infrastructure construct relates to ERP
3. Identifying how assessed organisation construct relates to ERP
4. Determine the overall viability

The viability analysis are conducted by an ERP expert during a semi-structured interview. This expert is asked to assess the viability from the energy supplier's point of view. The goal of this semi-structure interview is to assess the viability. The questions prepared for the interview can be found in Appendix C.5.

EXPERT OPINIONS EXECUTION

The respondent was contacted to invite him to participate in this viability analysis by email. For the interview, one 2-hour session was planned. The interview is conducted face-to-face at the Avanade's main office.

PARTICIPANT INTERVIEW 10

Respondent 10 is the EALA (Europe, Africa, and Latin America) solution lead for energy & utilities industry based on Microsoft Dynamics AX and senior manager for Dynamics AX service line for Avanade. (He is the same person as respondent 2 and 9). He was selected for this viability interview for his experience in Dynamics AX 2012, MECOMS 2012 and the utilities market.

DATA ANALYSIS

The interview data can be considered as qualitative data. These data are summarized, categorized and restructured to support the study.

8.2 Results fit and viability

This section presents the results and the conclusions drawn from interview 9 and 10. First, Section 8.2.1 elaborates on the fit, followed by Section 8.2.2 which elaborates on the viability.

8.2.1 Fit

Elaborating on the results of the fit analysis, first the fit of each business needs with MECOMS 2012 and with Microsoft Dynamics AX 2012 are discussed, followed by the explanation of the overall fit of MECOMS 2012 and Microsoft Dynamics AX 2012.

Figure 25 presents the fit of each business need with MECOMS 2012 and with Microsoft Dynamics AX 2012 in a radar chart. Each axis represents the fit of a business need. The fit of business needs is scored based on 7-point Likert-scale (1 = Large gap, 2 = Gap, 3 = Small gap, 4 = Undecided, 5 = Somewhat of a fit, 6 = Good Fit, 7 = Perfect fit). The value of the fit of each of the Dynamics AX versions is depicted on each axis and a coloured line is drawn to connect the values.

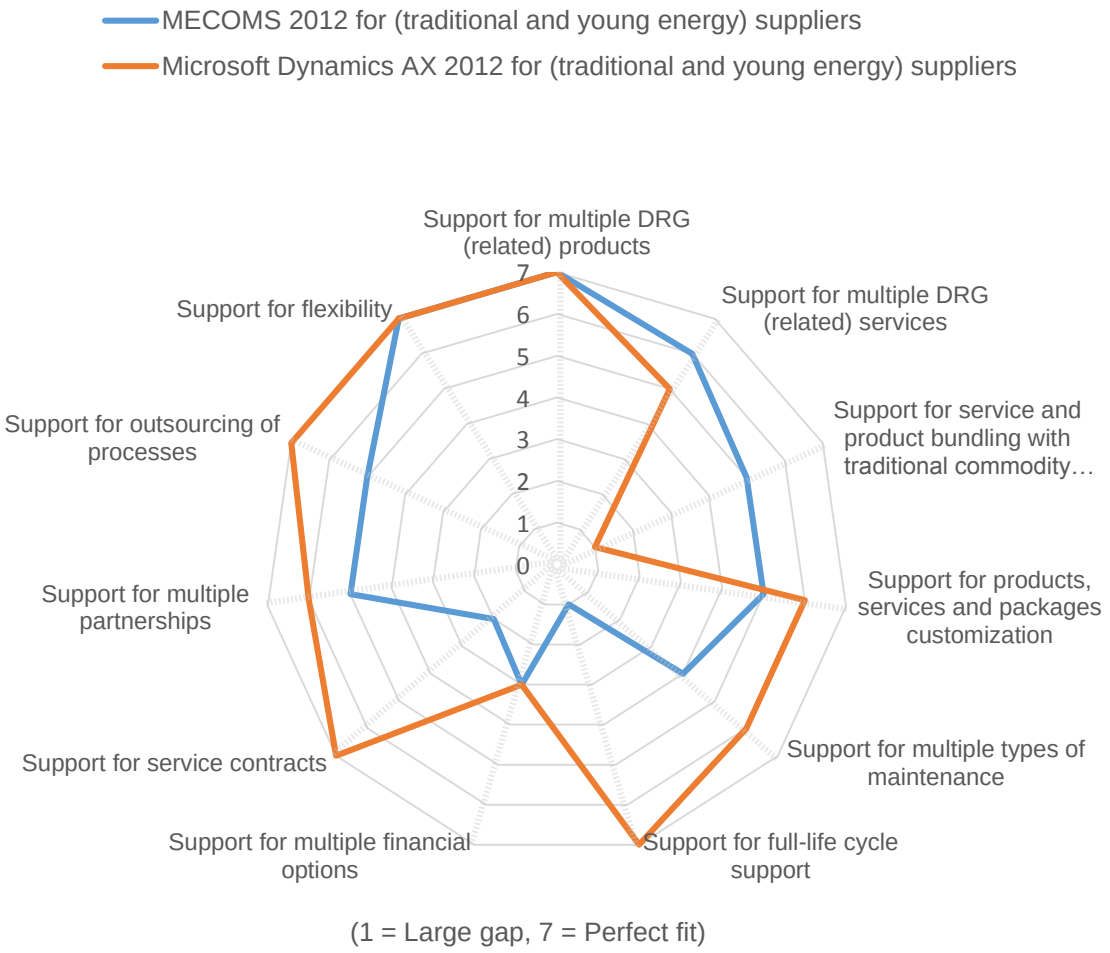

FIGURE 25: OVERVIEW FIT SEPARATE BUSINESS NEEDS BEFORE APPLYING RESOLUTION STRATEGIES

Figure 26 shows the overall fit of MECOMS 2012 and Microsoft Dynamics AX 2012. An important remark: The overall fit is not just a sum of the actual fit of each separate business need, because the impact and effects of the suggested resolution strategies are also taken into account and have influenced the final fit score of the separate business needs. The exact impact of these resolution strategies on the overall fit is determined by the respondent based on his expertise.

As can be seen in Figure 25 and Figure 26, there are a few difference between the fit of MECOMS 2012 and Microsoft Dynamics AX 2012. Microsoft Dynamics AX 2012 has a good or perfect fit with nine out of the eleven business needs, whereas MECOMS 2012 only has a good or perfect fit with three out of the eleven business needs (both after applying resolution strategies). Below each business need is briefly discussed in detail, followed by a discussion on the overall fit of MECOMS 2012 and Microsoft Dynamics AX 2012.

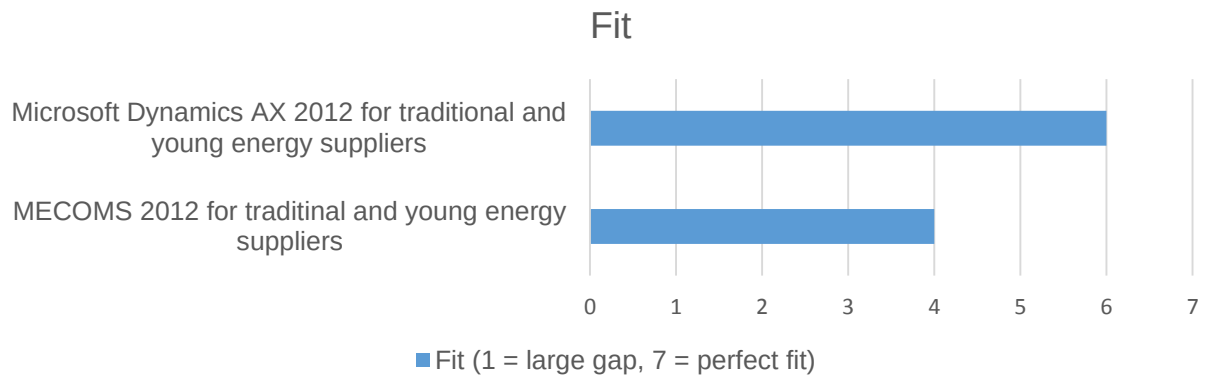

FIGURE 26: FIT MECOMS 2012 AND MICROSOFT DYNAMICS AX 2012 AFTER APPLYING RESOLUTION STRATEGIES

SUPPORT FOR MULTIPLE NON-COMMODITY PRODUCTS

Respondent argues that the non-commodity products can be entered in Dynamics AX 2012 and MECOMS 2012 as an article or bill of materials, and sold to customers via a sales order. In addition to these articles or bills of materials, services items for delivery and installation services can be added to the sales order. To conclude, the support for multiple non-commodity products is considered a perfect fit for Dynamics AX 2012 and MECOMS 2012, and no resolution strategies need to be considered,

SUPPORT FOR MULTIPLE NON-COMMODITY SERVICES

The sales of the smart home and smart business services are perfectly supported, but respondent argues that some custom work is required for the delivery of these services. There is a Smart Data Architecture Solution available for MECOMS 2012 to interact with energy management tools, which can be used. The integration of this solution in Dynamics AX is much more work than integrating it in MECOMS 2012. To summarize, the support for multiple non-commodity services is therefore considered as a somewhat of a fit for Dynamics AX 2012 and a good fit for MECOMS 2012.

SUPPORT FOR BUNDLING OF NON-COMMODITY PRODUCTS AND SERVICES WITH TRADITIONAL COMMODITY PRODUCTS

The support for bundling of non-commodity products and services with commodities is seen by the respondent as a large gap for Dynamics AX 2012 and a somewhat of a fit for MECOMS 2012. Dynamics AX 2012 supports packages of standard products and services. However, a traditional commodity product is not a standard product (which can be entered into ERP as an article or a bill of materials), but instead a rather unique product (which need to be entered into ERP as a contract). Because the traditional commodity products are not well supported in Dynamics AX 2012, he argues that the bundling of non-commodity products with commodity products is not possible. In order for Dynamics AX 2012 to support this bundling an integration with the current commodity solution is required or (in case there no commodity solution available) an expensive extension is required to support the traditional commodity products and services.

In MECOMS 2012 (which is especially built for commodity products), the commodity products are well supported. Therefore, the bundling of non-commodity products with commodity products is possible. Nevertheless, he argues that there are still some adjustments required to create a good or perfect fit. For example, the billing of both the non-commodity products and services and the commodity products at the same time is not yet possible. Therefore, the support for bundling of non-commodity products and services with commodity products is considered a large gap for Dynamics AX 2012 and a somewhat of a fit for MECOMS 2012 by the respondent.

SUPPORT FOR PRODUCTS, SERVICES AND PACKAGES CUSTOMIZATION

In Dynamics AX 2012, respondent argues that all sorts of product details (e.g., colours, lengths, heights, etc.) and service details (e.g., moment of delivery) can be entered in the system. As mentioned before, Dynamics AX 2012 supports only the packages consisting of non-commodity products and services, and not the traditional commodity products (which require an extra extension). The customization of these non-commodity packages is supported in Dynamics AX 2012. However, the options to customize such a package is limited.

MECOMS 2012 has overall fewer possibilities concerning the options to add all sorts of products, services and packages details. Therefore, the overall support for customization is considered to be less ideal. In MECOMS 2012, multiple adjustments are required to allow the same amount of customization in MECOMS 2012 as in Dynamics AX 2012. To conclude, he states that Dynamics AX 2012 has a good fit and MECOMS 2012 has a somewhat of a fit for the support for product, service and package customization.

SUPPORT FOR MULTIPLE TYPES OF MAINTENANCE

Respondent indicates that reactive maintenance is well supported by either Dynamics AX 2012 as MECOMS 2012, but, on the other hand, proactive maintenance is not. In Dynamics AX 2012, he suggests a small extension is required. In MECOMS 2012 he indicates that this small extension is not sufficient and (more) custom work is required. For aggressive maintenance, it depends on the type of aggressive maintenance. In this analysis, aggressive maintenance is considered as a firmware update for devices. He mentions that both Dynamics AX 2012 and MECOMS 2012 can track which devices require an update, but the update itself cannot be pushed by Dynamics AX 2012 or MECOMS 2012. For pushing the update, another application is required. To summarize, the support for multiple types of maintenance services is considered as good fit for Dynamics AX 2012 and as undecided for MECOMS 2012, according to the respondent.

SUPPORT FOR FULL-LIFE CYCLE SUPPORT

Respondent argues that the return flow of articles is well supported in Dynamics AX 2012, but not in MECOMS 2012. In MECOMS 2012, this functionality is not available. He indicates there is no extension available for MECOMS 2012; this implies that custom work is required. To conclude, he indicates that the support for the full-life cycle has a perfect fit for Dynamics AX 2012 and large misfit for MECOMS 2012.

SUPPORT FOR MULTIPLE FINANCIAL OPTIONS

Respondent mentions both the full payment and paying in terms are well supported by both versions, but the hire purchase and lease option are not. The lease option requires a lease administration (e.g., including the lease item on the balance sheet, tracking which customer is leasing the item during what period) and the hire purchase option requires a hire administration, which are both not available in Dynamics AX 2012 or MECOMS 2012. In order to include these administrations, he suggests an extension in a form of an add-on, is required for both Dynamics AX 2012 and MECOMS 2012. To summarize, the support for multiple financial options is considered a small misfit for both Dynamics AX 2012 and MECOMS 2012, according to the respondent.

SUPPORT FOR SERVICE CONTRACTS

Respondent indicates that service contracts are supported in Dynamics AX 2012, but not in MECOMS 2012. In MECOMS 2012, he argues that only commodity contracts are supported, and there is no support for contracts for service items such as maintenance. Therefore, he suggests that adjustments to the code are required for MECOMS 2012. To conclude, he suggests that there is a perfect fit for Dynamics AX 2012 and a gap for MECOMS 2012 considering the support for a service contract.

SUPPORT FOR MULTIPLE PARTNERSHIPS

Dynamics AX 2012 provides a good support for the partnership with an installation partner and financial partner. Respondent indicates that Dynamics AX 2012 can send work orders and exchange emails with third parties. For Dynamics AX 2012 to exchange large data sets with third parties, some custom work is required. He suggests that an extra interface needs to be built to support the export of these data. This export of data is necessary, both for a good support of the big data partner and for a hardware / software partner. MECOMS 2012 can also exchange emails with third parties, but there is no standard support for work orders and data experts. This requires some custom work. To summarize, the support for multiple partnerships is considered a good fit for Dynamics AX 2012 and a somewhat of a fit for MECOMS 2012.

SUPPORT FOR THE OUTSOURCING OF PROCESSES

Respondent argues that sub-contracting is well supported in the Dynamics AX 2012. On the other hand, in MECOMS 2012 he argues it is a bit more difficult to set up, and some adjustments are necessary. To conclude, the support for outsourcing is seen as a perfect fit in Dynamics AX 2012 and as a somewhat of a fit in MECOMS 2012.

SUPPORT FOR FLEXIBILITY

In this interview, flexibility is defined as implementing changes quickly and with a low effort. Respondent argues that both systems are very flexible in comparison with other ERP systems such as SAP. Both Dynamics AX 2012 and MECOMS 2012 are built on the Microsoft AX platform which allows changes to be implemented relatively fast and with a low effort, compared to ERP systems which are built on SAP or Oracle platforms. One important note is that, he agrees, that when you compare Dynamics AX 2012 and MECOMS 2012 with a non-ERP solution such as Dynamics CRM or Mendix (which are outside the scope of this research), these are not as flexible as the latter two technologies. To summarize, the support for flexibility is considered as a perfect fit for both Dynamics AX 2012 and MECOMS 2012, according to the respondent.

OVERALL FIT

Finally, the overall fit is assessed for both Dynamics AX versions. Respondent sees a good fit with Dynamics AX 2012. He argues that Dynamics AX 2012 has a good overall support (fit) for the needs related to non-commodity products and services. Even if the support is not yet perfect there are several resolution strategies available, which require an acceptable amount of custom work. One exception is that the support for bundling non-commodity products and services with traditional commodity products is troublesome and expensive. This is a result of the lacking support for the traditional commodity products and services (e.g., gas and electricity) in the Dynamics AX 2012. For Dynamics AX 2012 to support this bundling an integration with the current commodity solution is required, or (in case there no commodity solution available) an expensive extension is required to support the traditional commodity products and services.

Therefore, as a separate IT solution for only non-commodity products and services he sees Dynamics AX 2012 as a good fit, but as an integrated solution for non-commodity products and services and commodity products (which combination is outside the scope of this research), he considers the fit for Dynamics AX 2012 will probably be less optimal. Besides, this integrated solution will be a lot more expensive; this option is only interesting if the organisations already have Dynamics AX 2012 in place as their commodity solution or are planning to replace their current commodity solution (in which they already have invested a lot).

MECOMS 2012, on the other hand, works well with the traditional commodity products and services. MECOMS 2012 requires no extension or integration with the currently available commodity solution to support commodity products and services. However, MECOMS 2012 works not so well with the (new) non-commodity products and services. MECOMS 2012 is built on Dynamics AX 2012 but makes poor use of the standard capabilities of Dynamics AX 2012. Therefore, a lot of expensive custom work is required to fulfil the needs related to the non-commodity products and services in MECOMS 2012. As a separate IT solution for non-commodity products and services only, he scores MECOMS 2012 fit as undecided. However, as an integrated solution for both commodity and non-commodity products and services (which combination is

outside the scope of this research), he argues that MECOMS 2012 is an interesting option to consider. This integrated solution is interesting for organisations which already have MECOMS 2012 implemented as their commodity solution or for an organisation which is planning to replace its current commodity ERP solution.

8.2.2 Viability

To determine the viability of an ERP solution to support non-commodity products and services, a viability analysis is conducted using the collected data and expert knowledge. First the scores of the economic, IT infrastructure and organisation construct are discussed, followed by the explanation of the overall viability. The viability is determined for two versions of Dynamics AX: Microsoft Dynamics AX 2012 and MECOMS 2012 (see 7.2) and (only in the case of the Microsoft Dynamics AX 2012) also for two types of Energy suppliers: traditional energy suppliers (founded before 2000) and young energy suppliers (founded after 2000). This differentiation is made as a results of the different positions towards the organisational construct. The viability is discussed from the point of view of the energy supplier. (Due to time constraints at the time of the interview, the viability of MECOMS 2012 for energy suppliers with relative short history, has not been discussed).

Figure 27 presents the scores of the economic, IT infrastructure and organisation constructs. Each axis represents the economic, IT infrastructure and organisation construct. These constructs are scored based on 7-point Likert-scale (1 = Very bad, 2 = Bad, 3 = Somewhat bad, 4 = Undecided (not bad and not good) , 5 = Somewhat good, 6 = Good, 7 = Very good). The value of each Dynamics AX version is depicted on each axis, and a line is drawn to connect the values.

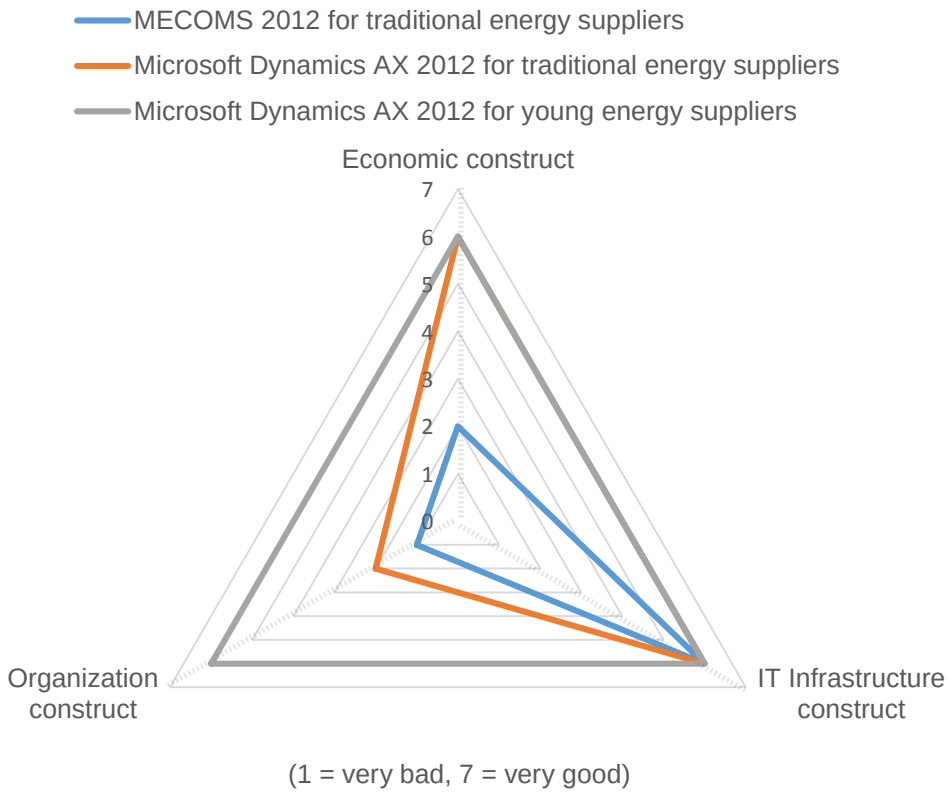

FIGURE 27: OVERALL VIABILITY OF THE ECONOMIC, IT INFRASTRUCTURE AND ORGANISATION CONSTRUCT

The results in Figure 28 show the overall viability of MECOMS 2012 for energy suppliers with a long business history, the overall viability of Microsoft Dynamics AX 2012 for traditional energy suppliers (e.g., energy supplier A, B and C), and the overall viability of Microsoft Dynamics AX 2012 for young energy suppliers (e.g., energy supplier D). Please, not that each overall viability is not a sum of the individual values of the economic, IT infrastructure and organisation construct, because not all individual values have the same weight. The exact weight of the constructs is determined based on the expertise of the respondent. Respondent indicates that the economic construct and organisation construct have a higher impact on the overall viability than the IT infrastructure construct. Nevertheless, the IT infrastructure construct is still of importance.

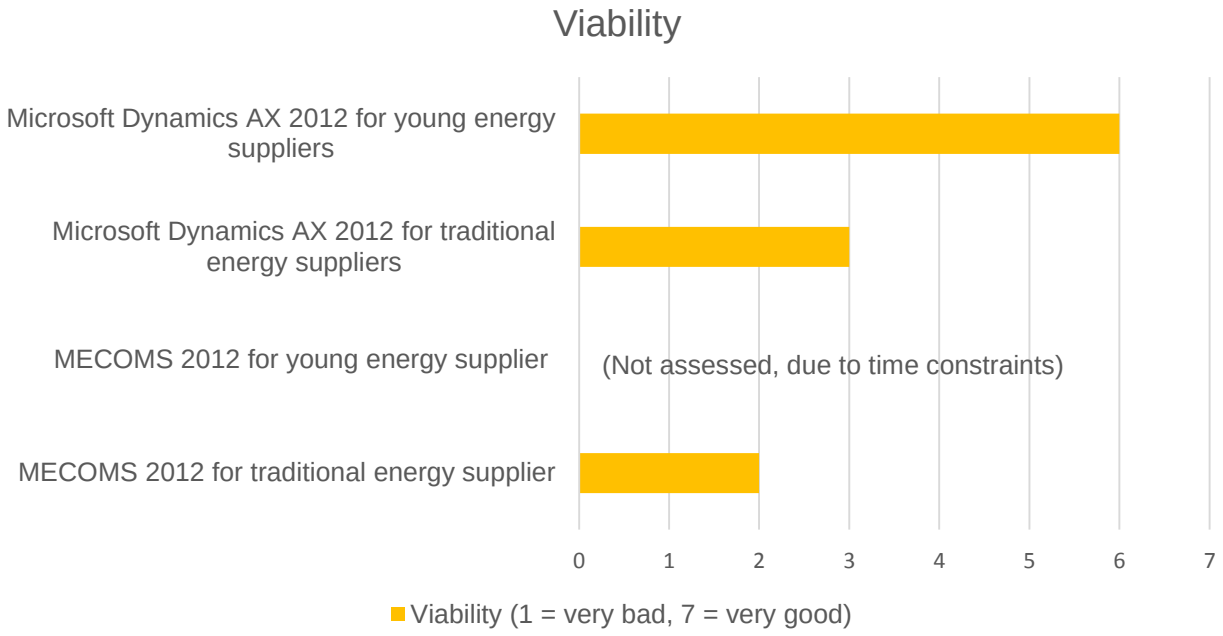

FIGURE 28: VIABILITY MECOMS 2012 AND DYNAMICS AX 2012

As can been seen, there are few differences between the fit of MECOMS 2012 for traditional energy suppliers (e.g., energy supplier A, B and C), Microsoft Dynamics AX 2012 for traditional energy suppliers and Microsoft Dynamics AX 2012 for young energy suppliers (e.g., energy supplier D). Microsoft Dynamics AX 2012 is for young energy suppliers a good viable solution to support non-commodity products and services. Microsoft Dynamics AX 2012 is for traditional energy suppliers a somewhat bad viable solution, and MECOMS 2012 is for traditional energy suppliers even a bad viable solution. Next, the difference are discussed shortly.

ECONOMIC CONSTRUCT

When discussing the economic constructs, the respondent argues that Dynamics AX 2012 is one of the cheaper and low-risks ERP solution in the market and, therefore, a good feasible and justifiable ERP solution when these organisations are searching for a structural solution for non-commodity products and services. However, he indicates that the costs much depend on the number of users, the quantity of data to be included, integration with legacy systems, etc. These factors can push up the price. Similarly, he indicates that the justification depends on the number of non-commodity products and services they expect to sell. In case of less than 10.000 a year, this solution will not be justifiable. However, taken into account the input and high non-commodity expectations of respondents 5, 6, 7 and 8, the respondent expects the costs and risks to be acceptable and the justification to be good. On the other hand, he indicates that MECOMS 2012 is a lot more expensive than Dynamics AX 2012. He notes that MECOMS 2012 will only be a justifiable and feasible solution when respondents 5, 6, 7 and 2 are searching for an integrated solution to support both their commodity products and the non-commodity products and services at the same time, or have

MECOMS 2012 already implemented as a solution for their commodity products. Nevertheless, taking into account that the scope of this research is a separate solution for non-commodity products and services and not an integrated solution, he indicates that the economic feasibility and justification of MECOMS 2012 as separate solution for non-commodity products and services is undesirable.

IT INFRASTRUCTURE CONSTRUCT

In the following discussion on the IT infrastructure construct, the respondent indicates that he expects no big problems with the integration of Dynamics AX 2012 into the current IT infrastructure and architecture. He argues that Dynamics AX 2012 has a good integration layer and is in comparison to other ERP systems quite open. He indicates too that an integration with old legacy systems is more time consuming and thus more expensive. However taken into account the input of respondents 5, 6, 7 and 8, who all indicated to have recently invested in a new IT solutions for commodity products, he expects their IT infrastructure to be quite up to date. Thus, he describes the IT infrastructure readiness as good for Dynamics AX 2012. Furthermore, he also expects the IT infrastructure readiness as good too for MECOMS 2012, since MECOMS 2012 has the same integration layer and openness as Dynamics AX 2012.

ORGANISATION CONSTRUCT

The respondent's strongest concern is with the organisation construct, as he indicates that it is difficult to implement an ERP solution at a traditional energy supplier. As respondents 5, 6 and 8 already mentioned, there is much resistance towards change and risks, and there are different interests and many internal politics to consider. This makes the energy market a difficult market to implement ERP in. Therefore, the respondent argues that the organisational readiness for Dynamics AX 2012 in terms of organisational culture, resistance to change and organisational support is undesirable for these traditional organisations. Furthermore, he indicates the organisational readiness for MECOMS 2012 is also considered to be undesirable for the same reasons. However, there is one exception: the energy supplier D of respondent 7 is very open to change and new solutions. Respondent 8 argues that it is a lot easier to implement an ERP solution at these types of organisations (= being young energy suppliers). He indicates that the organisational readiness for Dynamics AX 2012 for this kind of organisation is considered to be good. (Due to time constraints, the organisational readiness for MECOMS 2012 for this kind of organisations is not discussed).

OVERALL VIABILITY

Finally, the overall viability (see Figure 27) for both versions of Dynamics AX is discussed. The respondent sees Dynamics AX 2012 as a good viable solution for the young energy suppliers such as Energy supplier D (characterised by "flexible and open-for-change" culture), and somewhat of bad viable solution for the traditional energy suppliers such as Energy suppliers A, B and C (characterised by "rigid and change-resistant" culture). He argues that when the organisations get the correct support to improve the organisational readiness, Dynamics AX 2012 can and will be a viable solution for these organisations too. However, the importance of this support on the viability of Dynamics AX 2012 should not be underestimated.

For MECOMS 2012, only the overall viability of the traditional energy suppliers such as Energy suppliers A, B and C is discussed and not for young energy suppliers such as Energy supplier D. As a separate solution for non-commodity products and services, he sees MECOMS 2012 as a bad viable solution. Both the economic feasibility and justification for MECOMS 2012 as a separate solution for non-commodity products and services are not so good. Comparable as with Dynamics AX 2012, the organisational readiness is cumbersome too. When MECOMS 2012 would be considered as an integrated solution for both commodity products and non-commodity products and services (which is outside the scope of this research), MECOMS 2012 would be a more viable solution. This integrated solution is more viable for organisations which already have MECOMS 2012 implemented as their commodity solution, or for an organisation which is planning to replace its current commodity solution. This will improve the economic feasibility and justification and thus the overall viability of MECOMS 2012.

9 STEP 5: DETERMINE THE EXPECTED PERFORMANCE

This chapter presents the results of the fifth and last step of the methodology. In this step, the expected performance of two types of ERP systems to support the non-commodity products and services by two types of energy suppliers is determined (predicted). First, the procedure is explained (9.1), and next, the results are presented (9.2).

9.1 Determination procedure

To determine the expected performance of the ERP systems for the different types of organisations, a performance analysis is conducted. The results of the previous step (step 4, see chapter 8) are input for this performance analysis.

The performance analysis is a technique used to predict the performance. The expected performance is rated based on the fit and viability scores as presented in 8.2.1 (fit) and 8.2.2 (viability). Below, the procedure of the analysis to predict the performance is presented:

1. Position the selected ERP system for the selected type of organisation in the Fit-Viability model (matrix) of Liang by Liang et al. [51] (see Figure 11)
2. Determine the expected performance of the selected ERP system for the selected organisation

The determination of the expected performance requires no other input than the scores of the fit and viability, and, therefore, no experts or interviews are involved in this analysis.

9.2 Performance

This section presents the results of the performance analysis. First, the scores of both the fit and viability are visualized together in one figure (see Figure 29), and secondly, the expected performance is determined by positioning MECOMS 2012 and Microsoft Dynamics AX 2012 in the Fit-Viability model of Liang, by Liang et al. [51]. See Figure 30.

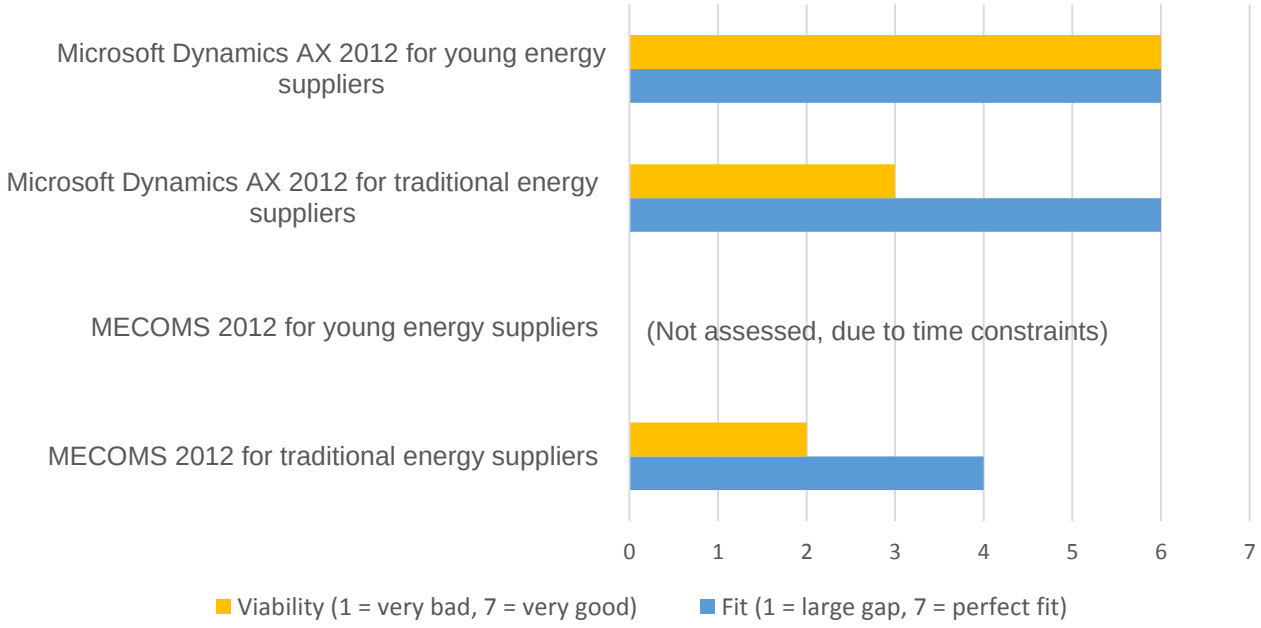

FIGURE 29: OVERVIEW FIT AND VIABILITY DYNAMICS AX 2012 AND MECOMS 2012

Figure 29 presents an overview of the viability and fit scores for Microsoft Dynamics AX 2012 for young energy suppliers (e.g., Energy supplier D), Microsoft Dynamics AX 2012 for traditional energy suppliers (e.g., energy suppliers A, B and C) and MECOMS 2012 for traditional energy suppliers. Figure 29 is structured as follows. Fit is based on Likert-scale (1 = Large gap, 2 = Gap, 3 = Small gap, 4 = Undecided, 5 = Somewhat of a fit, 6 = Good Fit, 7 = Perfect fit). Viability is based on Likert-scale (1 = Very bad, 2 = Bad, 3 = Somewhat bad, 4 = Undecided (not bad, not good), 5 = Somewhat good, 6 = Good, 7 = Very good).

Figure 30 shows the relative position of MECOMS 2012, to support non-commodity products and services, for traditional energy suppliers (red colored dot in the figure), Microsoft Dynamics AX 2012 for traditional energy suppliers (grey dot), and Microsoft Dynamics AX 2012 for young energy suppliers (blue dot). The matrix has two dimensions, which divide the matrix into four categories ("Find Alternative Technology"; "Good target"; "Organizational Restructuring" and the category "Forget it"): the x-axis represents the fit dimension and the y-axis represents the viability dimension. In this research, the fit or viability is considered high when the score is higher than four.

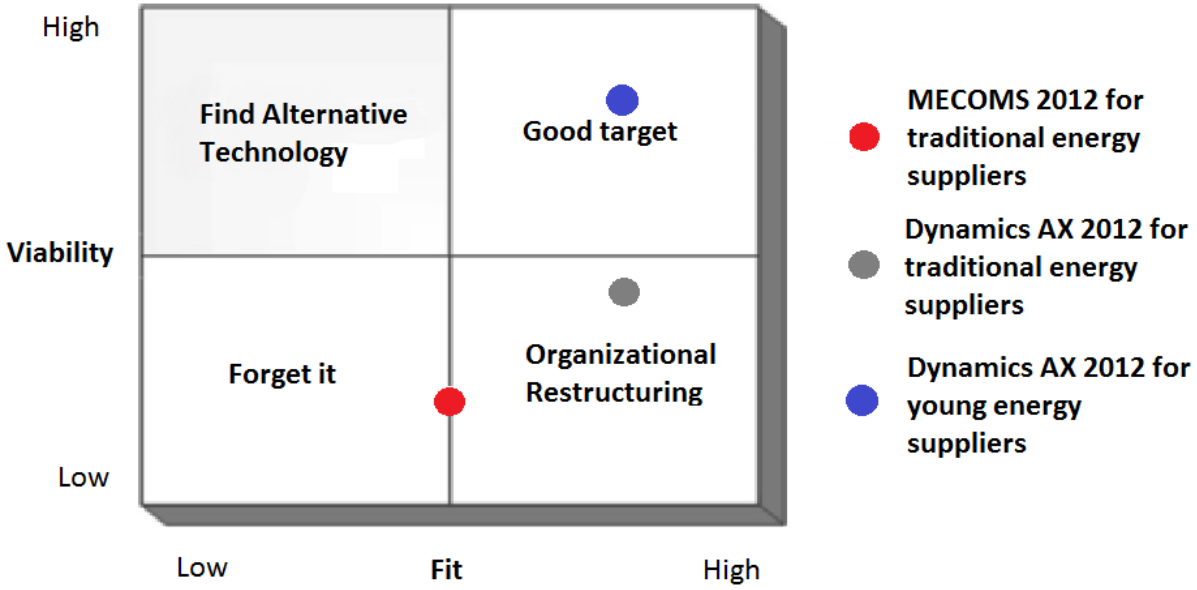

FIGURE 30: EXPECTED PERFORMANCE DYNAMICS AX 2012 AND MECOMS 2012

As can be seen in Figure 30, the performance of the different ERP systems for the different types of organisations are not all the same, but positioned differently in the matrix. Of the three "ERP-Organisation" combinations that are investigated, one combination falls in the category of "good target" (upper right box), one in the category of "organisational restructuring" (lower right box), and one falls in the middle between the categories "organisational restructuring" and "forget it" (low and in the middle).

The category "good target" means that there is a good chance of success, when the selected ERP will be used by the specified organisation and little to no organisational restructuring (before the implementation starts) is needed. This is the case for the combination "Dynamics AX 2012 for young energy suppliers". The flexible and open-for-change culture within the organisation explains - in combination with the good fit between the Business needs and the ERP functionalities - why there is a good chance of success. Employees will adopt the new products and services and the new working methods fast.

For the combination "Dynamics AX 2012 and a traditional organisation", the expected performance is less optimal. This combination falls in the category "organisational restructuring". Despite the good fit between the Business needs and the ERP functionalities, the "rigid and change-resistant" culture will hinder the implementation and lower the chance of success. Employees will not adopt the new products and services

and the new working methods fast. An organisational restructuring is needed before the implementation takes place to ensure success. Restructuring the organisation refers to the need for an organisational change project to change the culture of the organisation from “closed and change-resistant” into a “flexible and open-for-change” culture. In such cases, all the constituent parts of an organisational change project that includes change management, changes in the organisational structures and changes in the organisational culture, have to take place. This kind of change projects can be very complex and time consuming, but will be needed to get the right mind setting within the organisation.

The combination “MECOMS 2012 and the traditional energy suppliers” is positioned on the line between “forget it” and “organisational restructuring” and is the most difficult case, with the lowest chance of success. In order to ensure success, organisational restructuring is highly needed. However, the degree of success is even then still undecided because there is no good fit between the Business needs and the ERP functionalities. This makes it questionable whether the selected ERP is the best technology for this type of organisations. Another technology should be considered fitting better with the needs and circumstances.

10 EVALUATION

This chapter discusses the results of the research. Both the conceptual model and methodology as well as the results of the prediction of ERP performance in the changing and challenging energy market are evaluated. Based on this evaluation, the conceptual model and methodology are updated, and the external validity of the results is described. First, the evaluation procedure is described (10.1), and secondly, the results of the evaluation are presented (10.2, 10.3 and 10.4).

10.1 Evaluation procedure

This section describes the evaluation procedure. Frist, the procedure and its participants are introduced (10.1.1), followed by the explanation of the data analysis (10.1.2).

10.1.1 Semi-structured interviews 10 and 11, its procedure and participants

DATA COLLECTION

Data for the evaluation are collected by two semi-structured interviews. The goal of these interviews is to evaluate the used model and methodology, and to evaluate the results of the prediction of ERP performance in the changing and challenging energy market.

The data used as input for the evaluation, are the conceptual model (4.6), conceptual methodology (4.7) and results of the demonstration phase (chapter 5 - 9).

The questions prepared for these interviews can be found in Appendix C.6.

EXPERT OPINIONS EXECUTION

The respondents were contacted by email to invite them to participate in this evaluation. For the interview, a 45-min semi-structure interview is planned. The interviews are conducted face-to-face at Avanade's main office.

PARTICIPANT OF INTERVIEW 11

Respondent 11 is EALA (Europe, Africa, and Latin America) solution lead for energy & utilities industry based on Microsoft Dynamics AX and senior manager for Dynamics AX service line for Avanade (He is the same person as respondent 2, 9 and 10). Respondent 11 was selected for this interview for his experience on Dynamics AX implementations.

PARTICIPANT OF INTERVIEW 12

Respondent 12 is solution lead for retail for Dynamics AX service line for Avanade. Respondent 12 was selected for this interview for his experience in Dynamics AX implementations and retail market.

10.1.2 Data analysis

With permission of the respondents, each interview is recorded and summarized. After the summarization, the data of the two interviews are compared, synthesized and linked to existing literature to create a clear and comprehensive understanding of the results.

10.2 Results

This section presents the results of the evaluation interviews.

10.2.1 Results of interview 11

The first impression of respondent 11 of the conceptual model is positive. He confirms the importance of all defined constructs, measures and structural relationships involving the expected ERP performance. He argues that the model is a good and recognizable representation of the reality, because it matches ERP with the organisation's wishes (fit) on the one hand and on the other hand, it takes into account how ERP is expected to land in the organisation (viability). Also he indicates that the viability part is often underexposed in an ERP implementation, even though it is of great importance to realize a successful ERP implementation.

When discussing how this model can be improved, respondent 11 has some suggestions. First, he indicates the drivers (why a new ERP solution is considered) are missing in the model. He states that there are multiple drivers which stimulate organisations to consider a new ERP solution (e.g., the licence of current technology expires; the current IT landscape is too expensive; the current IT landscape is not able to meet the demands of the market). He argues that these drivers influence the business needs and, therefore, have to be taken into account too. The second suggestion of respondent 11 is an addition to the IT infrastructure construct. He argues that this construct is not only influenced by the current IT infrastructure, but also by the organisation's plans for the future direction of the IT infrastructure and architecture (e.g., the move of the whole IT landscape to the cloud). Furthermore, respondent 11 has a third suggestion for improvement. He suggests an addition to the organisation construct. He claims the organisation construct is influenced by the organisational culture, resistance to change, organisational support of key-users, organisational support of management, knowledge level of the employees and organisational changes that already or soon will take place. He indicates that the organisation support depends on two groups: the key-users (e.g., the people in the project group) and the management (e.g., the people in the steering committee). He argues that a viable ERP solution needs the support of both groups. The knowledge level of the employees is best described as the ability of users to use and apply the software and the changed processes. In case this knowledge level is insufficient, training should be considered. The 'organisational changes' refer to expected changes in the organisation in the next few years. Two examples of organisational changes he mentions are the merging and splitting of departments.

Next, the methodology is discussed. The first impression of respondent 11 is positive too. He argues that the methodology reflects the model and presents the required steps you need to undertake to predict the ERP performance. Also, he sees similarities with the company's approach to determine the fit of ERP.

In the discussion of how the methodology can be improved, respondent 11 has two suggestions. First, he indicates that the improvements of the model should be incorporated in the methodology as well. Secondly, he indicates that the methodology provides a snapshot of the (expected) performance at one given moment. He argues that the snapshot of the performance can lead to new insights, which influence the context on which the snapshot is based. Therefore, it can be interesting to take a new snapshot based on this changed context. Furthermore, he claims that it could be interesting to re-apply this methodology after implementing an ERP solution to see if the prediction matches the reality and to see if the intended goals are indeed met.

Next, the application of this model and methodology in other markets (than the energy market) is discussed. Respondent 11 argues that the model and methodology can be used in any market for each (more or less) standard ERP solution because this model and methodology is very generic. In addition, he claims he also sees potential of applying this model and methodology to predict the performance of other technologies, such as custom relation management solutions (CRM).

To conclude the interview, the credibility of the prediction of the ERP performance in the changing and challenging energy market is discussed. Respondent 11 acknowledges the prediction and indicates that the prediction gives a fairly reliable overview of the reality. However, he argues that the suggested

improvements to the model (and methodology) can lead to a different ERP performance prediction because more information becomes available to serve as an even better basis for the prediction.

10.2.2 Results of interview 12

When introducing the conceptual model to respondent 12, his first impression is positive. He confirms that the importance of all defined constructs, measures and structural relationships that are involved when predicting ERP performance. He argues the model takes the match between ERP and the TO-BE situation (= business needs) into account, as well as the economic, IT infrastructure and organisational aspects.

In the next discussion on how this model can be improved, respondent 12 indicates that the *reason why a new ERP solution is considered* is missing in this model. He argues that there are multiple reasons why organisations could considering a new ERP solution (e.g., the current IT solution is outdated; to tap into a new market; or demanded by the shareholders). He indicates that these reasons affect the desired business needs, and a good understanding of the reasons helps to define the business needs. Another remark by respondent 12 is an addition to the organisation construct. He argues that the organisational aspect is not only influenced by the organisational culture, resistance to change and organisational support, but also by the support by a strong sponsor and support by a good project (implementation) team. He mentions that both support by the sponsor and project team during the implementation are needed for a successful ERP implementation. The third and final remark by respondent 12 is the inclusion of the third party aspect. He argues that the viability with regards to large IT solutions such as ERP depends on the presence and support of involved third parties too. As an example, he mentions that the presence and the support of a consulting firm, assisting the implementation process, can positively contribute to the viability of the ERP solution. However, you can also think of third parties which may have a structural role in executing parts of the business processes.

Next, the methodology is discussed. Again, the first impression of respondent 12 was positive. He argued that the methodology reflected the model. Nevertheless, he had one suggestion for improvement. He indicates that most change projects regarding ERP have several phases and, therefore, are not finished after complementing step 5 the first time. He argues that most projects return to step 2 after finishing step 5 to update the business needs (based on the results of step 5). This process continues until there is a suitable solution in place.

Finally, the application of this model and methodology in other markets (than the energy market) is discussed. Respondent 12 indicates that the model and methodology is very generic, and therefore he sees no obstacles to apply it in other markets as well. Also in the retail market (of which the respondent is an expert), he confirms the potential of this model and methodology to predict the performance of ERP propositions.

10.3 Conceptual model and methodology Evaluation

This section synthesizes the discussions on how the conceptual model and methodology is received by experts and links the findings to existing literature to determine if there are any suggestions for improvement. First, each suggestion is discussed and, if needed, the conceptual research model and methodology are updated accordingly (10.3.1 and 10.3.2). Secondly, the external viability of the model and methodology is discussed (10.3.3).

10.3.1 Updated research model

The literature review provided evidence for ten constructs, several measures and four structural relations (see Section 4.6) involved when predicting the ERP performance. All of these constructs, measures and structural relations are confirmed by the respondents. In addition, the respondents have some suggestions for new constructs and measures. These suggestions are discussed next and linked to findings in existing literature.

The first interesting result of the evaluation is the missing drivers construct. This construct explains why a new ERP solution is considered. The literature review on ERP Fit suggested that the business needs were based on the current business situation influenced by the future developments, the organisation's mission, vision and strategy. This turned out not to be entirely correct. Respondents 11 and 12 indicated there are multiple reasons why an organisation considers ERP (e.g., the licence of current technology expires; the current IT landscape is too expensive; the current IT landscape is not able to meet the demands of the market; to tap into a new market; or demanded by the shareholders). Both respondents 11 and 12 highlighted the impact these drivers (or reasons) have on defining the desired business needs. This claim is coherent with the findings of Bradford and Florin [41] and Somers and Nelson [77]. They also recognised the importance of the organizational objectives that drive the ERP initiative. This implies that the business needs construct in the final model is based on *the current business situation and drivers, influenced by the future developments, and the organisation's mission, vision and strategy.* The renewed structural relationship of the business needs constructs is defined as: *The current business situation and the drivers influence the business needs.*

The second result concerns the missing third party construct. This construct is important because of the impact third parties can have on the viability of the ERP solution. The literature review on the concepts of fit-viability theory provided the indication that the viability is based on the economic, IT infrastructure and organisation construct. However, respondent 12 claims that, if a third party is involved in the ERP implementation, the support by this third party (e.g., a consulting firm) is important too and will have an influence on the overall viability of the ERP solution. This claim is supported by Ehie and Madsen [28] and Somers and Nelson [77]. Ehie and Madsen [28] found a strong correlation between successfully implementing ERP and consulting services, and Somers and Nelson [77] emphasises the importance of the support of the vendor. This may also apply to third parties which play a role in the (by ERP affected) business processes. However, no support for this is found in existing literature and more research is required to support this claim. It can be concluded that the support of involved third parties (e.g., vendors and consulting firms and may be also others) are important for a viable ERP solution. The third party construct is, therefore, included in the final research model. The construct is best described *to which extent an involved third party is willing (and able) to support the (implementation of the) selected technology (third party support).*

The third interesting result of the evaluation is the improved definition of the IT infrastructure construct. Based on the literature review, the IT infrastructure construct refers *to the extent the selected technology can be integrated smoothly into the current IT infrastructure and architecture (readiness).* This definition does not take the alignment of the future direction of the IT infrastructure and architecture into account. Respondent 11 argues that the IT infrastructure construct is both determined by the fit with the current IT infrastructure and architecture (readiness) and the alignment with the future direction of the IT infrastructure and architecture (future alignment). This suggests the IT infrastructure construct would be defined as *to the extent the selected technology can be integrated easily into the current IT infrastructure and architecture (readiness) and is aligned with the plans for the IT infrastructure and architecture (future alignment).* However, this claim is not supported by existing literature, and more research is required to support this claim. Therefore, this refinement is not taken into account in the final research model.

The fourth and final result of the evaluation is the improved definition of the organisation construct. In section 4.6.1, the organisation construct is defined as *to the extent the organisation is willing to implement the selected technology (organisational support) and is ready for using this technology (organisational culture and resistance to change).* This turned out not to be entirely accurate. Respondent 11 claims that the organisational construct is influenced by the organisational culture, resistance to change, organisational support of key-users, organisational support of management, knowledge level of the employees and organisational changes. Respondent 12 indicates that the organisation construct is influenced by organisational culture, resistance to change, support by a strong sponsor and support by a good project team. Although these claims are not (fully) supported by the concepts of fit-viability theory and ERP fit theory, they are consistent with the outcomes of other researchers, such as Dezdar and Ainin [78], Zhang et al. [39], Bradford and Florin [41], Amoako-Gyampah and Salam [40], and Somers and Nelson [77].

The support by a good project team and the organisational support by key-users refer both to the support bykey-users. This claim is consistent with the findings of Zhang et al. [39]. They support the positive relationship between the commitment of key users during the ERP implementation and the success of ERP. The support by the management and by a strong sponsor, both refer to the support by the top management. Dezdar and Ainin [78], Zhang et al. [39] and Somers and Nelson [77] showed there is a positive relationship between top management support and organizational impact and the success of an ERP implementation. They recognised a strong relationship between the commitment of top management and the success of an ERP implementation. Thus, this implies splitting up the organisational support measure into a key-users support measure and a management support measure, is a good refinement of the organisational support measurement.

The knowledge level of the employees is a new measurement and is best described as the ability of users to use and apply the ERP software and to execute the changed processes. This claim is coherent with the findings of Bradford and Florin [41], Dezdar and Ainin [78], Amoako-Gyampah and Salam [40], and Somers and Nelson [77]. They state ERP is a complex system, and a higher level of understanding positively influences the organizational impact and success of an ERP implementation. All users must be able to take full advantages of the ERP system's capabilities. It can be concluded that the knowledge level of the employees is an additional measure to the organisational construct.

The organisational change is also a new measurement and is best described as the expected changes in the organisation (e.g., the merging or splitting of departments). This claim is, however, not supported by existing literature, and more research is required to support this claim. Therefore, this measure is not taken into account in the final research model.

To complete the evaluation of the organisation construct, the refined definition in the final model is as follows: the organisation construct refers *to the extent the organisation is willing to implement the selected technology (by organisational support by key-users and organisation support by management) and is ready for using this technology (organisational culture, resistance to change, and knowledge level of the employees).*

Above mentioned changes in the constructs also result in an improved definition of the viability construct and its structural relation, this refined construct is bescribed as: *the extent to which the ERP is economic feasible, ready for the IT infrastructure, and supported by the organisation and the third parties involved.* The structural relationship of the viability construct is changed to: *Economic, IT Infrastructure, Organisation and Third party influence Viability.*

Figure 31 visualizes the combined results of the evaluation in the updated and final research model. The new constructs are shown in dark blue; the updated constructs are shown in light blue.

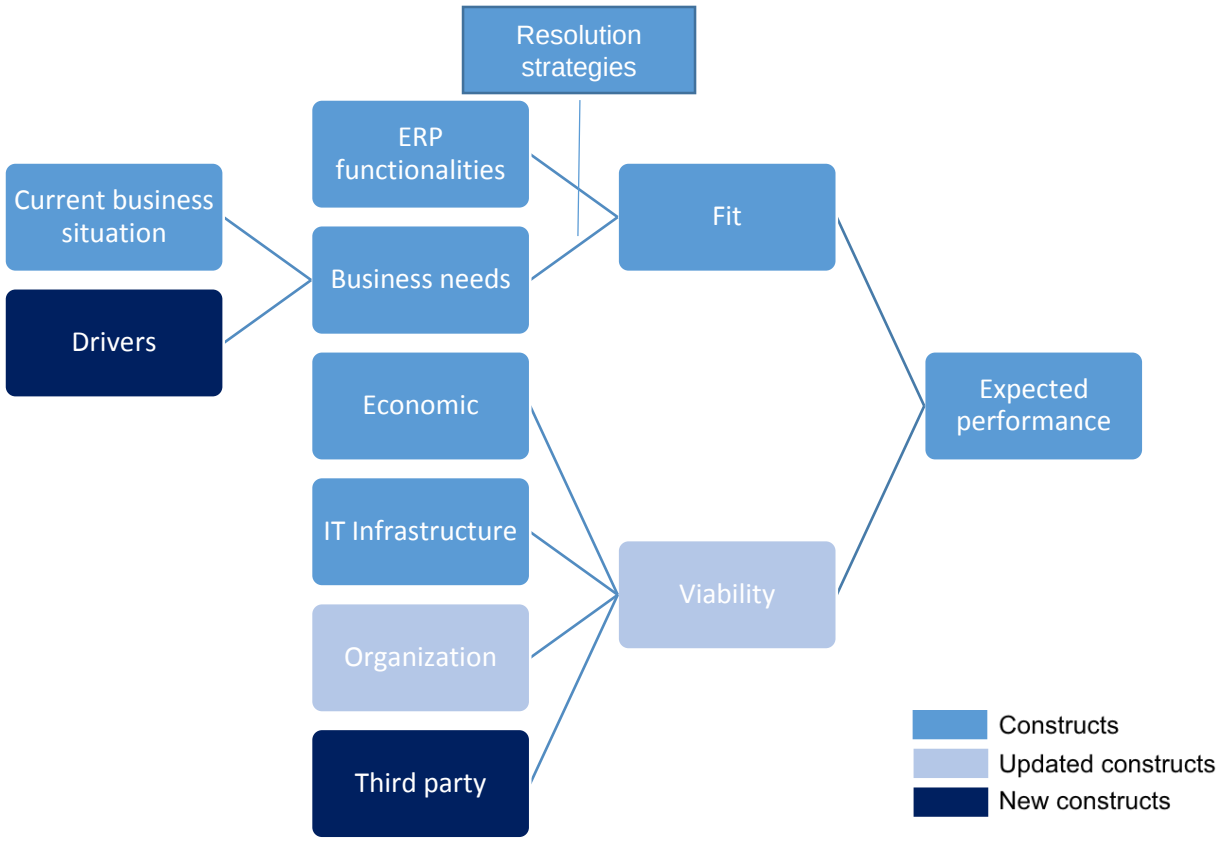

FIGURE 31: UPDATED AND FINAL RESEARCH MODEL AFTER EVALUATION

10.3.2 Updated version of the methodology

The model and literature review provided evidence for a five-step methodology (see Section 4.7) involved when predicting the ERP performance. All of these steps are confirmed by the respondents. In addition, the respondents have some suggestions for improvement. These suggestions are discussed next and linked to findings in existing literature.

The first result of the evaluation is the impact of the changes in the research model. Respondent 11 argues that the improvements of the model should be incorporated in the methodology as well. This means that the assessment of the drivers has to be incorporated in step 1, and the assessment of the third party has to be incorporated in step 2 as well as the refined measures regarding the organization construct.

A second interesting result of the evaluation is the iterative process of selecting and implementing a new ERP in an organisation. Both respondents argue that the current methodology allows to create a snapshot of predicted ERP performance at one given moment in time. However, the snapshot itself or other developments can change the context on which this snapshot is build. Therefore, it could be interesting to reassess step 2 to step 5 to create a new snapshot based on this changed context. Ehie and Madsen [28] support this claim. They emphases the importance of continuous monitoring and self-diagnosis throughout the implementation process. It is very likeable the same counts for the selecting process. This implies that an iterative methodology serves better as a basis for predicting ERP performance in a particular market.

Figure 32 visualizes the combined results of the evaluation leading to an updated and final methodology. The new iterative arrow is shown in dark blue, and the updated steps are shown in light blue.

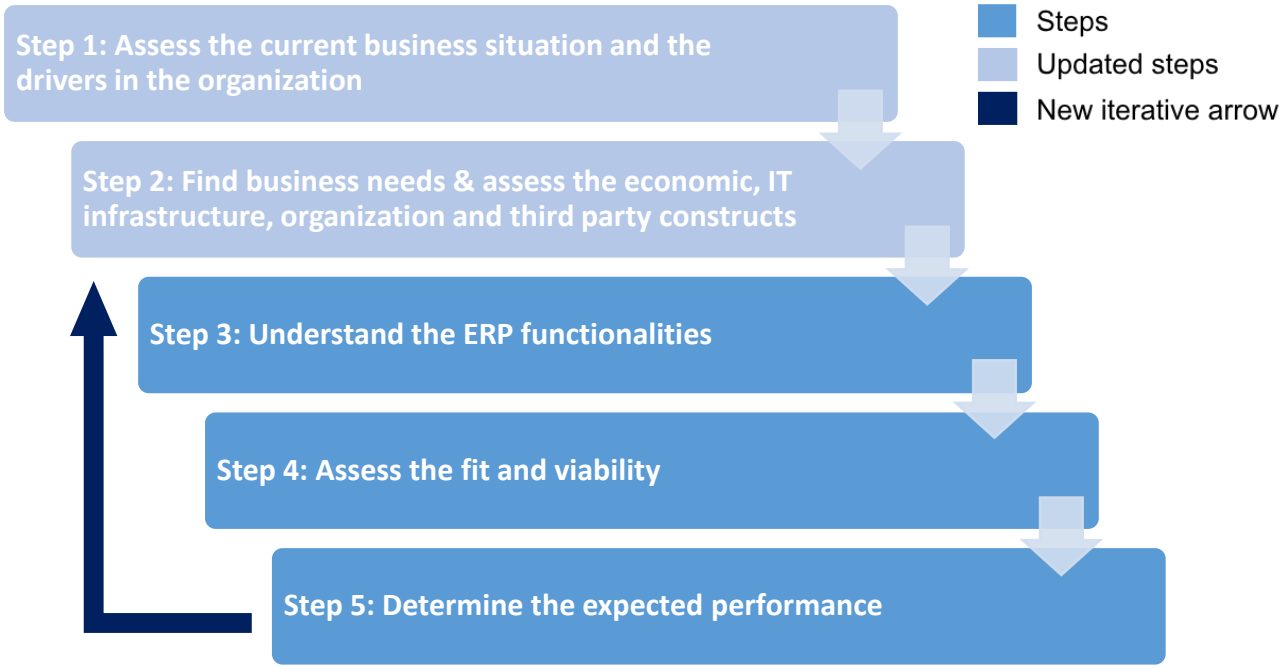

FIGURE 32: UPDATED AND FINAL METHODOLOGY AFTER EVALUATION

10.3.3 External validity of the model and methodology

The credibility of the research findings depends on the validity of the research. The concept of external validity examines to what degree the observed findings can be generalized from the sample to other people, organisations, context and time.

The external validity of the model and methodology is discussed during the evaluation interviews. The first impression of the model and methodology was positive. Both respondents argue that the model and methodology are very generic, and claim that the model and methodology could be applied in each market for each more or less standard ERP solution (and for other software solutions as well). Based on these two observations and taken into account the model and methodology are based on proven concepts, the model and methodology are considered to be relevant for each organisation in any particular market which consider an ERP implementation. Nevertheless, these organisations have to take the limitations (section 11.3) of this research into account.

10.4 Prediction evaluation

This section synthesizes the discussions on how the prediction of ERP performance in the changing and challenging energy market is received and determines how valid the prediction is.

The validity of the prediction is discussed with respondent 11 during the evaluation interviews. The first impression of respondent 11 was positive. He argues that the prediction gives a fairly reliable overview of the reality, and he can identify with the results. He claims that the results are relevant for all energy suppliers considering MECOMS 2012 or Dynamics AX 2012. However, he argues that the prediction is a snapshot of a particular moment based on the information gathered during the research. More information (obtained by the suggested improvements of the model and methodology) or changed information at a given moment (due to a changed context), could lead to a different ERP performance prediction in the future. Based on this observation and taken into account the model and methodology are based on proven concepts, the predictions are considered to be relevant (but not absolute) for each energy supplier that are considering an MECOMS 2012 or Dynamics AX 2012 as solution to support non-commodity products and services. The organisations have to take the snapshot aspect and the other limitations (section 11.3) of this research into account.

11 CONCLUSION

This chapter presents the conclusions of this research. The research questions are answered in Section 11.1, followed by a description of the contributions in Section 11.2. Section 11.3 concludes the chapter and the research with a discussion on the limitations of the research and the opportunities for future work.

11.1 Conclusions

This research presents an answer to the main research question stated below. In order to answer this question adequately, six sub-questions are answered first.

What is the expected performance of ERP as a solution for non-commodity products and services?

The first sub-question to answer concerns the determination of the enablers of ERP performance:

1. *What are the factors that enable a good ERP performance?*

As presented in the literature review, there are numerous frameworks to explain the performance of ERP. However, there are only a few frameworks to predict a successful adoption of ERP. Based on a literature review on the fit-viability theory and ERP fit theory, this thesis introduced a new model (and methodology) to predict the performance of ERP adoption. The results of such a prediction is the “Expected performance”. The model (and methodology) is empirically demonstrated and evaluated with subject matter experts and updated accordingly (see Section 10.3). The final set of enablers related to ERP performance are presented in Figure 33.

Expected performance is defined as *the degree to which an ERP implementation provides the expected benefits for the organisation*. The expected performance is dependent on the fit and viability of the ERP system. When a system has a good fit and is viable, the system will provide the expected benefits and users will be satisfied.

Fit concerns: *the extent to which the business needs match with the ERP functionalities mediated by the resolution strategies*. The business needs are best described as detailed knowledge about the desired business processes and its context (value proposition and market actors). The business needs are accessed based on the current business situation and drivers. The current business situation is best described as detailed knowledge about the current business processes and its context. The drivers are seen as the reasons why a new ERP system is considered. The ERP functionalities is a description of the capabilities of the selected ERP system. The resolution strategies refer to the strategies that can be used to reduce the number of identified misfits and increase the overall fit of the ERP system.

Viability concerns: *the extent to which the ERP is economically feasible, ready for the IT infrastructure and supported by the organisation and third parties*. The economic feasibility depends on the question whether the ERP system is considered cost-beneficial (feasible) and has a positive effect on the competitive advantages of the organisation (justifiable). IT Infrastructure readiness refers to the extent the selected technology can be integrated into the current IT infrastructure (readiness). The organisation readiness refers to the extent the organisation is willing to implement the selected ERP system (organisational support by key-users and the management) and is ready for using this technology (organisational culture, resistance to change, and knowledge level of the employees). The third party construct refers to which extent an (involved) third party is willing to support the selected ERP system (third party support).

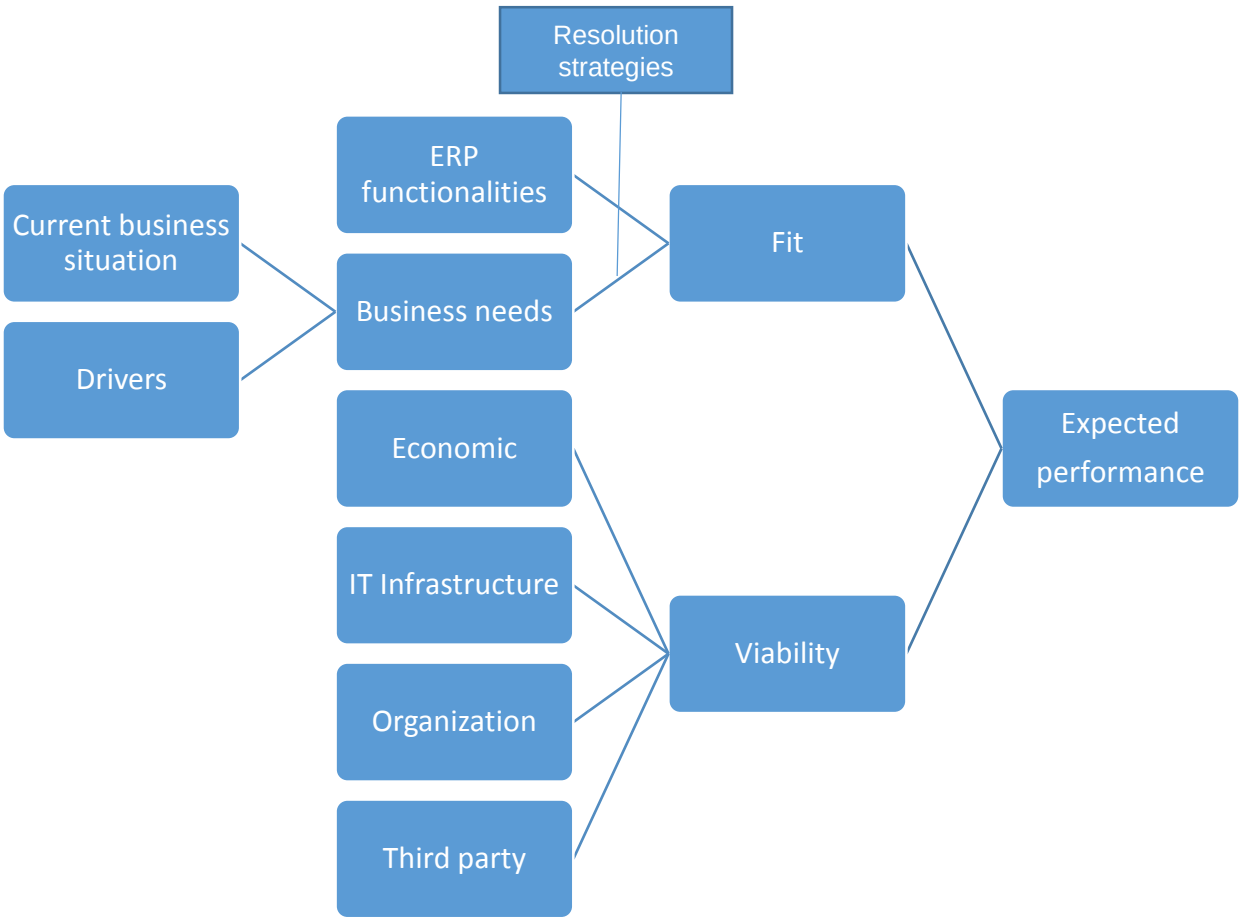

FIGURE 33: FINAL RESEARCH MODEL

The next research sub-question concerns the developed methodology (based on the previously explained model) to predict the performance of ERP adoption. The second sub-question is as follows:

2. *What methodology can be used to predict ERP performance?*

Based on the previously introduced conceptual model to predict the performance of ERP and the results of the literature review, a conceptual methodology is developed (see Figure 10). The methodology is inspired by frameworks of Štemberger et al. [30], Liang et al. [49], and Turban et al. [52], and will serve as a guideline for predicting the performance of ERP in a particular market. This methodology is empirically demonstrated and updated accordingly. Figure 34 presents an overview of the methodology.

Step 1: Assess the current business situation and the drivers in the organisation
The first step aims at assessing the current business situation and the drivers in the organisation. The drivers are the reasons why the organisation is considering ERP. The current situation is best described as the current value propositions, market actors and business processes. The knowledge of value propositions can provide insights into the business model. Additionally, the understanding of the market actors and business processes help understanding how these value propositions are realized. To acquire this knowledge about the current business situation, an organisation can best perform a business process analysis. This analysis can help to create a process model, which is an abstract presentation of the processes. This process model, together with the descriptions of the value propositions and actors, provides a solid representation of the current situation in the organisation.

FIGURE 34: FINAL METHODOLOGY

Step 2: Find business needs & assess the economic, IT infrastructure, organisation and third party constructs

The second step aims at finding the business needs and at assessing the economic, IT infrastructure, organisation and third party constructs. The business needs are determined in the form of a list of needs, which represent the desired business processes and the desired context (value propositions and market actors). Several data objects can be used as input for this stage. This research recommends to base the business needs on the current business situation and the drivers, as well as to take the future developments, the organisations mission, vision and strategy into account.

The economic, IT infrastructure, organization, and third party constructs can be assessed in the form of an expert perception. Expert interviews or a questionnaire can be used as input for this step. The economic construct is measured based on economic feasibility and justifiability of the selected ERP; the IT infrastructure construct is measured based on the extent to which the selected ERP fits in the current IT infrastructure; the organization construct is measured based on the extent the organisation is willing to implement the selected ERP and is ready for using this ERP; and the third party construct is measured based on the extent to which third parties (involved) support the selected ERP.

Step 3: Understand the ERP functionalities

The third step aims at understanding the selected ERP system(s). This research recommends to involve ERP experts, or to analyse the functionalities of the selected ERP system(s) by studying the reference models or any other training materials on the selected ERP system.

Step 4: Assess the fit and viability

During step one, two and three all the necessary data are collected to determine the fit and viability. The fourth step aims at determining the fit and viability of the selected ERP system(s) for the organization. The fit is determined based on matching the business needs and ERP functionalities. For each identified gap a resolution strategy can be considered. These resolution strategies moderate the effects of the identified gaps on the overall fit score of the selected ERP system. Additionally, the viability is determined based on analysing the economic, IT infrastructure, organisation and third party constructs related to the ERP system.

For scoring both the fit and viability constructs a seven-point Likert-scale (from 1 = large gap/very bad till 7 = perfect fit/very good) is used. This research recommends to approach experts of the selected ERP to help an organisation in determining the fit and viability.

Step 5: Determine the expected performance
Finally, the last step aims at determining the expected performance of the selected ERP system(s). The expected performance is scored based on the fit and viability scores. These scores help to position the expected performance of the selected ERP system in the Fit-Viability model [51]: a high fit and high viability suggests a good target (high performance); a high fit and low viability suggests a good chance of success on the condition that the organisation is restructured (medium performance); a low fit and high viability suggests to find an alternative technology (medium performance); and a low fit and low viability suggests to forget the whole idea of using such a kind of technology (low performance). After positioning the performance of the selected ERP system(s), the organisation can consider (not) to implement the selected ERP system(s), and/or to start a restructuring of the organization if needed, to predict the performance of another ERP system(s) (return to step 2), or to update the business needs according to the new insights and to reassess the performance (return to step 2).

The third sub-question concerns the developments and needs of energy suppliers related to the transition to non-commodities. The third sub-question is as follows:

3. *What are the needs of energy suppliers related to non-commodity products and services?*

Both the studied literature as the approached experts confirm that the current business model of energy suppliers (which is purely focussed on the production and/or the sales of the commodity products gas and/or electricity) is no longer sustainable in the future. In addition, customers are moving from passive payers of monthly energy bills to persons who are more proactive and engaged in both energy consumption and production. Therefore, energy suppliers have to redesign themselves to survive. They have to transform themselves to become more customer and service focused. To make this transition, non-commodity products and services are of great importance. These non-commodity products and services empower the customers to become also engaged in energy consumption and production, and provide energy suppliers the possibility to deliver assets and to stimulate optimal use of energy resources.

Table 17 provides an overview of the business needs related to these non-commodity products and services which are identified and confirmed. A business need is confirmed when at least 75% of the approached respondents, acknowledge the need.

Acknowledged, Revised and New Business needs		
Energy service specialist	1	Support for multiple non-commodity products
	2	Support for multiple non-commodity services
	3	Support for non-commodity products and services with traditional commodity products
	4	Support for products, services and packages customization
After sales specialist	5	Support for multiple types of maintenance
	6	Support for full-life cycle support
New capabilities	7	Support for multiple financial options
	8	Support for service contracts
	9	Support for multiple partnerships
	10	Support for the outsourcing of processes
	11	Support for flexibility

TABLE 17: THE NEEDS OF ENERGY SUPPLIERS RELATED TO NON-COMMODITY

In order to understand how these business needs relate to ERP, the following sub-question is answered:

4. *How do these needs of energy suppliers relate to ERP?*

In this research, the relation between the needs of the energy suppliers and ERP is defined as the fit. The fit is the extent to which the business needs match with the ERP functionalities moderated by the resolution strategies.

Figure 35 displays the fit of two versions of Microsoft's ERP system: MECOMS 2012 (Microsoft Dynamics AX solution for the energy and utilities sector) and Dynamics AX 2012 (Microsoft Dynamics AX standard solution). The timeframe of this research was too short to assess other ERP systems. (1 = large gap, 7 = perfect fit).

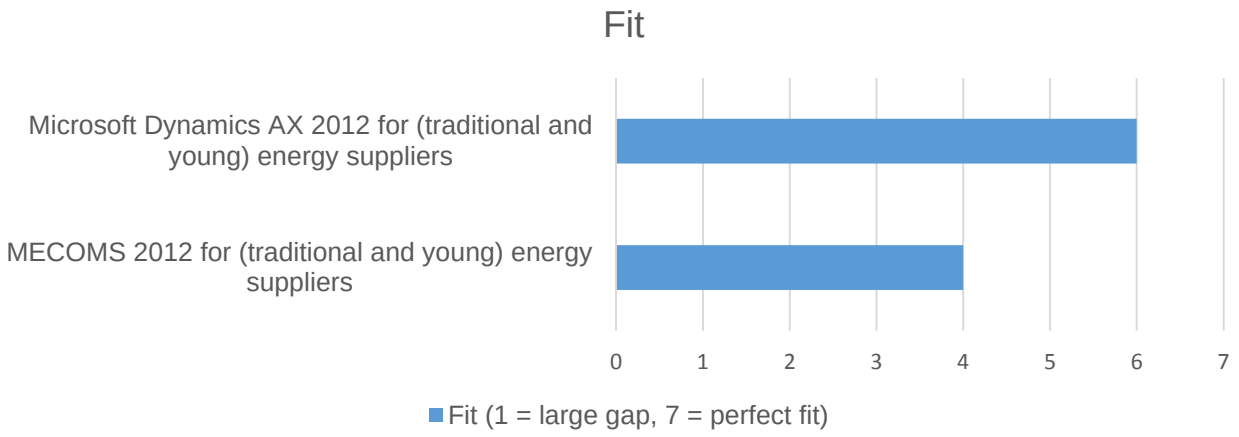

FIGURE 35: VISUAL REPRESENTATION OF THE FIT FOR DYNAMICS AX 2012 AND MECOMS 2012

An interesting positive match was found between Dynamics AX 2012 and the needs of energy suppliers regarding non-commodity products and services. This means there is a good fit for Dynamics AX 2012. Dynamics AX 2012 well supports most of the needs, and in case the support is insufficient there are several resolution strategies available for an acceptable amount of custom work. However, there is one exception which prevents Dynamics AX 2012 from being a perfect fit. There is a clear mismatch for bundling of non-commodity products and services with the traditional commodity products (e.g., gas and electricity). This is a result of the lacking support for the traditional commodities in the Dynamics AX 2012. In order for Dynamics AX 2012 to support this bundling an integration with the current commodity solution is required, or (in case there is no commodity solution available) an expensive extension is required to support the traditionally commodity products and services too.

The overall inferior support of MECOMS 2012 for the needs related to non-commodity products and services can be explained by the lack of support for products and services other than commodity products. MECOMS 2012 is especially built to support the needs of commodity products (e.g., electricity and gas), which differ from the needs of non-commodity products and services. Therefore, as a separate solution for non-commodity products and services, the fit of MECOMS 2012 is considered by the interviewed expert as undecided. However as an integrated solution for both non-commodity products and services and commodity products (which is outside the scope of this research), MECOMS 2012 is more promising. This integrated solution is especially interesting for organisations which already have MECOMS 2012 implemented as their commodity ERP solution or for an organisation planning to replace its current ERP commodity solution.

The fifth sub-question is about the understanding to what extent the energy suppliers are ready for ERP.

5. *To what extent are energy suppliers ready for ERP?*

The readiness of the energy suppliers for ERP is, in this research, defined as the viability. In the demonstration phase, the viability is based on the extent to which the ERP is a) economic feasible and justifiable, b) fits in the IT infrastructure, and c) the organisation is ready for the ERP.

Figure 36 presents the viability of two versions of Microsoft's ERP system: MECOMS 2012 (Dynamics AX solution for the energy and utilities sector) and Dynamics AX 2012 (Standard Dynamics AX), and for two types of energy suppliers: traditional energy suppliers (founded before 2000 and characterised by "rigid and change-resistant" culture) and young energy suppliers (founded after 2000 and characterised as "flexible and open-for-change" culture). This differentiation is made on account of the different position towards the organisation construct.

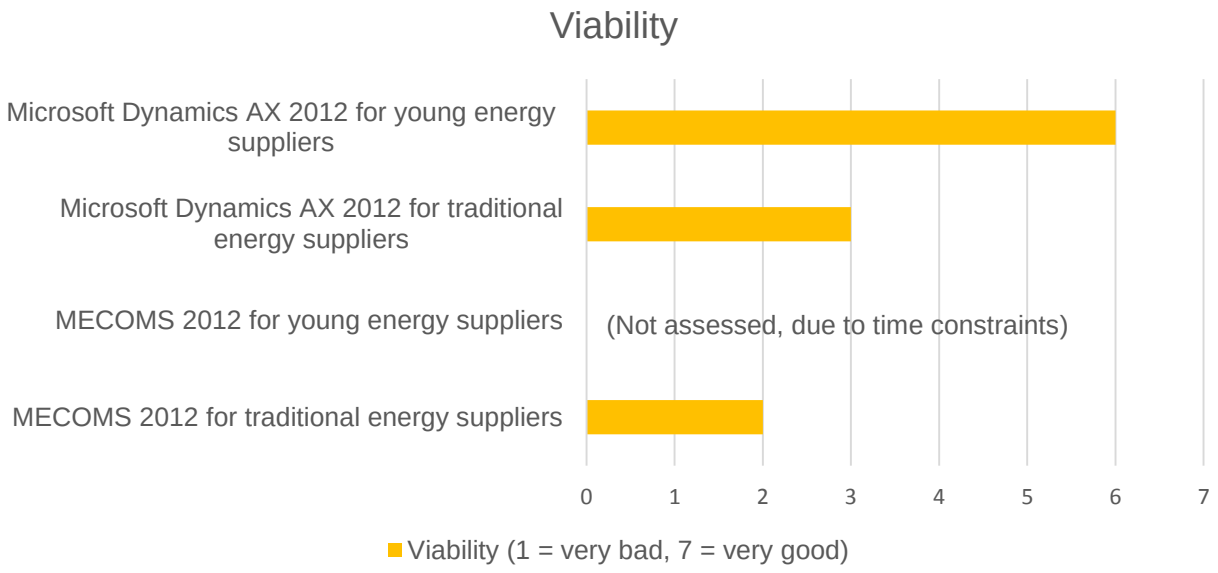

FIGURE 36: VISUAL REPRESENTATION OF THE VIABILITY FOR DYNAMICS AX 2012 AND MECOMS 2012

Dynamics AX 2012 is a viable solution for young energy suppliers. Dynamics AX 2012 is claimed to be a relative cheap, low-risk and open ERP system in comparison to another ERP system. Furthermore, this energy supplier has a "flexible and open-for-change" organisation culture, which also has a positive influence on the viability of the ERP system. The timeframe of this research was too short to assess the viability of MECOMS 2012 for young energy suppliers.

On the other hand, the somewhat negative viability of Dynamics AX 2012 for traditional energy suppliers can be explained by the organisations' lack of openness to change and the "rigid and change-resistant" organisational culture. These energy suppliers have an organisational culture that is characterised by different interests, many internal politics and risk aversion, which negatively influence the viability of Dynamics AX 2012.

MECOMS 2012 negative viability for traditional energy suppliers can be explained too by the organisations' lack of openness to change and the "rigid and change-resistant" organisational culture and by the (lack of) economic feasibility and justification. Where Dynamics AX 2012 is claimed to be a relative cheap solution, MECOMS 2012 is considered to be relatively expensive as a solution just for non-commodity products and services. MECOMS 2012 would only be more economic feasible and justifiable when it is considered as an integrated solution for commodity products and non-commodity products and services, rather than a

separate solution for non-commodity products and services only. The integrated solution is interesting for organisations which already have MECOMS 2012 implemented as their commodity ERP solution or for an organisation planning to replace its current commodity ERP solution.

Finally, to help answering the main question, the following last sub-question is answered:

6. *To what extent can the developed model and methodology be used to predict the performance of ERP?*

The developed model and methodology has led to interesting and recognizable predictions of Dynamics AX in the changing and challenging energy market. Furthermore, the developed model and methodology is considered to be generic, and claims to be applicable in whatever market for each more or less standard ERP system. To conclude, this implies that the developed model and methodology is a good starting point to predict the performance of ERP (taken the limitations of this research (see 11.3) into account).

The previous six sub-questions together answer the *main research question*:

What is the expected performance of ERP as a solution for non-commodity products and services?

For young energy suppliers (founded after 2000 and characterised by a “flexible and open-for-change” culture) Microsoft Dynamics AX 2012 is a good solution to consider because little to no (complex) organisational restructuring is required. For traditional energy suppliers (founded before 2000 and characterised by a “rigid and change-resistant” culture) Microsoft Dynamics AX 2012 is a good solution to consider on the condition that the organisation is first restructured. A major problem with Microsoft Dynamics AX 2012 for these traditional energy suppliers is the resistance to change and culture of these organisations. Without a culture characterised by open to change and flexibility, the implementation of ERP is endangered. Restructuring the organisation (via an organisational change project that includes change management, changes in organisational structures and changes in the organisational culture) is required to decrease the resistance to change and to get a more “flexible and open-for-change” culture. This to enhance the viability of the selected ERP system and thus the expected performance.

For traditional energy suppliers, MECOMS 2012 is a questionable solution to consider. There will be a need for organisational restructuring, but even then, it will be questionable whether MECOMS 2012 is a right system to consider if the solution is only used for non-commodity products and services. A major problem of MECOMS 2012 for traditional energy suppliers is, in addition to the “rigid and change-resistant“ culture of these organisations, the economic feasibility and low-fit of MECOMS 2012. MECOMS 2012 works well with the traditional commodity products, but no so well with the (new) non-commodity products and services only. Therefore as a solution for non-commodity products and services, it may be better to consider another system that fits better with the needs of the energy suppliers regarding non-commodity products and services.

The results of this thesis are displayed in Figure 37 (see also Chapter 9).

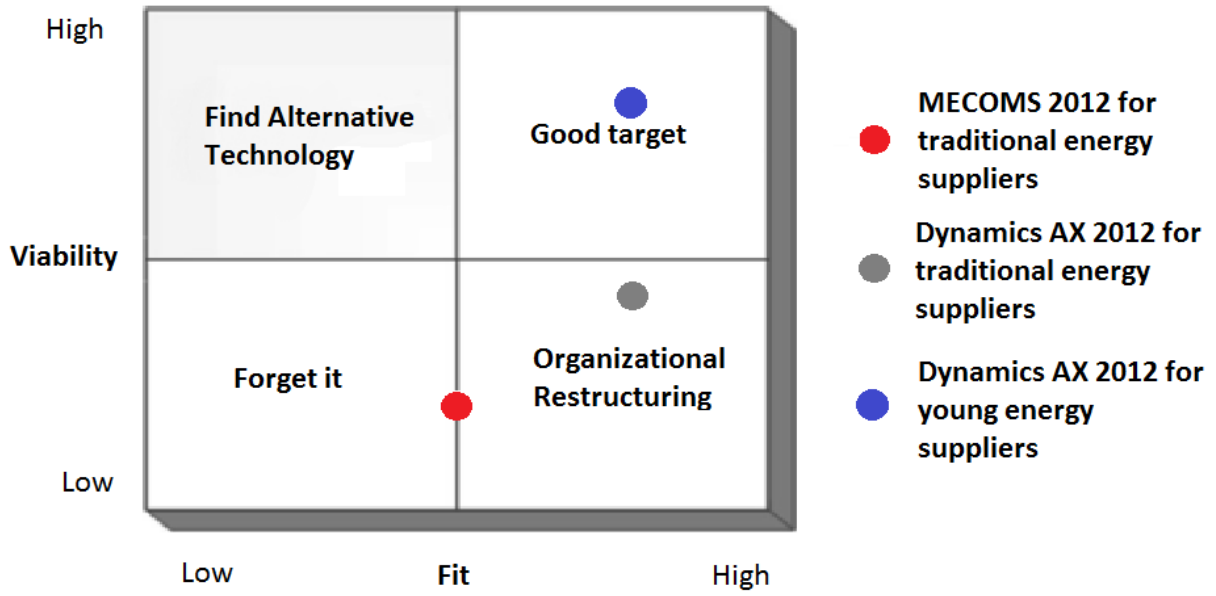

FIGURE 37: VISUAL REPRESENTATION OF THE ANSWER TO THE MAIN RESEARCH QUESTION

11.2 Contributions

This section indicates how this research contributes to theory and practice. First, the contribution to theory is described (11.2.1), followed by the description of the contribution to practice (11.2.2).

11.2.1 Contribution to Theory

This research provides three contributions to current theory in the field of predicting ERP performance and mapping of ERP gaps.

First, as indicated in Section 4.4, there is hardly any literature on predicting ERP performance. This research incorporates the fit-viability theory and ERP fit theory in a single model to predict the performance of ERP in a particular market. No prior research has applied the fit-viability theory in combination with the ERP fit theory to predict the performance of ERP, according to the literature review. This research gives a first indication of the potential of the fit-viability theory for predicting ERP performance.

Secondly, this research introduces a methodology based on the previously introduced model and existing frameworks [30], [49], [52] to predict the performance of ERP in a particular market. This methodology is empirically demonstrated, evaluated and updated accordingly. During the evaluation, the potential of this methodology for predicting ERP performance is confirmed.

Third, this research contributes to the mapping of ERP gaps. Current literature on ERP gaps is still limited. In this research, the bundling of traditional commodity products and the new non-commodity products and services is for exampled mapped as a (new) gap in ERP systems studied.

11.2.2 Contribution to Practice

This research provides two contributions to the energy sector and two contributions to Avanade and the IT consulting sector in general, by revealing what the business needs of energy suppliers are in relation to non-commodity products and services, how these needs can be supported by ERP, and to what extent energy suppliers are ready for a new ERP solution.

As a first contribution to the energy sector, this research provides evidence confirming and rejecting or changing various business needs in relation to non-commodity products and services. This provides

managers with an idea about the actual needs in relation to non-commodities and what is likely to be not (at this moment).

Secondly, this research provides the energy sector with a first indication of the potential of ERP as a solution for non-commodity products and services by energy suppliers. By matching the business needs with the ERP functionalities and by analysing to what extent the energy suppliers are ready for ERP, the potential of ERP as a solution for non-commodity products and services is determined. Reducing the ambiguity surrounding the contribution of ERP helps the management to decide whether or not it makes sense to invest in ERP as a separate solution for non-commodity products and services.

The contribution to Avanade and other IT consulting firms is two-fold. First, this study revealed the potential performance of two versions of Dynamics AX as a solution for non-commodity products and services. These insights offer Avanade and other IT consulting firms an understanding of the changing and challenging energy market, and the added value of ERP solutions in this market. Moreover, these insights help them to decide whether or not to promote an ERP solution in the energy market. Secondly, this study introduced an approach (model and methodology) to predict the performance of an ERP solution in a particular market. This approach can be applied to predict the performance of ERP proposition in other markets too.

11.3 Limitations and future work

This chapter outlines the limitations of this research and the recommendations for future work.

11.3.1 Limitations

In this research, a number of limitations are present.

The most important limitation of this research is that the data collection is based on small sample size of experts. For this research, six sector experts and three ERP experts are approached. While their expertise on the topic is unquestionable, it is possible that their views are biased or differ from other experts. More research with a larger and more diverse sample size of respondents (e.g., small energy suppliers, customers and collective customer groups) will help to further generalize the results.

Another important limitation is the small sample size of ERP solutions. This research focusses on two Microsoft-based ERP solutions (Dynamics AX 2012 and MECOMS 2012) and doesn't include any other ERP solutions from other ERP vendors (e.g., SAP and Oracle). Future research should investigate the applicability of this model and methodology with regard to other ERP solutions to further generalize the results. Additionally, future research should investigate how these other ERP solutions are expected to perform as a solution for non-commodity products and services, and how the performance of these solutions differs from that of Microsoft Dynamics AX 2012 and MECOMS 2012.

The third limitation of this study is the focus on one market. The model and methodology is demonstrated in the energy market. However, this model and methodology could be applied in other markets as well. More research is needed to further confirm the applicability of this model and methodology in other markets too.

Because the researcher had a role in summarizing and analysing the data collected by semi-structured interviews with experts from the energy sector before presenting these results to the ERP expert, the results may be affected by a wrong summarization or interpretation by the researcher. Further research is required to verify and validate the results.

11.3.2 Future work

This study provides a number of interesting opportunities for future research. First of all, the limitations discussed in the previous section suggest new work for overcoming these limitations. Secondly, the research led to some thought-provoking possibilities.

During the evaluation, two suggestions were made towards to improvement of the research model that were not supported by existing literature. The first improvement is the inclusion of the future alignment measure in the IT infrastructure construct. The second improvement is the inclusion of the organisational changes that are already foreseen in the organisational construct. Further research is required to confirm or rejected these improvements, and, if needed, to update the model and methodology accordingly.

In this research, the performance of ERP as a solution for non-commodity products and services is determined. The question is whether energy suppliers want to have a separate solution for non-commodities only, or whether they prefer one integrated solution for the non-commodities and their commodity products. This requires further research in which also the needs concerning all commodity products are taken into account.

A next step could be to automate this methodology. An automated tool can help organisations to apply this model and methodology easily and quickly, and help them to determine the potential of ERP in their organisation. Further research is required to design and build such a tool.

This research introduces a (new) model and methodology to predict the performance of an ERP package. During the evaluation, one expert also saw potential in applying this model and methodology to predict the performance of other software packages (e.g., CRM). Further research is required to confirm to the applicability of this model and methodology for other software packages.

In order to predict the success of an ERP solution, much information is gathered. This kind of information may be reused during the design and implementation phase of the ERP solution to speed up the process. Further research is required to determine the benefits of predicting ERP performance on the design and implementation phase of an ERP solution.

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APPENDIX A LITERATURE REVIEW METHODOLOGY

A.1 Literature review structure

In order to structure the literature review, the concept-centric approach by Webster and Watson [25] is used. This approach describes the work of various authors concerning a certain concept together and synthesizing the findings where possible.

A.2 Search Process Overview

The search approach used in this study is based on the 'Grounded Theory Literature-Review Method' by Wolfswinkel, Furtmueller, & Wilderom [7]. Their iterative search method consists of three stages: 'Define', 'Search', and 'Select', which are repeated until the last step did not result in any new literature (see Figure 38). 'Define' stage consists of making out the scope of the review as well as inclusion and exclusion criteria, the appropriate 'fields' of research, the appropriate sources, and the specific search terms. 'Search' stage consists of the search as defined in the 'Define' stage. 'Select' stage consists of reviewing the results. This is done by reading the titles, abstract or more of the text, and forwarding and backwarding citations.

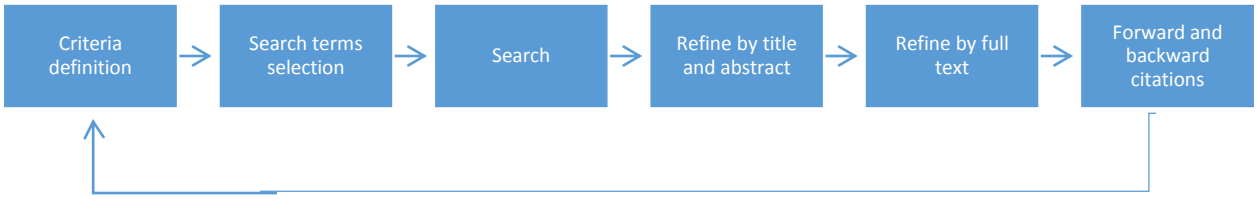

FIGURE 38: OVERVIEW LITERATURE SEARCH METHOD

Criteria definition

In order to limit the amount of papers to include, criteria are set. In this research, two search engines were used: Google Scholar and Scopus. The following criteria were set for both engines:

General Criteria:

- The material is from 2005 and later

Google Scholar specific criteria:

- Sorted by relevance
- Within first 25 results

Scopus specific criteria:

- Scope is 'Title, Abstract & Keywords'
- Sorted by relevance
- Within first 50 results

Keywords

The keywords used in the literature search are based on the central concepts of this thesis. In this search into two key concepts are searched: "Theory related to predicting the success of ERP" and "Theory on developments in non-commodity and the energy sector". For each concept, a separate literature search is conducted. The set of keywords changed during each search iteration. Table 18 provides an overview of the used keywords during this research:

Keywords first review	*Keywords second review*
"Enterprise resource planning" or "ERP" and "Success factors"	"Decentralised renewable generation" or "Distributed renewable generation"
"Fit" and "Viability"	"Trends" and "Utility" or "Energy"
"Enterprise resource planning" or "ERP" and "Fit" or "Misfit"	
"Enterprise resource planning" or "ERP" and "Viability"	
"Enterprise resource planning" or "ERP" and "Business process design"	

TABLE 18: KEYWORDS USED IN LITERATURE STUDY

APPENDIX B PHOTOVOLTAIC SYSTEMS AND WIND SYSTEMS

The next two sections discuss these two technologies in more detail. The other technologies are not discussed in detail in this thesis.

B.1 Photovoltaic systems.

Of the available renewable energy sources, solar energy is one of the most promising options [22], [79]. Solar energy is extensively available and has therefore an enormous potential. Some studies have indicated that, in theory, a thousand times the global energy demand can be fulfilled purely by using solar energy [18], [80]. Taken into account that only 0.02% of this energy is used today, there is still a lot of do.

Solar Photovoltaic (PV) systems are solid-state semiconductor devices which convert solar energy directly into electricity [22]. Several materials can be used on PV panels, and the materials used today are, among others: monocrystalline silicon, polycrystalline silicon, microcrystalline silicon, copper indium selenide, and cadmium telluride [21]. Most of the PV systems are ground-mounted or built on the roofs and walls of buildings and residential houses. These PV systems have a capacity ranging from 195 to 350 kWp [81]. A typical PV system is expected to be operational at 90% of its rated power capacity for up to 10 years and 80% for up to 25 years [22], [81].

Over the last 30 years, solar systems have evolved in a rapid pace. The production costs have reduced drastically and the output-efficiency has increased significantly over the years [22], [81]. In addition researchers are still working on new technologies for even lower production costs or higher energy conversion efficiency, which will even further decrease the costs per MW. Some studies expect these costs to drop to € 0.05 per kWh [18]. Because of these advancements and the low environmental impact of PV systems, solar energy is expected to be a serious alternative for fossil energy, and this creates huge opportunities for PV systems. Resulting in a fast-growing market for PV systems. The installed base of PV systems in Europa already exceeded 10 GW by the end of 2009 and is expected to grow to at least 90 GW by 2020 [3], [21], [22]. In this energy revolution, Germany takes the lead, followed by Italy and Belgium. However, the popularity of PV systems is growing in the Netherlands as well. By the end of 2013 the installed base of PV systems in the Netherlands exceeded 650 MW [18], [81].

Besides the technical and economic challenges that still need to be overcome, there is also the growing concern about the characteristics of solar energy regarding the match between supply and demand. Solar energy is a supply dependent energy source [18]. The generation of electricity from a PV system depends on the intensity of the sun at a specific moment. It does not depend on the demand at a specific moment. This causes mismatches if the solar energy cannot be stored properly.

B.2 Wind systems.

Also wind energy is widely available in many parts of the world, and can be a major source for electricity. Research has indicated that wind speeds from 4 – 25 m/s are already adequate for wind energy production [82]. In today's market for central renewable energy generation wind energy is seen as the most competitive technology among the renewable energy technologies [10]. This has resulted in a fast growing number of large offshore and onshore wind parks.

Meanwhile, micro wind turbines are still a niche application [3]. Micro wind turbines are solid-state semi-conductor devices that convert the kinetic energy of streaming air to electricity. Previously, the micro wind turbine market was dominated by Horizontal Axis Wind Turbines [61]. These are stand-alone turbines with a main rotor shaft and electrical generator at the top of a long tower (about 11m), and their capacity is

ranging from 2.5 – 20 KW. However, more recently, also building-integrated turbines are introduced [61]. These can be built on roofs or walls and are a lot smaller than the Horizontal Axis Wind Turbines. Their capacity is up-to 1.5 KW.

Although the market for micro wind turbines is growing, and consumers are showing interest in small wind energy, the global sales only just exceeded 40MW by the end of 2009 [83]. There are still technical and economic challenges to overcome which hinder the advancements of the micro wind turbine market. This includes the high costs per kWh, the noise, visual impact, animal (bat) strike and the impact of profusion of multiple turbins in one area, and the performance of the individual turbines [61], [83]. Also wind energy is a supply dependent energy source, just like solar energy.

This all requires further research and development into advanced materials, manufacturing techniques and design of wind turbines and energy storage capacity.

APPENDIX C EXPERT OPINIONS

This appendix describes in detail which experts are accessed and how they are approached.

C.1 Experts overview

The following Table 19 provides an overview of what expert are accessed at what moment of the research.

Purpose	Type of contact	Organization	Function	Documentation
Assessment current situation in the organisation	Unstructured interview	Avanade	Business development executive for energy & utilities	-
	Unstructured interview	Avanade	Solution lead for energy & utilities industry	-
	Semi-structured interview	Energy supplier A (Traditional energy supplier)	Domain Architect for the lead to contract	Appendix C.2
	Semi-structured interview	Installation partner of energy supplier A	Manager process innovation	Appendix C.2
Validation of business needs and assessment of economic, IT infrastructure and organisation construct	Semi-structured interview	Energy supplier B (Traditional energy supplier)	Manager for product management and business development	Appendix C.3
	Semi-structured interview	Energy supplier C (Traditional energy supplier)	Manager marketing & sales and manager service management	Appendix C.3
	Semi-structured interview	Energy supplier C (Traditional energy supplier)	Business consultant	Appendix C.3.
	Semi-structured interview	Energy supplier D (Young energy supplier)	Head of the customer service and back-office	Appendix C.3
Assessment of fit and viability	Semi-structured interview	Avanade	Solution lead for energy & utilities industry	Appendix C.4
	Semi-structured interview	Avanade	Solution lead for energy & utilities industry	Appendix C.4
Evaluation results, model and methodology	Semi-structured interview	Avanade	Solution lead for energy & utilities industry	Appendix C.5
	Semi-structured interview	Avanade	Solution lead for Retail industry	Appendix C.5

TABLE 19: OVERVIEW APPROACHED EXPERTS

C.2 Semi-structured interviews #1: Prepared questions

Het interview bestaat uit drie onderdelen. Eerst zullen de huidige ontwikkelingen op het gebied van decentrale energie opwekking worden besproken, daarna zal er in worden gegaan op de producten en diensten die uw organisatie aanbiedt gerelateerd aan decentrale energie opwekking. Tot slot wordt er gefocust op de belangrijkste processen van een van deze producten.

HUIDIGE ONTWIKKELINGEN

1. Hoe zou u de huidige ontwikkelingen op het gebied van decentrale energie opwekking beschrijven?
2. Wat betekent dit nu voor uw organisatie?
3. Wat betekent dit in de toekomst voor uw organisatie?

PRODUCTEN EN SERVICES

4. Welke producten met betrekking tot decentrale energie opwekking verkoopt uw organisatie?
5. Welke after-sales diensten worden door uw organisatie aangeboden met betrekking tot decentrale energie opwekking?

PROCESSEN

Voor elke proces en sub-proces worden de volgende vragen gesteld:

6. Hoe zou u dit proces beschrijven?
7. Welk event triggert dit proces?
8. Welke data / documenten zijn nodig voor dit proces?
9. Welke events worden gegenereerd door dit proces?
10. Wie is betrokken bij dit proces?
11. Wat zijn de sterkste punten van dit proces?
12. Wat zijn de pijnpunten punten van dit proces?

C.3 Semi-structured interviews #2: Prepared questions

Het interview zal bestaan uit drie onderdelen. Eerst is zal de rol van non-commodity producten in uw organisatie worden besproken. Daarna worden de resultaten van de vooraf ingevulde vragenlijst besproken en tot slot wordt er gefocust op de haalbaarheid van een (nieuwe) IT oplossing ter ondersteuning van de verkoop non-commoditie producten.

Voordat er op de specifieke onderdelen is ingegaan zijn de volgende vragen gesteld:

1. Waar staan jullie als organisatie voor?
2. En wat is uw rol in de organisatie?

NON-COMMODITY PRODUCTEN

3. Welke non-commoditie producten verkopen jullie vandaag?
4. Welke percentage van jullie verkopen komt voort uit non-commoditie producten vandaag?
5. Hoe verwachten jullie dat zich dit ontwikkeld in de komende jaren?
6. Wat zijn de marges op de non-commodity producten in vergelijking met de traditionele commoditie producten?

ONTWIKKELINGEN OP HET GEBIED VAN NON-COMMODITY PRODUCTEN

7. Wat is uw algemene indruk van de genoemde trends in de vooraf ingevulde vragenlijst?
8. Zijn er trends die volgens u ontbreken in deze lijst?
9. Als we kijken naar deze trends, welke verwacht u dat de meeste impact op uw organisatie zal hebben?

10. Zou u ook voor de andere trends kunnen aangeven welke impact deze op uw organisatie zullen hebben?

IMPACT OP IT

11. Hebben jullie in de afgelopen tijd geïnvesteerd in een IT oplossing ter ondersteuning van de verkoop van non-commodity processen zoals zonnepanelen en gerelateerde services?

In het geval de organisatie in de afgelopen tijd heeft geïnvesteerd in een nieuwe IT oplossing zijn de volgende vragen gesteld:

12. Wat is uw ervaring met deze IT oplossing?
13. Welke van de vooraf genoemde ontwikkelingen worden ondersteund door deze oplossing?
14. Kwam de bereikte resultaat overeen met de vooraf gestelde verwachtingen?

In het geval de organisatie overweegt te investeren in een nieuwe IT oplossing zijn de volgende vragen gesteld:

14. Welke van de vooraf genoemde ontwikkelingen zouden jullie stimuleren om een nieuwe IT oplossing in te voeren?
15. Welke bedrage van IT zou u blij maken?
16. Zijn er nog andere doelen die jullie graag zouden bereiken met deze IT oplossing?
17. Zijn er bepaalde risico's die u zouden weerhouden een nieuwe IT oplossing te overwegen?

In beide gevallen gelden zijn de volgende vragen gesteld:

18. Zou uw voorkeur uitgaan naar een 'on the premise', 'hybrid' of 'cloud' solution?
19. Hoe staan jullie als organisatie tegenover de verandering van processen?
20. Hoe zou u jullie huidige IT architectuur omschrijven?
21. Waar verwacht u de meeste draagvlak voor deze oplossing in jullie organisatie?
22. Verwacht u bij het invoeren van deze nieuwe IT oplossing veel weerstand?

C.4 Semi-structured interview #3: Prepared questions

Dit interview bestaat uit drie onderdelen. Eerst wordt de fit en daarna op de viabiliteit van Dynamics AX 2012 en MECOMS 2012 als oplossing voor non-commoditie producten en diensten besproken.

MATCH THE BUSINESS NEEDS WITH ERP FUNCTIONALITIES

Aan hand van de parktijkstudie is de volgende lijst van business needs opgesteld:

Support for multiple non-commodity products
Support for multiple non-commodity services
Support for bundling of non-commodity products and services with traditional commodity products
Support for product, service and packages customization
Support for multiple types of maintenance
Support for full-life cycle support
Support for multiple financial options
Support for service contracts
Support for multiple partnerships
Support for the outsourcing of processes
Support to react fast on new developments

1. Zou u voor iedere business needs kunnen aangeven of dit mogelijk is binnen Dynamics AX 2012 (fit) of niet (gap)?
2. Zou u voor iedere business needs kunnen aangeven of dit mogelijk is binnen MECOMS 2012 (fit) of niet (gap)?

IN CASE OF A GAP, IDENTIFYING WHAT A SUITABLE RESOLUTION STRATEGY IS SUITABLE TO AVOID THIS GAP.

3. Zou u voor iedere gap kunnen aangeven wat de grootste uitdaging is?
4. Zou u voor iedere gap kunnen aangeven wat een mogelijk oplossing is?

IN CASE OF A SUITABLE RESOLUTION STRATEGY, IDENTIFYING THE EXPECTED EFFORT OF IMPLEMENTING THIS RESOLUTION STRATEGY

5. Zou u voor iedere mogelijk oplossing kunnen aangeven wat de verwacht inspanning is van het implementeren van deze oplossing?

DETERMINE THE FIT

6. Zou u voor iedere business need de fit voor Dynamics AX 2012 en de fit voor MECOMS 2012 kunnen beoordelen? Op een schaal van 1 tot 7?

7. Aan hand van de zojuist geïdentificeerde gaps en oplossingen, hoe zou u de fit van Dynamics AX 2012 en de fit van MECOMS 2012 als oplossing voor non-commoditie producten en diensten beoordelen? Op een schaal van 1 tot 7?

C.5 Semi-structured interview #4: Prepared questions

Dit interview bestaat uit vier onderdelen. Eerst wordt er ingegaan op de economic construct, daarna op de IT infrastructure construct, gevolgd bij de organisation construct. Tot slot wordt de levensvatbaarheid (viabiliteit) van Dynamics AX 2012 en MECOMS 2012 als oplossing voor non-commoditie producten en diensten bepaald. De geinterviewde wordt gevraagd deze vier onderdelen vanuit het oogpunt van de klant te beoordelen.

IDENTIFYING HOW THE ASSESSED ECONOMIC CONSTRUCT RELATES TO ERP

Aan hand van de parktijkstudie is de economisch uitvoerbaarheid als volgt beoordeeld:

Construct	Measure	Position
Economic	Feasibility	A high feasible solution has clear and low-risk upfront costs and is preferably cheap.
	Justification	A high justifiable solution is suitable for non-commodity products and services, preferably also for commodity products and suitable for continuous improvement.

1. Hoe beïnvloed dit de levensvatbaarheid Dynamics AX 2012?
2. Hoe beïnvloed dit de levensvatbaarheid MECOMS 2012?
3. Waar zitten de grootste uitdagingen?
4. Op een schaal van 1 tot 7, hoe zou u economische haalbaarheid van Dynamics AX 2012 beoordelen?
5. Op een schaal van 1 tot 7, hoe zou u economische haalbaarheid van MECOMS 2012 beoordelen?

IDENTIFYING HOW THE ASSESSED IT INFRASTRUCTURE CONSTRUCT RELATES TO ERP

Aan hand van de parktijkstudie is de infrastructuur als volgt beoordeeld:

Construct	Measure	Position
IT Infrastructure	Readiness	A ready solution integrates easily with SAP or Microsoft based IT solution as well as with multiple other applications.

6. Hoe beïnvloed dit de levensvatbaarheid Dynamics AX 2012?
7. Hoe beïnvloed dit de levensvatbaarheid MECOMS 2012?
8. Waar zitten de grootste uitdagingen?
9. Op een schaal van 1 tot 7, hoe zou u de geschiktheid van de huidige infrastructuur voor Dynamics AX 2012 beoordelen?
10. Op een schaal van 1 tot 7, hoe zou u de geschiktheid van de huidige infrastructuur voor MECOMS 2012 beoordelen?

IDENTIFYING HOW ASSESSED ORGANISATION CONSTRUCT RELATES TO ERP

Aan hand van de parktijkstudie is de organisatie bereidheid als volgt beoordeeld:

Construct	Measure	Position	Depended factor
Organisation	Organisational culture	A “rigid and change-resistant” organisational culture	A traditional energy supplier (Energy Suppliers A, B and C)
		A “flexible and open-for-change” organisational culture	A young energy supplier (Energy Suppliers D)
	Resistance to change	A high resistance to change of processes and IT	A traditional energy supplier (Energy Suppliers A, B and C)
		A low resistance to change of processes and IT	A young energy supplier (Energy Suppliers D)
	Organisational support	A strong support for new or improved IT solutions that support the realization of the redesign of their organisation.	

11. Hoe beïnvloed dit de levensvatbaarheid Dynamics AX 2012?
12. Hoe beïnvloed dit de levensvatbaarheid MECOMS 2012?
13. Waar zitten de grootste uitdagingen?
14. Op een schaal van 1 tot 7, hoe zou u de organisatorische bereidheid voor Dynamics AX 2012 beoordelen?
15. Op een schaal van 1 tot 7, hoe zou u organisatorische bereidheid voor MECOMS 2012 beoordelen?

DETERMINE THE VIABILITY

16. Op een schaal van 1 tot 7, hoe zou u viabiliteit voor Dynamics AX 2012 beoordelen?
17. Op een schaal van 1 tot 7, hoe zou u viabiliteit voor MECOMS 2012 beoordelen?

C.6 Semi-structured interviews #5: Prepared questions

Het interview bestaat uit twee onderdelen. Eerst wordt het opgestelde model en methodologie geëvalueerd en daarna worden de gerealiseerde resultaten omtrent de voorspelling van de prestatie van ERP als oplossing voor non-commoditie producten en diensten besproken en geëvalueerd.

EVALUATION MODEL AND METHODOLOGY

1. Wat is uw eerste indruk van dit model?
2. Wat is volgens u goed aan dit model?
3. Wat kan volgens u aan dit model worden verbeterd?
4. Wat is uw eerste indruk van deze methodologie?
5. Wat is volgens u goed aan deze methodologie?
6. Wat kan volgens u aan deze methodologie worden verbeterd?
7. Voor wie acht u dit model en methodologie als nuttig?

EVALUATION PERFORMANCE

7. Wat is uw eerste indruk van deze resultaten?
8. Sluit u zich aan bij deze resultaten?
9. Hoe betrouwbaar acht u deze resultaten?
10. Voor wie acht u deze resultaten nuttig?

APPENDIX D MARKET ANALYSIS RESULTS

Market analysis results are removed because of confidentiality.

APPENDIX E RESULTS QUESTIONNAIRE

Results questionnaire are removed because of confidentiality.