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Understanding Solution Quality

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ABSTRACT

The integration of services and products into solutions can open up new business opportunities for firms. This thesis concerns how firms can provide solutions that are perceived as high quality. Solutions are often provided over several years, which implies a changed customer relationship compared to product provisions. Since the solution aims to support the customer's activities, firms face new challenges when introducing solutions. One challenge is to integrate all components and activities of the solution, and simultaneously support the customer's activities. In addition, the firm must ensure that the solution and all of its parts are of high quality.

Most of the existing research on quality is related to the management of a firm's internal activities and the interaction during exchange. Within the research on quality, customer orientation means that a firm should manage the relevant product or service to meet customer requirements. When this is achieved, the product or service is of high quality. Since solutions are seen as services and products that are integrated as an outcome, as well as a customer relational process that aims to support the customer's activities, firms have little to learn from previous research about the quality of solutions.

The aim of this thesis is to increase knowledge about how to manage solution quality. The thesis combines insights from research on quality with research on solutions and servitization. Three research questions are answered. The first question concerns the content of solution quality; the second deals with how firms can, with support from interventions, meet the new challenges that arise from solution provision; and the third question concerns how customers can be involved to achieve solution quality. The research questions are answered through five papers based on literature studies and empirical data. The papers contribute to an increased knowledge of solution quality and how firms can work to achieve it.

The results of the thesis suggest that solution quality is built on seven quality dimensions: *reliability*, *communicability*, *internal consistency*, *empathy*, *approachability*, *tangibility*, and *adaptability*. In addition, *knowledge of processes* and *customer relationships* are two prerequisites for the concept. These dimensions and prerequisites are supported by interventions that can provide a change. However, it has become evident that whatever intervention is used must be related to the dimensions that are supposed to be improved. Furthermore, customer involvement is argued to be an intervention to support the prerequisites for solution quality, especially

during the solution development. The results of this thesis extend the research on quality by increasing the knowledge of the solution quality concept and by changing the view of customers and their involvement during solution development.

SAMMANFATTNING

Den här avhandlingen berör hur företag kan möjliggöra så att produkter och tjänster, integrerade i så kallade helhetslösningar, kan levereras med hög kvalitet. Helhetslösningar levereras ofta över en längre tid vilket medför en förändrad kundrelation till skillnad mot när endast en produkt levereras. Helhetslösningar syftar till att stödja kunden i dess aktiviteter. Det medför att företagen möter nya utmaningar. En utmaning är att få den komplexa helhetslösningen, bestående av olika komponenter och aktiviteter, att passa ihop och samtidigt bidra till att stötta kundens aktiviteter. Dessutom behöver företagen säkerställa att helhetslösningen och alla dess delar har hög kvalitet.

Tidigare forskning inom kvalitetsutveckling berör företags interna processer och aktiviteter. När man inom kvalitetsutveckling talar om kundorientering innebär det att företaget med interna medel ska arbeta för att möjliggöra så produkten eller tjänsten möter kundens specifikationer. När detta är uppnått har produkten eller tjänsten hög kvalitet. Företagen har här inga riktlinjer att följa när de ska leverera helhetslösningar som ska anpassas efter kundens aktiviteter och när en så tydlig kundrelation ska utvecklas. Det finns med andra ord ingen vägledning för vad som är kvalitet eller hur man möjliggör hög kvalitet på helhetslösningar.

Den här avhandlingen visar vad som ingår i begreppet kvalitet när det gäller helhetslösningar (lösningskvalitet) samt hur företag kan möjliggöra det. Tre olika frågor har huvudsakligen behandlats. Den första frågan besvarar vad lösningskvalitet innehåller. Den andra berör hur företag med hjälp av åtgärder kan bidra till en förändring inom företaget för att möta de nya utmaningar som uppstår med att leverera helhetslösningar. Den tredje frågan berör på vilket sätt kunden kan involveras för att uppnå lösningskvalitet. För att besvara frågorna har ett antal studier baserade på empiriskt material genomförts, och fem artiklar har författats under forskningsprocessen. Artiklarna bidrar till att öka förståelsen för lösningskvalitet och hur företag kan arbeta för att uppnå det.

Avhandlingens resultat visar att lösningskvalitet består av sju olika dimensioner: *tillförlitlighet*, *kommunicerbarhet*, *intern överensstämmelse*, *empati*, *nåbarhet*, *påtaglighet*, och *anpassningsbarhet*. Dessutom är *kunskap om processer* och *kundrelationer* två förutsättningar för att uppnå lösningskvalitet. Dimensionerna betraktas som riktmärken för lösningskvalitet som företag kan arbeta mot. Dimensionerna och förutsättningarna stötts i sin tur av åtgärder som används för att bidra till den interna förändringen inom företaget. Resultaten visar dock att använda åtgärder inte alltid leder till en förändring. Endast noga utvalda åtgärder som relaterar

till en specifik dimension möjliggör en förändring. Exempel på en möjlig åtgärd är kundinvolvering. Speciellt vid utveckling av helhetslösningar, betraktas kundinvolvering som en möjlig åtgärd för att stötta förutsättningarna till lösningskvalitet. Resultaten i den här avhandlingen bidrar huvudsakligen till en ökad kunskap om vad kvalitet är när det gäller helhetslösningar. Ytterligare ett bidrag är att föreslå kundens förändrade roll under utveckling och vid leverans av helhetslösningar för att uppnå lösningskvalitet.

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April, Linköping 2016

Elisabeth Johansson

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APPENDED PAPERS

This thesis includes a compilation summary and five appended papers.

- I Johansson, Elisabeth, Lars Witell, and Mattias Elg (2013), “Changing quality initiative – does the quality profile really change?,” *Total Quality Management & Business Excellence*, 24 (1-2), 79–90.
- II Johansson, Elisabeth, Lars Witell and Åsa Rönnbäck (2013), “Using interventions to change the quality profile of an organisation,” *International Journal of Quality and Service Sciences*, 5 (1), 32–45.
- III Johansson A. Elisabeth, Lars Witell, Ida Gremyr, and Mattias Elg (2016), “Understanding solution quality: prerequisites and dimensions,” *Submitted for publication*.
- IV Johansson, A. Elisabeth, Chris Raddats, and Lars Witell (2016), “The role of customer involvement for incremental and radical service innovation in manufacturers,” *Submitted for publication*.
- V Johansson, A. Elisabeth (2016), “Solution quality maturity,” *Working paper*.

CONTRIBUTIONS

- Paper I Johansson, Elisabeth, Lars Witell and Mattias Elg.
- Witell initiated the paper. Johansson was primarily responsible for data collection and data analysis. Johansson and Witell jointly wrote the paper. Elg reviewed the paper.
- Paper II Johansson, Elisabeth, Lars Witell and Åsa Rönnbäck
- Witell initiated the paper, Rönnbäck was responsible for data collection. Johansson, Witell and Rönnbäck jointly performed the data analysis and wrote the paper.
- Paper III Johansson, A. Elisabeth, Lars Witell, Ida Gremyr and Mattias Elg
- Johansson initiated the paper and drafted the theoretical perspective. Johansson took main responsibility for data collection, Gremyr and Witell participated. Johansson, Gremyr, Witell and Elg conducted the data analysis together. Johansson, Gremyr and Witell wrote the paper together and Elg reviewed the paper.
- Paper IV Johansson, A. Elisabeth, Chris Raddats and Lars Witell
- Johansson initiated the paper. Witell made the data collection. Johansson and Raddats drafted the theoretical perspective. Johansson took main responsibility for data analysis. Johansson and Raddats wrote the paper jointly. Witell reviewed the paper.
- Paper V Johansson, A. Elisabeth
- Johansson is the sole author.

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1 INTRODUCTION

Imagine that you stand at home in front of your malfunctioning heat system that supports three houses. The system is old, you have only recently moved into the house, it is very cold outside and the temperature inside decreases. You have tried all instructions in the manual and feel despair. Then your eye catches a sticker with a phone number of the company that delivered the heat system. You call the number; they are busy but will try to come within a few days.

After three days, a nice technician arrives. He opens the manual and searches for what button to press. Since you have spent several hours in front of the heating system, you have figured out how it works. So, you tell him what button to press and continue to show him how the pipeline system is built. By the time the technician has left, you are alone with no solution for the malfunctioning heat system or what to do next. Again, you stand in front of the heat system with an unpleasant feeling.

It is really cold outside.

The example illustrates the multitude of factors that influence a customer's perception of a service. In this case, it is an after-sales service added to the installed heater (product). In the example, several things went wrong. First, the technician had no knowledge about the heater or how to make it work again. Second, he did not know about the customer's total heating system. It was not enough for the service technician to be nice; as a customer you would probably be disappointed with the provided service and consider the quality to be low.

This example concerned the perceived quality of the provided after-sales service. Now consider that, as the owner of three houses, you have bought the solution; 20°C indoors in every room. This changes the rule of the game, and makes the interaction and provision different for both you and the firm. As a customer, your expectations of the firm and what makes you satisfied will be different. Changing from providing a product with an added service, to provide a solution comprising the integration of products and services changes (1) the perception of quality; and (2) how to work to develop and provide high quality solutions – and this is the starting point for this thesis.

1.1 Background

This thesis deals with the integration of products and services into solutions. Many manufacturers view this integration as an additional competitive advantage (Davies, Brady, and Hobday 2006; Eloranta and Turunen 2015; Lightfoot, Baines, and Smart 2013). In the example above, simply delivering a heater to the customer and then leaving is different compared to providing a constant temperature in every room and ensuring that this is provided over a period of several years. This implies the manufacturer to ensure that performed service actions and products fit the customer's internal activities (Gebauer 2007; Mathieu 2001). Since the solution is provided over several years and supports the customer's internal activities, customers expect the solution to provide more benefits than they can create themselves (Brax and Jonsson 2009). This involves a changed customer relationship (Windahl and Lakemond 2006) which requires the manufacturer to understand the customer's activities. From the manufacturer's perspective, this implies a tight customer relationship that can improve customer loyalty (Ferreira et al. 2013) but also challenges with new ways of working (Paiola et al. 2013) and increased customer knowledge (Windahl and Lakemond 2006).

As the manufacturer's traditional quality management activities are designed to improve internal activities to enable the quality of products and services (Llopis and José Tarí 2003), the manufacturer will have little or no experience regarding how to support the added services and new activities taking place in the customer's

processes. Therefore, important components, such as services, and activities of the solution that contribute to improving customers' perception find little support in the quality manual of the manufacturing firm. Consequently, there will be few guidelines on what activities to perform in the customer's processes of the solution provision.

For several decades now, researchers have studied how manufacturers and service firms can improve quality of products or services (Garvin 1984; Grönroos 1984; Parasuraman, Zeithaml, and Berry 1985). In particular, research on quality has focused on managing the firm's internal activities. For example, emphasis is placed on activities supporting products and services to meet customer needs (e.g., Dean and Bowen 1994; Gremyr and Elg 2014) and/or the interaction during the moment of exchange (e.g., Čater and Čater 2010; Lakhali and Pasin 2008; Wu et al. 2015). This is reflected in the interventions used to improve quality. An intervention is seen as activities that aim at introducing new ways of working through a series of practices and techniques (Assarlind et al. 2013; Dean and Bowen 1994; Done, Voss, and Rytter 2011; Hackman and Wageman 1995). These are supporting internal activities, while as support for activities taking place in the customer's processes is missing. Consequently, the manufacturer that provides solutions that support activities taking place in the customer's processes can learn little from the research on quality, especially when the manufacturer works to improve quality of the provided solution.

The increased attention towards solutions from research, combined with the fact that many manufacturing firms are struggling with providing solutions (Hakanen and Jaakkola 2012; Paiola et al. 2013), has meant that research on quality needs to increase knowledge of how to improve quality of solutions. In addition, solution quality as a concept has recently been introduced (Johansson 2013; Macdonald, Kleinaltenkamp, and Wilson 2016) and an increased understanding of what the concept comprises is needed.

1.2 Aim and research questions

This thesis aims to provide insights into how quality can be managed to improve the solution in a business-to-business setting. In particular, the focus is on solution quality, not only as an outcome, but also as a customer relational and dynamic process (Storbacka, Polsa, and Sääksjärvi 2011; Tuli, Kohli, and Bharadwaj 2007). In this thesis, the solution quality concept is recognised as a complex interplay of components supported by interventions. The solution is a concept in a dyad involving one provider and one customer. This view is consistent with the perspective that several factors and actors contribute to explaining and managing

quality (Golder, Mitra, and Moorman 2012). Therefore, the argument in this thesis is that, through interventions, understanding and supporting solution quality are vital for the success of a manufacturer's solution provision.

Knowledge of customer needs is regarded as a key source for manufacturers aiming to provide successful solutions (Hakanen and Jaakkola 2012). The contribution of the present thesis is not to recognise the customer as a passive source of information, but as a strategic component involved during solution development and provision. This thesis builds on and combines research on quality concepts (Garvin 1984; Golder, Mitra, and Moorman 2012), customer involvement during service and solution development, and servitization (Gebauer and Friedli 2005; Gremyr et al. 2014; Hakanen and Jaakkola 2012).

If solution quality is seen as a complex concept that is influenced by several factors and different actors, and combines it with the fact that scarce research exists about the concept, it becomes apparent that an increased understanding of quality in a solution is required. Therefore, the overall purpose of this thesis is *to increase knowledge about how to manage solution quality*.

The purpose is decomposed into three research questions. The first research question will investigate the concept of solution quality and describe the factors that influence this concept. Previous research on quality (in a manufacturing context) has touched on the subject of how quality of solutions can be explained (Johansson 2013; Macdonald, Kleinaltenkamp, and Wilson 2016). However, there is a need for a more thorough investigation to understand solution quality and its various components.

RQ1: How can solution quality be conceptualised?

The second research question is based on that the research on quality and solutions offers limited understanding of how a provider can internally manage quality of offerings such as solutions. Hackman and Wageman (1995) argued that interventions, such as education and cross-functional teams, support the provider during the management of quality. The provider faces challenges to provide solution quality, which can only be met if internal changes are made. Therefore, increased knowledge is required regarding how various interventions influence the provider's internal changes and management to improve solution quality.

RQ2: How can interventions influence the improvement of solution quality?

The third research question addresses the challenges of involving customers to improve solution quality. Prior research has argued that quality is managed through internal improvements (Dean and Bowen 1994), which leads to customer satisfaction and improved firm performance (Lakhal and Pasin 2008). However, the research on solutions emphasises the importance of using customers during the solution development in order to customise the solution provision (Hakanen and Jaakkola 2012). In addition, given that the research on quality provides limited understanding of how customer involvement can be used in the improvement of solution quality, additional research on customer involvement is required.

RQ3: How can customer involvement, as an intervention in the development of solutions, improve solution quality?

1.3 The linkage between purpose and appended papers

All of the appended papers contribute to the overall purpose and research questions; see Table 1. The papers are all based on empirical studies using quantitative and qualitative research strategies. Furthermore, each paper addresses one research question and contributes to the research on quality and servitization.

Table 1 The papers' contribution and linkage to research questions

Paper	Research field	Contribution to this thesis	Linkage to research question
I	Quality	Increases the understanding of how and if the quality principles evolve over time	RQ2
II	Quality	Shows the relation between interventions and quality principles and how interventions can change quality principles	RQ2
III	Quality, servitization	Increases the understanding of the solution quality concept by testing theoretically developed quality dimensions on empirical data	RQ1
IV	Servitization	Tests the effect of customer involvement during new service development in manufacturing firms	RQ3
V	Quality, servitization	Increases the understanding of the solution quality maturity over time	RQ1

1.4 Scope of the thesis

The emphasis in this thesis is on studying the solution quality concept from the provider's perspective in a business-to-business setting in which one provider and one customer are involved in a dyad. A provider could be either a manufacturing firm or a service firm in the dyad. Since the dyad includes one provider, the manufacturing firm takes the role as provider when solutions are discussed, thus a solution provider. If a service firm would provide the solution, a network of other actors contributing with components would be necessary.

The solution is framed within a dyadic relationship between the provider and the customer. As shown in Figure 1, the *dyad* consist of three 'spheres': (i) the *provider* sphere with the provider's internal activities; (ii) the *interaction* sphere, where the customer and the provider meet and interact; and (iii) the *customer* sphere, with the activities performed in the customer's processes (Grönroos and Voima 2013). When the provider, the interaction and the customer are discussed, the three spheres in the studied dyad are referred to.

Figure 1 The spheres in the studied dyad (adapted from Grönroos and Voima 2013)

This thesis uses the term *offering*. Whereas the terms product or service are more likely to be regarded as single unbundled resources, offering is perceived as being more inclusive. A market offering is a value-supporting process that includes goods, services and interactions between the provider and the customer (Grönroos 2008). The term offering refers to offering the customer something, but the customer decides how to perceive it. This corresponds to the idea that quality is perceived by the customer (Parasuraman, Zeithaml, and Berry 1985). Another reason for using this term is to reduce the discussion about products and services when this is not the intention. So, unless stated otherwise, the term offering covers products, services and solutions.

1.5 Structure of the thesis

This thesis is a compilation built on a compilation summary consisting of six chapters and five appended papers. The compilation summary serves several purposes. Most importantly, it combines the papers. The theoretical chapter is more extensive than the papers and contains a reflection of the research process.

The discussion is based on findings across the papers and the compilation summary provides more depth. The compilation summary is organised as follows.

Chapter 1 introduces the studied concepts and the theoretical field. It contains a problem description leading to the aim of the thesis and the research questions.

Chapter 2 presents the theoretical framework. It provides an overview of previous research related to the introduced concepts and constitutes a foundation of the thesis. The chapter concludes with a reflection on the relation between the described concepts and their further use in this thesis.

Chapter 3 describes the research design of the empirical studies. Five empirical studies are presented and reflected upon. The chapter concludes with an evaluation of the overall research process and empirical studies.

Chapter 4 summarises the five appended papers based on the empirical studies. Focus is on the findings related to the research questions stated in this thesis.

Chapter 5 discusses the results of the thesis in relation to existing theory. This chapter aims at answering the research questions and intends to extend the discussions in the appended papers.

Chapter 6 presents the conclusions and implications of the thesis. Furthermore, this chapter presents limitations of the thesis and provides suggestions of areas for future research.

2 THEORETICAL BACKGROUND

This chapter presents the most influential theoretical concepts and perspectives that frame this thesis. I start by describing the quality concept and traditional views of what quality is, before presenting the theoretical concept of solutions. The chapter concludes by relating the theoretical concepts to the studied dyad in this thesis.

2.1 Quality

The word *quality* originates from the Latin word *qualis*, which means ‘such as the thing really is’. The word is used regularly and products and services that are perceived as excellent are referred to as quality (Dale 2003). Although the word itself is familiar to most people, the concept of quality is complex (Karmarkar and Apte 2007) and, as Dale (2003, p. 4) described it, ‘quite difficult for people to understand, and confusion and myth surrounds it’.

The concept of quality has been important in many research fields, although with different emphasis. For instance, research in strategic management focuses on quality connected to managerial questions and change processes in an organisational context

(e.g., Almaraz 1994; Reger et al. 1994). The field of marketing emphasises the quality during interaction of the exchange between firms and customers and customer satisfaction and loyalty (e.g., Čater and Čater 2010; Fornell et al. 1996; Hennig-Thurau 2000). In operations management, the emphasis is on the influence from internal quality practices on firm performance (e.g., Flynn, Schroeder, and Sakakibara 1994; Kaynak 2003; Nair 2006). Despite this difference regarding emphasis across research fields, there are also variations in emphasis within research fields (e.g., Golder, Mitra, and Moorman 2012).

2.1.1 A framework of quality concepts

The diversity of emphasis across research fields contributes to increased knowledge, but it also leads to a diversity of approaches concerning the quality concept (Reeves and Bednar 1994). Garvin (1984) presented five quality approaches intended to cover the diverse emphasis in the different research fields:

- i. The user-based approach. Quality lies in the eyes of the beholder. Individual consumers are assumed to have different wants or needs, and the resources that best satisfy the consumers preferences are those that are regarded as having the highest quality. (Marketing)
- ii. The manufacturing-based approach. Focuses on the supplier, primarily with engineering and manufacturing practice. Almost all manufacturing-based definitions regard quality as meeting requirements. (Strategic management, operations management)
- iii. The product-based approach. Quality is viewed as a precise and measurable variable. This approach lends a vertical or hierarchical dimension to quality. Resources can be ranked according to the amount of the desired attribute they possess. (Economics, operations management)
- iv. The transcendent approach. Proponents of this view claim that quality cannot be defined precisely; quality is a simple, unanalysable property that we learn to recognise only through experience. It borrows greatly from Plato's discussion of beauty in the Symposium. (Common definition in philosophy)
- v. The value-based approach. Quality is defined in terms of costs and prices. According to this view, a quality resource is one that provides performance at an acceptable price or conformance at an acceptable cost. (Economics)

These different approaches show the variety among the views of the quality concept. This is no disadvantage, contradictory all approaches are needed to embrace this complex multifaceted concept (Garvin 1988). The various views of quality also

imply the need to be specific and clear during operationalisation. For example, taking a transcendent approach is unsuitable when determining the characteristics of a product.

Based on the presentation above and in line with the studied dyad, the *user-based*, *manufacturing-based* and *product-based* approaches of quality are used in this thesis. These three approaches can be placed in the provider's sphere, the customer's sphere, and/or in the sphere of interaction. I have excluded the value-based approach, with research that emphasise the unobserved quality related to pricing (e.g., Kirmani and Rao 2000; Phillips and Sertsios 2013), and the transcendent approach, which argues that quality is recognised only through experience and evaluated with abstract terms in fields such as music and art (Reeves and Bednar 1994). These two approaches are either too vague or their emphasis is beyond the scope of this thesis, and are therefore not further used when quality is demarcated.

It is challenging to define quality as an all-including concept that covers the three selected quality approaches. Common quality definitions fall under one quality approach. For instance, defining quality as '*fitness for use*' (Juran 2000, p. 2.2) adheres to the user-based approach. The definition '*The quality of a product is its ability to satisfy, or preferably exceed, the needs and expectations of the customers*' (Bergman and Klefsjö 2010, p. 23) follows the same approach. On the other hand, Crosby's definition of quality as '*conformance to requirements*' (Crosby 1979, p. 15) adopts the manufacturing-based approach. These definitions are abstract and hard to operationalise. They tend to simplify a complicated concept and are therefore not used in this thesis.

However, in thesis quality is understood through quality categories that provide the content in the chosen quality approaches; see Figure 2. These quality categories are product quality, service quality, e-service quality, relationship quality and communication quality. When investigating the quality categories, a number of dimensions related to each of them are identified (Garvin 1984; Santos 2003). Several dimensions involve measureable product attributes, others have individual preferences, some are objective and timeless, while others are dynamic. The quality dimensions are regarded as guiding principles when improving the quality category (Garvin 1987) and the diversity of these dimensions helps to evaluate the quality category. Thus, when each quality dimension is considered separately, conflicts concerning different views of quality can be avoided (Garvin 1988). In turn, internal management improvement programmes contribute with interventions and practices to support the improvement of each quality category (Llopis and José Tarí 2003).

Quality approaches	<ul style="list-style-type: none"> • Product-based • Manufacturing-based • User-based 				
Quality categories	Product quality <ul style="list-style-type: none"> • Performance • Features • Reliability • Conformance • Durability • Serviceability • Aesthetics • Perceived quality 	Service quality <ul style="list-style-type: none"> • Reliability • Empathy • Tangibility • Responsiveness • Assurance 	E-service quality <ul style="list-style-type: none"> • Reliability/Fulfilment • Responsiveness • Ease of use/Usability, • Privacy/Security • Web design • Information quality/Content 	Relationship quality <ul style="list-style-type: none"> • Cooperation • Adaption • Atmosphere • Satisfaction • Trust • Loyalty • Commitment 	Communication quality <ul style="list-style-type: none"> • Usefulness of feedback • Frequency • Formality • Knowledge of important criteria • Information accuracy
Quality management improvement programmes	<div style="text-align: center;"> Interventions <div style="display: inline-block; vertical-align: middle;"> <div style="display: inline-block; vertical-align: middle;"> → Practices → Techniques </div> <div style="display: inline-block; vertical-align: middle; font-size: 2em;">}</div> <div style="display: inline-block; vertical-align: middle;">→ Principles</div> </div> </div>				

Figure 2 A framework of quality concepts

Quality management improvement programmes such as Total Quality Management, Lean Production and Six Sigma provide a platform for the quality categories. These improvement programmes emphasise different interventions, that are seen as activities aiming at introducing new ways of working through a set of practices and techniques; for instance, control charts and Pareto-analysis (Assarilind et al. 2013; Dean and Bowen 1994; Hackman and Wageman 1995; Llopis and José Tarí 2003). In the present thesis, the interventions steer the practices and techniques that, in turn, influence a change in the principle being emphasised. The principles are seen as essential characteristics of quality management and include, for example, process orientation and employee orientation. These are indirectly supported by the interventions. In this thesis, the interventions can either be encompassed by a quality management improvement programme or used independently.

2.1.2 Quality categories

The five central theoretical quality categories related to this thesis studied dyad are product quality (which many researchers refer to as quality), service quality, e-service quality, relationship quality, and communication quality.¹ All five of these presented categories are included in a research discussion that is in line with the research interest of this thesis.

¹ There are many other quality categories in relation to the studied dyad. However, the excluded categories are either too narrow (such as decision quality) or too similar to the above-mentioned categories (such as retail service quality).

Product quality

Although product quality is the quality category that most people can relate to in everyday life, this category has many definitions. Different research fields use slightly different meanings for product quality. Lin and Lu (2006) viewed product quality as the number of problems per resource, while Berry and Waldfogel (2010) considered it to be cost-based, where higher quality increases cost. However, the definition of product quality as *‘a perceived fundamental characteristic of products that meet or exceed customer expectations regarding features and performance’* (Calantone and Knight 2000, p. 495) corresponds to the approaches of quality used in the present thesis. The different meanings of product quality show the diversity of approaches used to understand and explain this quality category.

Garvin (1987) included all five quality approaches with his presentation of eight dimensions that build product quality: (i) performance, (ii) features, (iii) reliability, (iv) conformance, (v) durability, (vi) serviceability, (vii) aesthetics and (viii) perceived quality. Sebastianelli and Tamimi (2002) tested the relation between the product quality dimensions and approaches of quality. They concluded that the transcendent approach was connected with two dimensions (conformance and aesthetics). The product-based, user-based and manufacturing-based quality approaches were connected to one dimension each (performance, perceived quality and conformance, respectively). Two of the product quality dimensions did not relate to any quality approach (features and serviceability). Like Sebastianelli and Tamimi (2002), many other studies on product quality have built on or used Garvin’s dimensions (e.g., Agus 2005; Ahire, Golhar, and Waller 1996; Lakhali and Pasin 2008). Similarly, the product quality dimensions are viewed in this thesis as founding the product quality category.

A popular use of the product quality category is to use quantitative studies to test its influence on firm performance or market positioning, (e.g., Agus 2005; Calantone and Knight 2000; Morgan and Vorhies 2001). Those studies defined product quality through measured items building the category. Furthermore, product quality is seen as one of several factors that contribute to increased firm performance (Zhou et al. 2008). In addition, product quality is often merged with quality management and described as one of the drivers for the implementation of quality management (Llopis and José Tarí 2003). However, some studies have investigated product quality as the outcome and it is then the central category (e.g., Ahire, Golhar, and Waller 1996; Jacobson and Aaker 1987).

The presented research on product quality is related to two spheres of the dyad in this thesis: the provider’s sphere with its internal activities, and the sphere of

interaction. For example, the quality dimensions can be guided by interventions to improve product quality and are related to the activities that take place in the provider's sphere. On the other hand, the studies that relate product quality to customer satisfaction and loyalty are connected to the sphere of interaction.

Service quality

Service quality has been the subject of mainly marketing research since the 1980s. The service quality category started to attract research interest because of the difficulty of evaluating the provided service with product quality dimensions (Grönroos 1984; Parasuraman, Zeithaml, and Berry 1985). Compared to the product quality category, only a few definitions of service quality are commonly used. Parasuraman, Zeithaml, and Berry (1988) presented the most common definition of service quality, as *'perceived by customers stems from a comparison of their expectations or desires from the service provider with their perceptions of the actual service performance'* (Parasuraman, Zeithaml, and Berry 1988, p. 5). Together, this definition and the quality dimensions build the service quality gap model (SERVQUAL). The five service quality dimensions – reliability, empathy, tangibility, responsiveness and assurance – are measured during the interaction of exchange. The model is used to measure the gap between the customers' expectation and the provided service performance.

A competing definition of service quality that builds on the gap between expected service and perceived service is the Nordic model presented by Grönroos in 1984 (Brady and Cronin 2001). Grönroos (1984) built the model on the technical and functional quality dimensions. Technical quality regards the 'what' of the service and corresponds to the service outcome and performance. The customer can measure this dimension in an objective manner since it concerns the perception of the service outcome. In addition, the customer is interested in the process of the service; that is, the functional quality. Both dimensions influence the service quality perception. The image of the service firm also impacts the customer's service perception (Grönroos 1984). A service firm with a good reputation will increase a customer's expectation regarding the service provision. This has a positive influence on customer satisfaction (Anderson, Fornell, and Lehmann 1994; Fornell et al. 1996).

The model that Grönroos (1984) presented has a clear point, with technical and functional quality leading to the customer's service quality perception. However, the dimensions are abstract and simplifies an otherwise multi-dimensional quality category. In addition, the more detailed level of the quality dimensions presented by Parasuraman, Zeithaml, and Berry (1988) are in line with the chosen product quality dimensions. Therefore, in the present thesis, service quality is built on the five quality

dimensions – reliability, empathy, tangibility, responsiveness and assurance – that are managed internally within the provider’s sphere and during the interaction.

Research into service quality covers a variety of service contexts, including restaurants, bank call centres, and insurance companies in a consumer setting (e.g., Brady and Cronin 2001; Malhotra and Mukherjee 2004). The studies are based on service firms, a few of which are in a business-to-business setting (e.g., Ho, Sharma, and Hosie 2015; Jayawardhena 2010) and others in a business-to-consumer setting, where services have been seen as being produced and consumed simultaneously (Grönroos 1979; Parasuraman, Zeithaml, and Berry 1985; Santos 2002).

Service quality research regards two of the three spheres in the studied dyad: the provider’s sphere and the sphere of interaction. The first sphere is related to the use of internal activities in the provider’s sphere that influence the improvement of the customer’s service perception (e.g., Calabrese 2012; Edvardsson, Larsson, and Setterlind 1997; Gustafsson, Nilsson, and Johnson 2003). These internal activities can be regarded as prerequisites for the coherence of the service outcome with customer expectations (Edvardsson and Olsson 1996), which in turn influences customer satisfaction and business performance (Gustafsson, Nilsson, and Johnson 2003). The second sphere is the sphere of interaction that takes place during the moment of exchange (e.g., Crane and Clarke 1988; Wu et al. 2015). Wu et al. (2015) argued that frontline employees’ service competences influence customers’ perceptions of service quality. The study showed that frontline employees’ professional service competences have a significant influence on reliability, whereas their social competences influenced the service quality dimensions of empathy and responsiveness (Brady and Cronin 2001; Wu et al. 2015). This shows that both the service process and service output are important during interaction of exchange.

E-service quality

E-service quality is generally researched in a business-to-consumer setting due to its relation to the online channel (Internet), where firms reach many consumers. This online channel enables consumers to compare prices and technical features more easily than through traditional offline channels, such as shops (Santos 2003). Therefore, e-service quality is associated with online purchasing and is defined as ‘*the extent to which a website facilitates efficient and effective shopping, purchasing and delivery when the consumer uses a firm’s website for purchasing*’ (Zeithaml 2002, p. 122). The focus for e-service quality is the moment of purchase and the contribution of the website design to the customers’ quality perception (Udo, Bagchi, and Kirs 2010; Valtakoski, Peltonen, and Laine 2010; Zeithaml, Parasuraman, and Malhotra 2002).

Studies of e-service quality have been influenced by the fact that consumers evaluate the service process and service outcome at the same time (Santos 2003). Thus, studies concern the outcome of the service and how the website design influence customer satisfaction and loyalty (e.g., Ribbink et al. 2004; Yen and Lu 2008). Most of the dimensions used in e-service quality are based on the service quality dimensions (Santos 2003). This is visualised both through the quality dimensions presented by Zeithaml, Parasuraman, and Malhotra (2002) and through the six dimensions that Ladhari (2010) identified in his literature review: (i) reliability/fulfilment, (ii) responsiveness, (iii) ease of use/usability, (iv) privacy/security, (v) web design, and (vi) information quality/content.

Research into e-service quality has helped increase our knowledge of the customers' perceptions of the e-service during purchase. Therefore, e-service quality regards the sphere of interaction in the dyad.

Relationship quality

Relationship quality is most commonly researched in a business-to-business setting. In this setting, relationships are characterised as long-term, comprising dimensions such as trust, loyalty and commitment that evolve over time (Reinartz, Krafft, and Hoyer 2004; Vandermerwe 1994; Woo and Ennew 2004). Additional dimensions used to build relationship quality include cooperation, adaption, atmosphere and satisfaction (Rauyruen and Miller 2007). The perspective comprising these dimensions regards relationship quality as an outcome of the influencing factors (Čater and Čater 2010). Kumar, Scheer, and Steenkamp (1995), on the other hand, argued that relationship quality is the source that leads to increased trust and commitment and causes fewer conflicts. This perspective has a process view, which implies relationship quality to lead to important factors for a sustaining relationship (Vandermerwe 1994). Holmlund (2008, p. 35) defined relationship quality with a process view as '*the joint cognitive evaluation of business interactions by significant individuals in both firms in the dyad. The evaluation encompasses a comparison of experienced with desired, potential, usual or previous interactions which constitute comparison standards*'.

In the present thesis, the relationship is regarded as an important factor that influences the activities that take place in the sphere of interaction. As the solution is provided over several years and includes a dynamic customer relationship (Macdonald et al. 2011), the perspective that relationship quality is a dynamic process is applied.

Relationship quality is similar to the research into relationship value. For example, Gil-Saura, Frassetto-Deltoro, and Cervera-Taulet (2009) argued that relationship value is a construct that helps generate trust, commitment and satisfaction. Furthermore, Jalkala and Keränen (2014) defined relationship value as a subjective, multidimensional construct conceived as a trade-off between benefits and sacrifices, where perceptions are relative and evolve over time. Additional studies about relationship value include Ravald and Grönroos (1996), Ulaga (2003) and Ulaga and Eggert (2005).

Communication quality

Communication quality is associated with how information is delivered and received. Research into this quality category is conducted in many settings, from internal communication between employees or functional departments to communication during purchase by end consumers (e.g., Mohr and Sohi 1995; Prahinski and Fan 2007; Schetzle and Delpechitre 2014). The common denominator is the interaction between the two parties under study. Communication quality is described with dimensions such as frequency, utility of feedback, knowledge of important criteria, formality, and information accuracy (Mohr and Sohi 1995; Prahinski and Fan 2007; Schetzle and Delpechitre 2014). Schetzle and Delpechitre (2014) argued that a manager's communication quality influenced the relation between the frontline employees' social interaction and willingness to cooperate with the manager. Furthermore, in a business-to-business setting, communication quality is seen as influencing a supplier's commitment to paying customers and increase the chances of the supplier's loyalty and retention (Prahinski and Fan 2007). Mohr and Sohi (1995, p. 396) defined communication quality as '*a function of the completeness, credibility, accuracy, timeliness and adequacy of communication flows*'.

The communication quality category corresponds well with the important activity of information sharing between provider and customer. Hakanen and Jaakkola (2012) made this exact point, arguing that the communication and information sharing are important factors during the solution development that contributes to a well-adapted and customised solution. Based on the fact that both the provider and customer are involved, communication quality contributes to the sphere of interaction in the dyad.

Quality category definitions and contributed spheres in the studied dyad

Gathering and summarising the presented quality categories shows that two of the three spheres of the studied dyad are supported; see Table 2. The support consists of the guidelines that each quality category receives from its underlying quality dimensions and previous research. The two supported spheres are the provider's and

the interaction sphere. The former is supported by the quality categories, product quality and service quality. The latter is supported by all of the presented quality categories. Neither quality category discuss quality in the customer's sphere. To conclude, previous research on the quality categories has provided knowledge of quality related to the provider's sphere and the sphere of interaction. This implies that there is less support regarding how to manage quality within the customer's sphere.

Table 2 *Definitions of quality concepts and spheres of interest*

Quality category	Sphere of interest	Definition
Product quality	Provider/ interaction	<i>'Quality a perceived fundamental characteristic of products that meet or exceed customer expectations regarding features and performance' (Calantone and Knight 2000, p. 495)</i>
Service quality	Provider/ interaction	<i>'Service quality as perceived by customers stems from a comparison of their expectations or desires from the service provider with their perceptions of the actual service performance' (Parasuraman, Zeithaml, and Berry 1988, p. 5)</i>
E-service quality	Interaction	<i>'E-service quality is the extent to which a web site facilitates efficient and effective shopping purchasing and delivery' (Zeithaml 2002, p. 122)</i>
Relationship quality	Interaction	<i>'Relationship quality is the joint cognitive evaluation of business interactions by significant individuals in both firms in the dyad. The evaluation encompasses a comparison of experienced with desired, potential, usual or previous interactions which constitute comparison standards' (Holmlund 2008, p. 35)</i>
Communication quality	Interaction	<i>'Communication quality is defined as a function of the completeness, credibility, accuracy, timeliness and adequacy of communication flows' (Mohr and Sohi 1995, p. 396)</i>

2.1.3 *Quality management improvement programmes*

Quality management improvement programmes can be traced back to the late 1800s, starting with engineers who wanted to produce saleable and working products (Godfrey 1999). The evolution of quality management started with formal inspection of produced products. It continued during the 1900s by using statistical quality control, quality assurance and total quality control (Feigenbaum 1983; Shewhart 1931). By the late 1900s and early 2000s, quality management had developed into various improvement programmes, such as Strategic and Total Quality Management and Lean Production (Dale 2003; Garvin 1988; Hines, Holweg, and Rich 2004). During this evolution, quality management has changed from being reactive and including control-focused tools to being more active, using practices, techniques and strategies, involving people from the entire firm. This enriches quality management with different quality approaches and enables the improvement of quality categories (Garvin 1988).

Many researchers regard quality management as improving internal activities, as illustrated by the following definition by Oakland (1995):

Quality management is an approach to improving the effectiveness and flexibility of providers as a whole. It is essentially a way of organizing and involving the whole organization; every department, every activity, every single person at every level. For an organization to be truly effective, each part of it must work properly together, recognizing that every person and every activity affects and in turn is affected by, others.

(Oakland 1995, p.16)

In the above definition, all levels of the organisation are present. All activities within the firm should work together and everyone should participate. However, one point where this definition fails is that it does not include the customer. Customer orientation is otherwise often seen as a base driver for quality management (Evans 2008; Hackman and Wageman 1995; Winter 2000). Dean and Bowen (1994) defined quality management as follows:

We see total quality [quality management in this thesis] as a philosophy or an approach to management that can be characterised by its, principles, practices and techniques.

(Dean and Bowen 1994, p. 394)

The above definition describes quality management as an approach for management that is characterised by principles, practices and techniques, which can

be adapted to diverse contexts with different prerequisites. This makes the definition useful for the present thesis – with just one change: the practices and techniques are steered by interventions (Hackman and Wageman 1995).

Interventions and principles

Quality management can be characterised by its interventions and principles; this is a common way to operationalise the quality management. In the definition of quality management stated by Dean and Bowen (1994), each principle is supported by a set of practices and techniques. In this thesis, the practices and techniques are steered by interventions used to improve a principle (Hackman and Wageman 1995); see Figure 3. Interventions are seen as activities that aim at introducing new ways of working through a series of practices (activities such as analysing processes or collecting customer information) and techniques, such as step-by-step methods (Assarlind et al. 2013; Dean and Bowen 1994; Done, Voss, and Rytter 2011). Therefore, interventions are used to realise a change in a principle. For example, the intervention employee education comprises a set of underlying practices and techniques that influence the principle employee orientation. In other words, the chosen intervention will determine what practices and techniques to use.

Figure 3 The relation between interventions and principles

A principle can be seen as an essential characteristic of quality management, for example, process orientation or employee orientation. Which principles are emphasised depends on the researcher, the improvement programme and the context. However, the most-used principles are process orientation, employee orientation, management commitment, customer orientation and continuous improvement (Dale 2003; Sila and Ebrahimpour 2002; Sousa and Voss 2002). In the present thesis, these five principles build quality management; see Table 3. Other researchers might have named them differently or used other principles to build quality management.

Table 3 Definitions of quality principles

Principle	Definition
Customer orientation	<i>‘The goal of satisfying customers is fundamental to Total Quality and is expressed by the organisation's attempt to design and deliver products and services that fulfil customer needs’ (Dean and Bowen 1994, p. 394)</i>
Process orientation	<i>‘The central problem of management in all aspects...is to understand better the meaning of variation, and to extract the information contained in variation’ (Deming 1989, p. 20)</i>
Employee orientation	<i>‘Employees must be recognised for their contribution and should feel that they are part of the organisation’ (Tsang and Antony 2001, p. 133)</i>
Management commitment	<i>‘Management committed to quality must convey the philosophy that quality will receive a higher priority over cost or schedule, and that in the long run, superior and consistent quality will lead to improvements in cost and delivery performance’ (Ahire, Golhar, and Waller 1996, p. 27)</i>
Continuous improvement	<i>‘Continuous improvement, means commitment to constant examination of technical and administrative processes in search of better methods.’ (Dean and Bowen 1994, p. 395)</i>

In a business context, the role of quality management has been debated extensively. Many studies have tested the relationship between implementing quality management and firm performance (e.g., Anderson, Fornell, and Lehmann 1994; Baird, Hu, and Reeve 2011; Gustafsson, Nilsson, and Johnson 2003; Lemak, Reed, and Satish 1997; Nilsson, Johnson, and Gustafsson 2001; O’Neill, Sohal, and Teng 2016). Although the results are contradictory, most studies show a positive relation between quality management and the performance of a firm. These results indicate that the implementation of quality management leads to a competitive advantage and an increased business performance (Kaynak 2003; Nair 2006).

The above description of quality management regards two spheres of the studied dyad in this thesis: the provider’s sphere and the sphere of interaction. The support for these both spheres is comprised of interventions that are connected to the activities taking place in the providers’ sphere to improve principles and research on the relation between quality management and customer satisfaction.

Customer orientation

While all five principles are important and contribute to quality management, customer orientation has been identified as one of the most central (Ahire and O'Shaughnessy 1998; Deming 1989; van der Wiele and Brown 2002). This is also apparent in books covering the research on quality management, most of which address customer orientation early on, or at least emphasise the importance of customers (Bergman and Klefsjö 2010; Deming 1989; Evans 2008; Feigenbaum 1983; Juran 1988). This point was also recognised by Sila and Ebrahimpour (2002), who argued that customer orientation is the most referred principle building quality management (Sousa and Voss 2002). This central principle of quality management obliges firms to take care of customer requirements and specifications (Dean and Bowen 1994; Sila and Ebrahimpour 2002).

Although the customer is seen as a central element and the reason for a firm's existence (Evans 2008; Godfrey 1999), explanations of what comprise customer orientation are seldom expressed (e.g., Anderson, Rungtusanatham, and Schroeder 1994; Black and Porter 1996; Sila and Ebrahimpour 2002) and often result in meeting customer needs and specifications (e.g., Dale 2003; Feigenbaum 1983; Winter 2000). Furthermore, books on quality management have devoted a surprisingly small amount of attention to customer orientation and the external activities that follow it, compared to the attention devoted to internal quality activities (e.g., Deming 1989; Evans 2008; Juran 2000). Ahire, Golhar, and Waller (1996) is one study that assessed customer orientation. Those authors argued that customer orientation is measured by the frequency and rigour of customer satisfaction surveys and the use of customer complaints and feedback. This information is used to improve product quality. Consequently, the customer is seen as a passive source of information, and reactive methods such as surveys, customer complaints and feedback are used to specify customer requirements.

Despite the scarcity of in-depth descriptions of customer orientation, some thorough investigations have been conducted. For example, Godfrey (1999) argued that during the early stages of new product development the focus lies on basic terms related to the ability of providing the product. Interventions supporting internal practices and techniques are used for this. Unfortunately, many firms do not proceed with this first stage towards the second and gather customer requirements (Godfrey 1999). Therefore, the biggest challenge lies in linking the activities supporting product characteristics with customer requirements. Hence, the internal orientation and internal practices and techniques supporting the offering is stronger than the orientation towards meeting customer requirements (Godfrey 1999).

Customer orientation can be further separated into internal and external customers (Hackman and Wageman 1995; Juran 1988; Motwani 2001; Winter 2000). The former refers to the next activity taking place in the process within the provider's sphere. These customers want consistent components at the right time and reliable deliveries (Motwani 2001). External customers are regarded as those customers outside the provider's sphere. They expect correct information, fast responsiveness to complaints, and offerings that fulfil specifications (Motwani 2001). A firm should meet requirements from both internal and external customers. However, when customers are discussed in this thesis, the external customer corresponds to the customer's sphere in the studied dyad. Therefore, the external customer is the customer type referred to in this thesis.

To conclude, although customer orientation is an emphasised principle of quality management, research on quality uses the customer as a passive source of information (Lagrosen and Lagrosen 2009). This results in interventions supporting internal activities to meet customer requirements. Consequently, research on quality management relates to and provides knowledge of supporting activities within the provider's sphere and the sphere of interaction.

2.2 Solutions

The manufacturers' provision of services and the combining of products and services into solutions are not new phenomena (Schmenner 2009). But methods used within the solutions research are generally case studies and conceptual articles that are typical of an emerging research field (Edmondson and Mcmanus 2007). Research focus is placed on how firms develop their offerings from products (e.g., Davies, Brady, and Hobday 2006; Matthyssens and Vandenbempt 2008; Paiola et al. 2013) or services in order to integrate these components into value-added solutions, and discussions about the content of the solution concept (Nordin and Kowalkowski 2010; Storbacka 2011; Windahl and Lakemond 2010).

2.2.1 *Solution definitions and perspectives*

A solution should comprise products and services (Artto, Valtakoski, and Kärki 2015; Davies and Brady 2000; Epp and Price 2011; Foote et al. 2001; Tuli, Kohli, and Bharadwaj 2007; Wise and Baumgartner 1999), integrated to provide better customer outcomes than the sum of the individual components (Nordin and Kowalkowski 2010; Sahwney 2006). In this thesis, the term *solutions*² encompasses other terms that have similar meanings, such as hybrid offerings, integrated offerings, (total) customer solutions, and integrated solutions (Biggemann et al. 2013; Brady, Davies, and Gann

² *Solutions* and *solution* are used interchangeably in this thesis.

2005; Brax and Jonsson 2009; Sahwney 2006; Ulaga and Reinartz 2011; Windahl and Lakemond 2006). These terms represent key attributes of the solution. For instance, solutions are seen as products and services that are *integrated (hybrid)* to address a customer's specific business or operational activities (e.g., Brady, Davies, and Gann 2005). The integration of components into solutions increases the complexity of the provided offering, which makes it harder for competitors to replicate (Tuli, Kohli, and Bharadwaj 2007; Ulaga and Reinartz 2011). The term *customer*, often combined with solutions, implies that the customer is important and solutions are often described as customised (e.g., Davies 2004; Miller et al. 2002). Hence, the solution is often designed to take over some of the customer's internal activities and generated to support the customer's daily activities (Brax and Jonsson 2009; Storbacka et al. 2013).

Tuli, Kohli, and Bharadwaj (2007) argued for the existence of separate views of solutions; the product-centric view and the customer-centric view. Along with the provider-centric view, a solution is seen as bundled products and services that are customised in line with customer needs. The latter view is the customer's perspective. This view regards the solution as a customer–supplier relational process comprised of (i) the customer requirement's definition; (ii) customisation and integration of products and services; and (iii) the provider's deployment and post-deployment customer support (Tuli, Kohli, and Bharadwaj 2007). This implies that a solution provider should have knowledge about the activities taking place in the customer's sphere, and such knowledge can be obtained through a close customer relationship (Nordin et al. 2011; Storbacka and Pennanen 2014).

The solution is often regarded as comprising the integration of products and services including a relational aspect; see Table 4. As for the names of the concept, commonly used terms when defining solutions include *integration* or *combination* of products and services, together with *customer* or *customised*.

Table 4 Definitions of the solution concept and identified perspectives

Perspective	Definition
Provider's perspective	<p><i>'In all sorts of industries...they are creating high-value solutions by integrating various products and services.'</i> (Foote et al. 2001, p. 84)</p> <p><i>'Hybrid offerings are products and services combined into innovative offerings.'</i> (Ulaga and Reinarts 2011, p. 5)</p> <p><i>'...firms offer solutions that are unique, are based on complex systems with multiple technologies, and integrated from multiple subcontractors' offerings'</i> (Artto et al. 2015, p. 71)</p>
Provider's perspective including the customer	<p><i>'The provision of products and services together as "integrated solutions" that address customer needs.'</i> (Davies 2004, p. 732)</p> <p><i>'The PSS [Product-service-system]³ solution is similar to the ISO definition of the term product, i.e. can include both physical parts and services, or at the extreme (depending on customer demand of function) only one of these.'</i> (Isaksson, Larsson, and Öhrwall-Rönnbäck 2009, p. 330)</p>
Increased value experienced by the customer	<p><i>'I define a solution as an integrated combination of products and services customised for a set of customers to achieve better outcomes than the sum of the individual components.'</i> (Sawhney 2006, p. 369)</p> <p><i>'Thus, it is not the bundling of offerings per se that characterises solutions; integration needs to deliver better customer outcomes than the sum of the individual components.'</i> (Nordin and Kowalkowski 2010, p. 454; Hakanen and Jaakkola 2012, p. 594)</p> <p><i>'A solution is seen as a set of customer-supplier relational processes comprising (1) customer requirements definition, (2) customisation and integration of goods and/or services and (3) their deployment, and (4) post-deployment customer support, all of which are aimed at meeting customers' business needs.'</i> (Tuli et al. 2007, p. 5)</p> <p><i>'...longitudinal relational processes, during which a solution provider integrates goods, services and knowledge components into unique combinations that solve strategically important customer specific problems, and is compensated on the basis of the customer's value-in-use.'</i> (Storbacka 2011, p. 699)</p>

³ This is a full research field covering the products entire life cycle, including remanufacturing and environmental effect. This field is beyond the scope of this thesis and is therefore not managed here.

Three perspectives can be recognised from the presented solution definitions. The first perspective takes the provider's view that solutions are a bundle of products and services (e.g., Foote et al. 2001; Ulaga and Reinartz 2011). The second perspective defines solutions from a providers' perspective but includes the customer. With this provider perspective, *customised* means a specific configuration of products and services that meet customer needs (e.g., Davies 2004; Isaksson, Larsson, and Öhrwall-Rönnbäck 2009). The third perspective either addresses the customer relational process during solution provision or the increased value provided with the solution. Hakanen and Jaakkola (2012), Nordin and Kowalkowski (2010) and Sahwney (2006) adopted the third perspective, with the solution being intended to '*deliver better customer outcomes than the sum of the individual components*' (Hakanen and Jaakkola 2012, p. 549; Nordin and Kowalkowski 2010, p. 454). This highlights the increased value experienced by the customer during the solution provision. Hence, the solution needs to provide more value than just the combination of products and services. Two definitions that adopt this last perspective differ from the others: Storbacka (2011) and Tuli, Kohli, and Bharadwaj (2007). These definitions add the customer relationship throughout the entire solution provision. Tuli, Kohli, and Bharadwaj (2007) defined solutions both as an outcome comprising integrated products and services meeting customer requirements, and as a relational process through deployment and post-deployment customer support. Storbacka's (2011) definition was narrower, arguing that a solution should solve important customer problems on the basis of the customer's internal activities.

Evanschitzky, Wangenheim, and Woisetschlager (2011) argued for a similar definition to Tuli, Kohli, and Bharadwaj (2007), but they separated solutions from solutions selling. Solutions are connected to the outcome of the integrated products and services adapted to customer problems. This should provide additional value for the customer than the sum of the individual components (Sahwney 2006). Solutions selling is the relational process that comprises the determination of the customer requirements, customisation and integration of products and services, their deployment and post-deployment customer support (Storbacka, Polsa, and Sääksjärvi 2011; Tuli, Kohli, and Bharadwaj 2007).

Of the definitions presented above, Tuli, Kohli, and Bharadwaj's (2007) corresponds most closely with the view of solutions adopted in the present thesis. Their definition covers both the integration of products and services, and it has an extensive view on customisation and the relational process during the provision of the solution. The solution embraces all three spheres of the dyad studied herein; that is, the provider's sphere, the interaction sphere and the customer's sphere.

2.2.2 *Becoming solution providers*

Manufacturers have shifted away from product offerings consisting of products with add-on services, and toward offering services as core activities that support activities taking place in the customer's sphere (Mathieu 2001; Oliva and Kallenberg 2003; Paiola et al. 2013). The research that comprise this phenomenon has been described as: manufacturing firms' service orientation (Bowen, Siehl, and Schneider 1989), servitization (Vandermerwe and Rada 1988), service transition (Oliva and Kallenberg 2003), service infusion (Kowalkowski, Witell, and Gustafsson 2013), and service strategies in manufacturing (Gebauer et al. 2012). This phenomenon is referred to in the present thesis as servitization. The major driver for servitization is typically the increased firm performance and competitiveness on a global market (Eloranta and Turunen 2015; Lightfoot, Baines, and Smart 2013; Vandermerwe and Rada 1988). Until recently, researchers have argued that the larger the service portfolio, the better the result (Fang, Palmatier, and Steenkamp 2008). However, Kowalkowski et al. (2015) and Fundin, Witell, and Gebauer (2012) argued that positioning on the goods-to-services continuum should suit the particular market and firm's strategy.

The research on solutions has mainly focused on internal support for providing solutions. Storbacka (2011) presented three challenges: industrialisation, commercialisation and solution platform. Industrialisation concerns the internal aspects and capabilities that support the solution development. Commercialisation refers to the firm's ability to understand the customers' value-creating activities. When the provider understand the activities and value created during usage, the solution development process can be managed to enable improved value for the customer (Grönroos and Voima 2013; Storbacka 2011). Thereafter, the solution platform enables the solution provision, with support from capabilities. This view is in line with how Davies, Brady, and Hobday (2006) and Paiola et al. (2013) viewed organisational managing. They argued that the provider's sphere, consisting of practices and interventions, supports the integration of services and products and the provision of solutions. Paiola et al. (2013) referred to this as capabilities that vary with the complexity of the provided solution. That is, after-sales services require support from internal capabilities. In addition, the provision of solutions requires external development of capabilities that are related to the activities taking place in the customer's sphere (Paiola et al. 2013; Storbacka and Pennanen 2014).

Development of solutions

Hakanen and Jaakkola (2012) identified several factors that influence the performance of the solution development. For example, the clarity and uniqueness of customer's problems and the customer's involvement during the development influence the solution's content. In addition, the solution content and customisation are influenced by the customer's openness and willingness to share information (Hakanen and Jaakkola 2012). To increase the knowledge of the customer's activities and develop solutions adapted for the target customer, the customer can be involved during the development (Storbacka 2011).

Witell et al. (2011) showed that proactive or reactive market research methods during new development affected the firm's performance in different ways. The proactive market research methods include customers with high knowledge of offering usage sharing their knowledge, and the lead user method (e.g., Lilien et al. 2002). Such methods influence the firm's profit margin more than traditional reactive market research methods such as surveys and interviews. Thus, during the development of the solution, the firm should see the customer as an active contributor with knowledge and skills rather than as a source of information (Hakanen and Jaakkola 2012; Storbacka 2011; Witell et al. 2011).

The customer involvement differs between product and service development (Kindström and Kowalkowski 2014). For example, product innovations with novel technologies, where the customer has little involvement, might face a threshold before customers accept the new product (Sandberg and Aarikka-Stenroos 2014). On the other hand, during the new service development, customers are seen as contributors. In these cases, the new service development can lead to novel service innovations; that is, radical service innovations (Perks, Gruber, and Edvardsson 2012). The category of radical service innovation refers to the high degree of change and significant shift in service content (Gallouj and Weinstein 1997; Snyder et al. 2016). When the shift in service content is minor, the service innovation is categorised as incremental. In the present thesis, the service innovation is seen as an outcome of the new service development.

From a long-term perspective, product and service innovation are likely to be required for success (Visnjic, Wiengarten, and Neely 2016); therefore, manufacturers must change existing new product development processes for new service development or create new processes suitable for developing services (Grenmyr, Löfberg, and Witell 2010; Santamaría, Jesús Nieto, and Miles 2012). Carlborg (2015) argued that manufacturers should take advantage of the realisation during new service development and participate during the customer's usage of the new service.

Consequently, the realisation of the new service is made in tight collaboration between provider and customer, which can result in service innovations being adapted to activities taking place in the customer's sphere.

Customer's role

A solution is seen as a longitudinal customer relational process, during which the solution provider integrates products and services supporting the activities taking place in the customer's sphere (Storbacka et al. 2013; Tuli, Kohli, and Bharadwaj 2007). When the solution provider makes sure that the solution supports the activities, the solution will also be used by the customer (Hakanen and Jaakkola 2012). The knowledge of activities taking place in the customer's sphere, together with the longitudinal customer relational process, are seen as key elements of succeeding with solutions (Storbacka 2011; Windahl and Lakemond 2006). By understanding the activities in the customer's sphere, the solution provider can identify solutions to customer's problems and thereby increase customisation and business opportunities (Storbacka and Pennanen 2014). An essential aspect then becomes the joint value creation between the solution provider and the customer performed during the interaction (Grönroos and Helle 2010). During the interaction, the solution provider has an opportunity to influence the customer's perception of the solution. After the interaction, value is created during usage within the customer's sphere (Grönroos and Voima 2013).

2.3 Concluding remarks

The concept of quality has been tightly connected to the improvement of activities taking place in the provider's sphere and activities taking place during interaction with the customer. The overview of research on quality categories supports this view. All quality categories contribute to the provider's sphere and the sphere of interaction in the dyad; see Figure 4. Research on quality management, product quality and service quality supports the provider's sphere. While as the activities taking place in the interaction sphere are supported by product quality, service quality, communication quality, relationship quality, e-service quality, and quality management.

Figure 4 The described theoretical concepts mapped in the dyad

In particular, traditional quality concepts such as quality management and product quality and service quality focus on the activities taking place in the provider's sphere. Most of the described quality categories concern activities in the interaction taking place between provider and customer. The quality management research covers both the provider's and the interaction spheres, with an emphasis on the internal activities taking place in the provider's sphere. This can be a result of the fact that most research on quality takes the provider's perspective. This is, in addition, reflected on that research on quality describes customer orientation as meeting customer requirements. Consequently, interventions are designed to support activities in the provider's and the interaction spheres and are further used to meet the customers' requirements.

The research on solutions, on the other hand, covers the three spheres in the studied dyad. During solution provision, a relational process exists between the solution provider and the customer. This relational process is on-going and the solution supports the activities taking place in the customer's sphere and satisfies customers' continuously changing needs. This implies that it is not enough for a solution provider to have an internal focus on the activities supporting the components building a solution, nor to focus on the interaction during exchange. The solution provider needs to increase the understanding and knowledge of the activities taking place in the customers' sphere and how the solution can support these activities.

The above discussion shows that the research on quality does not relate to the solution provision regarding how to manage quality; in particular, how to support the activities taking place in the customer's sphere. Hence, although research on the quality concepts contributes with support for the activities taking place in the provider's sphere and the interaction sphere, support for activities in the customer's

sphere is missing. Therefore, in order to increase the understanding of solution quality and knowledge of how to improve the concept, solutions, servitization – and, in particular, customer involvement during new service development – have been useful for meeting the aim of this thesis.

3 RESEARCH APPROACH

This chapter starts with the methodological considerations, followed by a description of the research process, including the five empirical studies and the corresponding analysis. Both qualitative and quantitative research strategies have been used during the research process. Each study has been presented in an appended paper that contributes to answering the research questions. After presenting the studies, I conclude the chapter with a reflection on the research process.

3.1 Methodological considerations

My background, including an MSc in engineering and being raised within the logical language of mathematics has influenced my perception of the world. My PhD studies in quality technology have contributed to me changing my view. My perception of the world as ultimately objective and measureable has evolved to see it as constructed, to some extent. That is, I believe that phenomena can be objectively observed – in natural sciences, for example – but not for all research fields or circumstances. For instance, in a research field where complex social phenomenon and behaviours commonly are studied, it is difficult or even impossible to pick out the

influence of one specific factor. In such cases, perspective and previous experience will influence knowledge creation (Guba and Lincoln 1994). This contributes to the challenge of justifying theories (Okasha 2002). However, despite the difficulty of justifying theories and making objective observations, each generation of and contribution to existing theory within a research field will contribute to knowledge creation. Based on this, I assume that the world exists but can only be perceived to a certain extent, given that all observers see the world different based on previous experience, knowledge and perspective (Guba and Lincoln 1994).

The present thesis has contributed by increasing our knowledge of the solution quality concept. Quality as a concept is described different depending on perspective and each observer perceives quality differently. Likewise, the solution will be described different by researchers from diverse research fields, such as the factors influencing solution quality. This shows that the studied concepts and management of them require both an increased understanding and testing of identified relationships. Based on this, qualitative research strategies to develop knowledge and quantitative research strategies to test identified relationships have been used during the research process.

3.2 Research process

As is the case with many PhD candidates, my research process and the research design has not been straight-forward. During my first years as a PhD candidate, I participated in small projects, funded by HELIX⁴, connected to single papers. This enabled me to participate in writing different papers with different data sets with different people. These small projects have contributed to the nuances in this thesis. The first two appended papers were written during this time period together with a working paper of the third appended paper. One of the advantages of small projects was that I had the opportunity to read and search for my research interest within research on quality and therefore state the details of research questions and research design myself.

This start of my research process resulted in a conceptual paper about solution quality based on an integrative literature review method (Snyder 2016). Later on, the conceptual idea was tested on empirical data gathered through interviews and focus groups, resulting in Paper III. After my licentiate degree and following my second period of parental leave, I joined a Vinnova-funded project (ATIT⁵). The project was

⁴ HELIX Vinn Excellence Centre is a research centre at Linköping University working with questions related to working life.

⁵ Avancerade Tjänster i Tillverkningsindustrin funded by the research program Produktion 2030 within Vinnova.

conducted jointly together with SWEREA/IVF⁶ and CTF⁷ at Karlstad University. My three last papers were funded by this project; see Figure 5. All of the appended papers in this thesis were initiated with a deductive approach. That is, the study was initiated from extant theory as a model, concept or phenomenon and tested using empirical data (Bryman and Bell 2011; Hartman 2004).

Figure 5 The research process

Throughout my doctoral studies I have increased my knowledge through reading scientific literature, making empirical data collections and taking doctoral courses. This has resulted in five papers based on five different data sets and literature studies provided in three different research fields: quality, servitization and service innovation.

Because there have been different data collections during this research process, I have had the opportunity to increase knowledge of different research methods and data analysis techniques. In this way, my research interest was studied from different perspectives. Table 5 presents the five appended papers, together with information about empirical data, data analysis and addressed research question. During the data analysis I used both primary and secondary data. I reflect on the use of secondary data in the evaluation of the research process.

⁶ SWEREA/IVF is a research institute in Gothenburg

⁷ Centrum för tjänsteforskning (Service Research Center)

Table 5 Overview of the empirical data analysed during the research process

Paper	I	II	III	IV	V
Addressed research question	RQ2	RQ2	RQ1	RQ3	RQ1
Empirical data	Service providers (SIQ data set) n=4000	Värmlandstrafik n=1	SME manufacturer n=12	European manufacturers n=239	SME manufacturers n=3
Research strategy	Quantitative	Qualitative	Qualitative	Quantitative	Qualitative
Research method	Survey	Action research	Interview study	Survey	Action research
Data gathered by	Elisabeth Johansson, Lars Witell	Åsa Rönnbäck	Elisabeth Johansson, Ida Gremyr, Lars Witell	Lars Witell, Bo Edvardsson, Adrienne Schäfer, Thomas Meiren	Elisabeth Johansson, Nina Löffberg, Victor Aichagui, Lars Witell, Barbro Lagerholm
Data analysed by	Elisabeth Johansson, Lars Witell	Elisabeth Johansson, Åsa Rönnbäck, Lars Witell	Elisabeth, Johansson, Ida Gremyr, Lars Witell, Mattias Elg	Elisabeth Johansson, Chris Raddats	Elisabeth Johansson
Data analysis	ANOVA/ MANOVA	Analysed documents from observations, interviews and workshops	Coded transcribed interviews, cross-interview analysis	Structural equation modelling (SEM)	Coded transcribed material, analysed notes from workshops and coaching sessions, cross-table analysis

Qualitative and quantitative research were used during the research process. These research strategies are complementary and are used to increase knowledge of the studied phenomenon (Bryman 2011). Qualitative research strategies are often described as suitable when the aim is to understand a phenomenon or a complex concept, whereas quantitative research strategies are more suitable for testing hypotheses and theories in a generalisable setting (Amaratunga et al. 2002; Bryman and Bell 2011).

3.2.1 Quantitative research

Quantitative research presents the social reality as an external and objective reality (Bryman and Bell 2011). Thus, quantitative research is used when theories need to be tested (Field 2009). The type of methods used within quantitative research can both confirm and extend theories; hypothesis testing is a common way to test relations between constructs. A hypothesis can be defined as ‘*an assertion or conjecture concerning one or more populations*’ (Walpole et al. 2002, p. 284). Quantitative research can be described as focusing on specific issues, the most important of which are measurement, causality, generalisation and replication (Bryman 2011). There are a number of different research methods, including surveys, simulations and experiments that are included in quantitative research strategies.

Two of the empirical data sets were gathered with the use of surveys. When collecting quantitative data through surveys, some key aspects need to be kept in mind, especially when testing existing theory (Hair et al. 2009). This is the case, for example, when confirmatory factor analysis should be performed. Thus, the survey should be developed in tune with theory and a pilot survey should be conducted before the survey is handed out (Bryman and Bell 2011). This makes the researcher aware of limitations and questions that are difficult to interpret and changes can then be made before the actual survey is performed.

3.2.2 *Qualitative research*

Qualitative research is used with the aim of describing observations and generating an increased knowledge of a studied phenomenon (Meredith 1998); it is often seen as an exploratory research strategy. Qualitative research is preferable when the social reality is represented as constantly shifting and constructed through individuals' interpretations (Bryman and Bell 2011; Easton 2002). However, research based on qualitative data can be used to assess theoretical concepts and models on empirical data (Barratt, Choi, and Li 2011; Ketokivi and Choi 2014; Voss, Tsikriktsis, and Frohlich 2002). Common qualitative research methods are interview studies, case studies and action research.

The empirical data collected for two of the appended papers were based on action research. Because of this, and the fact that action research has been challenged ever since it was introduced by Kurt Lewin and colleagues during the mid-1940s (Westbrook 1995), it will be discussed more thoroughly.

Action research

Action research is a research method that is used for making an action happen instead of passively observing an action (Westbrook 1995). This is one of the characteristics that distinguishes this research method from case studies. Other characteristics of action research are that the researcher should participate in providing the change, the research should create fundamental increase of knowledge, and the research should be applicable to the knowledge of how to make a change (Coughlan and Coughlan 2002). Thus, action research suits implementation processes where the journey is more interesting than the goal itself, as often can be the circumstance for case studies (Westbrook 1995). Therefore, action research can be used to generate new knowledge (Brydon-Miller, Greenwood, and Maguire 2003).

Before starting an action research project, some aspects need to be decided on. These include a clear picture of what knowledge is sought, a set plan for what actions to use to improve the process, and what theory to increase knowledge about (Coughlan

and Coughlan 2002). Thereafter, a suitable firm environment for the research project can be decided on before continuing (Coughlan and Coughlan 2002).

Action researchers can take different positions during the research project; see Table 6. The continuum of positions ranges from narrative research, where the researcher studies his or her own self or own practice, towards studies where researchers only study the phenomenon or setting (Herr and Anderson 2005).

Table 6 Continuum of action research positionality (adapted from Herr and Anderson 2005)

Positionality of researcher	Traditions
1. Insider (researcher studies own self/practice)	Narrative research, autobiography, self-study
2. Insider in collaboration with other insiders	Feminist consciousness raising groups, inquiry/study groups, teams
3. Insider(s) in collaboration with outsider(s)	Inquiry/study groups
4. Reciprocal collaboration (insider-outsider teams)	Collaborative forms of participatory action research that achieve equitable power relations
5. Outsider(s) in collaboration with insider(s)	Mainstream change agency: consultancies, industrial democracy, organisational learning; radical change
6. Outsider(s) studies insider(s)	University-based, academic research on action research methods or action research projects

One major challenge with action research is to discriminate between making practice more effective and build knowledge (Coughlan and Coughlan 2002). Therefore, reflection on research conducted during the process is vital (Herr and Anderson 2005; Westbrook 1995). Another challenge is that the firms participating in the study must show progress on their own. That is, after the action research project has finished, a substantial sustainable change must be present in the firm (Coughlan and Coughlan 2002).

3.3 Empirical data and data analysis

Each of the papers appended to this thesis is based on an empirical study. Therefore, five different data sets have been analysed.

3.3.1 *Paper I – A survey study based on the SIQ data set*

The first appended paper is related to the second research question of this thesis and aims to determine relationships among quality management principles. The data set was initially collected by the Swedish Institute for Quality (SIQ) and is based on a survey. The survey has been conducted yearly since 2004 for the purpose of distributing the Swedish Quality Award among Swedish firms (SIQ 2016). The data suitable for the aim of this study were collected by the researchers conducting the data analyses and writing the paper.

The survey data is based on a number of self-assessment surveys conducted at 138 Swedish service firms during the period from 2004 to 2010. The survey is distributed throughout the firm, covering various different hierarchical levels, from employees to managers. Between 10 and 300 respondents from each firm participated, which resulted in more than 4000 respondents. The main firm types in the data set are educational, real estate, and consulting firms. Eleven firms conducted several self-assessment surveys during a period of five years.

The developed self-assessment survey is based on the SIQ model (the Swedish alternative to Malcolm Baldrige) and includes more than 100 items. Each item was scored on a six-point scale ranging from '0' to '100', and a 'don't know' alternative was included. The individual items all followed a similar structure, such as 'We have modes of operation and methods that make our decisions based on facts.' To operationalise the constructs of leadership, employee orientation, process orientation and customer orientation, 65 items were used in the quantitative study. The principle of leadership was built from 19 items, employee orientation 12 items, process orientation 11 items, and customer orientation 14 items. Items concerning results were also included in the data analyses.

The normality test, deletion of outliers and missing data as well as the further analyses were performed in SPSS. Because 11 firms conducted the self-assessment survey more than once, the data were divided into two samples: (i) firms that performed one self-assessment survey and (ii) firms that performed two or more self-assessment surveys. An exploratory factor analysis was performed on the first sample to separate the factors from one another. Reliability and validity tests showed that the factors had satisfactory Cronbach's alphas. The data set was then clustered into three different performance levels and ANOVAs were conducted to identify possible

differences in the quality principles (factors) between the grouped performance level. For the second study, the data were analysed using a mixed-design ANOVA to identify possible differences in quality principles over time.

3.3.2 Paper II –An action research study based on Värmlandstrafik

Paper II is related to the second research question. The intention of this paper was to investigate how different interventions develop and how they can change quality principles. This data set was collected as part of a larger research project conducted over a period of five years from the beginning of 2006 to the end of 2010. The project was conducted at Värmlandstrafik AB, the traffic organiser for public transport in the Värmland County of Sweden. Since the aim of the study was to make a change within the firm and the researcher collaborated with the people at the firm during the project, action research was used.

The data was collected by one of the authors of the second paper. The researcher collected the data through conducting interviews, studying documents, conducting workshops, educating employees and managers and performing observations. During data collection, the researcher conducted 28 five-hour sessions with members of the management team, several cross-functional team meetings, meetings with all employees of the firm, and meetings with the CEO and other representatives of the firm and its partners. An interview study that covered 26 managers and employees of the firm and its largest partner was conducted in 2006 and 2007.

The collected data was analysed in two stages. First, the observations and interviews were analysed in order to identify the different principles, in the order in which they were adopted and the principles emphasised during the period of study. Secondly, to capture the change of the principles, the study was separated into three periods. Thereafter, the interventions conducted during the five-year period were described and sorted into the period in which they were applied. Furthermore, the principles that were partly supported by the intervention were identified. The data analysis was performed jointly in meetings with all authors of the paper present. During the writing of the paper, several telephone meetings were held.

3.3.3 Paper III –An interview study based on Swedish manufacturers

The third paper is related to the first research question. The data were collected with the intention to find empirical support, for the concept solution quality. Manufacturing firms were found to be suitable for the study since they have the experience of providing products, which is one of the key components comprised in a solution. Thirteen manufacturing firms that provided products and services separately were chosen for the study. All participants in the study had extensive

knowledge about providing products and services. They were either the CEO (in small and medium-sized manufacturing firms) or, in larger manufacturing firms, managers with key knowledge of the specific area of interest.

The data was collected through 10 semi-structured interviews and one focus group. The main subject during the interviews were solution provision and meeting customer needs. The interviews lasted between 45 and 80 minutes. All interviews followed a standardised interview guide, were recorded, and later transcribed by me. Each interviewed person read the transcribed interview. The focus group was conducted after the interviews and it was a discussion of the preliminary results. This focus group lasted for 78 minutes with participants from five different manufacturing firms and three researchers. During the session, the main topic discussed was solution quality and its dimensions. Two of the participating firms were also interviewed, while the other three firms only participated in the focus group.

The data was analysed with an interpretive approach and the idea was to link theory with the empirical data that enabled themes to emerge and the theory to be refined. The data analysis was performed in several steps. First, all transcribed interviews were coded. All participating researchers read the same two interviews and coded them based on the quality dimensions identified in the literature. This enabled a standardisation of the coding. Thereafter, each transcribed interview was coded by two researchers. To get a view of the entire data set, I coded all of the transcribed interviews. Second, we made a thematic cross-interview analysis inspired from a case-ordered matrix by Miles and Huberman (1994). Thirdly, to enhance confidence of the findings, we performed the focus group simultaneously with the data analysis.

3.3.4 Paper IV – A survey study based on European manufacturers

The fourth paper is related to the third research question and tests the customer's role in new service development in manufacturing firms. The survey that is the foundation for this paper is based on 239 European manufacturing firms from Sweden, Switzerland and Germany that each have 50 or more employees. The survey was designed to capture respondents' new service development experiences and the including constructs and items were primarily based on existing scales for new service development. The questionnaire was first developed in English and then translated to Swedish and German. Pre-interviews were conducted and a pilot survey was distributed and tested on a number of manufacturers (not participating in the complete sample). Based on the pilot survey, minor improvements were made before the final version was distributed via mail. The included items were measured on a 10-point Likert-scale ranging from 1 (strongly disagree) to 10 (strongly agree). After distribution, two follow-up approaches were made to improve the response rate.

Reminders were sent to non-respondents one and two weeks after initial mailing. This yielded a response rate of 13 per cent, which is in line with other cross-sectional studies of new service development (Melton and Hartline 2010).

The empirical data was tested on a theoretical model comprised of a set of constructs. The constructs of interest were as follows, with the majority of scales taken from previous research: ‘customer participation’, ‘variety of customer information’, ‘customer research methods’, ‘integrated development teams’, ‘customer knowledge development’, ‘service innovation performance’ and ‘firm performance’. We used two control variables in the study: ‘technological turbulence’ and ‘market turbulence’. These were included to control for the role of technology in the manufacturer’s industry and the market characteristics.

Partial least squares structural equation modelling (PLS-SEM) using SmartPLS3 (Ringle, Wende, and Becker 2015) was chosen as the method to estimate the relationship between customer involvement and service innovation performance. This modelling technique is based on ordinary least squares regression and makes no distributional assumptions. PLS-SEM is also preferable for smaller sample sizes and complex models (Hair et al. 2012). After the initial normality and outlier tests, the quality of the conceptual model was tested. These tests showed that all items loaded highest onto their latent construct and the average variance extracted (AVE) for each construct were greater than their shared variance with any other construct. Therefore, the discriminant validity was supported (Fornell and Larcker 1981). In addition, the constructs composite reliability was above the stated threshold of 0.7, which implies that the quality of the model was sound. After this statement, we tested whether innovation level had a moderating effect on customer involvement. The data set was split into two groups – incremental (n=139) and radical (n=100). To test the moderating effect of innovation level we used a multi-group-analysis with PLS-SEM.

3.3.5 Paper V – An action research study based on SME manufacturers

Paper V addressed the first research question and was performed to investigate solution quality maturity. The empirical data for this paper was collected during a one-year period in which the researchers collaborated with three small and medium-sized Swedish manufacturing firms striving to provide solutions. Since the aim of the study was to make a change within the participating firms, action research was used. Rigorous planning took place prior to the project starting. The planning included the decision of which theoretical model to follow (see, Kristensson, Gustafsson, and Witell 2014), criteria for firms’ participation, and activities to use during the phases of the model. For a detailed picture of the different activities performed during the research process; see Appendix A. The participating firms were chosen based on a set

of criteria. All three manufacturing firms had fewer than 250 employees and already provided products and services. Other criteria the firms met were management commitment and striving to increase service provision and provide solutions. The participants from each firm were owners and/or CEOs, which made it possible for changes and ideas generated during the meetings to be implemented during the project.

The data was collected by five researchers through semi-structured interviews, workshops, coaching sessions and a seminar. The interviews were performed during the start of the project to track the initial state of the firms. The three participating firms were interviewed once. A semi-structured interview guide was followed during the interviews, which lasted between 54 and 84 minutes each. All interviews were recorded and later transcribed. Besides the interviews, 12 coaching sessions and six workshops were conducted during the project. The workshops lasted between four and six hours and were held with all participating firms present. During these workshops we introduced assignments that the firms should perform before the next coaching session. In this way we made sure that changes were made without our participation. The coaching sessions were performed with one firm at a time and lasted between 50 and 140 minutes each. Before each coaching session, a guideline was developed to help the firms and to track the changes within each firm. Notes were taken during all coaching sessions, and six coaching sessions were recorded and transcribed. In addition, the coach helped the firm with obstacles that were encountered when performing the assignments from each workshop. Along with the project process, meetings with only researchers present were held. These meetings were used to reflect upon the process and decide on further steps connected to the theoretical model and activities suitable for the three participating firms (Herr and Anderson 2005).

In the data analysis, the material was separated into two different time periods: the initial and the final state. The data analysis was performed through reading the transcribed material and notes made connected to the two time periods. During the analysis, the dimensions of and prerequisites for solution quality were searched for and identified. These were then put in a time-ordered table (Miles and Huberman 1994) to show the firms' initial and final state. Finally, this table was used as support when the firms were put in the theoretical solution quality maturity model.

3.4 Evaluation of the research process

During the research process, I used several studies based on both quantitative and qualitative data. This breadth of empirical data and research methods has enriched this research process. However, like all scientific studies, it must pass certain quality criteria.

3.4.1 *Quality criteria*

My research process has included both quantitative and qualitative research strategies. Four criteria are commonly used to interpret the rigour of quantitative research: construct validity, internal validity, external validity and reliability (Bryman and Bell 2011; Scandura and Williams 2000). Researchers have challenged these criteria and argued that qualitative research should have other criteria suitable for studies performed on qualitative data (Guba and Lincoln 1994). Bryman (2011) argued for four appropriate criteria for qualitative research: credibility, transferability, dependability and confirmability. When these quality criteria are met, it reflects a rigorous qualitative research process (Bryman 2011; Guba and Lincoln 1994). Based on these discussions, quality criteria related to each of the two research strategies are used to evaluate this research process. The criteria are distinguished into two different tables: one for quantitative research and one for qualitative research; see Table 7 and Table 8 respectively.

Table 7 *Quantitative quality criteria of research process*

Quality Criterion	Theoretical description of the criterion	Paper	Evaluating the research process
Construct validity	How well the measures fit the theories for which a test is designed; includes convergent and discriminant validity (Scandura and Williams 2000)	I and IV	Items correlated, factors loading highest on own construct; AVEs for each construct are all over threshold and greater than the shared variance with other constructs
Internal validity	Concerns causality and that the study measures what it is supposed to measure and the research describes reality (Merriam 2009; Scandura and Williams 2000, p. 1252)	I and IV	Paper I includes a longitudinal study, pilot surveys have been handed out before the actual survey, the constructs used in Paper IV were based on existing scales
External validity	Refers to generalising across times, settings and individuals and relies upon establishing a true representation of the relationship between two constructs (Scandura and Williams 2000)	I and IV	Paper I is a survey conducted in Sweden and Paper IV is a sample survey conducted in Sweden, Germany and Switzerland
Reliability	Refers to the observed value, that it measures what it is ought to measure and is error-free (Hair et al. 2009); composite reliability means to weigh the internal consistency reliability (Hair et al. 2013)	I and IV	Paper I Cronbach's alphas >0.7 and Paper IV Composite reliability >0.7

Table 8 *Qualitative quality criteria of research process*

Quality Criterion	Theoretical description of the criterion	Paper	Evaluating the research process
Credibility	Refers to ensuring that the research process is in line with existing rules and the reality studied is perceived accurately (Bryman 2011)	II, III and V	Triangulation, validation of the transcribed material and the notes taken, ethical considerations were taken into account
Transferability	Refers to whether the results related to a specific context studied can be transferred to another environment (Bryman 2011)	II, III and V	Presentation of studied context, multiple firms participating in the studies, standardised interview protocols and question formulas to coaching sessions used and available
Dependability	Refers to researchers' ability to audit the data material. This implies a complete and available description of the research process (Bryman 2011)	II, III and V	Selection criteria of interviewees and participatory firms, transcribed interviews, workshops and coaching sessions, data analysis performed with cross-interview/table analysis the research processes thoroughly documented and described
Confirmability	Refers to the researcher acting with good intentions and not consciously letting personal valuations influence the result of the study (Bryman 2011)	II, III and V	Constructs well defined and grounded in existing research and conceptual models were followed during the studies, audit can be performed through access to saved data, several researchers participated during data analyses

Like all scientific studies, my research process has certain limitations. Firstly, two of my papers are based on analyses performed on data collected by other researchers and a third paper is based on data collected for a purpose different than the intention of the study. This is referred to as secondary data; that is, the data is used by people other than those who initially collected the data and/or for purposes different from the original project intentions (Bryman and Bell 2011).

For the study based on the first data set (the SIQ data set) we as the research team had little knowledge about the conditions surrounding the design of the survey since it had been used for several years. Instead, we brought in a fresh, creative, independent approach to the data analysis. This is often difficult for the original research team, which tends to hold firmly to its original ideas (Bryman and Bell 2011). Another challenge with this data set was to make it usable, since the original configuration was not ready for analysis. Therefore, the data was transformed before data analyses could be performed.

The second data set, Värmlandstrafik, was already collected before the initiative of writing the paper. The intention with the paper was in line with the purpose of the performed project. My two co-authors were involved in the project, so they informed me about the research design and choices made during the research project. The third data set, the European manufacturers, was also collected before starting to write the paper. During the data collection of this study, one of my co-authors participated in the design and distribution of the survey. This ensured that we had sound knowledge of the entire research process during data analysis and writing of the paper.

There are two main shortcomings regarding my use of secondary data. The first is the impossibility, as a researcher joining after the data collection, of influencing the already performed research activities. The second is that the gathered data sets were collected for a purpose that was different from that of my research interest. Despite these shortcomings, the opportunity to use secondary data has enabled my research process to include unique data sets. Firstly, one quantitative study included more than 4000 respondents over a period of several years, which made it possible to perform longitudinal data analyses. Secondly, one qualitative longitudinal study ranged over five years; and the third was a quantitative data set of European manufacturing firms.

Finally, two of the studies are based on data collected through action research. This research method can be criticised due to that it is hard to distinguish between changes performed by the researcher and performed by the participating firms (Herr and Anderson 2005). However, in the present studies performed with action research, activities made were carefully chosen to suit the specific firm and in addition, the firms performed changes actively. In addition, to decrease the similarity with

consultancy, the researchers regularly met and reflected upon the process to make sure of the knowledge contribution. The studies performed with this research method have contributed to an increased knowledge of firm changes (Coughlan and Coughlan 2002) and helped to test and further develop a conceptual model of solution quality. In addition, three Swedish small and medium-sized manufacturers were supported in their endeavour to provide solutions.

3.4.2 *Ethical considerations*

This research process has encountered certain ethical aspects. These are discussed in relation to the four ethical main areas presented by Bryman and Bell (2011): (i) harm to participants, (ii) lack of informed consent, (iii) invasion of privacy, and (iv) involvement of deception.

During my doctoral studies, my research interest lay in the dyad of a provider and its customer in a business-to-business setting. In particular, my intention has been to increase knowledge of the solution quality concept. To this end, no physical or psychological harm to participants took place.

During the interviews leading to Paper III, the participants were informed about the aim of the study and the data collected. I called and asked each person whether they agreed to an interview or not, and all of the eventual participants volunteered to participate. Furthermore, the interviewees were informed of their anonymity and the interviewees approved the recording before I started using the Dictaphone. Furthermore, when the material was transcribed, the interviewees read and approved the text before the data analysis was performed.

Before I was given access to the data set collected by SIQ I signed a document of professional secrecy. The same procedure was performed in the ATIT research project. All participants in that project agreed to professional secrecy. I am sure that this has contributed to the access of detailed information, the open discussions held during the meetings and problems raised during coaching sessions. This has been valuable for the outcome of that research project. All three firms participating in the ATIT research project have been thoroughly informed about the research project and are aware that the followed theoretical model was tested and further developed during the project. This has contributed to valuable suggestions for improvements of the model.

4 OVERVIEW OF APPENDED PAPERS

The following chapter briefly summarizes all five of the appended papers. Two of the papers have been published in peer-reviewed journals, two have been submitted to journals and the fifth is a working paper. Each paper summary includes the purpose, research method, results and contribution.

4.1 Paper I

Changing quality initiative – does the quality profile really change?

Johansson, E., Witell, L. and Elg, M.

Total Quality Management & Business Excellence (2013), 24 (1–2), 79–90.

This paper identifies a quality profile built by principles and investigates how the quality profile changes over time. Previous research has focused on how quality management impact firm performance. Many initiatives of quality management programmes fail even before the initiative has reached the entire firm (Easton and

Jarrell 2000). Instead of concentrating on the contribution from the management program on firm performance, this paper focuses on the quality profile as performance patterns of a set of quality principles; see Figure 6. In particular, this paper aims to identify specific quality profiles in service firms, and also to understand how (or if) these profiles change over time. Four different quality principles build the quality profile in this paper: leadership, employee orientation, process orientation and customer orientation. To identify the profile, a sample consisting of 138 service firms participating in a self-assessment survey was analysed. Each firm had between 10 and 300 respondents and there were a total of over 4000 respondents of the survey. Eleven firms filled in the survey on several occasions. This made it possible to perform an analysis following the change of the quality profile over time.

Figure 6 *A quality profile built by quality principles*

The results from the first analysis of this study showed that the order between the quality principles did not change between performance level. That is, the principle leadership had the highest performance at the low, medium and the high performance levels. The result from the second analysis showed that quality management improves over time and the performance of principles differs, but the shape of the profile was unchanged.

The contribution of this paper is twofold. Firstly, it shows that the same principles are emphasised over time. For instance, leadership was the most emphasised principle during the quality management initiative and also the most emphasised after some years. Thus, the emphasised working procedures within the firm do not change and the well-known activities continued to be used. Secondly, this paper shows that the performance level of the principles improves and evens out over time. In other words, working with quality management pays off and the principles with low performance in the beginning increase more in performance than the principles with high performance level from the beginning.

4.2 Paper II

Using interventions to change the quality profile of an organisation

Johansson, E., Witell, L. and Rönnbäck, Å.

International Journal of Quality and Service Sciences (2013), 5 (1), 32–45.

The emphasis of this paper is the use of interventions to change a quality principle. Earlier studies have shown that it is difficult to change the principles of the quality profile. Likewise, the principles emphasised during the quality management initiative are most heavily emphasised after several years. The purpose of this study was to investigate how a quality profile can evolve over time and, in particular, how different interventions can change the shape of it. This builds on the idea that an intervention, such as working with cross-functional teams, can change a specific quality principle; see Figure 7. The interventions comprise different practices and techniques used to operationalise the intervention. In this study, the quality principles building the quality profile were leadership, employee orientation, process orientation, continuous improvement and customer orientation. In order to investigate the evolvement of the quality profile, a quality management development initiative in a public transportation authority was followed over a five-year period.

Figure 7 A framework for developing and changing a quality profile

The results show that, with the right intervention adapted at the right time, a firm can change its quality profile. The evolution of the profile from the first to the second time period showed that the performed interventions influenced the targeted principles. The intervention education of employees applied during the second time period caused the performance of employee orientation to increase. This was also the

case for other targeted principles. One principle, customer orientation, was only targeted at the end of the study, so this principle had minor support until then. This is reflected in the profile, through the absence of increased customer orientation.

This study contributed several insights. Firstly, it shifts the emphasis away from quality programmes towards interventions that influence principles, which in turn builds quality profiles. This can be useful for larger firms that use more than one quality management programme simultaneously. Secondly, this study shows that when the right intervention is practised, a change in shape of the quality profile can occur. However, one or more principles need to be targeted by the intervention or else the principle will not improve, or will only improve to a minor degree. Thirdly, the most emphasised principles are related to internal practices and techniques. When these perform well, the emphasis shifts to external orientation; that is, customers.

4.3 Paper III

Understanding solution quality: prerequisites and dimensions

Johansson, A.E., Witell, L., Gremyr, I. and Elg, M.

Submitted for publication.

This paper contributes to knowledge of the concept of solution quality. Many manufacturers that provide products, services and solutions face challenges when aiming to improve the quality of their offerings. Previous research has mainly focused on manufacturers managing product quality and service firms managing service quality. The main concern in research on quality has been the management of internal activities for improving product and service quality with the view that customers are satisfied when the characteristics of the offering meet customer specifications. Improvement of service quality in service firms and product quality in general have been well investigated, but how this is applied by a manufacturing firm seeking to improve quality of services and solutions has attracted little research interest. The purpose of this paper was to develop knowledge about solution quality in manufacturers. In particular, this study develops and distinguishes the concepts of product, service and solution quality from each other. Ten interviews and one focus group were conducted, including 13 manufacturing firms.

The results of this paper include the definition of solution quality based on the seven quality dimensions of (i) tangibility, (ii) reliability, (iii) internal consistency, (iv) empathy, (v) communication, (vi) approachability, and (vii) adaptability. Furthermore, a conceptual model comprising the dimensions and the identified

prerequisites customer relationship and knowledge of processes was presented; see Figure 8.

Figure 8 A solution quality conceptual model

This paper makes three main contributions. Firstly, the paper helps increase the understanding of solution quality. Solution quality is based on the perceptions of quality when products and services are perceived as an integrated entity with unique benefits in relation to the customer’s processes and needs. Secondly, the conceptual model shows that solution quality can be managed through improving the seven quality dimensions. Each dimension contributes to improve solution quality. Thirdly, this study argues that two prerequisites are needed in order to provide solution quality. Thus, increased customer relationship and knowledge of processes are necessary for solution quality.

4.4 Paper IV

The role of customer involvement for incremental and radical service innovation in manufacturers

Johansson, A.E., Raddats, C. and Witell, L.

Submitted for publication.

This paper tests the role of customer involvement during new service development in manufacturing firms. Over a long period of time, manufacturers have seen competition increase. To meet this competition, manufacturers provide services as an add-on or integrate services with their product offerings. Although research on service innovation is increasing, research addressing the topic in a manufacturing context is scarce. It lacks knowledge regarding how manufacturers develop knowledge about customers and involve customers in the new service development. The importance of customer involvement in new service development has been acknowledged in the service sector but is lacking in a manufacturing context. Considering that, the purpose of this paper was twofold: (1) to identify how customer involvement in manufacturers' new service development activities influences service innovation performance and, in turn, the impact of service innovation on manufacturers' overall performance; and (2) to test whether innovation level plays a moderating role on customer involvement in manufacturers' service innovation performance and overall performance.

A theoretical model with hypothesised relationships was proposed and tested with empirical data from Germany, Sweden, and Switzerland, including 239 manufacturing firms; see Figure 9. The proposed theoretical model was evaluated and tested in two phases. The first phase included all firms in order to assess the impact of customer involvement and the second phase tested how the innovation level moderates these relationships. The data analysis was performed using partial least squares structural equation modelling.

Figure 9 Customer involvement during new service development

The contributions from this study are threefold. Firstly, customer involvement in new service development has a positive impact on service innovation and manufacturers' firm performance. Secondly, the study showed involvement of customers are more important for manufacturers developing incremental service innovations than those developing radical service innovations. Finally, for manufacturers developing radical service innovations, successful service innovation leads to higher firm performance than manufacturers developing incremental service innovations.

4.5 Paper V

Solution quality maturity

Johansson, A.E

Working paper.

This paper develops and tests a conceptual model of solution quality maturity. With solution provision, manufacturers face challenges when products and services are integrated. Extant research has addressed some of the challenges, such as the organisational changes and involvement of customers when developing new offerings. However, what quality is of a solution has not been clearly addressed. Previous research on the solution quality concept is scarce and the evolution over time needs further investigation. Therefore, the aim of this paper is to test a theoretical model of solution quality maturity evolution.

To address the paper’s purpose, a theoretical model was proposed; see Figure 10. The model shows that solution providers start to focus on internal processes and the products before the interaction processes are managed together with services connected to the product. Thereafter, the customer’s processes and the solution is managed, which makes it possible to achieve solution quality. This theoretical model was further tested on manufacturing firms working to provide high-quality solutions.

Figure 10 The solution quality maturity model

This paper contributes in two ways. The first way is with the theoretical model that shows the three maturity levels of the solution quality concept. This model relates the quality dimensions and prerequisites with the maturity of the concept. The model implies the importance of the customer relationships and that these relationships should be maintained in order to improve solution quality. Secondly, the paper contributes to the solution quality concept with empirical support on that solution providers start with a focus on internal processes. Later, emphasis is placed on improving the interaction process. This study revealed that it is difficult to reach the third level of maturity. In addition, this study showed that additional quality dimensions were added by the solution provider over time.

5 DISCUSSION

This chapter contains the final discussion about the main findings during the research process. Three subchapters can be recognised. The first is understanding solution quality, which aims to answer the first research question. The second is managing solution quality with interventions, which answers the second research question. Finally, customer involvement as intervention addresses the third research question. Furthermore, this chapter intends to extend rather than replace the discussions in the appended papers. These papers are referenced in normal referencing style.

5.1 Understanding solution quality

The main argument in this thesis has been that the solution provision has only partly support from previous research on quality. Previous research on quality has mainly focused on the activities taking place in the provider's sphere and the sphere of interaction. This is sufficient for quality of products and services. However, since the provided solution also acts in the customer's sphere to support activities taking place there, these additional activities contribute to the perception of the solution (Storbacka

and Pennanen 2014). This shows that the guidance from the research on quality is insufficient when solutions are provided and support for the activities taking place in the customer’s sphere is missing. Therefore, the research on quality must extend to support these activities taking place in the customer’s sphere. To start with, an increased understanding of the solution quality concept is required.

The solution quality concept aims to encompass quality in all three spheres of the studied dyad; see Figure 11. The concept is built by the quality dimensions and the prerequisites. They are seen as guidelines for the solution provider during the management of quality and are thoroughly described further on; first, however, the definition of solution quality is presented and discussed.

Figure 11 Solution quality encompassing all three spheres of the dyad

I define solution quality in line with Johansson et al. (2016, p. 4): ‘*solution quality is when the solution is perceived as an integrated entity with unique benefits in relation to the customer’s processes and needs*’. This definition takes fundamental characteristics of a solution into account. That is, this quality definition has emerged from definitions of a solution (e.g., Storbacka 2011; Tuli, Kohli, and Bharadwaj 2007). Firstly, the definition of solution quality indicates that ‘*the solution is perceived as an integrated entity with unique benefits*’. This is in line with Storbacka (2011), who argued that the solution should to be a unique combination of components that solves a customer’s specific problems. Thus, if the components building the solution are perceived higher as individual components, the customer will not purchase the solution. This corresponds with Nordin and Kowalkowski (2010, p. 454), who argued that, ‘*it is not the bundling of offerings per se that characterises a solution ...*’ but the fact that the integration of components are perceived as an entity with benefits. The second part of the definition, ‘*in relation to the customer’s processes and needs*’, is in line with Storbacka (2011) and Tuli, Kohli, and Bharadwaj (2007). This part of the quality definition implies the need for a deepened customer relationship that gives the solution provider the opening to increase knowledge of the activities taking place in the customer’s sphere. Based on this knowledge, the solution provider can support the activities taking place in the customer’s sphere.

5.1.1 Solution quality dimensions

To operationalise the solution quality concept, quality dimensions and prerequisites are introduced. The quality dimensions are guiding principles for the solution provider. The seven dimensions are (i) reliability, (ii) communicability, (iii) internal consistency, (iv) empathy, (v) approachability, (vi) tangibility, and (vii) adaptability; see Table 9. Some of the quality dimensions are similar to the dimensions of product quality and service quality (Garvin 1987; Parasuraman, Zeithaml, and Berry 1985), while others are unique for solution quality (Johansson et al. 2016).

Table 9 *Solution quality dimensions (Johansson et al. 2016)*

Quality dimension	Description
Reliability	How the provided solution coheres with promised agreements of resources and other constraints
Communicability	How well the firm communicates internally and informs customers of changes and delays
Internal consistency	How consistent the solution is according to the firm strategy
Empathy	How service-minded the employees of the firm are
Approachability	How accessible the firm is for the customer, and how quickly the firm reacts to customer concerns
Tangibility	The extent to which the hard resources and the surrounding physical environment live up to agreements and activities
Adaptability	The extent to which the firm delivers a solution in coherence with customer's processes and changing needs

Each presented dimension build the solution quality concept and the quality of a solution can be classified as high on one dimension and low on another (Garvin 1988). In many cases, however, the dimensions are related. That is, an improvement in one dimension may improve or decrease another. The quality dimensions that build solution quality can be seen as a guide for the solution provider to internally manage what activities to use to improve the quality of the solution. This concurs with Garvin (1987), who argued for the importance of advancing each quality dimension to improve the quality of the offering. The dimensions are mostly related to the operationalisation of the solution within the provider's sphere and sphere of interaction. However, the dimension adaptability, for example, is in addition related

to the customer's sphere (Johansson et al. 2016). To improve this dimension, the solution provider must increase the knowledge of the activities taking place in the customer's sphere. This further implies that the quality dimensions and prerequisites for solution quality are related. The prerequisites for the solution quality concept also takes the customer's sphere into account.

5.1.2 Solution quality prerequisites

There are two prerequisites (Edvardsson and Olsson 1996), *customer relationship* and *knowledge of processes*, for providing solution quality (Johansson et al. 2016). These prerequisites for the solution quality concept concern customer relationships and knowledge of the processes taking place in all three spheres. The first prerequisite, customer relationship, is in line with the research on relationship quality. That is, the customer relationship evolves over time and leads to trust and increased customer loyalty (e.g., Čater and Čater 2010; Holmlund 2008). This can increase knowledge of customer's activities. However, Macdonald et al. (2011) argued that there was a risk of a decreased customer relationship over time. That is, if the relationship is not maintained, it will probably not survive for long. In addition, this decreases the solution provider's ability to know the activities taking place in the customer's sphere and decreases the customer's perception of the solution provider's trustworthiness (Macdonald et al. 2011). The second prerequisite, knowledge of processes, coheres with the view that solutions are comprised by components made within the provider's sphere and activities provided during interaction and in the customer's sphere. This implies that the solution provider must have knowledge of the internal activities. In addition, the solution shall provide added value for the customer and thus support the activities taking place within the customer's sphere (Tuli, Kohli, and Bharadwaj 2007). Thereto, the activities during the interaction between solution provider and customer affects the perception of the solution (Grönroos and Helle 2010) and should then be known by the solution provider. So, in order to achieve solution quality, the solution provider must have knowledge of the activities taking place in all three spheres in the dyad.

The two prerequisites are linked to each other. Consequently, the first prerequisite – an increased customer relationship – will open up the opportunity for knowledge about processes taking place in the customer's sphere, a part of the second prerequisite. Hence, mutual understanding and trust between solution provider and customer is key to gaining a deepened relationship and access to information (Rauyruen and Miller 2007; Theron, Terblanche, and Boshoff 2008). Over time, if this relationship is maintained properly, it can evolve into a collaboration between solution provider and customer (Johansson et al. 2016). Such collaboration can result

in, for example, the solution provider taking responsibility for customer's activities (Raddats et al. 2016). Brax and Jonsson (2009) argued that such collaboration must offer more benefits than the customer can create on its own. Furthermore, the collaboration should decrease the customer's risk. Consequently, with the increased responsibility, the solution provider takes a central role of the activities taking place in the customer's sphere and, thus, the solution supports activities in the customer's sphere.

Furthermore, Johansson (2016) revealed the difficulty of achieving solution quality. A common view among solution providers are that value is created during the production of components. However, when solutions are provided, this view must change into see value as created during the interaction with customers and during usage. This is in line with the view of value creation by Grönroos and Voima (2013), which in turn corresponds to Hakanen and Jaakkola, (2012) that address the importance of customer co-creation during solution development (Friend and Malshe 2016). When the view that value is created during usage is taken, it will enable solutions that cohere better with the activities taking place in the customer's sphere. In addition, since value is created during the interaction, the activities taking place in this sphere are important for the solution provider to have knowledge about (Grönroos and Voima 2013). During this interaction, the solution provider has an opportunity to influence the customer's perception of the offering (Grönroos and Helle 2010). Hence, in line with the results from Johansson (2016), to improve quality of solutions, the solution provider should see value as created in all three spheres of the studied dyad.

There are no shortcuts to achieve quality of solutions. A further aspect to take into account when discussing solution quality is the long-term perspective (Johansson 2016). This concurs Storbacka et al. (2013) that argued for the need to initiate, with knowledge of internal processes, in order to ensure that the activities and components building the solution are reliable. Thereafter, the solution provider maintains customer relationships during the interaction to enable an increased knowledge of the customer's sphere (Storbacka et al. 2013). Like the customer relationship, the needs and activities within the customer's sphere are dynamic and change over time. Therefore, a solution provider must adapt and change the content of the solution to suit the specific customer. This corresponds with Brax and Jonsson (2009), who argued that a provided solution consists of complex customer specifications, which allows the solution to solve customer problems related to the customer's activities. Thus, each solution should be customised to fit the customer's activities, which could support the customer's ability to differentiate itself from other competitors. However, other researchers have argued that the initial solution is co-developed and customised for one specific customer (Biggemann et al. 2013). Thereafter, a solution platform

consisting of components and activities supporting the solution provision, is created (Storbacka and Pennanen 2014). These arguments both contradict and concur with the solution quality concept. Hence, standardising components that build a solution would simplify the assurance of the solution provider's internal activities to support solution quality. On the other hand, a standard solution would decrease the ability to create unique benefits. Consequently, it appears difficult to use a component platform and simultaneously customise the solution. However, Storbacka and Pennanen (2014) argued that the solution provider can overcome this challenge by developing a solution, based on several standard components, in collaboration with the customer.

To conclude, the solution quality concept encompasses the three spheres of the dyad. The concept can be operationalised with the use of the discussed quality dimensions and the prerequisites for the concept. In addition, it is argued that the solution provider must see to value during usage to increase the awareness of the customer's activities and to provide solution quality. This result is in line with Paiola et al. (2013) and Storbacka (2011), who claimed that customer relationships, knowledge of processes and support from internal activities are necessary for successful solution provision.

5.2 Managing solution quality with interventions

The quality dimensions that have been argued to support the operationalisation of solution quality can be related to the management of quality. These dimensions are not equal to principles, but the same assumption – that activities emphasising a dimension can provide its improvement – is applicable. That is, each dimension can be supported by interventions through the use of practices and techniques (activities) (Hackman and Wageman 1995). This is in line with Johansson, Witell, and Rönnbäck (2013), who argued that four of the five quality principles – management commitment, process orientation, employee orientation and continuous improvement related to the provider's sphere – were emphasised first. Thereafter, focus shifted toward the principle customer orientation. Sila and Ebrahimpour (2002) contradict this research by suggesting that customer orientation is the most commonly referred quality principle, closely followed by management commitment and other principles supporting internal activities taking place in the provider's sphere. However, the internal activities are emphasised when interventions are used to support and improve principles (Poksinska et al. 2010; Talib, Rahman, and Qureshi 2011).

Furthermore, Johansson, Witell, and Rönnbäck (2013) showed that the provider can change orientation when using interventions that aim to change a specific quality principle. That is, employee-oriented providers can change their orientation towards processes. However, this can only be accomplished after carefully chosen

interventions that target a specific principle are conducted (Assarlind et al. 2013). For example, interventions aiming at a change of a principle comprising external activities will improve the performance of that principle (Johansson, Witell, and Rönnbäck 2013). This implies the need to contemplate long-term planning for enabling a change of the provider's orientation. This discussion partly contradicts the studies performed by Ahire (1996) and Johansson, Witell, and Elg (2013), whose results show that no change in emphasised principles occurred over time. For instance, they showed that the principle management commitment was emphasised during the initiative and was also the most emphasised principle over time. These two studies are based on quantitative data, including hundreds of providers, that showed the relation between emphasised principles over time. However, since these studies did not make any active effort to actually change the emphasised principle over time, the emphasised principle did not change. Johansson, Witell, and Rönnbäck (2013), on the other hand, actively supported the provider, over the course of several years, to realise the change of emphasised principle. This long-term work resulted in a changed orientation within the provider's sphere. This result supports the present discussion, that the right intervention will affect the targeted principle and, over time, change the provider's orientation.

If the discussion above is used in relation to the research on solutions, it concurs with Storbacka (2011), who argued that a solution should be supported by capabilities and managerial activities. These capabilities are not equal to interventions, but a solution provider can learn from the studies related to the use of interventions to provide a change in a principle. Firstly, it is possible to change orientation within the provider's sphere. That is, when looking at providers' servitizing, a solution provider must move away from product-oriented activities towards activities that support services and finally solutions (Löfberg, Witell, and Gustafsson 2015). Consequently, the solution provider can change orientation by carefully selecting the right intervention to affect the targeted principles. Secondly, the results discussed above argue that interventions should initiate emphasis on internal activities supporting the solution (Johansson 2016). Thus, when these activities and components manage to support the solution, the solution provider can start to expand and use interventions supporting the interaction and the customer's sphere (Storbacka 2011). Consequently, internal well-functioning processes are useful when traditional product providers extend their offering portfolio to include solutions.

The change of orientation within the provider's sphere takes time, but can enable a solution provider to increase the portfolio of offerings without a decrease of support from internal activities. That is, over time and with the right interventions, the solution

provider can enable components and activities building solutions to be reliable and of high quality; see Figure 12.

Figure 12 The solution quality framework

To conclude, the solution quality framework shows that the interventions performed by the solution provider, comprises activities that enable the improvement of solution quality. This is accomplished through the influence of interventions on principles, prerequisites and quality dimensions. The prerequisites and quality dimensions are influenced by interventions, both directly and indirectly through the principles. That is, the activities comprised by the interventions, when carefully chosen, provide a change of working procedures within the provider's sphere (Johansson, Witell, and Rönnbäck 2013). Thus, the intervention can provide a change in emphasised principles, dimensions and/or prerequisites. For instance, the principle process orientation will influence the knowledge of the activities within the provider's sphere. In addition, the dimensions related to process orientation will be affected by that principle. Furthermore, the dimensions and prerequisites building solution quality, are inter-related. That is, the prerequisite, knowledge of processes, influences the corresponding solution quality dimensions. For example, the dimensions reliability and tangibility are influenced by knowledge of the activities taking place in the provider's sphere (Johansson et al. 2016). In addition, solution quality dimensions influence the prerequisites. For example, the dimensions, empathy and communicability influence the prerequisite customer relationships. Finally, the dimensions and prerequisites improve solution quality. Thus, the right interventions related to the provider's sphere, the sphere of interaction and the customer's sphere, can provide an improvement of solution quality. This argument is in line with and extends research on solution providers servitizing (e.g., Paiola et al. 2013; Storbäck et al. 2013). It further corresponds to Jayaram and Xu (2016) that argued for internal activities to influence the improvement of quality performance.

5.3 Customer involvement as intervention

Previous research has addressed the involvement of customers during new solution development to increase customisation and thereby contribute to the solution's success (e.g., Brax and Jonsson 2009; Hakanen and Jaakkola 2012; Storbacka 2011). Customers are generally seen as contributing with knowledge about their preferences and are therefore involved during new product and new service development (Mahr, Lievens, and Blazevic 2014). This is in line with Chen, Tsou, and Ching (2011), who argued that the involvement of customers increases the awareness of customers' thoughts and opinions. However, the involvement takes a different character depending on whether products, services or solutions are developed (Kindström and Kowalkowski 2009). A solution provider with usually product-oriented innovations meets challenges when developing services and solutions (Löfberg 2014) and must look to how service are developed. Consequently, a solution provider can be inspired by research on customer involvement in new service development and, in particular, in a manufacturing context when improving solution quality.

For service innovation, researchers have argued that the customer should have an active role during the development. That is, the involvement of customers is related to an increased service innovation performance and firm performance (Carbonell and Rodriguez-Escudero 2014; Frambach, Fiss, and Ingenbleek 2016). Witell et al. (2011) showed that traditional market research methods were best used to capture customers' spoken needs. However, in order to capture latent needs, proactive market research methods such as the lead user method and frequent connection with customers during usage, are needed. That is, different types of customer needs are revealed depending on whether proactive or reactive market research methods are used. This is in line with Johansson, Raddats, and Witell (2016) showing that if the customer was less involved during the development, resulting in radical service innovations, it led successful new services. For incremental service innovations, the case was the opposite. That is, when the customer was involved to a high degree during the development, the incremental service innovation was more successful. So, for radical service innovations the customer should be involved less compared to incremental service innovation, where the customer should be involved more to increase service innovation performance. Furthermore, Carlborg (2015) took the new service development a step further and argued that the provider should participate during the customers usage of the new service, since it increases knowledge of the service's usage. This concurs with Hakanen and Jaakkola (2012), who argued for collaboration between solution provider and customer throughout the solution development (Isaksson, Larsson, and Öhrwall-Rönnbäck 2009). Hence, the development activities performed jointly together affects many factors contributing to solution quality. For

instance, dimensions such as, adaptability and communicability and the two prerequisites, customer relationship and knowledge of processes, will gain from this collaboration.

The above discussion corresponds to previous research performed on solution development (e.g., Biggemann et al. 2013; Brax and Jonsson 2009; Hakanen and Jaakkola 2012) stating that increased customer involvement during solution development results in coherence of the solution with the customer's activities (Friend and Malshe 2016). This is in line with the discussions held in the previous subsection that an increased involvement of customers (increased customer relationship) will contribute with gained knowledge of activities taking place in the customer's sphere, which in turn leads to improved solution quality. This is also supported by Storbacka and Pennanen (2014), who argued that the solution provider should identify so-called lead customers, who are seen as representative of a market segment. The solution provider should then collaborate with the identified customers during the solution development. This collaboration is seen as beneficial for both parties. Hence, the customer's outcome is a solution that is well adapted to its activities and the solution provider's outcome is a solution platform that can be used as base when developing new solutions in the future. Furthermore, Johansson, Raddats, and Witell (2016) identified a positive relationship between customer involvement during new service development and the performance of service innovations. The service innovation performance, in turn, influenced the manufacturers' overall performance. This is in line with earlier research on services in manufacturing firms (Carlborg 2015; Eloranta and Turunen 2015; Fang, Palmatier, and Steenkamp 2008; Gebauer, Gustafsson, and Witell 2011). This is useful for solution providers developing new solutions. They can be inspired by activities and techniques used that concerns the customer involvement during the different development phases (e.g., Carbonell, Rodríguez-Escudero, and Pujari 2009; Witell, Gustafsson, and Johnson 2014) to improve quality of the provided solution.

6 CONCLUSIONS AND IMPLICATIONS

The purpose of this thesis was to increase knowledge about how to manage solution quality. This closing chapter presents the conclusions of this thesis, the theoretical and managerial implications, limitations, and areas identified for future research.

6.1 Conclusions

Research on quality can be traced back over centuries and many different quality concepts have been used throughout the years, within many research fields. This thesis revealed, five quality categories and quality management that were identified as relevant to understand quality in a dyad of customer and provider. Some of the quality categorises are resource-bounded (product, service and e-service quality) while others are activity-bounded (relationship and communication quality). The point is that an improvement in any quality category contribute to improving the perception of a solution. However, it is not enough to improve the solution provision and achieve high

solution quality. Consequently, this thesis has increased the knowledge of the solution quality concept.

The solution quality concept is built by seven quality dimensions – *reliability*, *communicability*, *internal consistency*, *empathy*, *approachability*, *tangibility*, and *adaptability* – tighter related to the operationalisation of activities taking place in the provider's sphere and during the interaction with the customer. Each dimension influences the perception of the solution. In addition, *customer relationship* and *knowledge of processes* are prerequisites for achieving solution quality, these are related to all three spheres of the dyad. Furthermore, solution quality is defined as when the solution is perceived as an entity with unique benefits in relation to the customer's activities and needs.

In addition, the prerequisites for and quality dimensions of the solution quality concept can be influenced by interventions. That is, when a provider changes orientation towards solutions, the use of interventions provides a change of dimensions and prerequisites and, in turn, a changed orientation. While managing for solution quality, the solution provider initiates with interventions targeting the dimensions related to activities taking place in the solution provider's sphere. Thereafter, interventions targeting the interaction and customer's sphere are conducted. For example, the added intervention, customer involvement during solution development can, when used, improve the solution provider's knowledge of activities in the customer's sphere that in turn will support improvement of solution quality.

This thesis has been influenced by the research on quality, servitization and customer involvement during new service development. This made it possible to increase knowledge of how a solution provider can manage to provide solutions of high quality. The solution quality concept, extends the research on quality by covering all spheres of the dyad in this thesis. In fact, all discussed quality concepts in this thesis contribute to the quality of solutions; see Figure 13.

Figure 13 Extending the research on quality with solution quality

The intention of Figure 13 is to show that existing quality concepts in the research on quality has a relation to solution quality. It also shows that the findings in this thesis are necessary in order for research on quality to support complex offerings such as solutions that are present in all parts of the dyad; that is, the provider's sphere, the sphere of interaction and the customer's sphere. The added intervention, customer involvement during solution development, emphasises the interaction and customer's sphere to support the improvement of solution quality. In addition, some of the concepts are similar; that is, the research on quality categories, for instance, can influence the solution quality concept. For example, the prerequisite customer relationship discussed here has many similarities with the quality category relationship quality. Both concepts are built on trust and mutual understanding between provider and customer that develops over time. Furthermore, the categories of product quality and service quality contribute to and support the solution by components of high quality, just as the other quality categories included in the model contribute to high-quality solutions

6.2 Theoretical implications

This thesis has contributed to the research on quality and servitization. In particular, the thesis contributes to the stream of research concerning what quality is for a solution and the active involvement of customers during the service and solution development in manufacturing firms. Furthermore, it adds to the literature by synthesising findings from research on servitization and solutions and identify how these can contribute to further research on quality. The theoretical contributions are threefold.

First, the definition and further knowledge development of solution quality contributes to the research on quality. The contribution focuses on the seven dimensions and two prerequisites of the solution quality concept. Research on quality has traditionally focused on the internal activities improving the quality of a product or service (e.g., Gremyr and Elg 2014; Nilsson, Johnson, and Gustafsson 2001). The present thesis adds to this understanding by elaborating on the influence of provider's knowledge of customers' activities on solution quality. That is, with the increased knowledge of the customer's activities and that value is created during usage, prerequisites for solution quality will be influenced. In addition, the different quality dimensions building solution quality contributes to theory with the further development and enrichment of existing dimensions that build product and service quality.

Secondly, previous research on quality has argued that interventions can influence a change in working procedures within the provider's sphere (Hackman and Wageman 1995). The solution quality framework presented in this thesis contributes to this research discussion by further showing and arguing for the relations between interventions, principles, quality dimensions and prerequisites. Although earlier studies have shown that the use of interventions can provide a change (Assarlind et al. 2013), this thesis extends this by contributing to the influence of interventions on the quality dimensions and the prerequisites of the solution quality concept. Following this, interventions can provide an improvement of quality of provided solutions. Furthermore, the introduced framework of solution quality, provides an overview of how the solution provider's internal activities influence the activities taking place both during interaction and in the customer's sphere to influence solution quality.

Thirdly, research on the use of customer involvement during new service and solution development contributes to research on quality and servitization. To research on quality, the main contribution is that the customer is seen as an active provider of information and used in the development of a new solution, rather than a passive source of information (e.g., Winter 2000). This improves quality of the solution. To the research on servitization, the theoretical implication is the involvement of customers during new service development within manufacturers. Previous research has shown that service innovation influences manufacturing firm's overall performance (Eloranta and Turunen 2015; Fang, Palmatier, and Steenkamp 2008; Lightfoot, Baines, and Smart 2013). In detail, this thesis tests the effects of involving customers to different degrees in manufacturers' new service development. The results showed that the service innovation degree (incremental and radical) influenced the relation between customer involvement in new service development and service

innovation performance. Furthermore, the degree of service innovation has an effect on the manufacturers overall performance.

6.3 Managerial implications

This thesis has also made three managerial contributions. Firstly, with support based on findings from two of the studies, this thesis contributes with the increased knowledge that conducting the right interventions can provide a change of working activities within the provider's sphere. That is, the use of interventions can influence an improvement of quality dimensions and prerequisites for the solution quality and other offerings.

Secondly, this thesis contributes to the further extension of customer involvement during new development, particularly during service development in manufacturing firms. That is, involving customers during new service development leads to more successful incremental service innovations. In turn, making radical service innovations when customer involvement during new service development is low leads to a higher overall firm profit for the manufacturer.

Thirdly, this thesis shows that aiming for solution quality takes time and must be built on a customer relationship consisting of trust and mutual understanding. Two of the studies revealed that internal challenges were met first to improve product and service quality, after which the firms turned to improving the quality of the provided solutions. Furthermore, the customer relationship enabled solution providers' improvement of solution quality through increased knowledge of the activities taking place in the customer's sphere.

6.4 Limitations and further research

The current study may be viewed as a first attempt to understand the concept of solution quality. As is usually the case when digging deep into a subject, more questions and interesting research areas are identified. The identified limitations may also contribute to ideas for future research.

Like all research, this thesis has certain limitations. Concerns can be raised due to the fact that the customer was not involved when investigating a concept building on the customer's perception of a provided offering. One possible argument would be that this study, which addresses solution quality, does not explore the customer's sphere. However, this study focused on the solution provider's ability to manage quality and, in particular, investigated the solution quality concept. However, this limitation is taken into consideration and is discussed further on.

In line with the presented limitation, empirical data collected from the customer's sphere is missing. To gain an even deeper understanding of solution quality, this view is needed. Taking this perspective while investigating the concept would contribute to more nuances and challenge the quality dimensions and prerequisites presented in this thesis.

Furthermore, the studies in this thesis have taken an investigative character when increasing the knowledge of solution quality. Therefore, future studies could test theory around this concept by making additional confirmatory studies. This would contribute to an increased knowledge of the identified relationships between the interventions, quality dimensions, prerequisites and the solution quality concept. The effect of solution quality on firm performance is another interesting research idea, especially when customers are involved during the solution development.

Finally, research on quality categories and management has been examined in this thesis, which has revealed the large scope of research conducted on quality. Within the research fields of operations management, marketing, service marketing and strategic management alone, a tremendous amount of research on quality categories, quality management or quality satisfaction has been identified. Therefore, this thesis ends with a call to structure all of the literature related to research on quality. Consequently, a structured literature review will show the relations among all existing quality concepts.

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The activities performed during the ATIT research project

Papers

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