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Return on Quality or Just Returning Customers?

A Study of the Return on Quality in an After-Market Setting

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Abstract:

Companies with efficient after-market service operations are better at securing long-term growth and thus remain competitive facing an intensifying global competition (Jacob & Ulaga, 2008). One way of achieving operational efficiency is to invest in quality. Scholars propose that quality of operations not only reduces costs, but it also has beneficial effects on customer satisfaction, retention and repurchase behaviour. In an influential article, Rust et al., (1995) argued that (1) *Quality is an investment.* (2) *Quality efforts must be financially viable.* (3) *It is possible to spend too much on quality.* (4) *Not all quality efforts are equally valid.* The present study empirically investigates whether there is a Return on Quality (ROQ) in an after-market operation setting. We conceptualize quality in two different ways in our study; operating performance which is followed up internally, and quality that customers perceive (customer satisfaction). Analysing internal company data from four of the studied organisation's major markets, we find weak support for the ROQ in an after-market setting. First of all, operating performance measures do not fully explain the variation in customer satisfaction. Second, customer satisfaction is only weakly linked to purchasing behaviour in the short run. Finally, we do find some indications of a positive relationship between operating and financial performance, but the improvements in operating performance need to be relatively large. Given our ambiguous results, we believe that the ROQ is difficult to achieve in the short term, and propose further research of long-term customer behaviour based on the customers' current satisfaction with after-market services.

Keywords: Customer Satisfaction, Operating Performance, Return on Quality, Supply Chain Management, After-Market, Longitudinal Analysis, Cross-Sectional Analysis

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Julia Appelgren and Oscar Nordling

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1. Introduction

After-market services are becoming increasingly important for industrial companies in today's highly competitive markets. Current management literature is almost completely unanimous in suggesting that companies should focus more on their service operations (Oliva & Kallenberg, 2003). The logic behind this is that companies with efficient after-market operations are better at securing long-term growth and thus remain competitive in today's market (Jacob & Ulaga, 2008). First of all, there is increased revenue potential due to the often higher margins from services and a more stable revenue stream that is less affected by economic downturns. Secondly, customers nowadays demand more services because of their own pressure to become more efficient and focus on core competencies. Finally, services are much harder for competitors to imitate and thus become much more of a competitive advantage (Oliva & Kallenberg, 2003).

In this study we investigate if an industrial company, which has previously focused on its products, can leverage the opportunities in its after-market operations. The company has taken steps to improve its after-market service quality by, among other things, initiating a supply chain management project. This is in line with marketing theory logic, proposing that investing in quality should result in a positive financial outcome. This positive financial outcome stems from either or both of two sources; increases in revenue (e.g. Nagar & Rajan, 2001) and reduction of costs (e.g. Ou et al., 2010). Rust et al. (1995) argue that there is a positive return on quality through the "Return on Quality" (ROQ) model. In it, they state that: (1) *Quality is an investment.* (2) *Quality efforts must be financially viable.* (3) *It is possible to spend too much on quality.* (4) *Not all quality efforts are equally valid.*

The purpose of this study is to investigate the Return on Quality in an after-market setting. More specifically, we try to answer the call in the previous literature for a more in-depth and longitudinal case study to identify whether there is an opportunity to invest in operational quality improvements and get a positive return, and if such is the case, what to invest in (Zeithaml, 2000).

Defining the term "quality" is not an easy task, nor is the operationalization of it in a measure straightforward. We conceptualize quality in two different ways in our study. First, we think of quality as the operating performance which is followed up internally – e.g. how many deliveries have been packed correctly. Thereafter, it is defined as the quality that customers perceive – e.g. the customers' satisfaction with the deliveries. Of course the last definition is the ultimately important one, as it is up to the customer to make a purchasing decision based on, among other things, the perceived quality of the service. For this reason we measure both customer satisfaction and operating performance in this study. We then analyse how gross profit and revenues relate to quality improvements to find out if there is a positive return and how large it is.

The relationship between operating and financial performance has been studied earlier in both single and multiple case studies (see the condensed compilation of previous studies in Appendix E), but not in an after-market setting as we intend to do. In order to link financial and operating performance, many previous studies have used customer satisfaction (see Appendix E), which is also our intention. The contribution to previous research in this particular area is that by using data from four different countries over a period of three to five years, our study is both longitudinal and cross-sectional.

1.1. Disposition

The remainder of this paper is disposed as follows. The 2nd section covers previous research investigating the relationship between operating performance, financial performance and customer satisfaction. In the 3rd section we describe the methodology used in this study and thereafter present the data set in section 4. The 5th section contains an analysis of the findings as well as a discussion of the validity and reliability of our findings. Finally our conclusion is followed by suggestions for further research in the 6th and 7th sections respectively. Tables and graphs supporting our analysis are enclosed in the Appendices.

2. Previous Research

In this section, we introduce the reader to the body of research overlapping with the topic of this study. We cover the relationships found between customer satisfaction and organizational performance as well as operating and financial performance. In the end of the section, a short summary of theory and empirical findings in previous research is presented together with what the present study will contribute to the research field. A condensed compilation of previous studies is enclosed in Appendix E.

In the end of the eighties and the beginning of the nineties, the "total quality" mantra swept the world (Greising, 1994). Articles such as "How to Deal With Tougher Customers" (Rice, 1990) made most companies providing some kind of service aware of the importance of quality for customers. However, this kind of blind focus on quality without caring for the costs eventually led to the demise of a number of companies (Greising, 1994). This led to a new way of looking at quality, the so called "Return on Quality" (ROQ) model by Rust et al. (1995).

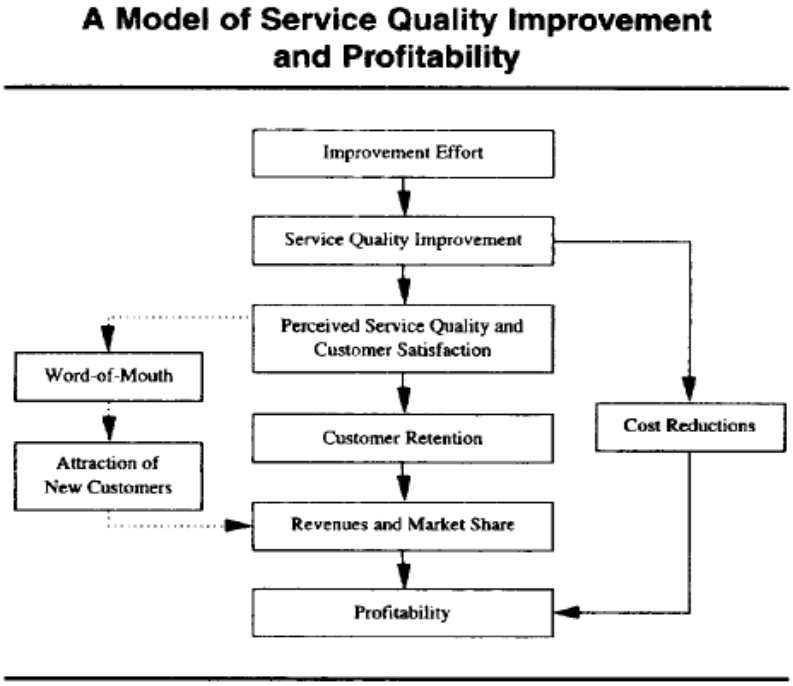


Figure 1. "Return on Quality" (ROQ) model from Rust et al. (1995)

As can be seen in Figure 1, Rust et al. (1995) suggest that quality efforts lead to increased customer satisfaction, which then supposedly leads to increased retention and also attraction of new customers through Word-of-Mouth, increasing the firm's revenues and, together with cost efforts, profits. In addition to this, customer satisfaction has also been suggested to increase several other revenue drivers, most protruding "Share of Wallet" (Mägi, 2003), which is the share of one customer's total spending with a certain supplier. Of the above however, customer retention has by far received most attention.

The idea that increased retention from increased customer satisfaction leads to profit growth has been suggested by various other authors, such as Heskett et al. (1997) with their "Service-Profit Chain", and Anderson & Mittal (2000) with their more general "Satisfaction-Profit Chain" (see Figures 2 and 3). Whether this is true or not has been widely debated within the academic community.

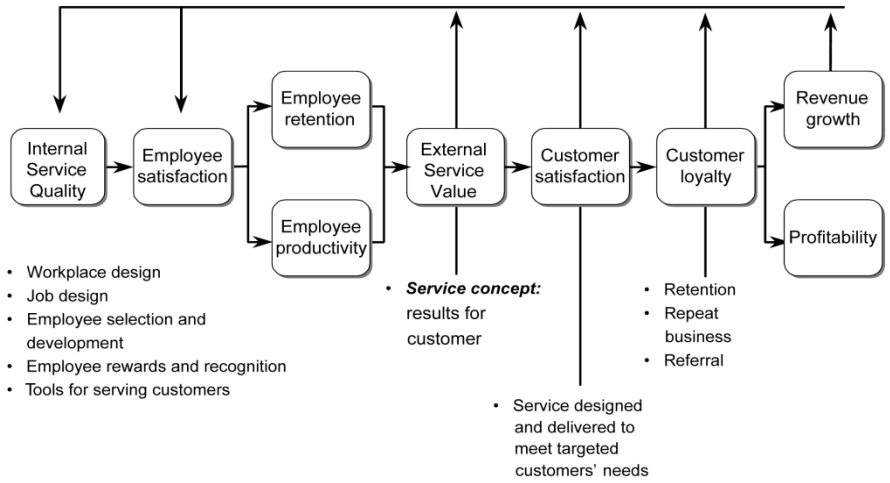


Figure 2. "Service-Profit Chain" adapted from Heskett et al. (1997)

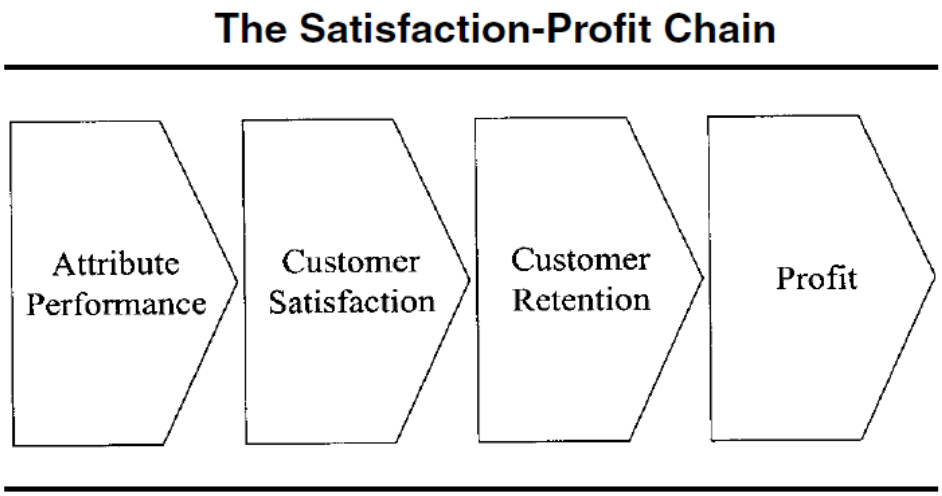


Figure 3. "Satisfaction-Profit Chain" from Anderson & Mittal (2000)

2.1. Customer Satisfaction and Organisational Performance

One of the earliest and most comprehensive studies of the subject was done by Ittner & Larcker (1998). In the first part of their study, they use a random sample of 2491 business customers buying a specific service in 1995 from a major US telecommunications firm.

They conclude that customer satisfaction is a significant predictor of future customer behaviour, in terms that higher satisfaction levels result in higher retention rates.

However, they find that the explanatory power of customer satisfaction on retention is low and therefore suggest that it is only one of many factors explaining customer purchase behaviour in this segment of the telecommunications industry. In the second part of their study, Ittner & Larcker (1998) investigate how increased satisfaction is related to costs, profits and the amount of new customers on a business-unit level. They conduct these tests using data from 73 retail branch banks of a leading financial services provider in the US. This part of the study indicates that satisfaction measures have some predictive ability for future accounting performance, but that many of the accounting gains seem to come indirectly from growth in new customers rather than directly through increased profits from existing customers, somewhat disagreeing with Mägi (2003). They also conclude that there are "thresholds" in customer satisfactions which have to be met in order to increase number of customers and branch performance, and that these are fairly large.

In her 2000 literature study, Zeithaml did a summary of the findings regarding service quality, profitability and the economic worth of customers so far. While acknowledging that perceived service quality and customer satisfaction are strongly related but somewhat conceptually different constructs (a difference she chose not to focus on as the two in practice are treated as virtually the same), she came up with a number of valuable conclusions:

1) In terms of the *direct relationship* between service quality and profits, she concludes that what we know is that both positive and negative relationships have been confirmed. What we need to learn is what marketing and managerial variables moderate the relationship.
2) The offensive effects of service quality (see Figure 4), defined by Fornell & Wenerfelt (1987, 1988) as the impact of service on obtaining new customers, require considerable research according to Zeithaml. Most of what is currently known comes from the PIMS (Profit Impact of Marketing Strategies) cross-sectional company database with its inherent limitation of no direct measure of perceived service quality.
3) For the *defensive effects* of service quality (see Figure 4), defined by Fornell & Wenerfelt (1987, 1988) as the impact of service on keeping customers the firm *already has*, what we know according to Zeithaml is that retention in itself positively affects profits. Citing among others Reichheld & Sasser (1990), Heskett et al. (1997) and various empirical studies of the Service-Profit Chain (e.g. Loveman, 1998), she argues that it does so through lowered costs, increased purchases, willingness to pay a price premium, and positive word-of-mouth. She does conclude however that we need to learn how service quality variables influence retention and its financial outcomes.
4) Regarding the *relationship between service quality and purchase intentions*, she finds it has sparked sufficient research linking perceptual measures of service quality and purchase intentions, but insufficient work tying purchase intentions to purchase behaviours.

5) In terms of *individual customer and segment profitability*, Zeithaml concludes that what we know is that all customers are not equally profitable. We need to learn how to identify, to reach, and to respond to customers at different levels of profitability.

6) For *key drivers of service quality, customer retention and profits*, she finds that we know the key drivers of service quality, but that we need to learn the key drivers of behavioural intentions, purchase, customer retention, and *financial outcomes*.

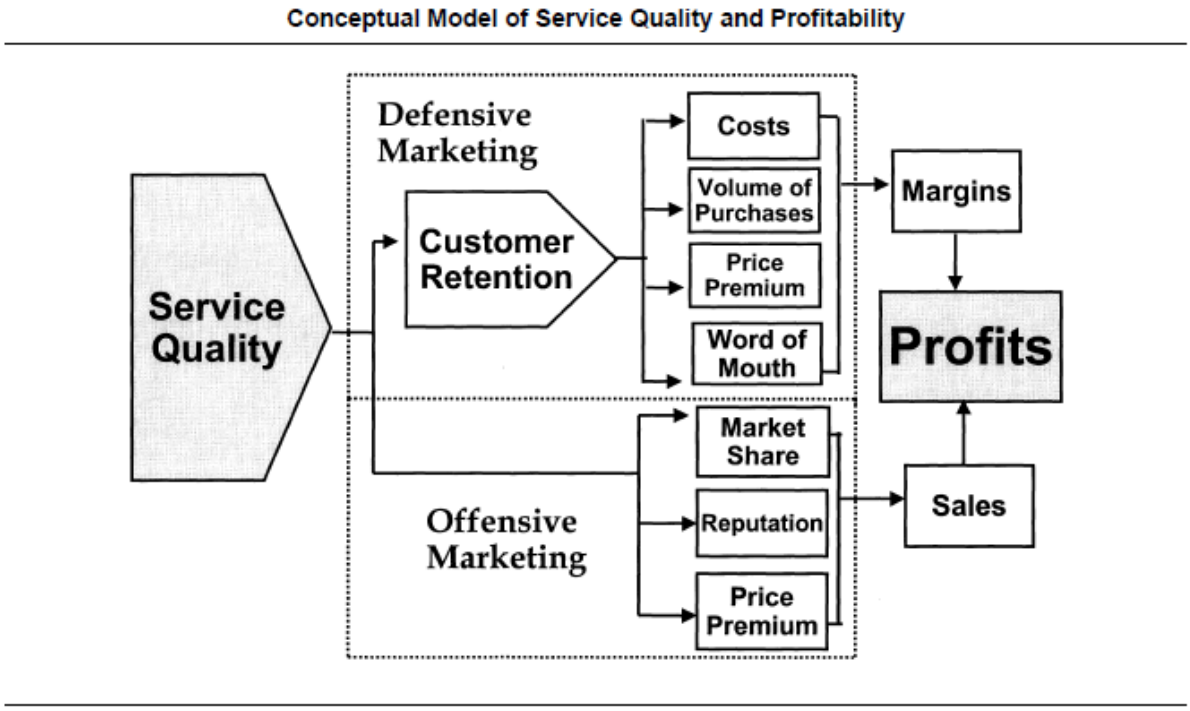


Figure 4. Conceptual Model of Service Quality and Profitability from Fornell & Wenerfelt (1987, 1988)

Zeithaml (2000) notes that virtually all research so far have been cross-sectional studies spanning companies and industries. Although she finds them invaluable for demonstrating general relationships of interest to academics and scholars, she suggests that firms are also highly interested in more managerial evidence of the relationship. According to her, longitudinal approaches that involve satisfaction and financial performance data in individual firms are needed, as are more cross-sectional studies within firms that have multiple outlets such as automobile dealerships and franchises. One example of such a study is by Bernhardt et al. (2000), who find in their study of a US chain of fast-food restaurants that there is no significant relationship between customer satisfaction and profits in any given period, but that a change in customer satisfaction over time is positively related to a change in profit over time. They suggest that by only examining single-period data, previous researchers might have erroneously concluded that customer satisfaction is an unimportant managerial concern.

Williams & Naumann (2011) make similar conclusions in their longitudinal study of a Business-to-business (B2B) *Fortune 100* company with both manufacturing and service units, finding moderate-to-strong associations between satisfaction levels and financial performance, and strong links between customer satisfaction, and retention and revenue on a firm level.

In later research, the findings of Keiningham et al.'s (2005) study of an institutional securities firm in North America and Europe suggest that share of wallet is a mediator between customer satisfaction and revenue, as suggested by Mägi (2003). However, they find that customer revenue then only correlates positively with profit for profitable customers, and negatively with unprofitable customers. This is in line with Zeithaml's (2000) first conclusion and suggests that the chains in the Service-Profit-Chain and in the Satisfaction-Profit Chain might not be as simple as suggested in the models. Banker & Mashruwala (2007) continue this thought and suggest that based on the mixed results of earlier studies, the relation between non-financial measures, such as employee and customer satisfaction, and future financial performance may be contextual. As such, they decide to investigate the moderating role of competition on customer purchasing behaviour, doing a cross-sectional study of a large US department store chain. They find that employee and customer satisfaction are better leading indicators of financial performance in a competitive business environment than in a business area where competition is weak for both employees and customers. This suggests that it is mainly when the customers have a *plausible choice* in which firm to buy from that customer satisfaction really matters for profits. Bowman & Narayandas (2004) make a similar conclusion in a B2B context in their survey of customers of a major vendor in the processed metal business. Using and testing a modified version of the Service-Profit-Chain (see Figure 5) they conclude that customers that are more satisfied with competitor performance are likely to channel a greater portion of their total purchases to the competition.

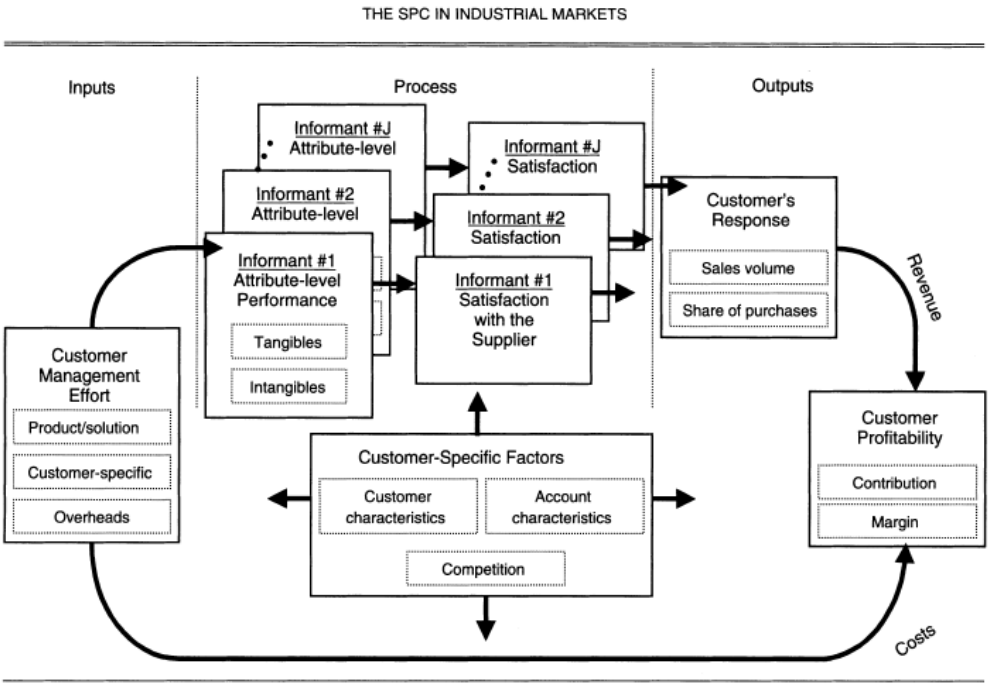


Figure 5. "Service-Profit Chain" in industrial markets from Bowman & Narayandas (2004)

Ittner & Larcker (1998) make a similar suggestion in the third part of their study, where they look at industry differences between stock market reactions on changes in customer satisfaction. They also find that the food processing industry has a negative relationship, which they propose might be due to the already high scores in the industry, making customer satisfaction less of a competitive advantage.

In a well cited article, Anderson et al. (1997) use customer satisfaction indices from the Swedish Customer Satisfaction Barometer (SCSB) and find that customer satisfaction is positively related with productivity for goods but negative for services, and that while customer satisfaction is positively related to ROI for both, it is significantly less so for services than goods. They find this especially to be true for services where competition is low, such as gas stations and department stores (where location in general is the deciding factor). The above articles suggest that customer satisfaction in itself might not be a very good predictor of future financial performance, but must be related to the market and how the firm's competitors are doing (or to itself in previous periods such as in Bernhardt et al., 2000). Contextuality is also touched upon by Bourne et al. (2005) who, based on their multiple case study in a UK-based company providing repair services, suggest that the way performance measurements and business performance are related in studies might be too simplistic and not take into account necessary contextual variables.

A field not touched upon by Zeithaml (2000) is *how*, rather than *if*, customer satisfaction is linked with profit. The relationship between customer satisfaction and profit is not necessarily linear (Rust et al., 1995; Ittner & Larcker, 1998; Bowman & Narayandas, 2004). In addition to suggesting the ROQ-model, Rust et al. (1995) find that investments in quality generally have diminishing returns, resulting in the conclusion: *"It is possible to spend too much on quality."* In their very comprehensive study, Ittner & Larcker (1998) also conclude that the return on customer satisfaction is diminishing at high satisfaction levels. Bowman & Narayandas (2004) also find that profits and profit margins show diminishing returns from increased customer satisfaction in a B2B context.

While many studies find relationships between customer satisfaction and profit, many do not. Using longitudinal panel data from 36 retail branch banks in Taiwan managed by an international financial institution, Yu (2007) does not find any significant relation between customer satisfaction and customer profitability. She does however find that both customer costs and revenues increase as customer satisfaction improves. A similar finding is done in a longitudinal study by Wiersma (2008) when testing for the information content in two non-financial measures which are believed to be closely related to customer satisfaction – absence frequency and on-time delivery. Using a proprietary database of 27 responsibility centres of a large Dutch service firm, he finds that when trying to predict future performance, these two measures do not have more relative information content than lagged financial measures. However, he concludes that they do have incremental information to lagged financial data when it comes to predicting both future costs and revenues.

An implication of Wiersma's (2008) findings is also that it may be difficult to study the relationship between financial and operating performance, even when using time series data sets, and that studied relationships may be spurious due to the overlap in information content.

All in all, we can see that there have been various studies on the subject of customer satisfaction and financial performance, with a number of different results. There have been several models created, and while most suggest a direct linkage between customer satisfaction and profit, studies trying to confirm this relationship have had varying results. In general however, there seems to be some kind of relationship, *especially* when focusing on and adjusting for specific variables (Nagar & Rajan, 2001; Bowman & Narayandas, 2004; Mittal et al., 2005; Bourne et al., 2005; Banker & Mashruwala, 2007; Wiersma, 2008), and when investigating non-linear relationships (Rust, et al., 1995; Ittner & Larcker, 1998; Bowman & Narayandas, 2004). As such, we believe that while a lot of the topics suggested by Zeithaml (2000) have been investigated, there are still a number of important ones left. In our study, we will therefore try to answer one that we believe is among the most important ones for many companies: *"Where should investments in service quality be made to have the greatest impact on service quality, purchase, customer retention, and financial outcomes?"* (Zeithaml, 2000), or in other words; which factors affect customer satisfaction enough for getting a positive return from investing in them?

In previous literature, supply chain management has been regarded as an important way for increasing customer satisfaction, especially in B2B relations. In their study of the future sales implications of product quality measures for 11 plants of a manufacturing group in a *Fortune 500* firm, Nagar & Rajan (2001) find that non-financial quality measures, such defect rates and on-time deliveries are related to upcoming profits, and that changes in external failure costs negatively affect profits for several quarters forward. As an example of this, they find that a $1 increase in external failure cost results in a $13 lowering of revenue per quarter in the two subsequent quarters. According to Li et al. (2006), supply chain management has since the 1980's been regarded as one of the most effective ways for firms to improve their competitive advantage, and documented to be positively associated with enhanced competitiveness and improved firm performance. A successful supply chain management implementation is suggested to enhance the relationship between upstream suppliers and downstream customers, and thereby increase customer satisfaction and firm performance.

2.2. Supply Chain Management and Organisational Performance

"[T]he literature portrays supply chain management practices from a variety of different perspectives with a common goal of ultimately improving organizational performance." (Li et al., 2006)

The literature provides conceptual and prescriptive statements regarding best practice supply chain management and its impact on organisational financial performance.

An example is that efficient supply chain management helps the firm gain competitive advantage by offering a good level of service at the lowest possible cost (Aronsson et al., 2003). However, there is little guidance for supply chain management practitioners in general (Li et al., 2006) and, especially, on *how to determine* which level of service is optimal. In practice there will always be customers whose demands do not fit into mathematical models such as EOQ and Newsvendor Model[1]. The lack of practical methodology in the supply chain management literature may be what has led researchers to test the actual relationships between (operating) supply chain performance and the impact on the organisational bottom line. Below we cover studies which investigate the linkages between financial and operating performance.

Bharadwaj & Matsuno (2006) survey over 200 procurement professionals, asking them to rate their suppliers' performance, indicate future purchase intentions and their level of satisfaction. Supply chain efficiency, measured as Order management cycle[2] performance, is found to have a direct positive correlation with trust and indirectly correlate with customer satisfaction and repurchase intentions (see Figure 8).

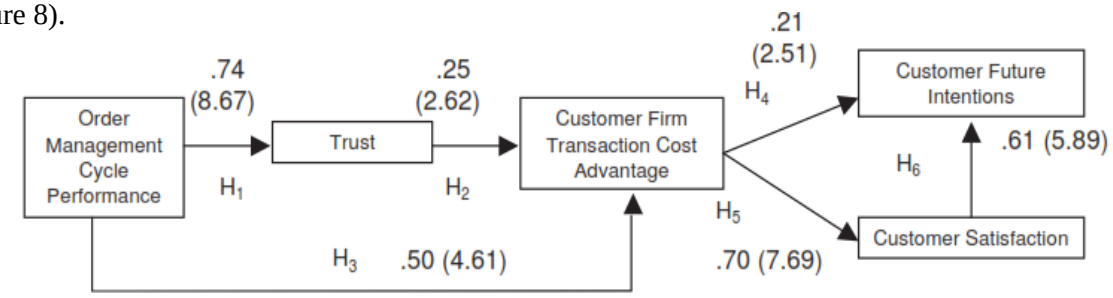


Figure 8. Standardised estimates in the Theoretical Model from Bharadwaj & Matsuno (2006)

Bharadwaj & Matsuno's (2006) findings are not unexpected, yet they illustrate that as one moves further in their model, from the operating performance indicator to trust, onwards to transaction cost advantage and finally to customer satisfaction and future purchase intentions, the strength of the relationship may weaken.

[1] EOQ: The Economic Order Quantity (EOQ) model computes the optimal order quantity which minimizes total storage (not to be confused with inventory value) and ordering costs. Newsvendor Model: This model is used to find the optimal inventory level given a demand distribution (e.g. uniform or normal)

[2] Order management cycle covers the critical activity sequence that a customer order follows from the time that the customer firm has placed an order through post-sales assistance

There are always moderating effects on all variables, especially in a cross-sectional study, although it makes perfect sense to think that improved management cycle performance should lead higher customer satisfaction.

The relationship between supply chain operating performance and financial performance is investigated by Li et al. (2006). They find support for the hypothesised positive relationship between supply chain management practices and organisational performance in a sample of 196 firms. Supply chain management practice variables include strategic supplier partnership, customer relationship, level of information sharing, quality of information sharing, postponement[3], organisational performance (operationalized as market share), ROI, growth in market share, growth in sales, growth in ROI, profit margin on sales and overall competitive position. In a similar study, Ou et al. (2010) find significant positive relationships between (1) supply chain management operating performance and customer satisfaction as well as (2) between operating performance and financial performance. In addition to this they test whether (3) customer satisfaction has a positive effect on financial performance and find support for this hypothesis as well, although the relationships is weaker than for (1) and (2). However, their sample size is smaller (95) and is limited to IT firms in Taiwan, compared to Li et al. (2006) who use a sample from a population of six industries in US. There is also some unclarity as of how Ou et al. (2010) choose to operationalize all of their variables – according to the study the respondents were asked about their attitudes on each topic, and there is no definition of neither operating nor financial performance in their report. In his 2008 study, which was mentioned earlier, Wiersma also finds a connection between operating and financial performance, as he discovers that an increase in on-time deliveries results in both lower future costs and higher future revenues.

After covering a relatively wide research area in a small sample of studies, we can see that there are inconsistent findings of how operating performance, specifically in supply chains, relates to financial performance. Researchers trying to handle this issue have so far done so by including contextual factors in their studies. The major gaps in literature seems to be on (1) the *organisational level*, as many studies are done across a large sample of firms and industries and (2) investigation of the relationship between operating and financial performance *over a period of time*. In addition to this, there is to our best knowledge no study which shows how practitioners working in after-market settings should be able to leverage from the intelligence which exists in the research community through practical guidelines. For this reason, we intend to use this study as an opportunity to further current research by bridging these gaps.

[3] Postponement is the practice of moving forward one or more operations or activities, making, sourcing and delivering, to a much later point in the supply chain

3. Methodology

This section focuses on the research methodology. First, we cover the design, statistical method, scope, and limitations of our study. This is followed by a short discussion about validity and reliability.

3.1. Study Design

The purpose of this study is to investigate the Return on Quality in an after-market setting. In order to achieve our purpose, the study is done in three steps as illustrated in Figure 9 and described in detail in sections 3.1.1. to 3.1.3.

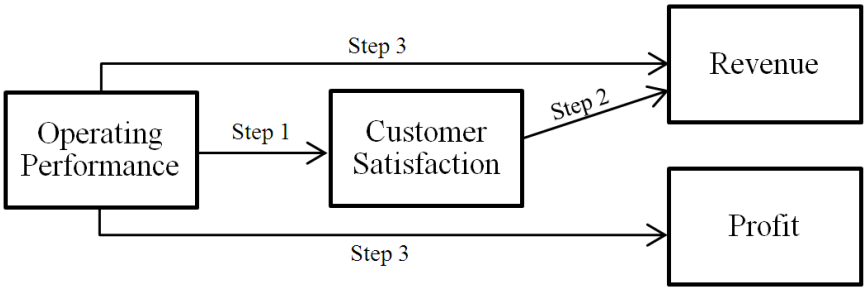


Figure 9. Illustration of the analysis steps in our study

3.1.1. Step 1: The Relationship between Customer Satisfaction and Operating Performance

First, we look at which operating performance variables (or factors) might affect customer satisfaction, in order to get a better understanding for the drivers of customer satisfaction in an after-market setting. The operating performance variables, defined and described in section *4. Empirical Data*, are Queries on Time, Backorders per Machine, Non-Conformances per Machine, Service Index, Delivery Days (Canada), Availability (Australia), Delivery Efficiency (South Africa), DC Delivery Performance, DC Stock Availability and DC Pick & Pack Quality. All of the operating performance variables are computed as 12 months rolling averages up to period *t*, while the customer satisfaction score, the dependent variable, is measured at period *t*. This is done in order to allow customers to react to after-market service performance. Due to customer satisfaction only being measured annually, a linear estimation based on the yearly observations is done in order to match it with the monthly observations. The analysis is performed on aggregate and country level data. Below follows our hypothesis and a general model specification.

Hypothesis 1: Better (worse) operating performance is associated with higher (lower) customer satisfaction

$$Customer\ Satisfaction_{t,m} = \beta_0 + \beta_1 * Operating\ Perfromance\ Variable_{i,12MonthsRollingAvg_t,m}$$

$t = time\ period\ in\ months\ (all\ operating\ performance\ indicators\ are\ followed\ up\ monthly)$

$i = the\ i^{th}\ operating\ performance\ indicator$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

3.1.2. Step 2: The Relationship between Total/Customer Revenue and Customer Satisfaction

In step 2, we investigate whether there is a connection between customer satisfaction and customer revenue in an after-market setting, both on an individual customer and aggregate level, in order to ensure that the positive relationship, which almost all previous studies in this field have found, also exists in an after-market setting. We perform a test on *absolute values* on the aggregate level, meaning that we regress revenue in period *t* on customer satisfaction score in the same period. As in step 1, customer satisfaction is linearly estimated to fit with revenue data. A test of changes is then performed on a sample of returning customers. In this test, we regress a percentage *change* in revenue between two periods (years) on a *change* in customer satisfaction over the same periods. Below follow our hypotheses and general model specifications.

Hypothesis 2 (a): Higher (lower) customer satisfaction is associated with higher (lower) total revenues

$$Revenue_{t,m} = \beta_0 + \beta_1 * Customer\ Satisfaction_{t,m}$$

$t = time\ period\ in\ months$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

Hypothesis 2 (b): An increase (decrease) in customer satisfaction is associated with an increase (decrease) in customer revenues

$$\%\Delta Customer\ Revenue_{\tau,c,m} = \beta_0 + \beta_1 * \Delta Customer\ Satisfaction_{\tau,c,m}$$

$\Delta = change\ between\ two\ separe\ years\ \tau$

$\tau = time\ period\ in\ years$

$c = the\ c^{th}\ returning\ customer\ (only\ returning\ customers\ are\ included\ in\ this\ sample)$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

3.1.3. Step 3: The Relationship between Operating Performance, Revenues and Gross Profit

In the final step, we test the relationship between operating and financial performance. The operating performance variables, defined and described in chapter *4. Empirical Data*, are Queries on Time, Backorders per Machine, Non-Conformances per Machine, Service Index, Delivery Days (Canada), Availability (Australia), Delivery Efficiency (South Africa), DC Delivery Performance, DC Stock Availability and DC Pick & Pack Quality. All these factors are supply chain variables that the company has a possibility to affect. In other words, we want to test if there is a return on quality that is actually realisable, as opposed to previous studies which are just interested in whether one may exist. As in step 1, all of the operating performance variables are computed as 12 months rolling averages up to period *t*, while financial performance, the dependent variables, is measured at period *t*. Consistent measurement of the operating performance variables enables us to compare the results in steps 1 and 3.

Financial performance is operationalized as revenues and gross profit. Previous studies have struggled to find an unambiguous relationship between customer satisfaction and profit, as increasing customer satisfaction may not only increase sales, but also costs. Therefore we test the direct relationship between operating performance variables and financial performance in this step, allowing for cases where operating performance from the customers' perspective serves as a qualifier (expected in the business), rather than a delighter.

We hypothesize a positive relationship between operating performance variables and revenue. For example, higher inventory service levels (e.g. Service Index) and shorter delivery times (e.g. Delivery Days (Canada)) will lead to fewer order cancellations and higher revenues in general due to higher service reliability. The relationship between operating performance and gross profit is also believed to be positive in general, as it would make no sense for the company to invest in improving operating performance if it would not result in an increase in (gross) profit. Below follow our hypotheses and general model specifications.

Hypothesis 3 (a): Better (worse) operating performance is associated with higher (lower) revenue

$$Revenue_{t,m} = \beta_0 + \beta_1 * Operating\ Perfromance\ Variable_{i,12MonthsRollingAvg_t,m}$$

$t = time\ period\ in\ months\ (all\ operating\ performance\ indicators\ are\ followed\ up\ monthly)$

$i = the\ i^{th}\ operating\ performance\ indicator$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

Hypothesis 3 (b): Better (worse) operating performance is associated with higher (lower) gross profit

$$Gross\ Profit_{t,m} = \beta_0 + \beta_1 * Operating\ Perfromance\ Variable_{i,12MonthsRollingAvg_t,m}$$

$t = time\ period\ in\ months\ (all\ operating\ performance\ indicators\ are\ followed\ up\ monthly)$

$i = the\ i^{th}\ operating\ performance\ indicator$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

3.2. Statistical Method

In order to analyse the relationship between customer satisfaction and financial and operating performance, we employ the ordinary least squares (OLS) regression analysis. A majority of previous studies use regression analysis. Three studies (Bowman & Narayandas, 2004; Keiningham et al., 2005; Bharadwaj & Matsuno, 2006) use a system of regressions, which is similar to the technique used in this study, in order to allow for mediating effects. Alternative techniques such as cross-tabulations, scatter plots, time trend graphs and t-tests are used as secondary analysis tools.

We construct all of models on an aggregate and on a country level. The customer level analysis is also performed on data sorted into quartiles based on average customer revenue.

Statistical issues are generally not discussed in the relatively short journal articles that are available to the research community in this particular field. By using systems of regressions, some authors seem to avoid issues such as multicollinearity[4], but instead, their models most likely suffer from omitted variable bias[5]. The principle followed in this study is that if a model displays signs of multicollinearity, we remove the insignificant independent variables. We believe omitted variable bias to be worse for our tests than multicollinearity. Heteroskedasticity[6] is another potential problem, which we try to adjust for by analysing sub-samples in all of our tests (see above).

[4] Multicollinearity in a multiple regression model is caused by high correlations among the independent variables. The model as a whole is still valid, but inferences based on the individual independent variables' coefficients and their significance should be drawn carefully. This is discussed in detail in section *5.5. Validity and Reliability of the Results*

[5] An incompletely specified regression model will be biased due to the compensation for omitted variables through over or underestimation of the effect of included variables. This is also discussed in detail in section *5.5. Validity and Reliability of the Results*

[6] Heteroskedasticity causes biased estimation of the variation of the population coefficients when the variance differs among population sub-groups. The coefficient estimators are still unbiased, and in an otherwise good model, heteroskedasticity is a minor issue. This is also discussed in detail in section *5.5. Validity and Reliability of the Results*.

3.3. Scope and Limitations

3.3.1. Selection Process

As explained in section *1. Introduction*, this is a longitudinal single-case study, as called for by Zeithaml (2000). Such a study requires a lot of data in order to get reliable and generalizable results. The company which we have chosen to work with is an old industrial manufacturer, InduCorp, with vast amounts of data available. An advantage of working with InduCorp is its global operations, which increase the variety of data further and enable us to perform cross-sectional analysis between countries, something that has not been done previously. Previous experience with the company enabled us to be more efficient when gathering data.

The choice of ServDiv, the division of InduCorp in which the study is done, was both seen as a delimitation opportunity and an interesting area to study, as no previous study within the field has been performed in an after-market supply chain setting. Since the management team of ServDiv showed interest in the results, they were able to help us gather data. ServDiv has operations in almost 70 different markets, and the four we have chosen, Australia, Canada, South Africa and US, represent two thirds of its revenue. These markets are also more interesting from the customer satisfaction perspective than for example Europe, as they are remote and both have longer delivery times as well as a need for local inventories. None of the previous studies in the field have been performed in South Africa, Australia and Canada.

Given our method of selecting the operating performance variables (see section *4. Empirical Data*) we asked for everything ServDiv and InduCorp's customer centres could provide us with, given that there was a sufficient amount of observations for statistical inference. Although we are aware that variables such as pricing, sales support and invoicing are important for customers and may affect customer satisfaction, they were excluded due to a combination of lack of availability, reliable measurement, as well as the fact that they have little to do with supply chain management of spare parts, our chosen area of study.

3.3.2. Geographical, Time Period and Organizational Scope

The purpose of the present study is to investigate the Return on Quality in an after-market setting. It is not our intention to examine how quality is achieved, measured and optimized in practice given organizational capabilities. Our findings can be used for these purposes, but we choose to limit our research to finding evidence for the existence of a realisable ROQ in our chosen business setting.

The data used in this study have time series ranging from January 1st 2008 to March 31st 2013.

Due to the short time frame and complexity of gathering reliable data, the time period, as well as the geographical scope, is limited. It is, however, worth mentioning that by looking at four markets we take a step forward from previous studies, the majority of which have been done in the US.

Having decided to perform the study in an after-market setting we were faced with the choice of including the technical service that the case company offers to perform on the customers' machines. Due to the limited time period, we chose to focus on the spare parts supply chain only.

3.3.3. Test Variables and Controls

Several factors may have an impact on the relationships we intend to study in order to arrive at a conclusion about Return on Quality in the after-market business. Below we discuss the presence and influence of these factors on the data that we use.

Customer satisfaction

As mentioned in section *1. Introduction*, we conceptualize quality in two different ways in our study. One of them is defined as the quality that customers perceive, for example the customers' satisfaction with the after-market service provided. Except for the effect of the actual service, customers' perceptions may be influenced by factors such as personal relationships, price levels and competitors' service performance. Unfortunately, we are not able to control for these in any way other than analysing customer satisfaction by country. By doing so, we allow for differences in the competitive environment, which should at least affect the last two factors.

Operating performance

Operating performance serves as the second operationalization of quality in our study. We do not expect any individual operating performance variable to be perfect, but we do expect that their mutual inclusion in this study enhances the validity and reliability of our measurement of non-financial performance. The validity of the measures is dependent on their construct and the reliability on the measurement quality per se. There is little we can do to control for invalid constructs, but we have tried to reasonably select variables relevant for the purpose of this study. For example, we have been given data on stock availability for stocked items only, and for all items regardless of stocking status. Out of these two variables we ended up choosing the one most relevant for the end customers – availability for all items regardless whether they are stocked or not. To control for measurement errors, we have cross-examined the data together with company representatives. As none of our selected performance metrics perfectly matches variables tested in previous studies, we can only draw general conclusions when comparing our results with previous findings. As with customer satisfaction, we allow for contextual influence on operating performance measurement, suggested to be non-trivial by, among others, Bourne et al. (2005), by studying different markets separately.

Financial Performance

In their article about ROQ, Rust et al. (1995) use net present value (NPV) to determine the return on quality investments. In our case there was, unfortunately, not enough accurate data which can be used as input in an NPV model. Instead we choose to include two measures of financial performance – revenues and gross profit. We expect revenues to be a function of volume and price, and volume a function of a natural growth element and customer satisfaction. In order to control for the natural business growth we divide total revenue by total fleet size in the market where it was generated. We have chosen not to control for price increases, as they are not uniform across the product range and often similar in size to increases in input prices. Gross profit may not be the optimal profit metric since there are other costs, below gross profit, which may be affected by operating performance in the spare parts supply chain. However, as the lines below gross profit are on a consolidated level, and therefore cannot be presented by market, product and service, we opted for gross profit in the end. Gross profit is also controlled by dividing by fleet size. A factor influencing both revenue and gross profit per machine is how much the machine is used, as full capacity usage inevitably will imply higher consumption of spare parts. This is very difficult to control for, but by having a large number of observations we expect these differences to even out over the sample.

3.4. Validity and Reliability of the Study

Validity concerns the measuring instrument, i.e. if the methodology is relevant for examining the phenomenon one wishes to study. Reliability refers to a test that is able produce the same outcome on repeated trials (Carmines & Zeller, 1979). This study is carefully designed to achieve a valid and reliable answer to the question: *Is there a return on quality in an after-market setting?* The return on quality has been studied earlier, but no previous study has been performed in an after-market service organisation. In order to ensure validity, the methodology as well as some of the variables used in our study is similar to those in previous research. Reliability is secured by using unmodified data, gathered at the company site, and by cross-examination of the data together with company representatives. Having access to internal company data requires measures of confidentiality, which in turn lowers the level of reliability. The reliability of the measurement performed within the company may be questioned. For this reason, several different variables measuring the same phenomenon have been sampled; two variables measuring customer satisfaction, ten variables measuring operating performance and two variables measuring revenue (see section *4. Empirical Data* for a detailed description). Sample size variation is largely due to availability of data and/or changes in measurement technique. Although we asked for as much data as possible, we had to settle with a small but comparable data sample for some of the variables. Validity and reliability is discussed further in section *5.5. Validity and Reliability of the Results*.

4. Empirical Data

The data set used to perform the study at hand is presented in detail in this section. We explain the organizational context of our research site and thereafter describe the three main categories of data – customer satisfaction, operating performance and financial performance data. A table summarizing the expected relationships between the different variables is presented at the end of this section.

4.1. Organisational Context

InduCorp is a global leader in the industrial tools market. The product offering ranges from custom made state-of-the-art equipment to standardised tools; from sales of spare parts to full service contracts, where the customer is guaranteed functionality over a predetermined period of time. In a recent re-organisation, all of InduCorp's business areas formed joint after-market service divisions in order to make the service experience more uniform from a customer perspective and to leverage economies of scale. Customers are divided into geographical areas and together with the product and service divisions, the customer centres form a matrix organisation.

The service division of our business area (ServDiv) is seeking to increase its internal efficiency in the spare parts supply chain. The stated vision is *"[...] to be the best service provider for customers in the XYZ industry".* ServDiv deals with InduCorp's existing customers and they are often in need of high levels of service, as a breakdown or similar situation halts their own production. For a range of spare parts, price sensitivity of customers is low due to high opportunity and switching costs; for other ranges, customers can easily substitute the products. The stochastic demand makes planning very difficult and ServDiv has to balance its inventory levels against lead times. The remote locations of customer sites add complexity to the supply chain management at ServDiv.

4.2. Customer Satisfaction Data

InduCorp performs an annual NPS[7] survey in which customers are asked to grade a large number of different aspects of the company in order to determine how satisfied they are. The survey is conducted in most of InduCorp's markets, and we have been given access to the raw data from the surveys in our chosen markets as far back as 2008. After evaluating the data available we have concluded that for the purpose of this study it would be best to use the After-Market Service Satisfaction score included in the survey, rather than NPS/recommendation or overall satisfaction scores.

[7] The Net Promoter Score (NPS) was developed by Reichheld (2003), Bain & Company and Satmetrix. It is a highly popular metric of customer loyalty. In an NPS survey the customers are asked how likely they are to recommend the company on a scale from 0-10. Thereafter the share of replies which are up to 6 (detractors) are subtracted from the share of replies which are above 8 (promoters) in order to arrive at the NPS (Reichheld, 2003)

While the dataset for the latter two have slightly more observations, our intention is to isolate the effects of after-market satisfaction and not include satisfaction due to, for example, machine quality or the likeability of the salesman. Also, when it comes to the importance of after-market services, the customers generally rank it very high, with an average continuous score of above 9 out of 10 (see Table 1). The response rate of the NPS survey is normally around 32% and the number of surveys, as well as number of customers, is presented in Table 1 below. The average After-Market Service Satisfaction has been relatively constant during 2008-2012 with scores generally ranging between 6,6 and 6,8. The higher average in 2008 is a result of only Canada participating that particular year. Excluding 2008, Repurchase Intention scores have increased from 7,3 to 8,1. From Table 3, we can see that the correlation between After-Market Service Satisfaction and Repurchase Intentions is significant and above 0,5 in all countries, implying that satisfaction with the after-market service to some extent should have a positive impact on repurchase intentions.

Table 1: Raw Customer Satisfaction Data - Descriptive Statistics

		2008	2009	2010	2011	2012
Participating countries	Australia		X	X	X	
	Canada	X	X	X	X	X
	South Africa		X	X	X	X
	USA		X	X		X
Total customers (estimate)[1]		750	3 400	3 400	1 250	2 200
Completed surveys		220	469	461	345	321
Response rate[2]		37%	37%	32%	25%	31%
After-Market Service Satisfaction	Average	7,2	6,6	6,8	6,6	6,8
	St. Dev.	2,3	2,7	2,5	2,4	2,6
After-market Service Importance	Average	9,2	9,1	9,1	9,3	9,4
	St. Dev.	1,3	1,6	1,6	1,3	1,1
Repurchase Intention	Average	8,1	7,3	7,6	7,8	8,1
	St. Dev.	1,9	2,3	2,2	2,0	1,9

[1]Number of purchasing customers in the participating markets

[2]Response rate based on number of surveys sent out (not all customers were surveyed and some customers got more than one survey each year)

Table 2: Returning Customer Sample Data - Descriptive Statistics

	N	Annual Customer Revenue (KSEK)	Change in Customer Revenue (%)	After-Market Service Satisfaction	Abs. change in After-Market Service Satisfaction	Repurchase Intention
Australia Avg.	71	15 230	76%	6,18	0,25	7,33
Canada Avg.	117	12 517	47%	7,35	-0,17	8,23
South Africa Avg.	34	15 580	21%	6,35	0,44	7,36
USA Avg.	30	8 112	46%	7,03	0,24	8,14
All Countries Avg.	252	13 170	51%	6,85	0,08	7,85
All Countries St. Dev.	252	22 577	1,29	2,18	2,64	1,70
Quartile 1 Avg.	63	298	39%	7,33	0,31	8,16
Quartile 2 Avg.	63	2 505	93%	6,63	-0,08	7,62
Quartile 3 Avg.	63	8 260	28%	7,06	0,19	7,98
Quartile 4 Avg.	63	41 617	46%	6,37	-0,10	7,65

Table 3: Customer Satisfaction Data – Correlations

Correlations between After-Market Service Satisfaction and Repurchase Intentions by market (raw data)

USA	Australia	Canada	South Africa	Whole sample
0,566***	0,543***	0,644***	0,686***	0,627***
n = 260	n = 429	n = 748	n = 300	n = 1737

Correlations between After-Market Service Satisfaction and Repurchase Intentions by quartile[1]

1	2	3	4
0,551***	0,477***	0,496***	0,699***
n = 61	n = 61	n = 61	n = 63

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

[1]A selected sample of returning customers are divided into quartiles based on their average annual spending with ServDiv

4.2.1. Customer Level Data

In order to test customer satisfaction on the customer level, we chose to test percentual differences in revenues against differences in customer satisfaction, as customer size varies a lot. Thus, we had to filter the data. First, we removed all observations of companies that only participated in the customer satisfaction study one year, as these would yield no differences. This left us with 1 427 observations. After this, we paired cases from the same company the same year and created averages[8], leaving only one observation per company per year per country.

[8] For several companies, multiple answers from different respondent were received. In those cases, an average of all scores for the same company the same year was computed

The exception to this was the cases in which we both had clearly identifiable data for both customer satisfaction and revenue for several years for a specific sub-division. In these cases, we divided the company into as many sub-divisions as possible and paired customer satisfaction and revenues for each. After this, we removed all observations where one customer does not buy anything the previous observation, as this would yield an infinite revenue increase. Finally, the observations with the 5% highest differences were removed, as these are outliers which in general are created by very low sales one year and quite high the subsequent observation. The data was also divided into quartiles based on average revenue, for which statistics can be seen for in Table 2 and 3 above.

Among the returning customers, After-Market Service Satisfaction and Repurchase Intention are highest in Canada with an average score of 7,35 and 8,23 respectively, while the lowest ones of 6,18 and 7,33 are observed in Australia. Interestingly, the quartile with the lowest average customer revenue has the highest average After-Market Service Satisfaction and Repurchase Intentions score of 7,33 and 8,16 respectively. At the same time, the biggest spenders (quartile 4), have the lowest average After-Market Service Satisfaction score of 6,37, but not the lowest Repurchase Intentions. T-tests enclosed in Appendix A show that the other quartiles and countries are not significantly different from the rest in terms of After-Market Service Satisfaction and Repurchase Intentions. Regarding the spending per se, we can see that the annual spending for all returning customers show an upward trend with an average yearly increase of 51% for all countries. Australian customers lead with an average yearly change in customer revenue of 76%, while the customers in South Africa have the lowest average of 21%. The quartile where spending grows most is quartile 2 with a 93% increase per year, while quartile 3 has the lowest average of 28%. We note that the two quartiles with the highest spending increases (quartile 2 and 4) interestingly enough display negative changes in After-Market Satisfaction. Among the countries, there is only one country which displays a negative average change in After-Market Satisfaction, Canada, with a yearly average of -0,17 points (on a scale between zero and ten). The other countries have increases ranging from 0,24 to 0,44 points.

4.3. Operating Performance Data

Two distributions centres (DCs) which are located in Sweden and the US serve the markets we are studying. The DCs purchase spare parts both internally and externally and keep the fastest moving ones in stock[9]. Our operating performance data comes from the DCs in Sweden and US, and dates back as far as January 1st 2010.

[9] There are guidelines for which items need to be stocked based on historical demand as well as a list of crucial spare parts for which must be available regardless of demand

The responsibility for distribution from the regional warehouses to the end customers falls on the customer centres (CCs), unless there is a direct delivery agreement set up from the DCs. End customers make spare part orders mostly in urgent or breakdown situations. These order types have high priority at the DCs. The remote locations of the major markets require relatively large local inventories, so in addition to end customer orders, the CCs can place stock replenishment or preventive service orders with the DCs. The operating performance data gathered on the local market level comes from the CCs in Australia, Canada, South Africa and US.

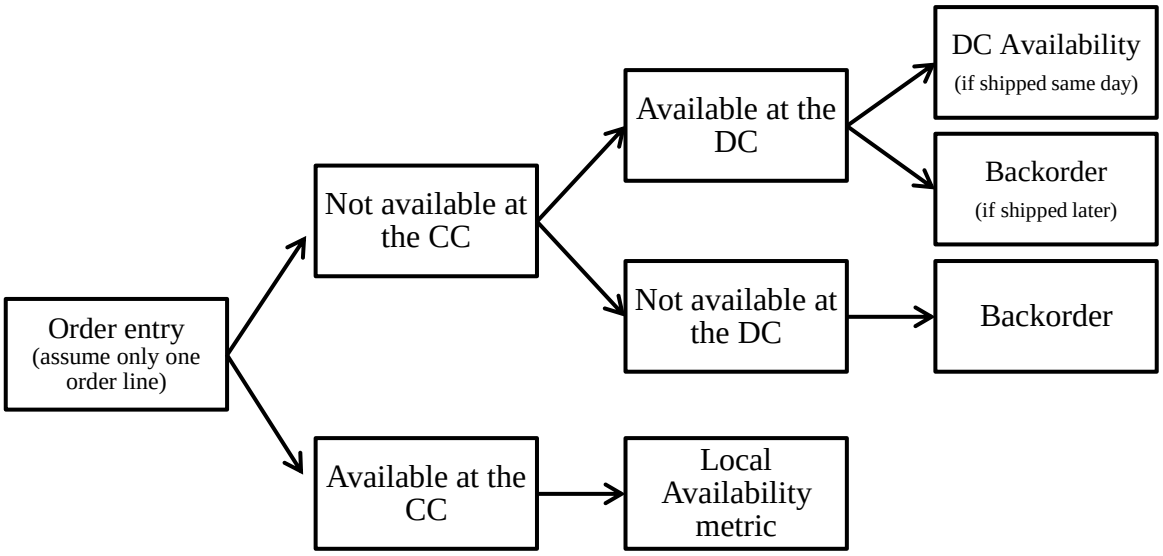


Figure 10. Operating performance metrics flow chart

4.3.1. Market-Specific Variables

Below follow descriptions of operating performance variables, which are measured on the market level, close to the end customer. These variables are followed up every month by ServDiv's local management teams and by the logistics development team. Data for all variables is available from January 1, 2010 except Service Index and Availability (Australia), which are available from January 1, 2008, Delivery Days (Canada), available from April 1st 2010, and Delivery Efficiency (South Africa), which is available from January 1, 2012. We present descriptive statistics for the operating performance indicators in Table 5 below. The variables used in the regressions are recalculated into 12 months rolling average values in order to capture the long ordering cycles and give room for customers to react to their experience of the after-market service.

Two of the operating performance variables (as well as two financial performance variables described in section *4.4. Financial Performance Data*) are divided by the number of machines on the market in order to adjust for different market sizes. These variables are Backorders per Machine and Non-Conformances per Machine.

In Table 4 below we present the descriptive statistics for the machine fleet in each country and the average machine age over time. In 2013 the US fleet of 4530 machines is as large as Australia's, Canada's and South Africa's taken together. US is also the only country where the fleet has decreased in size from 2008 to 2013. The smallest fleet as of 2013 is the Australian with a total of 1234 machines. The compound annual growth rate (CAGR) is 1,58% per year for all countries, with South Africa having the highest CAGR of 4,42% per year. Average fleet age has increased every year, meaning that there are relatively fewer new machines on the market now than six years ago. Under normal conditions, i.e. if the older machines are utilised as intensively as newer ones, they would require more spare parts as they age. Therefore we can expect a natural growth in revenues per machine over the same period (see section *4.4. Financial Performance Data*).

Table 4: Fleet Data - Descriptive Statistics

		2008	2009	2010	2011	2012	2013	CAGR
Fleet size	Australia	1 092	897	977	1 176	1 284	1 234	3,90%
	Canada	1 204	1 158	1 191	1 302	1 403	1 389	2,80%
	South Africa	1 005	1 034	1 079	1 245	1 345	1 290	4,42%
	USA	4 699	4 319	4 180	4 359	4 503	4 530	-0,03%
	All Countries	8 000	7 408	7 427	8 082	8 535	8 443	1,58%
Average age	All Countries	6,2	6,8	7,5	7,8	8,2	9,1	

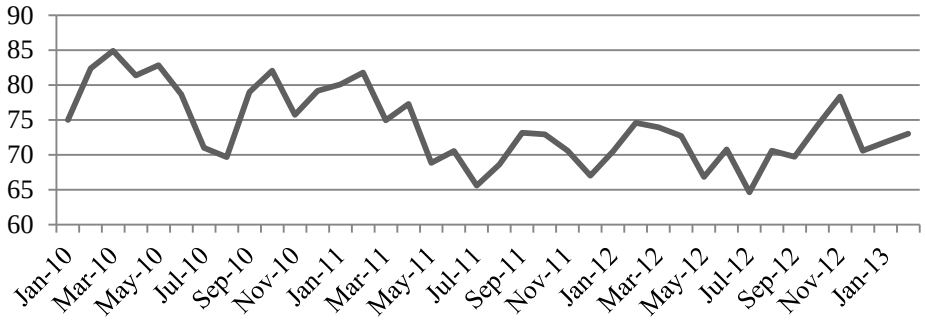
Table 5: Operating Performance Data - Descriptive Statistics (Country Level)

		Australia	Canada	South Africa	USA	All Countries
Queries on Time	Average	75,1%	73,8%	76,1%	71,4%	74,1%
	St. Dev.	7,5	7,8	8,2	5,7	7,5
Backorders per Machine	Average	0,03	0,05	0,12	0,02	0,05
	St. Dev.	0,02	0,01	0,05	0,01	0,05
Non-Conformances per Machine	Average	0,009	0,014	0,006	0,005	0,008
	St. Dev.	0,003	0,005	0,004	0,001	0,005
Service Index	Average	80,8%	75,3%	83,5%	65,3%	76,2%
	St. Dev.	2,9	5,4	4,5	4,2	8,2
Delivery Days (Canada)	Average		9,1			
	St. Dev.		2,8			
Delivery Efficiency (South Africa)	Average			80,5%		
	St. Dev.			9,1		
Availability (Australia)	Average	82,9%				
	St. Dev.	5,8				

Queries on Time = Share of queries handled within the promised response time

Once a query is registered in the internal communication system, it becomes assigned to a department which is in charge of handling it. The promised handling times vary by urgency status[10]. The average share of queries handled on time has shown a decreasing trend from 2010 to 2013, as illustrated in Graph 1 below. The average score for all markets is 74,1%, with South Africa being the top performer with 76,1% (see Table 5 above).

Graph 1: Queries on Time % - Time Trend



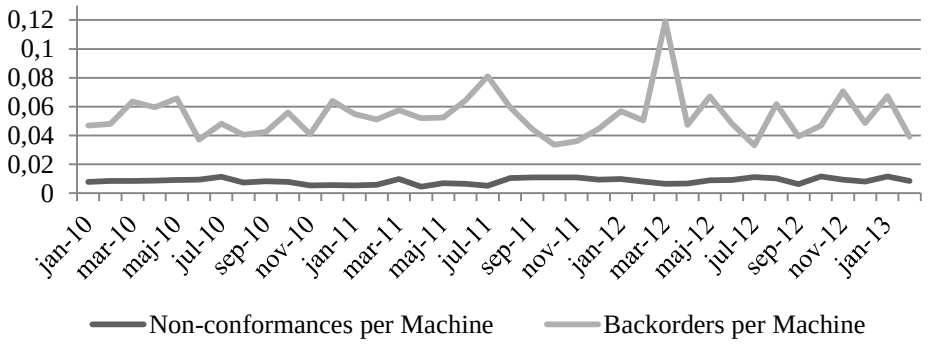
We expect the relationship between after-market service satisfaction and queries on time to be positive – the larger share of queries handled on time, the more satisfied the customers should feel. A change in the variable may be caused by fewer orders, which in turn would result in fewer queries or, everything else being equal, in a higher share of queries handled on time. However, customers may be satisfied with the quick service, but dissatisfied with the way that their problems are solved, should quality decrease in order to increase speed. The effect of increasing the share of queries on time should be positive on revenue, since we assume that more satisfied customers buy more. Increasing operating performance also has a cost however, and therefore the sign of the association with gross profit is ambiguous.

Backorders per Machine = Number of backorders divided by the number of machines in the market

As illustrated in the Operating performance metric flow chart (Figure 10) above, backorders occur when an order line is not available at the DC or shipped later than promised. On average there have been about 0,05 Backorders per Machine each month (see Table 5). This may seem like a small amount, but the standard deviation of 0,05 and the time trend shown in Graph 2 below convey a large variation in this performance metric. South Africa is the country with the highest average Backorders per Machine 0,12 and the US has the lowest number 0,02.

[10]There are three different urgency statuses: Normal – handled within 5 days, Urgent – handled within 3 days and Breakdown – handled within 24 hours

Graph 2: Backorders per Machine and Non-Conformances per Machine - Time Trend



Backorders are undesirable in general, but especially so in an after-market setting, where a breakdown situation may cause costly production interruption for the customer. For this reason, we expect the relationship between backorders per machine and after-market service satisfaction to be negative. As with queries on time, the amount of machines breaking down in a period affects this statistic. More backorders should result in both lower revenues, as we assume that less satisfied customers buy less, and higher costs, since backorders cause higher handling costs and more working capital. Reducing backorders may be costly, but this cost should be smaller than the increase in revenue together with the reduction in handling cost and working capital (affecting gross profit through increased obsolescence). Therefore we expect the relationship between backorders and gross profit to be negative.

Non-Conformances per Machine = Number of non-conformances divided by the number of machines in the market

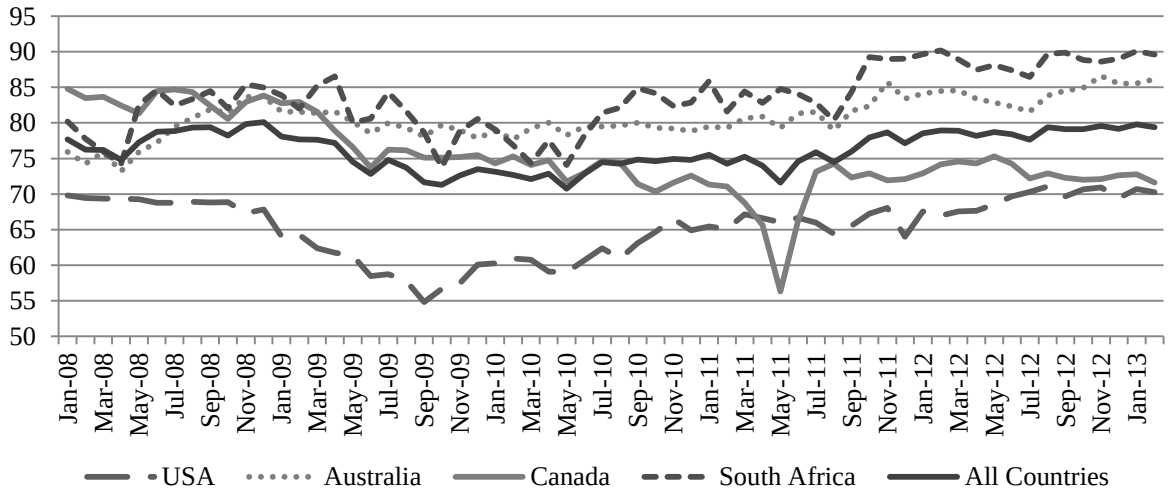
Non-conformances are queries filed internally when, for example, an ordered item is damaged. On average there have been 0,008 Non-Conformances per Machine each month (see Table 5). Compared to Backorders per Machine, this variable has been relatively low and more stable over time (see Graph 2 above). Canada is the country with the highest average Non-Conformances per Machine of 0,014 and the US has the lowest number of 0,005.

Non-conformances are issues which normally increase the order cycle time and result in inconvenience both for the firm and for the customer. We expect the relationship between after-market customer satisfaction and number of non-conformances per machine to be negative. As with queries on time and backorders, the amount of machines breaking down in a period affects this statistic. More non-conformances per machine should result in both lower revenues, since we assume that less satisfied customers buy less, and higher costs, since non-conformances result in higher handling costs and working capital. In the end, we believe that the increase in revenues should be higher than the increased cost, resulting in a negative relation with gross profit.

Service Index = Share of forecasted demand for next week that is in stock, measured in order lines

The service index is a local market measure of availability, or service level, and is measured in a uniform way over all of ServDiv's market units. As the metric is based on a forecast of next week's demand, we cannot be entirely sure that it reflects the true availability, but it is a close approximation of service level in the eye of the end customer. A higher Service Index means that a higher share of order lines can be filled locally (and therefore result in shorter delivery times) and should therefore be positively related to after-market service satisfaction. There is a lag in how the Service Index algorithm reacts to changes in demand, but since we use a 12 month rolling average of the index, we correct for this timing error. The average Service Index for 2008-2013 has been 76,2%, with the highest average value in South Africa of 83,5% and the lowest in USA of 65,3% (see Table 5). The metric has trended upward over the time period as displayed in Graph 3 below, but the variation has been relatively high on an aggregate level (standard deviation was 8,2%).

Graph 3: Service Index % - Time Trend



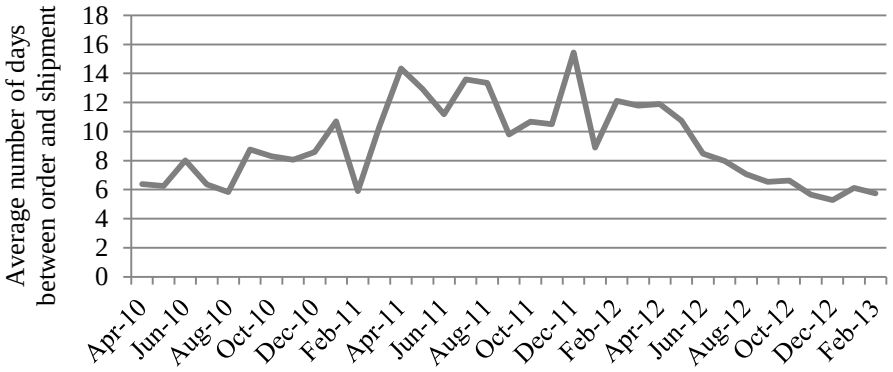
As we do expect higher Service Index to result in more satisfied customers, we can also expect higher revenues and fewer cancellations due to stock outs. Improving the service index does however imply higher handling costs and additional investments in working capital, so the effect on gross profit is ambiguous.

Delivery Days (Canada) = Average number of days between order date and shipping date

In Canada, the spare parts supply chain performance is followed up in a lead time measure called Delivery Days. To compute this metric, they count days between the date the order was placed and the date it was shipped to the end customer. Historical values are available from April 1st 2010. The average number of days over this period was 9,1 (see Table 5). From the Graph 4 above, we can see that there has been an improvement in performance during 2012.

We expect that higher number of delivery days will lower the satisfaction and therefore also revenues. The expected relationship with gross profit is ambiguous, as reducing lead times may be costly, but would also result in less working capital.

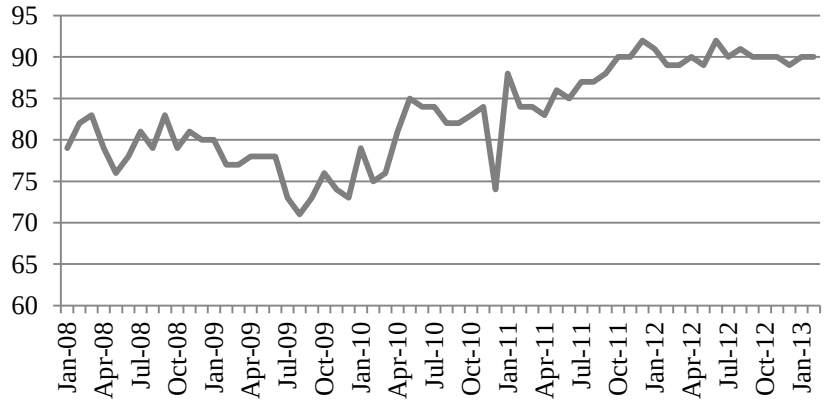
Graph 4: Delivery Days (Canada) - Time Trend



Availability (Australia) = Share of order lines filled within three days regardless whether articles are stocked or not

The Availability metric that is followed up in Australia records the ability to fill a complete order line and ship it within three days from the date it was received. This performance indicator is followed up on a monthly basis. Historical values for Availability (Australia) date back to January 1st 2008. This performance indicator has shown an upward trend and the average Availability (Australia) has been 82,9% for 2008-2013 (see Table 5). Availability should have a positive correlation to customer satisfaction and revenues. For the same reasons as with Service Index, the expected relation with gross profit is ambiguous.

Graph 5: Availability (Australia) % - Time Trend

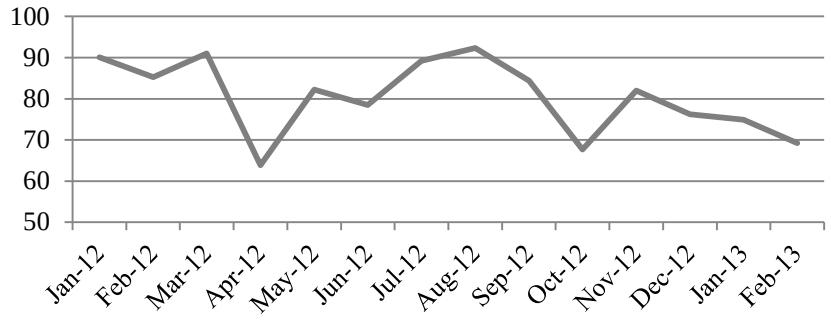


Delivery Efficiency (South Africa) = Share of order lines delivered within 48 hours from order received regardless of whether the item is in stock or not

South Africa is a big country, and it is estimated that it takes up to 48 hours to reach any delivery point.

Therefore, each delivery is checked whether it has been delivered to the end customer site in 48 hours after the point in time when the order is received, regardless of stocking status. The metric has been followed up monthly since January 1st 2012 and the average value has been 80,5% (see Table 5). Delivery Efficiency (South Africa) captures both the service level of the local stock as well as lead time to the end customer. We believe that it will have a both negative and positive impact on gross profit, since investments are needed in order to improve performance. The relationships between customer satisfaction and Delivery Efficiency (South Africa) and between revenue and Delivery Efficiency (South Africa) are expected to be positive.

Graph 6: Delivery Efficiency (South Africa) % - Time Trend



4.3.2. Distribution Centre Variables

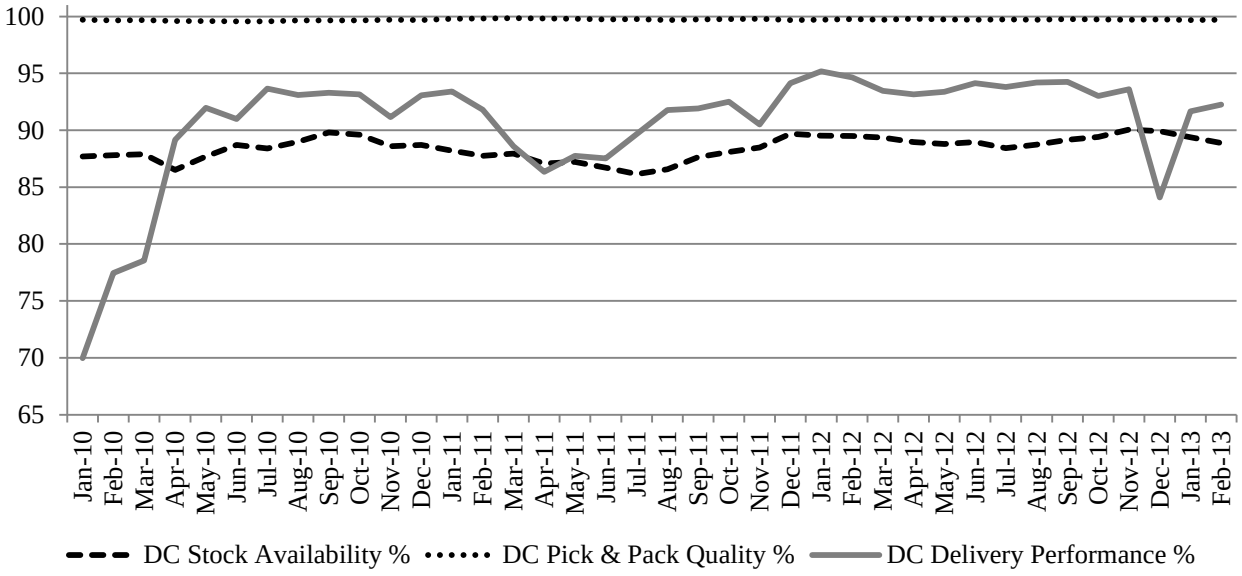
Below follow descriptions of the operating performance variables which are measured at the distribution centres (DCs) in Sweden and the US. DC variables are not only interesting on the aggregate level, but also for specific countries, where they may capture cases where local performance measures lack information content. These variables are followed up every month by the logistics development team at ServDiv. Data for all variables is available from January 1st 2010. We present descriptive statistics for the operating performance indicators in Table 6 below. The variables used in the regressions are recalculated into 12 months rolling average values in order to capture the long ordering cycles and give room for customers to react to their experience of the after-market service.

Table 6: Operating Performance Data - Descriptive Statistics (Distribution Centre Variables)

		2010	2011	2012	2013*	All years
DC Stock Availability %	Average	88,4	87,6	89,2	89,1	88,4
	St. Dev.	0,9	1,0	0,5	0,4	1,0
DC Delivery Performance %	Average	88,0	90,5	93,1	92,0	90,6
	St. Dev.	8,0	2,5	2,9	0,4	5,3
DC Pick & Pack Quality %	Average	99,6	99,8	99,7	99,7	99,7
	St. Dev.	0,055	0,052	0,027	0,024	0,068

*Data for 2013 covers only January and February

Graph 7: Distribution Centre Variables % - Time Trend



DC Stock Availability = Share of order lines filled on request regardless if articles are stocked or not

The distribution centre (DC) has a target level of how many stock requests should be met the same day as the orders are received. DC Stock Availability should be 95% on stocked items[11]. The requested units are measured as order lines, i.e. not complete orders, and the performance indicator is followed up monthly in both DCs. The average DC Stock Availability has been 88,4%.

High level of availability at the DC means that more orders are filled the same day, which should imply higher customer satisfaction (the opposite effect of backorders). As we do expect more satisfied customers, we can also expect higher revenues and fewer cancellations due to stock outs. Increasing the availability of spare parts at the DC level is costly since handling costs and working capital need to increase, so the effect on gross profit is ambiguous.

DC Delivery Performance = Share of order lines invoiced and shipped on the request date, regardless whether articles are stocked or not

The DC Delivery Performance is a measure of how well the DCs manage to pack and ship out order lines. The average DC Delivery Performance has been 90,6% for 2010-2013. There seems to have been a slight upward trend in this measure over time (see Graph 7). DC Delivery Performance is often higher than DC Stock Availability, as some countries do not get daily shipments. Therefore the DC may have time to order the missing articles and still be able to ship on time even though they were not available at the order date.

[11]As mentioned earlier, we choose to use the availability metric capturing all articles, regardless of their stocking status, resulting in a DC Stock Availability far from the target of 95%

We expect that improved DC Delivery Performance should have a positive effect on customer satisfaction. Although the DCs cannot ship out unavailable order lines, they can still handle the orders slowly and increase lead time to the end customers. As we do expect more satisfied customers, we can also expect higher revenues. The effect on gross profit is expected to be ambiguous, since improving the DC Delivery Performance implies increased handling costs.

DC Pick & Pack Quality = 1 - Share of faulty lines claimed by customer divided by total order lines received

The distribution centre (DC) handles a large amount of orders daily and sometimes mistakes are made in the packing station, which would normally result in a return or additional shipment of the missing items. The metric shows the share of order lines packed correctly in relation to the total order lines shipped out from the DC. DC Pick & Pack Quality has been relatively high and constant over time with an average of 99,7% order lines correctly picked and packed in 2010-2013.

Even if not all orders come directly from end customers, we believe that the better the packing quality, the more correct shipments are made to the end customers. Therefore the relationship between after-market satisfaction and DC Pick & Pack Quality should be positive, and as such, revenue as well. It will however probably cost to do so, creating an ambiguous relationship with gross profit.

4.4. Financial Performance Data

All financial data is consolidated from the group perspective and reported per country. This is preferable, as looking at local data would require us to take transfer pricing into consideration. Another advantage of using consolidated financial data is that the local currencies are translated to the reporting currency of the entity following IFRS guidelines. Financial performance data is available from January 1st 2008 to February 1st 2013.

Table 7: Financial Performance Data – Revenue per Machine per Month (KSEK)

	Australia	Canada	South Africa	USA	All Countries
Average	77,1	35,3	46,7	20,1	44,8
St. Dev.	17,4	10,7	14,8	3,4	24,4
Range	46-120	21-57	21-86	14-27	14-120
CAGR (%)	8,11%	10,42%	14,30%	4,26%	9,55%
n (months)	62	62	62	62	248
Fleet March 2013[1]	1 234	1 391	1 290	4 530	8 445

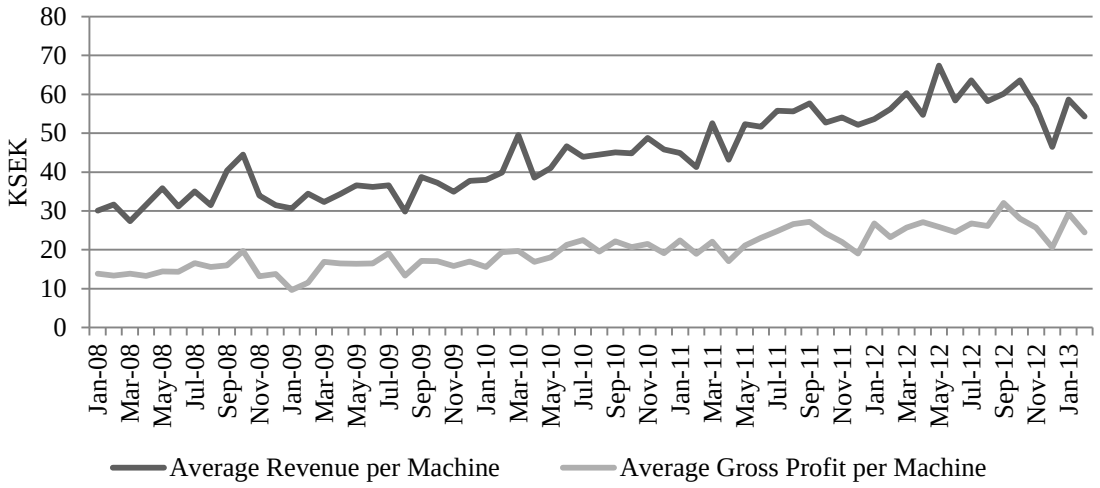
[1]Revenue per Machine per month is based on the fleet at that point in time. The fleet size in March 2013 is shown as reference
Average machine age was 9,1 years in 2013.

Table 8: Financial Performance Data – Gross Profit per Machine per Month (KSEK)

	Australia	Canada	South Africa	USA	All Countries
Average	35,9	15,1	22,1	6,7	19,9
St. Dev.	10,5	4,7	7,1	1,3	12,7
Range	17-77	6-26	8-38	4-10	4-77
Average Gross Margin per Machine	47%	43%	47%	33%	44%
CAGR (%)	8,82%	10,98%	12,64%	5,21%	9,83%
n (months)	62	62	62	62	248
Fleet March 2013[1]	1 234	1 391	1 290	4 530	8 445

[1] Gross Profit per Machine per month is based on the fleet at that point in time. The fleet size in March 2013 is shown as reference Average machine age was 9,1 years in 2013.

Graph 8: Revenue and Gross Profit per Machine (KSEK) - Time Trend



Revenue per Machine = Monthly sales revenue for spare parts sold to external customers divided by the number of machines on the market

Spare part revenue[12] data is available as a consolidated value per month and market, as well as per year per customer. We have chosen not to adjust it for price increases, as the resulting change in volume cannot be estimated accurately. The average revenue per machine was 44,8 KSEK per month for 2008-2013, ranging from 14 to 120 KSEK per month. The average revenue compound annual growth rate (CAGR) for the same period was 9,55%. The market with the highest average monthly revenue per machine is Australia with 77,1 KSEK per month. USA has the lowest average of 20,1 KSEK, which mainly is due to the distribution network structure of that market.

[12] Does not include revenue from sales of machines

Around half of the country's consolidated sales come from distributors, compared to the three other markets in which ServDiv only sells spare parts through InduCorp's own stores. The high share of distributors in the US requires ServDiv to charge lower prices for their spare parts in order to remain competitive toward the end customers after distributor fees. The US also has the lowest revenue CAGR of 4,26% for period. Given the relatively low average yearly growth of the fleet of 1,58% (see Table 4), the high increase in spare parts revenue indicates that sales per machine has increased[13].

Revenue per Customer = Yearly sales revenue for spare parts by end customer and market

In order to study how changes in After-market Satisfaction affect customers' purchasing behaviour, we have sorted out returning customers. An additional sorting was done based on these customers' responses to the annual NPS survey. This sample of customers contains 252 returning customers who have taken the survey more than one time (see the exact sorting procedure in section *4.2.1. Customer Level Data*). As can be seen in Table 2 in section *4.2. Customer Satisfaction Data*, the average yearly spending by customers are fairly similar between countries, around 12,5 million to 15,5 SEK, with the exception of the US, which has a much lower average of 8,1 million SEK. The customers were also sorted into quartiles based on their average yearly spending. There is a very high spread between the quartiles, with customers in the highest quartile spending on average almost 140 times as much per year as the customers in the lowest quartile.

Gross Profit per Machine = Difference between Monthly Sales Revenue and Monthly Cost of Goods Sold divided by the number of machines on the market

Data on gross profit is available as a consolidated value per month and market. It is defined as revenue minus cost of goods sold, including various adjustments for internal transactions, commission expenses and revaluation of inventory due to obsolescence.

As can be seen in Table 8 above, the average gross profit per machine was 19,9 KSEK per month for 2008-2013, and ranged between 4 and 77 KSEK. Australia has the highest average gross profit per machine of 35,9 KSEK per month while US has the lowest 6,7 KSEK per months, due to its distribution network structure. The average gross profit margin is 44% and is relatively similar across the countries except for the US with its 33%. The average annual growth in gross profit per machine is 9,83%, which is slightly higher than the average growth in revenue per machine of 9,55%, meaning that ServDiv has managed both to grow sales as well as margins.

[13] Another possible explanation is the increase in prices, but we have been informed that the average price increase has been around 5% per year, which is lower than 9,55%

Below follows a recapitulation of the operating performance variables presented in section *4. Empirical Data*, and the expected signs of their coefficients. This will facilitate the interpretation of the results which are presented in section *5. Analysis*.

Table 9: Summary of Operating Performance Variables

		After-Market Service Satisfaction	Revenue per Machine	Gross Profit per Machine
Market-specific Variables				
Queries on Time	*Share of queries handled within the promised response time*	+	+	?
Backorders per Machine	*Number of backorders divided by the number of machines in the market*	-	-	-
Non-Conformances per Machine	*Number of non-conformances divided by the number of machines in the market*	-	-	-
Service Index	*Share of forecasted demand for next week that is in stock, measured in order lines*	+	+	?
Delivery Days (Canada)	*Average number of days between order date and shipping date*	-	-	-
Availability (Australia)	*Share of order lines filled within three days regardless whether articles are stocked or not*	+	+	?
Delivery Efficiency (South Africa)	*Share of order lines delivered within 48 hours from order received regardless of whether the item is in stock or not*	+	+	?
Distribution Centre Variables				
DC Stock Availability	*Share of order lines filled on request regardless if articles are stocked or not*	+	+	?
DC Delivery Performance	*Share of order lines invoiced and shipped on the request date, regardless whether articles are stocked or not*	+	+	?
DC Pick and Pack Quality	*1 - Share of faulty lines claimed by customer divided by total order lines received*	+	+	?

5. Analysis

The structure of this section follows the one described in section 3.3. Study Design. *Each of the three steps of the study is covered under separate headlines. The hypotheses tested are presented at the beginning of each step of the analysis, followed by a quick recapitulation of our results and previous research. After this, we do a more detailed analysis of our own findings, and finally end each analysis step with a concluding section. Our findings are synthesised in section* 5.4. Synthesis *and in section* 5.5. Validity and Reliability of the Results *we discuss the validity and reliability of the results.*

5.1. Step 1: The Relationship between Customer Satisfaction and Operating Performance

In this section we present the results from the tests of *Hypothesis 1: Better (worse) operating performance is associated with higher (lower) customer satisfaction.* We do expect the general relationship between operating performance and customer satisfaction to be positive. The construct of the variables measuring operating performance implies that not all signs will be positive. The expected signs for the analysis can be seen in Table 9 in the previous section, as well as in the regression tables.

The positive relationship between operating performance and customer satisfaction, found by Bowman & Narayandas (2004), Bharadwaj & Matsuno (2006) and Ou et al. (2010), is somewhat supported in our tests. Bowman & Narayandas (2004) and Bharadwaj & Matsuno (2006) study the relationship using mediators (vendor effort, trust and transaction cost advantage), while our methodology is closer to the one used by Ou et al. (2010), who model the relationship directly. In addition to the findings in these studies, most other studies using operating performance as either a dependent or independent variable *assume* that better operating performance leads to higher customer satisfaction.

Our findings suggest that operating performance indicators, measured as 12-month rolling averages (chosen based on logical reasoning and empirical testing), explain a share of the variation in our chosen customer satisfaction variable After-Market Service Satisfaction. The signs of the coefficients however are not perfectly reliable in the full models due to multicollinearity. Multicollinearity diagnostics are enclosed in Appendix B and the effect on the reliability of the findings is discussed in section *5.5. Validity and Reliability of the Results*. The models are left intact in spite of this problem, but the insignificant variables are removed for the country-specific models[14].

[14] Following the advice of our statistics tutor Per-Olov Edlund

Table 10: The Relationship Between Customer Satisfaction and Operating Performance

Multiple OLS regressions are performed on the country level. The dependent variable is After-Market Satisfaction. All independent variables are operating performance metrics calculated as 12 months rolling averages. Insignificant variables have been excluded from the models.

	Expected sign of the coefficient	Australia $\hat{\beta}$	Canada $\hat{\beta}$	South Africa $\hat{\beta}$	USA $\hat{\beta}$	All Countries $\hat{\beta}$
Constant		8,93***	-454***	-14,889***	133***	-547***
Queries on Time	+	Excluded	Excluded	Excluded	-0,0113**	0,0314***
Backorders per Machine	-	Excluded	13,3**	Excluded	-8,55***	-3,38***
Non-Conformances per Machine	-	Excluded	54,8***	-8,617**	Excluded	30,4***
Service Index	+	-0,0902**	0,0466***	Excluded	0,0256***	-0,0199***
Delivery Days (Canada)	-	N/A	-0,0331*	N/A	N/A	N/A
Availability (Australia)	+	0,0590***	N/A	N/A	N/A	N/A
Delivery Efficiency (South Africa)	+	N/A	N/A	-0,00185*	N/A	N/A
DC Delivery Performance	+	Excluded	-0,0362***	-0,0216***	-0,0171***	-0,0129**
DC Stock Availability	+	Excluded	-0,145**	0,269***	0,0610***	0,287***
DC Pick & Pack Quality	+	Excluded	4,74***	Excluded	-1,31***	5,30***
R^2		0,411	0,932	0,999	0,914	0,517
Adjusted R^2		0,386	0,913	0,999	0,896	0,493
F-statistic		16,4	50,7	3030	52,8	21,4
n		50	34	14	37	148

Regression formula

$$After\text{-}Market\ Service\ Satisfaction_{Avg\ t,m} = \beta_0 + \beta_1 * Queries\ on\ Time_{12\ t\ Roll\ Avg_t,m} + \beta_2 * Backorders\ per\ Machine_{12\ t\ Roll\ Avg_t,m} + \beta_3 * Non\text{-}Conformances\ per\ Machine_{12\ t\ Roll\ Avg_t,m} + \beta_4 * Service\ Index_{12\ t\ Roll\ Avg_t,m} + \beta_5 * Delivery\ Days_{12\ t\ Roll\ Avg_t,Canada} + \beta_6 * Availability_{12\ t\ Roll\ Avg_t,Australia} + \beta_7 * Delivery\ Efficiency_{12\ t\ Roll\ Avg_t,South\ Africa} + \beta_8 * DC\ Delivery\ Performance_{12\ t\ Roll\ Avg_t} + \beta_9 * DC\ Stock\ Availability_{12\ t\ Roll\ Avg_t} + \beta_{10} * DC\ Pick\ \&\ Pack\ Quality_{12\ t\ Roll\ Avg_t}$$

$t = time\ period\ in\ months\ (all\ operating\ performance\ indicators\ are\ followed\ up\ monthly)$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

$The\ variables Delivery\ Days_{12\ t\ Roll\ Avg_t,Canada}, Availability_{12\ t\ Roll\ Avg_t,Australia}\ and\ Delivery\ Efficiency_{12\ t\ Roll\ Avg_t,South\ Africa}$ *are only included in the three country models for their respective countries.*

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

5.1.1. Expected Relationships

On an aggregate level, four out of the seven variables available for all countries show the expected signs while being significant on the 1% level. The adjusted R^2 of 0,493 is implying that the full variation in customer satisfaction is not explained by operating performance variables. On the country level, only nine out of the 31 possible relationships are significant and in line with our expectations. The significance levels of these vary between 1% and 10%. Adjusted R^2 is higher in three out of four countries than on the aggregate level, with South Africa showing an adjusted R^2 of 0,999, most likely a result of high multicollinearity. No individual variable is uniformly showing the same sign of association while also being significant in all models. This suggests that operating performance variables that seem to explain the variation in After-Market Service Satisfaction in one market are irrelevant in others, another indication of the large difference among our studied markets. No previous study of this relationship has been performed in multiple markets, and almost all studies, with Ou et al.'s (2010) Taiwanese research site being the exception, have been performed in the US. While being in line with findings in previous studies (Bowman & Narayandas, 2004; Bharadwaj & Matsuno, 2006 and Ou et al., 2010), our results also indicate that operating performance is not a perfect measure of perceived quality. ServDiv's customers' perception of after-market service quality may be affected by other factors than the ones we use in our study, e.g. price levels and relationship characteristics. Bourne et al. (2005) suggest that internal contextual factors, such as organizational culture and information system infrastructure, may affect performance measurement variables and processes. These factors make it difficult to study the relationship between performance measures (in our case operating performance variables), and actual performance (customer satisfaction). It is not our intention to discuss the quality of ServDiv's operating performance measurement practices but, at least for the purpose of this study, they may be imperfect as they do not fully explain the variation in After-Market Service Satisfaction.

For the local operating performance metrics in Australia and Canada, we find support for our expectations. Australia's Availability and Canada's Delivery Days have a positive and negative relation to After-Market Service Satisfaction, respectively. Considering the fact the majority of the other operating performance indicators were either insignificant or showed confusing signs of association, we can say that it seems like these *local* metrics in general are better aligned with customer experience than other metrics.

5.1.2. Unexpected Relationships

Many of the relationships found while testing *Hypothesis 1: Better (worse) operating performance is associated with higher (lower) customer satisfaction* do not support it on a 1% to 10% significance level. On the country level 22 out of 31 possible relationships are either insignificant or significant on the 1% to 10% level and contradict both theory and findings in previous studies.

No single variable is consistently showing the same coefficient sign across all countries. The distribution centre performance metrics DC Stock Availability and DC Delivery Performance display the most uniform sets of relationships with After-Market Service Satisfaction. While DC Stock Availability, as expected, generally correlates positively with After-Market Service Satisfaction, DC Delivery Performance shows the opposite signs, suggesting that lower performance increases customer satisfaction. The sign of the coefficient for DC Stock Availability is negative in Canada, signifying that having more items in stock and thus likely being able to ship items faster, decreases After-Market Service Satisfaction. We can see two possible explanations for these unexpected results; 1) multicollinearity and 2) a mismatch between customer experience and measured operating performance. The first reason is probably the most likely, as the independent variables in the models have high and positive correlation coefficients (see correlation matrix in Appendix B) and the adjusted R^2 is around 0,9 for three out of four countries. The second reason is more unlikely, since the customers responding the customer surveys should have experienced a 12-month rolling average operating performance and most likely experienced some kind of service during their relationship with ServDiv. It could be so that many customers get a perfect service experience and choose not to respond to the survey, making the sample of surveys biased. Yet, this does not seem to be the case either, as the distribution of the After-market Service Satisfaction scores has the form of an upward skewed normal distribution (distribution graphs are enclosed in Appendix C).

5.1.3. Conclusion Step 1

In conclusion, our findings do show some support for *Hypothesis 1: Better (worse) operating performance is associated with higher (lower) customer satisfaction* and are thus to a certain extent in line with theory and previous empirical research (Bowman & Narayandas, 2004; Bourne et al., 2005, Bharadwaj & Matsuno, 2006; Ou et al., 2010). On the aggregate level, four out of seven of our chosen operating performance variables display the significant relationships with After-Market Service Satisfaction which we expected. They do not mutually explain the full variation in the dependent variable and are therefore believed to be imperfectly aligned with customers' perceptions. It should also be noted that there may be other factors which influence customer satisfaction but are not included in the model. On the country level, nine out of 31 relationships between operating performance and After-Market Service Satisfaction are significant and show the expected signs of association. The results are inconsistent across countries, implying that contextuality has an impact on performance measures and performance.

Local operating performance metrics used in Australia and Canada are found to be better aligned with After-Market Service Satisfaction than other measures for these countries. Overall, the ambiguity of our results seems to be caused by a statistical problem – multicollinearity.

5.2. Step 2: The Relationship between Total/Customer Revenue and Customer Satisfaction

In this section we present the results from the tests of the two hypotheses: *Hypothesis 2 (a): Higher (lower) customer satisfaction is associated with higher (lower) revenues* and *Hypothesis 2 (b): An increase (decrease) in customer satisfaction is associated with an increase (decrease) in customer revenues*. We expect a positive relationship between After-Market Service Satisfaction and revenue both in in absolute terms on the aggregate level and relative terms/changes on the customer level.

We do find significantly positive relationships between Revenue per Machine and After-Market Service Satisfaction in two out of four markets, with quite a high explanatory power in one of them and somewhat lower in the other. When studying changes in Customer Revenue and changes in After-Market Service Satisfaction, our results are insignificant. Our findings are intriguing in light of the established view on the relationship between customer satisfaction and revenue. There is little disagreement among researchers about the relationship between customer satisfaction and revenue – it should be positive (e.g. Rust et al., 1995; Anderson et al., 1997; Ittner & Larcker, 1998; Keiningham et al., 2005; Yu, 2007; Willams & Naumann, 2011) in a variety of industries. Ittner & Larcker (1998) propose a positive, but non-linear or asymmetric relationship, as their findings indicate that there are customer satisfaction thresholds which must be reached in order to improve financial performance. Anderson & Mittal (2000) also suggest a non-linear relationship since dissatisfaction may have a larger impact on purchasing intentions than satisfaction.

5.2.1. Aggregate Level Analysis

Table 11: The Relationship Between Revenue per Machine and Customer Satisfaction

Single-variable OLS regressions are performed on the country level. The dependent variable is Revenue per Machine and the independent variable is After-Market Satisfaction.

	Australia	Canada	South Africa	USA	All Countries
$\hat{\beta}$	43,7***	-23,4***	10,9***	4,17	-15,9***
R^2	0,662	0,539	0,151	0,0225	0,107
n	50	62	50	50	212

Regression formula

$$Revenue\ per\ Machine_{t,m} = \beta_0 + \beta_1 * After\text{-}Market\ Service\ Satisfaction_{Avg\ t,m}$$

$t = time\ period\ in\ months$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

The aggregate analysis, performed on average After-Market Service Satisfaction scores for each country and period, shows a significantly (1% level) negative relationship between the two variables.

Splitting up the sample by country, we get insignificant result for USA, but significantly (1% level) positive relationships for Australia and South Africa and a negative relationship for Canada. Total (monthly) revenue, the dependent variable, is divided per machine in order to adjust for the different market sizes. The results are somewhat in line with the Return on Quality-framework (Rust et al., 1995) and findings of a positive relationship between revenue and customer satisfaction in previous studies (e.g. Ittner & Larcker, 1998; Keiningham et al., 2005; Yu, 2007; Willams & Naumann, 2011). Taking into account the fact that USA and Canada show insignificant and negative correlations respectively, although we cannot conclude that the relationship holds for all markets.

After-Market Service Satisfaction scores differ between countries. We performed an independent samples mean t-test with the result that there is a significant (at the 1% level) mean difference between all countries (see Appendix A). By looking at the data on the country level, we can see that the significant negative relationship in the whole sample is a result of the negative relationship found in Canada, where the After-Market Service Satisfaction is the highest of all our markets. This is a puzzling result, as it implies that less satisfied customers buy more. Considering the fact that this is an after-market setting, this could possibly be explained by the fact that a customer that has to spend more money on spare parts (per machine) will be less satisfied, i.e. an inverse relation.

It is also possible that by spending more, an after-market customer will experience more satisfaction-lowering issues such as late deliveries, back orders or non-conformance problems. For the remaining three markets the coefficients are positive, meaning that the findings in previous studies are supported in these countries' after-market settings. The positive relationship is relatively weaker in South Africa compared to Australia, as Australia's R^2 is 0,662 and South Africa's is 0,151. We have been informed that out of the four markets we studied, Australia and the US are the ones with the highest level of competition, which, according to Banker & Mashruwala (2007), should result in a stronger positive relationship between customer satisfaction and revenue than a market with lower competition. As such, this may be one reason for why the relationship between After-Market Service Satisfaction and Revenue per Machine is stronger in Australia than in South Africa.

As noted earlier, the positive association between customer satisfaction and revenue has been observed in a variety of industries, such as telecom (Ittner & Larcker, 1998), retail banking (Yu, 2007), retail (Banker & Mashruwala, 2007), institutional securities (Keiningham et al., 2005), hotels (Rust et al., 1995). However, the only study performed in a similar setting to ours is Willams & Naumann's (2011) research in a service division of a manufacturing company. Their findings are discussed further in the next section.

5.2.2. Customer Level Analysis

Table 12: The Relationship between Individual Customer Revenue and Satisfaction

Single-variable OLS regressions are performed on the country level. The dependent variable is Customer Revenue and the independent variable is After-Market Satisfaction.

	Australia	Canada	South Africa	USA	All Countries
$\hat{\beta}$	-0,0408	-0,0880*	0,0294	-0,0173	-0,0428
R^2	0,00571	0,0297	0,000885	0,00105	0,00764
n	71	117	34	30	252

Regression formula

$$\%\Delta Customer\ Revenue_{\tau,c,m} = \beta_0 + \beta_1 * \Delta After\text{-}Market\ Service\ Satisfaction_{\tau,c,m}$$

$\Delta = change\ between\ two\ separe\ years\ \tau$

$\tau = time\ period\ in\ years$

$c = the\ c^{th}\ returning\ customer\ (only\ returning\ customers\ are\ included\ in\ this\ sample)$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

Customers are divided up into quartiles based on average revenue. Single-variable OLS regressions are performed on quartiles. The dependent variable is Customer Revenue and the independent variable is After-Market Satisfaction.

	Quartile 1 – lowest average revenue	Quartile 2	Quartile 3	Quartile 4 – highest average revenue
$\hat{\beta}$	-0,0579	-0,0329	-0,0323	-0,0348
R^2	0,00884	0,004	0,0143	0,0120
n	63	63	63	63

Regression formula

$$\%\Delta Customer\ Revenue_{\tau,c,q} = \beta_0 + \beta_1 * \Delta After\text{-}Market\ Service\ Satisfaction_{\tau,c,q}$$

$\Delta = change\ between\ two\ separe\ years\ \tau$

$\tau = time\ period\ in\ years$

$c = the\ c^{th}\ returning\ customer\ (only\ returning\ customers\ are\ included\ in\ this\ sample)$

$q = the\ q^{th}\ quartile - note\ that\ each\ quartile\ has\ its\ own\ regression$

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

We now turn to study how changes in customer satisfaction affect actual purchasing behaviour on the customer level. By doing so we follow the methodology used by Ittner & Larcker (1998), Bernhardt et al. (2000) and Williams & Naumann (2011), who study both absolute levels as well as changes in the variables. Our results show no significant relationship between changes in Customer Revenue and changes in After-Market Service Satisfaction on the individual customer level when looking at the whole customer sample. The relationship is negative and significant on the 10% level for Canadian customers, while it is insignificant for the other countries. This result contradicts Ittner & Larcker's (1998), Bernhardt et al.'s (2000) and Williams & Naumann's (2011) findings, as they all find significant positive relationships between revenue changes and changes in customer satisfaction.

When dividing the customers into quartiles based on their average revenue, no significant relationship between changes in After-Market Service Satisfaction and changes in Customer Revenue is found. The data is plotted in order to investigate possible non-linear or asymmetric relationships between changes in After-Market Service Satisfaction and changes Customer Revenue (see Appendix C), as suggested in some previous studies (Ittner & Larcker, 1998; Anderson & Mittal, 2000). However, this does not seem to be the case with our data.

As mentioned above, these results are quite different from previous studies. This may be for a number of reasons. We believe that the main difference here is the after-market setting and the fact that purchase of machine spare parts is not related to how satisfied the customers are, but rather the condition of their machines. In fact, as previously suggested, customers might be less satisfied if they have a machine that is constantly breaking down. As suggested by Mägi (2003) and Keiningham et al. (2005), it is also possible that less satisfied customers will give a smaller share of wallet to one supplier and more to a competitor. However, in this case, the largest share of revenues come from firm-specific spare parts, where there is almost no competition[15], effectively taking away this option for many of the customers. The situation could therefore be compared to the findings of Banker & Mashruwala (2007), who conclude that customer satisfaction is not nearly as important in low competition markets as in high competition ones, as customers do not really have a choice anyway. The high standard deviation in After-Market Service Satisfaction scores (shown in Table 2 in section *4.2. Customer Satisfaction Data*) combined with a relatively low correlation between After-Market Service Satisfaction and Repurchase Intention (see Table 3 in section *4.2. Customer Satisfaction Data*) in this sample, which only includes returning customers, suggest that customers do not base their purchasing decision on their satisfaction with the after-market service.

Unfortunately, long-term customer retention could not be tested in this study because of the short-term nature of the data. Still, we do believe that this lack of correlation only exists in the short run due to the overwhelming theoretical support and empirical evidence for a positive association between customer satisfaction and revenue, especially over time. In the short run however, customers are "locked in" with ServDiv since they, at least to some extent, are forced to purchase original (company specific) spare parts so long they use their machine. The average age of InduCorp's sold machines still active is 9,1 years (2013), meaning that the average customer owns a machine for at least 9 years. When InduCorp's customers need to replace the main product – the machine – they will probably base their decision on several factors, one of them being their satisfaction with the after-market service. As such, the findings in this section should, especially from a practical standpoint, be used carefully.

[15] We have however been informed that there is a widespread piracy in some of ServDiv's markets, an aspect we cannot completely disregard

5.2.3. Conclusion Step 2

In conclusion, our findings do show some support for *Hypothesis 2 (a): Higher (lower) customer satisfaction is associated with higher (lower) revenues*, while *Hypothesis 2 (b): An increase (decrease) in customer satisfaction is associated with an increase (decrease) in customer revenues* is not supported. These results are somewhat in line with the Return on Quality-framework (Rust et al., 1995) and findings of a positive relationship between revenue and customer satisfaction in previous studies (e.g. Ittner & Larcker, 1998; Keiningham et al., 2005; Yu, 2007; Willams & Naumann, 2011).

On the aggregate level, the relationship between After-Market Service Satisfaction and Revenue per Machine is ambiguous. We believe this to be dependent on the business context in two ways; first, the competitive environments are different across the countries and second, the after-market setting is quite different from the primary markets studied previously. On the customer level, no significant relationship is found between changes in Customer Revenue and changes in After-Market Service Satisfaction. We find three possible reasons for this lack of association. First of all, dissatisfaction with machine performance may outweigh the satisfaction with the after-market service and make customers who spend a lot on spare parts less satisfied. Second, the low level of competition gives the customers no room to exhibit purchasing behavior according to their level of satisfaction as they are "locked in" with ServDiv. Finally, we believe that a positive relationship between customer satisfaction and revenue still exists in the long run, as customers may choose to replace their current machines with ones from other suppliers when the time comes.

5.3. Step 3: The Relationship between Operating Performance, Revenues and Gross Profit

In this section we present the results from the tests of the two hypotheses: *Hypothesis 3 (a): Better (worse) operating performance is associated with higher (lower) revenue* and *Hypothesis 3 (b): Better (worse) operating performance is associated with higher (lower) gross profit.* As such, we expect the relationship between operating performance and revenues to be positive, while the effect on gross profit may be ambiguous. As in step 1, the construct of the variables measuring operating performance implies that not all signs will be positive, and we therefore follow Table 9 in the end of section *4. Empirical Data*, showing the expected signs for each variable, in the analysis.

We do find a positive relationship between operating performance and Revenue per Machine, but the relationship is to a large extent insignificant on the country level. On the aggregate level, operating performance variables seem to have a positive impact on Revenue per Machine, while the association with Gross Profit per Machine is ambiguous and insignificant on the country level. In section *5.3.3. Operating Performance Variables Affecting both Gross Profit and Revenue*, four operating performance variables are analysed in more detail.

Our results are somewhat ambiguous, but partly in line with what is suggested in theory (Rust et al, 1995, Li et al., 2006 and Ou et al., 2010) and found in previous studies (Nagar & Rajan 2001, Li et al., 2006; Ou et al., 2010). It is argued that the ultimate purpose of improving operating performance is to lower costs and/or to increase revenues (Li et al., 2006). In theory, operating performance could have a positive impact on profits through the reduction of costs and increases in customer satisfaction and thereby revenue (Rust et al., 1995; Ou et al., 2010). There may also be negative effects on revenue from poor quality (Nagar & Rajan, 2001). Organisations providing higher quality products can charge a price premium from their (hopefully more satisfied) customers (Li et al., 2006) and customers are believed to use a company's services more when they realize they can rely on the company's processes (Wiersma, 2008). In their study, Nagar & Rajan (2001) offer a striking example of the strongly negative effect that external failure has on future revenues, finding that a $1 increase in external failure cost results in a $13 lowering of revenue per quarter in the two subsequent quarters. From our tests, two operating performance variables, Backorders per Machine and Service Index, seem to have the same impact on revenues (and gross profit) as external failures have in Nagar & Rajan's (2001) study. Wiersma's (2008) results indicate that there is a potential to increase firm profit when a variable such as On-Time-Delivery improves, as it results in lower future costs and higher future revenues. This relationship is expected to hold for goods, but not for services, according to Anderson et al., (1997). The authors find that simultaneous changes in productivity and customer satisfaction are positively related to ROI for goods, but for services this relationship is negative and insignificant. We do not find support for any trade-off between higher "efficiency" in the operations and customer satisfaction for the variable Backorders per Machine, thus agreeing with Wiersma (2008). The relationship is rather the opposite; implying that ServDiv can simultaneously grow revenues, gross profit and customer satisfaction. The ambiguity of the signs for the other variables is believed to be caused by multicollinearity.

5.3.1. Operating Performance and Revenues

As can be seen in Table 13 below, our operating performance variables are largely uncorrelated with Revenue per Machine on the country level[16]. The only variable which has such a correlation is DC Stock Availability in the US, which has a reversed sign compared to expectations. However, on an aggregate level, several variables are significantly related to Revenue per Machine, and three out of four have the expected signs. The significant difference between country level and aggregate level in this case is most likely due to the large differences between variables for different countries. While the variations may be small for a variable in a particular country, there are larger differences between countries. The results of independent samples' t-tests are presented in Appendix A and indicate significant differences between operating performance across countries.

[16] As a result of this, no variables have been removed as in step 1

Table 13: The Relationship Between Revenue per Machine and Operating Performance

Multiple OLS regressions are performed on the country level. The dependent variable is Revenue per Machine. All independent variables are operating performance metrics calculated as 12 months rolling averages.

	Expected sign of the coefficient	Australia $\hat{\beta}$	Canada $\hat{\beta}$	South Africa $\hat{\beta}$	USA $\hat{\beta}$	All Countries $\hat{\beta}$
Constant		-7 470	-170	-20 000	3 770	5 480
Queries on Time	+	-0,489	-0,481	-4,780	0,376	-0,259
Backorders per Machine	-	-584	-534	-1020	4,29	-420***
Non-Conformances per Machine	-	-2400	468	-18700	1620	130
Service Index	+	-4,01	0,0746	29,5	1,49	3,92***
Delivery Days (Canada)	-	N/A	2,64	N/A	N/A	N/A
Availability (Australia)	+	1,19	N/A	N/A	N/A	N/A
Delivery Efficiency (South Africa)	+	N/A	N/A	-1,03	N/A	N/A
DC Delivery Performance	+	0,223	-0,735	-10,3	-0,0663	0,653***
DC Stock Availability	+	4,37	1,82	-15,5	-5,91***	-10,8***
DC Pick & Pack Quality	+	74,8	1,45	206	-33,6	-48,0
R^2		0,722	0,802	0,601	0,586	0,811
Adjusted R^2		0,642	0,739	-0,0384	0,486	0,801
F-statistic		9,09	12,7	0,940	5,85	85,7
n		37	34	14	37	148

Regression formula

$$Revenue\ per\ Machine_{t,m} = \beta_0 + \beta_1 * Queries\ on\ Time_{12\ t\ Roll\ Avg_t,m} + \beta_2 * Backorders\ per\ Machine_{12\ t\ Roll\ Avg_t,m} + \beta_3 * Non\text{-}Conformances\ per\ Machine_{12\ t\ Roll\ Avg_t,m} + \beta_4 * Service\ Index_{12\ t\ Roll\ Avg_t,m} + \beta_5 * Delivery\ Days_{12\ t\ Roll\ Avg_t,Canada} + \beta_6 * Availability_{12\ t\ Roll\ Avg_t,Australia} + \beta_7 * Delivery\ Efficiency_{12\ t\ Roll\ Avg_t,South\ Africa} + \beta_8 * DC\ Delivery\ Performance_{12\ t\ Roll\ Avg_t} + \beta_9 * DC\ Stock\ Availability_{12\ t\ Roll\ Avg_t} + \beta_{10} * DC\ Pick\ \&\ Pack\ Quality_{12\ t\ Roll\ Avg_t}$$

$t = time\ period\ in\ months\ (all\ operating\ performance\ indicators\ are\ followed\ up\ monthly)$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

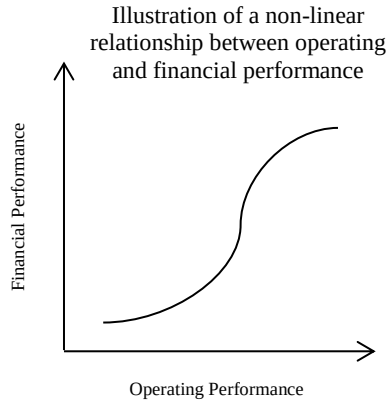
$The\ variables Delivery\ Days_{12\ t\ Roll\ Avg_t,Canada}, Availability_{12\ t\ Roll\ Avg_t,Australia}\ and\ Delivery\ Efficiency_{12\ t\ Roll\ Avg_t,South\ Africa}$ $are\ only\ included\ in\ the\ three\ country\ models\ for\ their\ respective\ countries.$

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

The regression results suggest that the variables Backorders per Machine, Service Index, DC Delivery Performance and DC Stock Availability, might be under a certain threshold for some countries, and as such, that revenues can be increased by increasing these up to this threshold. However, when plotting these variables against Revenue per Machine, we find hardly any correlation for DC Delivery Performance and DC Stock Availability. There seems to be a more pronounced relationship between Backorders per Machine, Service Index and Revenue per Machine, which can be seen in the corresponding scatter plots in Appendix C. We also discuss these four operating performance measures in detail in section *5.3.3. Operating Performance Variables Affecting both Gross Profit and Revenue*.

5.3.2. Operating Performance and Gross Profit

On the aggregate level, as many as five out of seven variables are significant on the 1% to 10% levels. As multicollinearity is present in this model (see a discussion in sections *5.1.2. Unexpected Relationships* and *5.5. Validity and Reliability of the Results*), we should be careful when interpreting the signs of the coefficients. Backorders per Machine has a negative coefficient, which is in line with our expectations. Service Index and DC Delivery Performance seem to be positively correlated with Gross Profit per Machine, and the opposite is the case with DC Pick & Pack Quality and DC Stock Availability. They are all logical, since the relationships between various operating performance variables and Gross Profit per Machine is mediated by revenues and costs, but we cannot be certain that the signs are correct.



The lack of significant relationships on the country level, except for Non-Conformances per Machine in US, can be explained by the fact that there is relatively little variation in the operating performance within the countries. However, the levels are different between the countries (see Table 5 in section *4.3.1. Market Specific Variables* and t-tests in Appendix A) causing significant relationships to appear in the aggregate level tests. A possible explanation could be that smaller improvements have a relatively small impact on financial performance – both Revenue and Gross Profit per Machine in this case. This relationship would hold until a certain minimum level, where the effect will be significantly higher until it planes out again, thus suggesting a non-linear relationship like the one illustrated (Rust et al., 1995; Ittner & Larcker, 1998; Bowman & Narayandas, 2004). When plotting the significant operating performance variables against financial performance, we can see such a non-linear trend in the data. This is discussed further below, in section *5.3.3. Operating Performance Variables Affecting both Gross Profit and Revenue*, with scatter plots enclosed in Appendix C.

Table 14: The Relationship Between Operating Performance and Gross Profit

Multiple OLS regressions are performed on the country level. The dependent variable is Gross Profit per Machine. All independent variables are operating performance metrics calculated as 12 months rolling averages.

	Expected sign of the coefficient	Australia $\hat{\beta}$	Canada $\hat{\beta}$	South Africa $\hat{\beta}$	USA $\hat{\beta}$	All Countries $\hat{\beta}$
Constant		-935	5 500	-179 000	1 030	4390**
Queries on Time	?	-1,21	-1,03	-5,53	0,0460	-0,223
Backorders per Machine	-	-153	-202	-80,8	-36,7	-208***
Non-Conformances per Machine	-	5060	-1250	701	948*	13,2
Service Index	?	-0,954	0,636	-10,2	0,319	2,06***
Delivery Days (Canada)	-	N/A	1,58	N/A	N/A	N/A
Stock Availability (Australia)	?	-0,718	N/A	N/A	N/A	N/A
Delivery Efficiency (South Africa)	?	N/A	N/A	-4,81	N/A	N/A
DC Delivery Performance	?	0,278	-0,887	-5,19	-0,0237	0,264*
DC Stock Availability	?	-0,097	4,26	79,7	-1,73	-5,10***
DC Pick &Pack Quality	?	12,4	-57,5	1740	-8,97	-40,8**
R^2		0,427	0,651	0,540	0,383	0,768
Adjusted R^2		0,263	0,540	-0,197	0,234	0,757
F-statistic		2,60	5,83	0,732	2,57	66,4
n		37	34	14	37	148

Regression formula

$$Gross\ Profit\ per\ Machine_{t,m} = \beta_0 + \beta_1 * Queries\ on\ Time_{12\ t\ Roll\ Avg_t,m} + \beta_2 * Backorders\ per\ Machine_{12\ t\ Roll\ Avg_t,m} + \beta_3 * Non\text{-}Conformances\ per\ Machine_{12\ t\ Roll\ Avg_t,m} + \beta_4 * Service\ Index_{12\ t\ Roll\ Avg_t,m} + \beta_5 * Delivery\ Days_{12\ t\ Roll\ Avg_t,Canada} + \beta_6 * Availability_{12\ t\ Roll\ Avg_t,Australia} + \beta_7 * Delivery\ Efficiency_{12\ t\ Roll\ Avg_t,South\ Africa} + \beta_8 * DC\ Delivery\ Performance_{12\ t\ Roll\ Avg_t} + \beta_9 * DC\ Stock\ Availability_{12\ t\ Roll\ Avg_t} + \beta_{10} * DC\ Pick\ \&\ Pack\ Quality_{12\ t\ Roll\ Avg_t}$$

$t = time\ period\ in\ months\ (all\ operating\ performance\ indicators\ are\ followed\ up\ monthly)$

$m = the\ m^{th}\ market/country\ out\ of\ Australia, Canada, South\ Africa\ and\ USA, or\ all\ countries\ in\ the\ aggregate\ model$

$The\ variables Delivery\ Days_{12\ t\ Roll\ Avg_t,Canada}, Availability_{12\ t\ Roll\ Avg_t,Australia}\ and\ Delivery\ Efficiency_{12\ t\ Roll\ Avg_t,South\ Africa}$ *are only included in the three country models for their respective countries.*

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

5.3.3. Operating Performance Variables Affecting both Gross Profit and Revenue

Comparing with the variables which were found to have significant relationships with Revenue per Machine on the aggregate level, we can see that only DC Pick & Pack Quality is insignificantly associated with revenue. This means that the reason Gross Profit per Machine seems to be negatively affected by DC Pick & Pack Quality is that costs increase when the distribution centres improve the packaging quality.

Backorders per Machine

We find significantly negative relationships (1% level) between Backorders per Machine and Revenue and Gross Profit per Machine respectively. The size of the coefficient is larger in the revenue model (-420) than in the gross profit model (-208). Multicollinearity causes some imprecision of sizes and signs of the coefficients, but it is certain that more backorders are not making ServDiv better off financially. The probable reason for the result is that the cost of lowering Backorders per Machine is positive, but lower than the additional revenue, resulting in a gross profit effect that is smaller than the revenue effect. We have plotted Backorders per Machine against both Revenue and Gross Profit per Machine in Appendix C, and there seems to be a clear trade-off between operating performance and financial outcomes. In section *5.1.1. Expected Relationships*, a significant negative relationship between After-Market Service Satisfaction and Backorders per Machine was found. For this reason, we assume that the negative impact Backorders per Machine has on Revenue per Machine is mediated by After-Market Service Satisfaction.

Service Index

Service Index is positively correlated with both Revenue and Gross Profit per Machine. The level of significance is 1% and again the coefficient is larger in the revenue model (3,92) than in the gross profit model (2,06). In this case however, we would like to be more cautious with the interpretation of signs and sizes. It is clear that revenue can increase with a higher Service Index due to lower likelihood of stock outs – customers will cancel fewer orders if the items are available. However, Service Index is based on a forecasted value, and the forecast can be wrong. This means that a customer will not be more likely to find an item not ordered frequently enough to get into the forecasted supply list. The fact that the relationship is positive for gross profit is also not fully convincing. Costs will unambiguously increase since ServDiv needs to invest in stock in order to increase the Service Index, which in turn could lead to higher stock obsolescence. We have plotted Service Index against both Revenue and Gross Profit per Machine in Appendix C. There seems to be a clear trade-off between operating performance and financial outcomes.

Service Index has mixed signs of association with After-Market Service Satisfaction for various reasons (discussed in *5.1.1. Expected Relationships* and *5.1.2. Unexpected Relationships*) and we cannot be certain that the relationship to Revenue per Machine is mediated by the After-Market Service Satisfaction variable.

DC Stock Availability

A negative relationship on the 1% level is found for DC Stock Availability in both the revenue and gross profit models. The coefficients are -10,8 and -5,1 in the revenue and gross profit models respectively. While being conceptually confusing, these relationships may be interpreted as a result of multicollinearity and/or reversed causality. By selling more, ServDiv inevitably faces a higher likelihood of stockouts in the short run. Therefore, DC Stock Availability may go down when Revenue per Machine increases. The scatter plots for DC Stock Availability and Revenue per Machine as well as Gross Profit per Machine are enclosed in the Appendix C. The negative relationships between operating performance and financial outcomes are very weak, and the variable exhibited a positive relationship with After-Market Service Satisfaction on the 1% significance level. In total, this suggests that it is difficult to satisfy customers by improving DC Stock Availability without losing money.

DC Delivery Performance

For DC Delivery Performance, our tests indicate a positive relationship with Revenue per Machine on the 1% level and a positive relationship with gross profit on the 10% level. The coefficient is 0,653 in the revenue model and 0,264 in the gross profit model. Improving DC Delivery Performance may have a negative effect on costs, the mediating variable, resulting in a lower gross profit model coefficient that is less significant. The scatter plots for DC Delivery Performance and Revenue per Machine as well as Gross Profit per Machine are enclosed in Appendix C. The positive relationships between operating performance and financial outcomes are very weak. Interestingly enough, DC Delivery Performance exhibits a significant negative relationship to After-Market Service Satisfaction both on the country and on the aggregate levels. We suspect that this is a result of multicollinearity and can therefore not be certain that After-Market Service Satisfaction is a mediator in the revenue model. Taking this factor and the weak level of significance in the gross profit model into account, it is difficult to draw a conclusion about this operating performance variable.

5.3.4. Conclusions Step 3

The theoretical positive relationship between operating and financial performance, as proposed in the ROQ-model (Rust et al., 1995) is supported in previous studies by Li et al. (2006), Wiersma (2008), Ou et al. (2010) and Nagar & Rajan (2001). Our results are ambiguous, but show some support for *Hypothesis 3 (a): Better (worse) operating performance is associated with higher (lower) revenue* and *Hypothesis 3 (b): Better (worse) operating performance is associated with higher (lower) gross profit*.

We have isolated the operating variables which have significant relationships with both Revenue per Machine and Gross Profit per Machine. These variables are Backorders per Machine, Service Index, DC Delivery Performance and DC Stock Availability, with the first two showing the strongest evidence of the existence of a Return on Quality (ROQ) as proposed by Rust et al. (1995). As an example, our findings suggest that if ServDiv manages to lower Backorders per Machine, the customers will be more satisfied. The additional Revenue per Machine will exceed the additional costs associated with the improvement effort, creating an additional Gross Profit per Machine. We also wish to point out that our findings are significant only on the aggregate level. This could be explained by a proposed non-linear relationship between operating and financial performance, as we argue that the relatively different levels of operating performance across countries contribute to a higher variation on the aggregate level.

5.4. Synthesis

The *ROQ-framework* was proposed by Rust et al. (1995) and developed into the *Service-Profit-Chain* by Heskett et al. (1997), *Satisfaction-Profit-Chain* by Anderson & Mittal (2000) and finally the most complex model "*Service-Profit Chain" in Industrial Markets* by Bowman & Narayandas (2004). In this study we investigate selected linkages present in all of these models in order to answer the question: *Is there a Return on Quality (ROQ) in an after-market operation setting?*

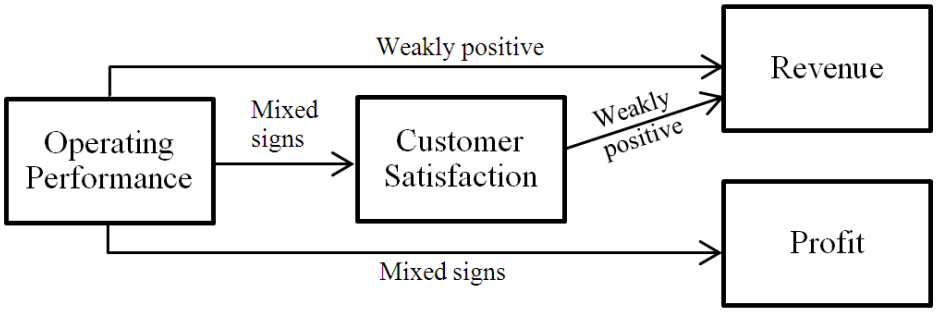


Figure 11. Illustration of the relations found in our study

Analysing internal company data from four of the organisation's major markets, we find weak support for the ROQ. First of all, operating performance measures do only explain a fraction of the variation in customer satisfaction. Second, customer satisfaction is weakly linked to purchasing behaviour in the short run. Finally, we do find relationships between operating and financial performance, but they seem to be mostly related to cost savings. Given our ambiguous results, we believe that the ROQ is difficult to achieve in the short term, and propose further research of long-term customer behaviour based on the customers' current satisfaction with after-market services

5.5. Validity and Reliability of the Results

As discussed in section *3.4. Validity and Reliability of the Study*, it is important that a study is both valid (testing what it is supposed to), and reliable (consistent over repeated trials). While the study is designed to produce valid and reliable results, some specific issues will be discussed below.

5.5.1. Internal Validity

Selection Bias

There is a variety of factors which may result in a selection bias in our study. First of all, we only use four countries out of the total of the 68 in which ServDiv does business in. However, as these four countries stand for around two thirds of ServDiv's sales, we assume them to be representative for the whole population. As a large part of the study is based on customer surveys, there may be some selection bias due to us not being able to investigate whether the population which did not respond to the survey differs from the one that did. However, as the response rate was around 32%, which is quite high, we believe our respondents to be representative.

The sample used for the tests on the customer level was reduced in several steps (see section *4.2.1 Customer Level Data*). As such, this population is a non-random subsample consisting only of customers responding to the survey more than once, and may be quite biased.

History Bias

The financial crisis starting in 2008 may have affected sales due to companies having difficulties raising funds in uncertain times and being less willing to invest. However, as the exact extent of the impact of the financial crisis on our industry, both regarding magnitude as well as time period, is unknown, this is very difficult to adjust for.

Heteroskedasticity

On the aggregate level heteroskedasticity, meaning varying variances between sub-groups (in this case our countries) could possibly be an issue and cause, among other things, incorrect estimates of statistical significance. However, in the descriptive statistics in section *4. Empirical Data*, all standard deviations on the country level seem quite similar. This should therefore not be an issue. Another test in which it could be a problem is how revenues are affected by customer satisfaction on the customer level. As the test uses data from individual customers, there could exist sub-groups which have dissimilar variances. We have done our best to avoid this by grouping customers into both countries and quartiles, but there could still be other sub-groups which were not testable.

5.5.2. External Validity

As the study is based on data from a single company, the findings might not be perfectly generalizable. The study is also limited to the supply chain of spare parts in this particular company. For this reason, other factors which might affect customer satisfaction and purchasing behaviour are excluded. Furthermore, as the study is done over a fairly short time period of five years, the results may not be generalizable over longer periods of time. This is especially true as the life-length of the machines being sold by InduCorp is up to 15-20 years, with an average current age of 9,1 years. Therefore, changes in operating performance and customer satisfaction may not be noticeable until several years into the future. In order to account for this we have done most tests with varying lags and rolling averages[17]. However, in order for the results to be truly generalizable over longer periods of time, we would need longer time-series of data.

5.5.3. Reliability

Multicollinearity

There is an inherent problem with multicollinearity, i.e. that the independent variables of a multiple regression correlate strongly and the coefficient estimates therefore might change erratically due to small changes in the data. This is especially true in these kinds of explorative tests (including many different operating performance variables), as several dimensions of operating performance can be improved simultaneously. In order to mediate this, we have removed a large number of variables with high correlation to the variables finally used in our tests. There are however still some quite high correlations between the variables used (see *Appendix B*), which will result in a certain multicollinearity-based reduction in reliability. As opposed to the operating performance and satisfaction model in step 1 (section 5.1), independent variables were not removed from the revenue and gross profit models on the country level in step 3 (section 5.3). The regressions showed high adjusted R^2 and insignificant coefficients for all of the independent variables, and selecting one variable at a time would give significant results, but they would also suffer from omitted variable bias (see next section). Therefore the seemingly strange models have been left intact.

Omitted-variable Bias

Going hand in hand with multicollinearity is the omitted-variable bias. If an independent variable used in an Ordinary Least Square regression is correlated with an omitted variable, which in turn is also correlated with the test's dependent variable, the estimated coefficient of the tested independent variable may be over- or underestimated.

[17] We have tried to find the optimal lags and rolling averages time periods experimentally, as well as by using statistical methods such as the Akaike Information Criterion

The model assigns changes in the dependent variable, which in reality are caused by the omitted variable, to the independent variable used. To mitigate this bias we have eliminated variables which essentially measure the same thing, while still keeping variables that may have quite high correlations with the dependent variable in order to not accidentally remove essential ones. However, there will always exist other factors that may affect our dependent variables, and some of these may also correlate with our chosen independent variables. This is especially true in our tests of how revenues are affected by customer satisfaction, as we only had one independent variable.

6. Conclusion

In this study we have investigated selected linkages from the Return on Quality (ROQ) framework developed by Rust et al. (1995), in order to answer the question: *Is there a Return on Quality (ROQ) in an after-market operation setting?* Analysing internal company data from four of the organisation's major markets, we find weak support for the ROQ.

In conclusion, our findings do show some support for the positive association between operating performance and customer satisfaction, and are thus in line with theory and previous empirical research (Bowman & Narayandas, 2004; Bourne et al., 2005, Bharadwaj & Matsuno, 2006 and Ou et al., 2010). However, operating performance variables seem to be imperfectly aligned with customers' perceptions. The results are also inconsistent across countries, implying that contextuality has an impact on performance measures and performance. Overall, a large part of the ambiguity of our results seems to be caused by a statistical problem – multicollinearity.

Moving on, we find weak support for the proposed positive relationship between customer satisfaction and revenue in absolute terms, and changes in customer satisfaction display no association with changes in customer revenues for returning customers. Together, these results correspond quite weakly to the earlier findings of a positive relationship between revenue and customer satisfaction (e.g. Ittner & Larcker, 1998; Keiningham et al., 2005; Yu, 2007; Willams & Naumann, 2011). We argue that the main reasons for the ambiguity of the results are 1) the after-market setting, 2) the short time period in relation to the expected product life, and 3) the different market environments in the markets studied.

A theoretical positive relationship between operating and financial performance is supported in previous studies by Nagar & Rajan (2001), Li et al. (2006), Wiersma (2008) and Ou et al. (2010). Our results are vague, but show some support for the positive relationship between operating performance and revenue. The relationship with gross profit is ambiguous, as some operating performance variables are more costly to improve than others. We have isolated the operating variables which have significant relationships with both Revenue per Machine and Gross Profit per Machine. The conclusion is that Backorders per Machine and Service Index show the strongest evidence for the existence of the ROQ.

For example, our findings suggest that if ServDiv manages to lower Backorders per Machine, the customers will be more satisfied. The additional Revenue per Machine will exceed the additional costs associated with the improvement effort, creating an additional Gross Profit per Machine. We also suggest that the relatively different levels of operating performance across countries form a non-linear relationship between operating and financial performance on the aggregate level, as shown by Rust et al. (1995), Ittner & Larcker (1998) and Bowman & Narayandas (2004).

Based on what we have seen at InduCorp, we do agree that after-market services are important for industrial companies in the long term. Customer satisfaction with the after-market service is positively correlated with repurchase intentions and, although short term financial gains from improvements in operating performance seem to exist, we believe that the largest financial return on quality will come in subsequent periods. Our case company, InduCorp, operates in an industry where customers are "locked in" for a substantial period of time. Only when the main product needs replacement, the customers are free to choose another supplier if dissatisfied with either the main product or service or both. As stated by Jacob & Ulaga (2008), companies with efficient after-market operations are better at securing long-term growth and thus remain competitive. Even though this study does not find any strong support for the ROQ within after-market services in the short run, it is still highly likely that it exists as a result of them over a longer period of time.

7. Further Research Opportunities

This study was done in an attempt to bridge the gaps identified in previous research. It was performed on the *organisational level*, while many of the previous studies are done across a large sample of firms and industries. We also investigated the relationship between customer satisfaction, operating and financial performance using *time series data*. Most importantly, the present study contributes with new knowledge about the Return on Quality in an after-market setting.

More research on how customer satisfaction impacts revenues including the whole product offering is needed. By the whole product offering we mean for example the main product/hardware, technical service and spare parts. We also suggest that future studies should look at longer time series for products with long life cycles. As mentioned in section *3.2. Scope and Limitations*, it has not been our intention to examine how quality is achieved, measured and optimized in practice given organizational capabilities. This would however be very interesting to investigate in light of our own findings.

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Appendix A – Mean Difference t-tests

Customer Satisfaction, Returning Customers – Mean Difference Independent Samples t-test

	Mean Differences for each Quartile compared to the rest of the population	
Quartile	**After-Market Service Satisfaction**	**Repurchase Intention**
Quartile 1	0,647**	0,409
Quartile 2	-0,295	-0,302
Quartile 3	0,282	0,171
Quartile 4	-0,634**	-0,272

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level. Unequal variances assumed.

Customer Satisfaction, Returning Customers - Mean Difference Independent Samples t-test

	Mean Differences for each Country compared to the rest of the population	
Country	**After-Market Service Satisfaction**	**Repurchase Intention**
Australia	-0,925***	-0,727***
Canada	0,934***	0,717***
South Africa	-0,571	-0,561
USA	0,205	0,343

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level. Unequal variances assumed.

Customer Satisfaction, All Customers - Mean Difference Independent Samples t-test

	Mean Differences for each Country compared to the rest of the population	
Country	**After-Market Service Satisfaction**	**Repurchase Intention**
Australia	-0,663***	-0,766***
Canada	0,779***	0,605***
South Africa	-0,531***	-0,226
USA	0,0777	0,237*

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level. Unequal variances assumed.

Operating Performance - Mean Difference Independent Samples t-test

	Mean Differences			
Country Pair	**Queries on Time**	**Backorders per Machine**	**Non-Conformances per Machine**	**Service Index**
Canada-USA	-2,427	-0,030***	-0,009***	-9,937***
Australia-USA	-3,701**	-0,010***	-0,004***	-15,418***
South Africa-USA	-4,733***	-0,102***	-0,001*	-18,114***
Australia-Canada	1,274	-0,019***	-0,005***	5,481***
South Africa-Canada	2,306	0,072***	-0,008***	8,177***
South Africa-Australia	1,032	0,092***	-0,003***	2,696***

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level. Unequal variances assumed.

Appendix B – Correlation Matrices

Operating Performance – Correlation Matrix – Aggregated

Variables	Queries on Time	Backorders per Machine	Non-Conformances per Machine	Service Index	DC Stock Availability	DC Pick & Pack Quality	DC Delivery Performance
Queries on Time	1,000***						
Backorders per Machine	0,130	1,000***					
Non-Conformances per Machine	0,0550	-0,108	1,000***				
Service Index	0,114	0,665***	0,0851	1,000***			
DC Stock Availability	-0,316***	0,00420	0,0853	0,169**	1,000***		
DC Pick & Pack Quality	-0,648***	0,0202	-0,0766	0,162**	0,00993	1,000***	
DC Delivery Performance	-0,501***	0,0253	-0,00864	0,153*	0,525***	0,458***	1,000***

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

Operating Performance – Correlation Matrix – Australia

Variables	Queries on Time	Backorders per Machine	Non-Conformances per Machine	Service Index	DC Stock Availability	DC Pick & Pack Quality	DC Delivery Performance	Stock Availability (Australia)
Queries on Time	1,000***							
Backorders per Machine	0,703***	1,000***						
Non-Conformances per Machine	0,449***	0,671***	1,000***					
Service Index	-0,904***	-0,832***	-0,728***	1,000***				
DC Stock Availability	-0,506***	-0,359**	-0,556***	0,642***	1,000***			
DC Pick & Pack Quality	-0,580***	-0,522***	-0,558***	0,608***	0,00993	1,000***		
DC Delivery Performance	-0,277*	-0,589***	-0,942***	0,590***	0,525***	0,458***	1,000***	
Stock Availability (Australia)	-0,720***	-0,812***	-0,909***	0,632***	0,584***	0,697***	0,854***	1,000***

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

Operating Performance – Correlation Matrix – Canada

Variables	Queries on Time	Backorders per Machine	Non-Conformances per Machine	Service Index	DC Stock Availability	DC Pick & Pack Quality	DC Delivery Performance	Delivery Days (Canada)
Queries on Time	1,000***							
Backorders per Machine	0,761***	1,000***						
Non-Conformances per Machine	-0,516***	-0,165	1,000***					
Service Index	0,629***	0,850***	0,0557	1,000***				
DC Stock Availability	-0,391**	0,0682	0,732***	0,182	1,000***			
DC Pick & Pack Quality	-0,799***	-0,744***	-0,0335	-0,661***	0,00993	1,000***		
DC Delivery Performance	-0,823***	-0,714***	0,669***	-0,650***	0,525***	0,458***	1,000***	
Delivery Days (Canada)	-0,898***	-0,839***	0,117	-0,628***	-0,0352	0,888***	0,677***	1,000***

***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

Operating Performance – Correlation Matrix – South Africa

Variables	Queries on Time	Backorders per Machine	Non-Conformances per Machine	Service Index	DC Stock Availability	DC Pick & Pack Quality	DC Delivery Performance	Delivery Days (Canada)
Queries on Time	1,000***							
Backorders per Machine	-0,288*	1,000***						
Non-Conformances per Machine	-0,123	-0,326**	1,000***					
Service Index	-0,419***	0,603***	-0,210	1,000***				
DC Stock Availability	0,273	0,0890	0,0245	0,568***	1,000***			
DC Pick & Pack Quality	-0,564***	0,512***	-0,448***	0,780***	0,00993	1,000***		
DC Delivery Performance	-0,074	0,647***	-0,584***	0,675***	0,525***	0,458***	1,000***	
Delivery Efficiency (South Africa)	-0,660**	-0,262	0,112	-0,798***	-0,776***	0,899***	-0,710***	1,000***

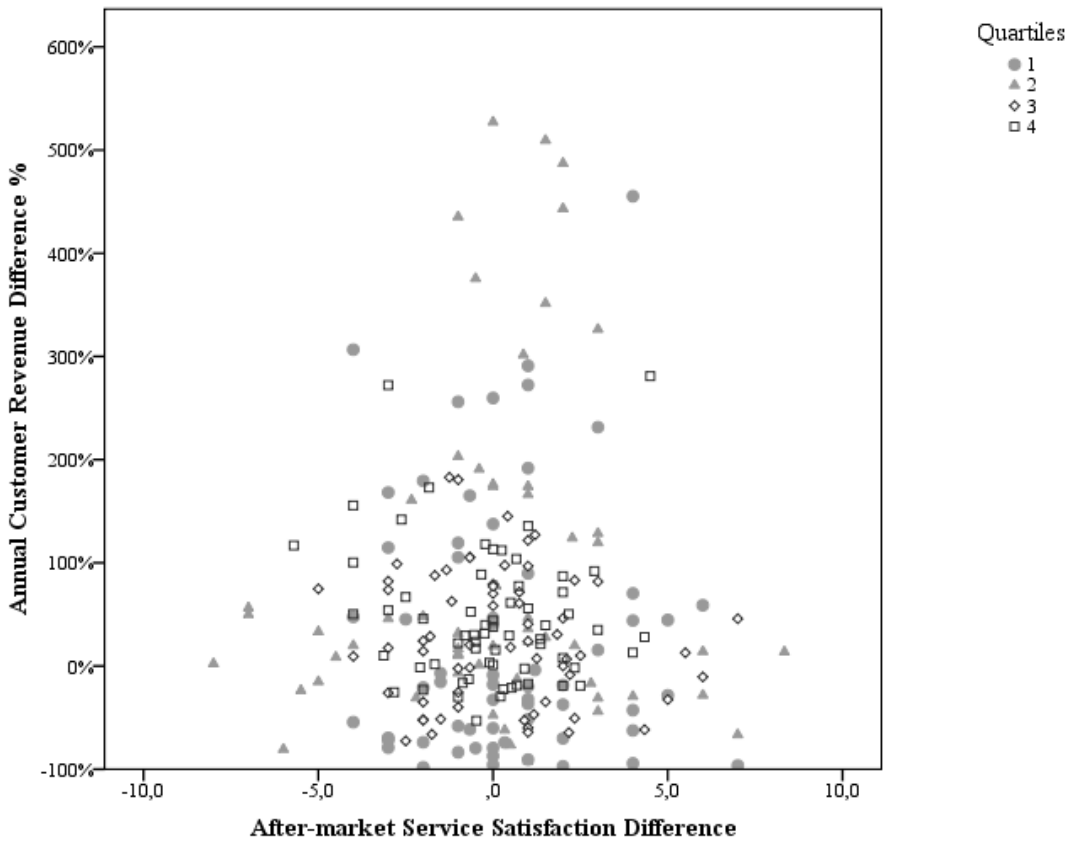
***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

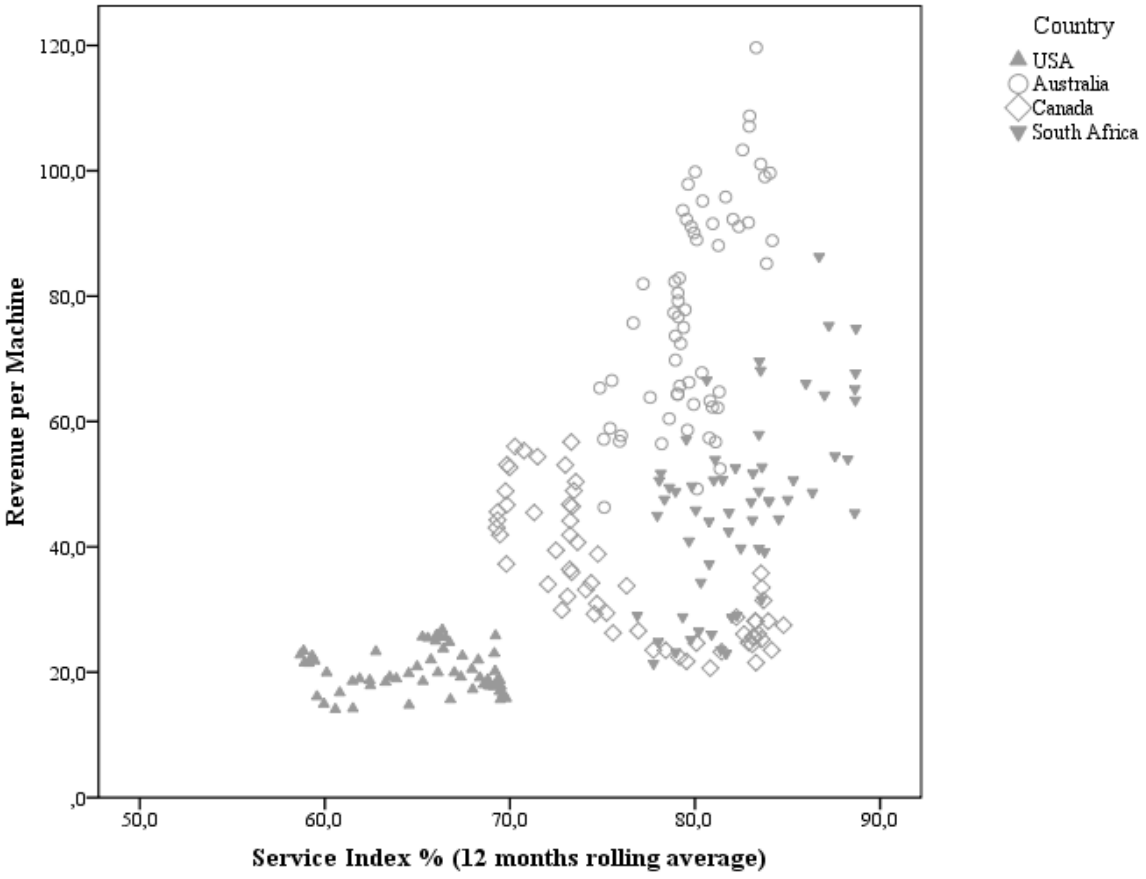
Operating Performance – Correlation Matrix - USA

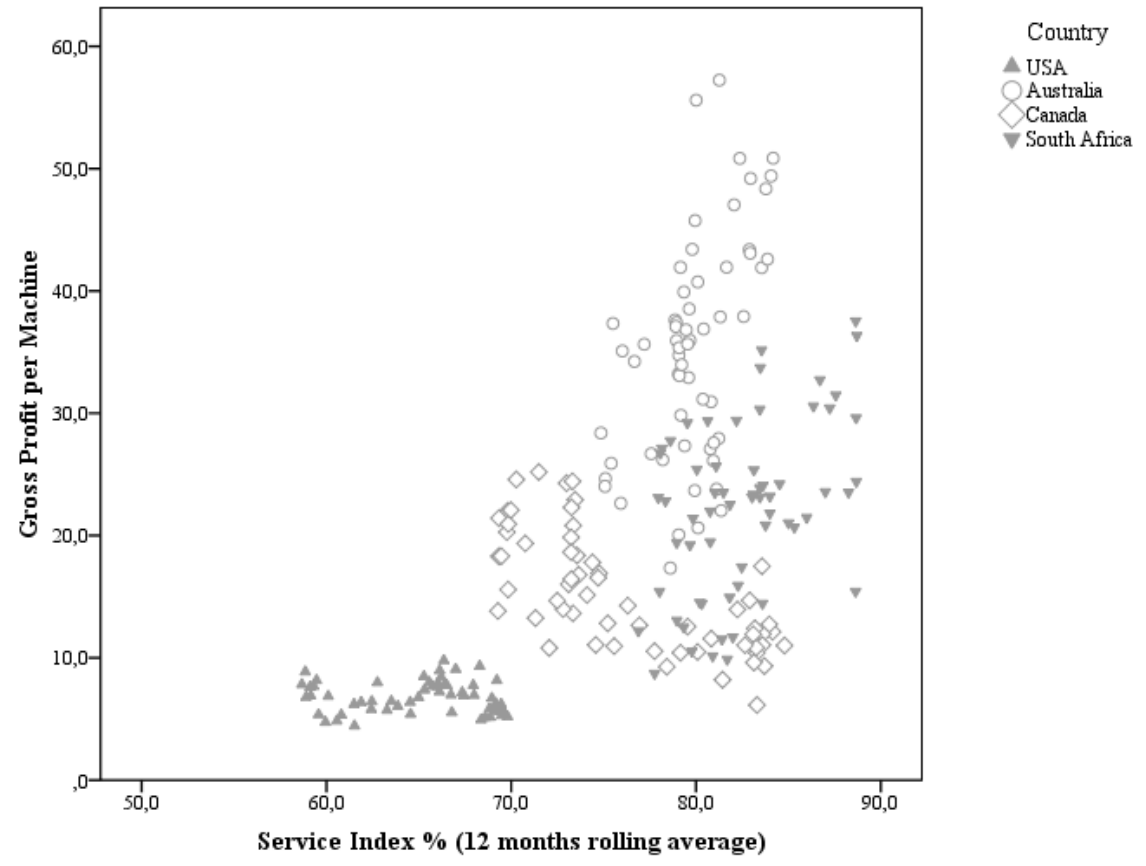
Variables	Queries on Time	Backorders per Machine	Non-Conformances per Machine	Service Index	DC Stock Availability	DC Pick & Pack Quality	DC Delivery Performance
Queries on Time	1,000***						
Backorders per Machine	-0,645***	1,000***					
Non-Conformances per Machine	-0,596***	0,229	1,000***				
Service Index	-0,976***	0,566***	0,607***	1,000***			
DC Stock Availability	-0,587***	0,349**	0,345**	0,545***	1,000***		
DC Pick & Pack Quality	-0,753***	0,566***	0,427***	0,787***	0,00993	1,000***	
DC Delivery Performance	-0,752***	0,114	0,446***	0,814***	0,525***	0,458***	1,000***

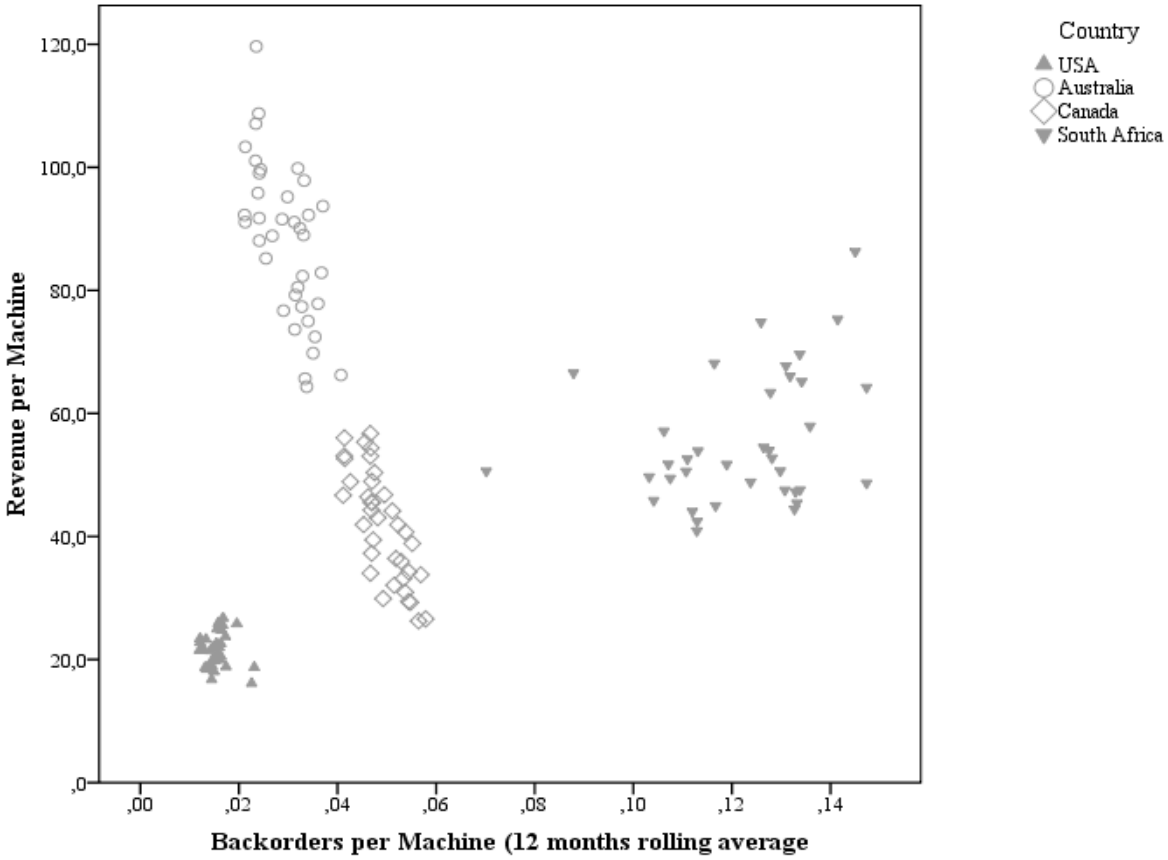
***Significant at the 1% level; **Significant at the 5% level; *Significant at the 10% level

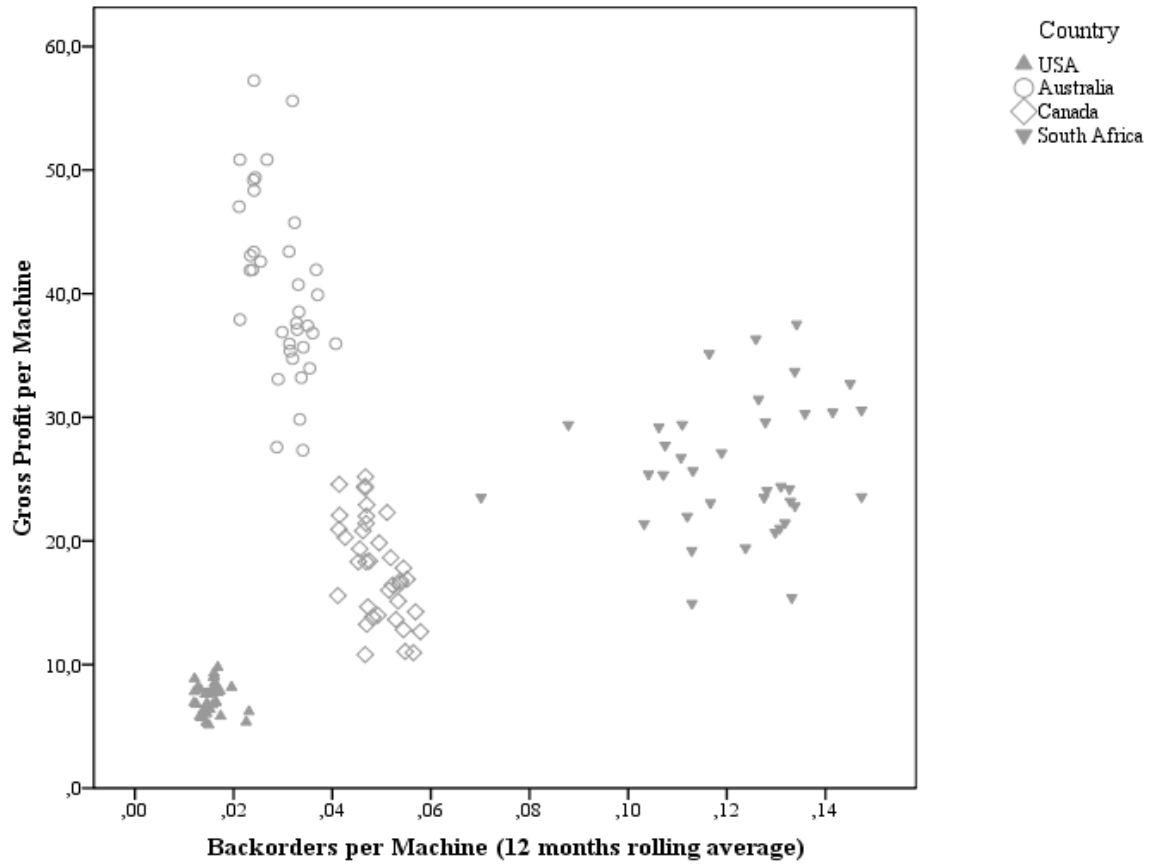
Appendix C – Scatter Plots of Operating and Financial Performance

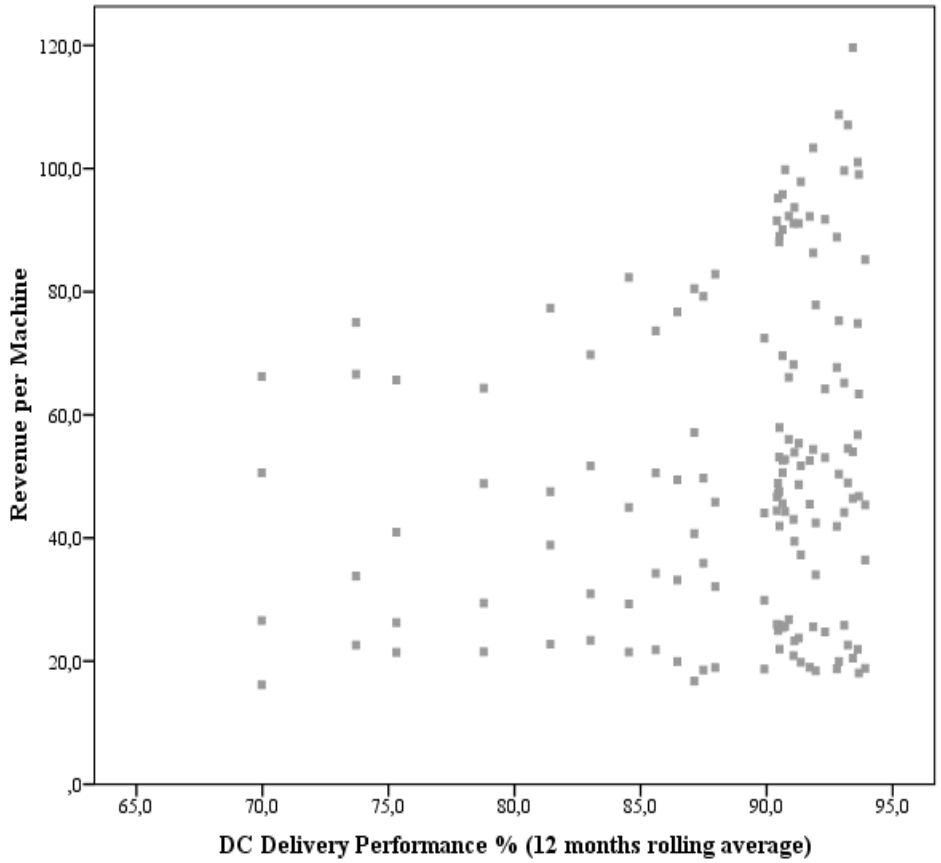


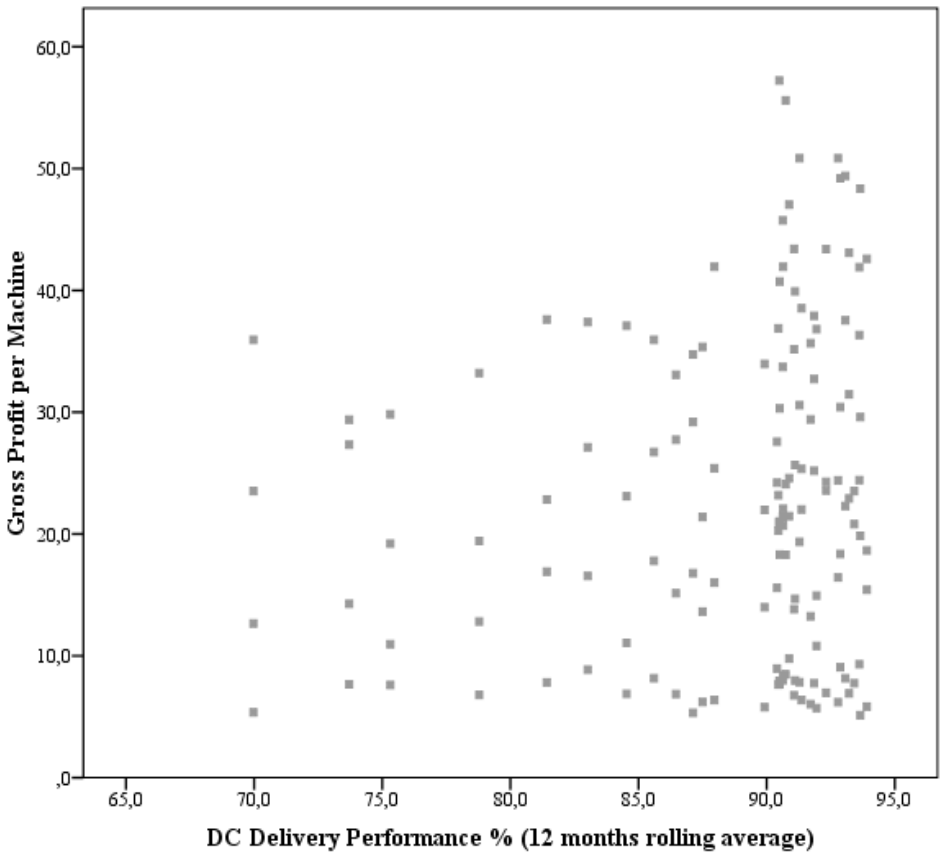

Country
USA
Australia
Canada
South Africa
Revenue per Machine
120,0
100,0
80,0
60,0
40,0
20,0
,0
50,0
60,0
70,0
80,0
90,0
Service Index % (12 months rolling average)

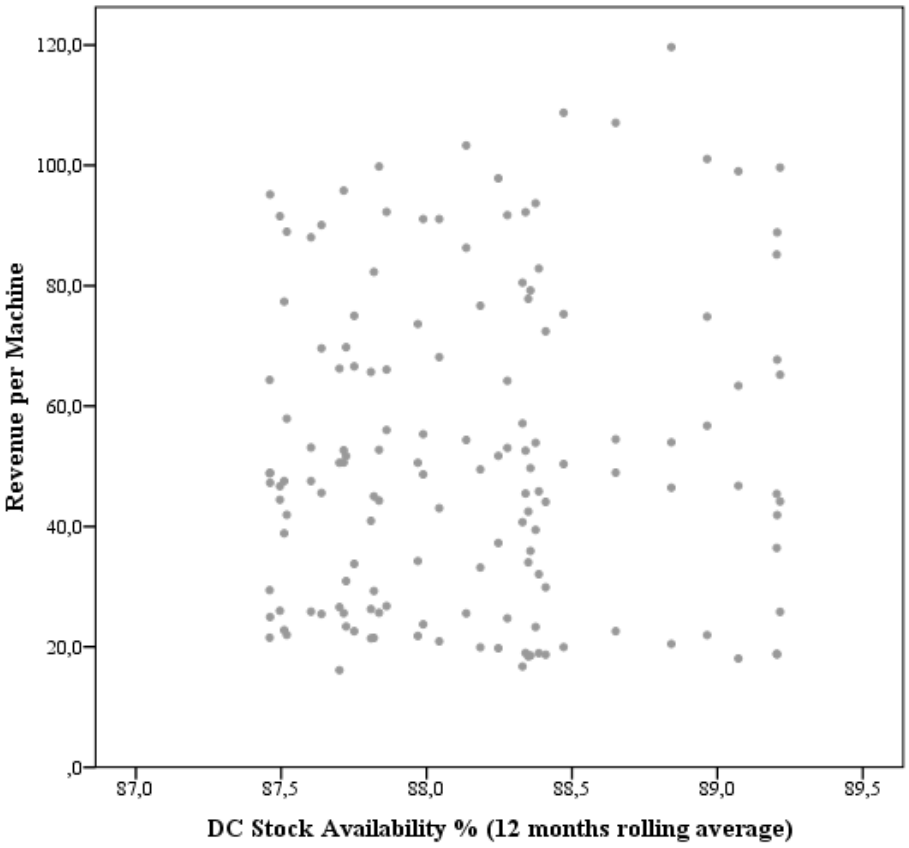

Country
USA
Australia
Canada
South Africa
Gross Profit per Machine
60,0
50,0
40,0
30,0
20,0
10,0
,0
50,0
60,0
70,0
80,0
90,0
Service Index % (12 months rolling average)

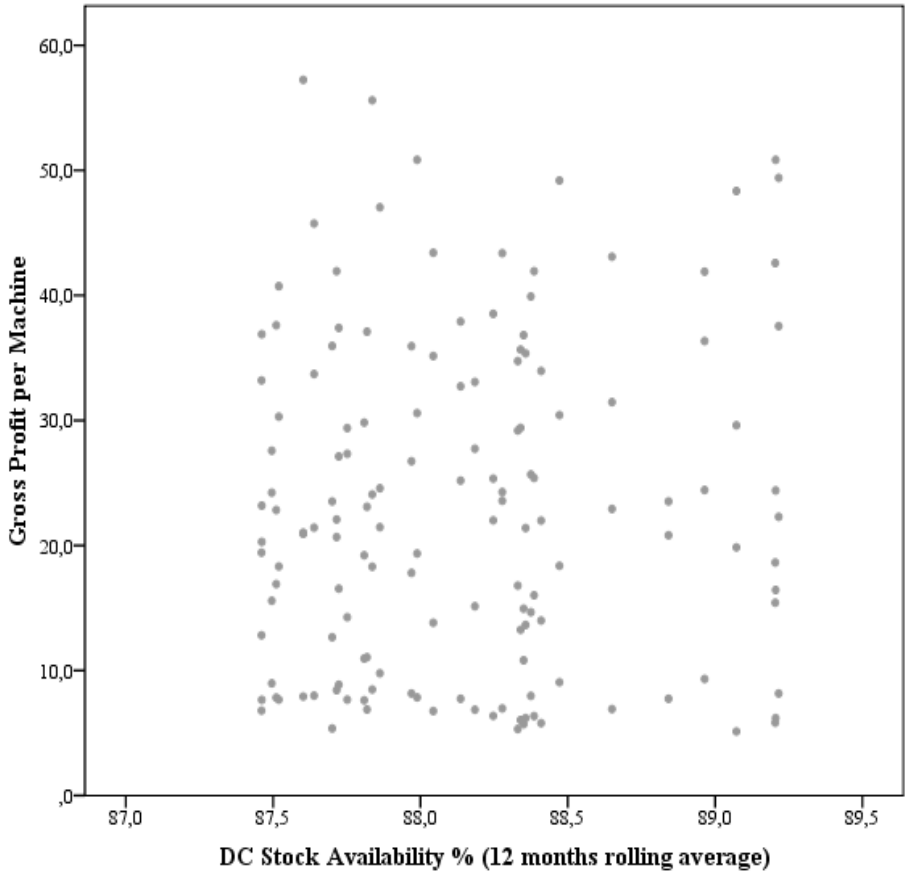

Country
USA
Australia
Canada
South Africa
Revenue per Machine
120,0
100,0
80,0
60,0
40,0
20,0
,0
,00
,02
,04
,06
,08
,10
,12
,14
Backorders per Machine (12 months rolling average


Country
USA
Australia
Canada
South Africa
Gross Profit per Machine
60,0
50,0
40,0
30,0
20,0
10,0
,0
,00
,02
,04
,06
,08
,10
,12
,14
Backorders per Machine (12 months rolling average)


Revenue per Machine
120,0
100,0
80,0
60,0
40,0
20,0
,0
65,0
70,0
75,0
80,0
85,0
90,0
95,0
DC Delivery Performance % (12 months rolling average)

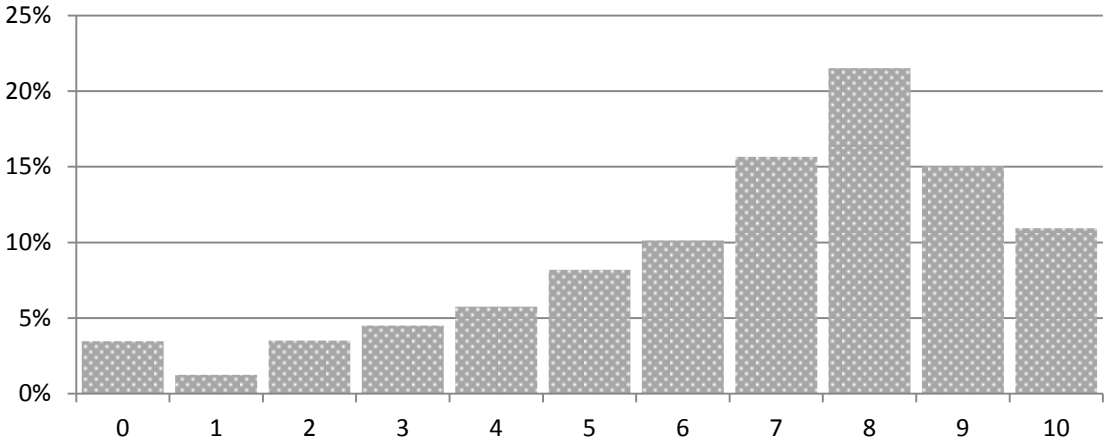

Gross Profit per Machine
60,0
50,0
40,0
30,0
20,0
10,0
,0
65,0
70,0
75,0
80,0
85,0
90,0
95,0
DC Delivery Performance % (12 months rolling average)


Revenue per Machine
120,0
100,0
80,0
60,0
40,0
20,0
,0
87,0
87,5
88,0
88,5
89,0
89,5
DC Stock Availability % (12 months rolling average)

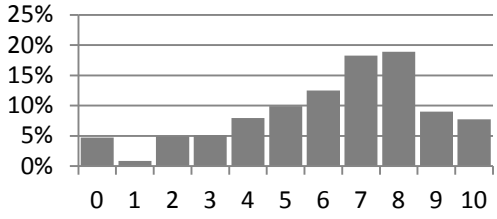

Gross Profit per Machine
60,0
50,0
40,0
30,0
20,0
10,0
,0
87,0
87,5
88,0
88,5
89,0
89,5
DC Stock Availability % (12 months rolling average)

Appendix D – Customer Satisfaction Distribution

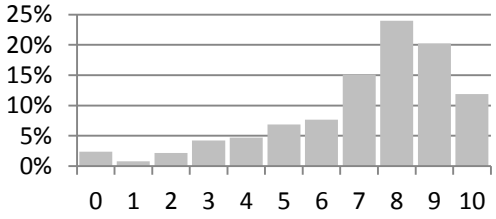
Share of Customers by After-market Satisfaction Score for NPS 2008-2012
(1908 customers)



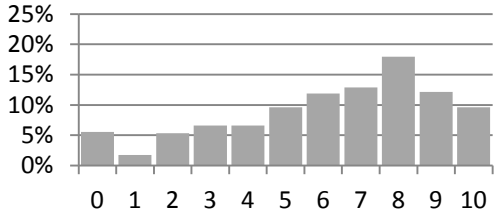
Australia
(445 customers)



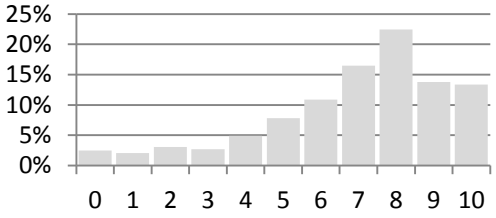
Canada
(782 customers)



South Africa
(328 customers)



USA
(271 customers)



Appendix E – Compilation of Previous Studies

COMPILATION OF PREVIOUS STUDIES 1995-1998

Author(s), Title	Facts About the Study	Independent Variable(s)	Dependent Variable(s)	Control Variable(s)	Method	Relevant Finding(s)
Rust et al. (1995) *Return on Quality (ROQ): Making Service Quality Financially Accountable*	Study: Single case, cross-sectional, internal company data Industry: Hotels, B2C, US Time period: 1 year, period not specified	N/A	N/A	N/A	The ROQ-model with inputs: customer processes, customer retention, satisfaction and repurchase behaviour, market size, market share, market growth, contribution margins, cost of capital etc. The model gives an NPV output	• The diminishing return on customer satisfaction, implies that efforts need to be focused on converting dissatisfied customers into satisfied ones rather than increasing satisfaction for all • The profit potential analysis is not disclosed but the return on improving quality is expected to be above 40%
Anderson et al. (1997) *Customer Satisfaction, Productivity, and Profitability: Differences Between Goods and Services*	Study: Multiple case, 170 obs. Longitudinal, publicly available data Industry: Various industries, B2C, Sweden Time period: 1989-1992	Customer satisfaction, Productivity = firms' total sales divided by number of employees	Productivity = firms' total sales divided by number of employees, Financial performance = ROI	Service and goods as main product offering	Regression analysis	• Tradeoff Hypothesis: services exhibit tradeoffs between customer satisfaction and productivity (negative relationship) while the same relationship is positive for goods. • Profitability Hypothesis: simultaneous changes in productivity and customer satisfaction is positively related to ROI for goods but for services this relationship is negative (and insignificant).
Ittner & Larcker (a) & (b) (1998) *Are nonfinancial measures leading indicators of financial performance? An analysis of customer satisfaction*	Study (a): Single case, > 2400 obs. Longitudinal, customer level analysis Internal company and publicly available data Industry (a): Telecom, B2B, US Time period (a): 1995-1996	Customer Satisfaction Index	Retention, Revenue, Revenue Change	Customer size, Customer age	Regression analysis (OLS, GLM and PLS)	• Customer satisfaction correlates positively with customer retention, revenue and change in revenue. • The relationship between customer satisfaction and purchasing behaviour is non-linear. There are satisfaction thresholds; revenue jumps when customer satisfaction reaches a certain level. There is moderate support for the hypothesis that customer satisfaction is a leading indicator of operating performance.
	Study (b): Single case, 73 branches, Longitudinal, Business unit level analysis, Internal company and publicly available data Industry (b): Retail Bank - B2C and B2B, US Time period (b): 1995-1996	Customer Satisfaction Index	Performance variables: Revenues, Expenses, Margins, Return on Sales	Customer type (B2B or B2C), Past Performance	Regression analysis (OLS, GLM and PLS)	• Customer satisfaction is a leading indicator of financial performance, but the authors argue that customer satisfaction has a higher impact on growth of the customer base than it has on increases in profits from existing customers. • There are customer satisfaction thresholds (non-linear relationship) that must be reached in order to improve (financial) performance. • No significant relationship between costs and customer satisfaction was found in the study. Relatively large changes in customer satisfaction are required in order to get an impact on accounting book values.

COMPILATION OF PREVIOUS STUDIES 2000-2005

Author(s), Title	Facts About the Study	Independent Variable(s)	Dependent Variable(s)	Control Variable(s)	Method	Relevant Finding(s)
Bernhardt et al. (2000) *A Longitudinal Analysis of Satisfaction and Profitability*	Study: Single case, >300 outlets, Longitudinal, Internal company data Industry: Fast food restaurant, B2C, US Time period:1992-1993	Customer satisfaction, Employee satisfaction	Profit, Sales	No control variables, but they do time series analysis	Time series and cross-sectional analysis	• Weak relationships between profit/sales and customer satisfaction and profit/sales and employee satisfaction in the current period. • Satisfied customers indicate that they will return to the restaurants in the future, so the relationship between customer satisfaction and behaviour intent is positive. • Positive relationship between change in customer satisfaction from previous periods and a change in current profit/sales.
Nagar & Rajan (2001) *The revenue implications of financial and operational measures of product quality*	Study: Single case, 11 factories, Longitudinal, Internal company data Industry: Clad metal & Semiconductors, B2B, US Time period: 23 quarters, period not specified	Non-financial quality metrics: Defect Rates and Number of On-Time-Shipments	Sales Revenue	Quality cost categories: Prevention, Appraisal, Internal Failure and External Failure	Regression analysis	• Financial quality measures (costs) are leading indicators of future revenue • Non-financial quality measures have incremental explanatory value on future revenue after controlling for financial quality measures
Bowman & Narayandas (2004) *Linking Customer Management Effort to Customer Profitability in Business Markets*	Study: Multiple cases, 160 obs. Cross-sectional, Internal company data Industry: Processed metal, B2B, US Time period: 12-month window, year not specified	Customer Profitability, Share of Wallet, Customer Satisfaction, Sales Personnel - Length of Tenure and Sales Representative, Product Quality, Product Line Breadth and Availability, Responsiveness, Delivery, Direct Customer Management Costs, Allocated Customer Management Costs, Customer Size, Pricing Policy, Satisfaction with Closest Competitor and Direct Customer Management Effort. No control variables, the system of equations allows for non-linear relationships			System of equations allowing for asymmetric and non-linear relationships	• There are positive relationships between: 1) vendor effort and attribute performance; 2) attribute performance and overall satisfaction; 3) overall satisfaction and share of wallet and 4) share of wallet and customer profitability. • There a negative impact on customer profitability from the customer management efforts. The relationships are found to be non-linear and asymmetric e.g. the size of the customer increases margins, but diminishes the effect of customer satisfaction on share of wallet and the overall satisfaction to attribute performance.
Keiningham et al. (2005) *Does customer satisfaction lead to profitability? The mediating role of share-of-wallet*	Study: Single case, >80 obs. Survey data, Cross-sectional Industry: Institutional securities B2B, EU & US Time period: 12 month period	Share of Wallet, Revenue, Profit	Customer satisfaction, Share-of -Wallet	No control variables	Regression analysis, system of regressions. Two segments based on profitability that are analysed both together and separately	• Share of wallet is positively correlated to customer revenues for unsegmented data and both profitable and unprofitable customers. The relationship between customer share of wallet and profitability will be mediated by customer revenue for profitable customers • Customer revenue is positively correlated to customer profitability for profitable customers • The relationship between customer satisfaction and revenue are mediated by customer share of wallet for unsegmented data and profitable customers

COMPILATION OF PREVIOUS STUDIES 2006-2007

Author(s), Title	Facts About the Study	Independent Variable(s)	Dependent Variable(s)	Control Variable(s)	Method	Relevant Finding(s)
Bharadwaj & Matsuno (2006) *Investigating the antecedents and outcomes of customer firm transaction cost savings in a supply chain relationship*	Study: Multiple case, >150 obs. Cross-sectional, Survey data Industry: Computer and electronics manufacturers, B2B, US Time period: Not specified	Order Management Cycle (OMC) Performance = A construct of supplier's order cycle time, on-time delivery, order accuracy, emergency order fullfillment, billing accuracy, defect rates and post-sales assistance, Trust, Customer Firm Transaction Cost Advantage, Customer Future Intentions, Customer Satisfaction.		No control variables, but they look at both direct and indirect effects	System of regressions	• There is a positive association between the customer firm's assessment of the supplier's OMC performance and customer's level of trust in the supplier. • The supplier's OMC performance is positively related to transaction cost advantage as so is trust to transaction cost advantage. • Transaction cost advantage and customer's future intentions with the vendor are positively correlated. The transaction cost advantage that the customer receives from the supplier relationship has a positive impact on customer satisfaction. • Customer satisfaction is positively related to future intentions with the vendor.
Li et al. (2006) *The impact of supply chain management practices on advantage and organizational performance*	Study: Multiple cases, >190 obs. Cross-sectional, survey data and publicly available data Industry: Various manufacturing industries, B2B, US Time period: Not specified	Competitive Advantage constructs♦ Supply chain management Practice constructs♣	Competitive Advantage constructs♦ Marketing Performance and Financial Performance	No control variables specified	Regression analysis ♦Competitive Advantage constructs: Advantage constructs: Price/Cost, Quality, Delivery Dependability, Product Innovation and Time to Market ♣supply chain management Practice constructs: Strategic Supplier Partnership, Customer Relationship, Level of Information Sharing, Quality of Information Sharing and Postponement	• There is a significantly positive relationship between supply chain management practices and Organisational Performance. • A positive association between supply chain management practices and competitive advantage. • Higher levels of competitive advantage are associated with higher levels of organisational performance.
Banker & Mashruwala (2007) *The Moderating Role of Competition in the Relationship between Nonfinancial Measures and Future Financial Performance*	Study: Single case, >800 outlets, Longitudinal, Internal company data Industry: Retail chain, B2C, US Time period: 5 years, time period disguised	Customer satisfaction, Employee satisfaction	Profit per square foot per store (adjusting for size), Revenue	Past earnings (Profit per square foot), Low / High competition location (interaction variable)	Regression analysis, OLS and Logit models	• Nonfinancial metrics do have predictive ability for future earnings when controlling for past earnings. • Employee and customer satisfaction are better leading indicators of financial performance in a competitive business environment than in a business area where competition is weak for both employees and customers

COMPILATION OF PREVIOUS STUDIES 2007-2011

Author(s), Title	Facts About the Study	Independent Variable(s)	Dependent Variable(s)	Control Variable(s)	Method	Relevant Finding(s)
Yu (2007) *An Empirical Investigation on the Economic Consequences of Customer Satisfaction*	Study: Single case, 36 branches, Cross-sectional, Internal company data Industry: Retail Banking, B2C, Taiwan Time period: 1998	Customer satisfaction dimensions: Responsiveness, Speed, Empathy, Reliability, Tangibles, Price and Total Satisfaction	Willingness to Recommend, Customers Repurchase Intentions, Profit per Customer, Revenue per Customer and Activity Cost per Customer	Sex and Education Degree	Regression analysis	• Customer satisfaction affects existing customers' purchase behaviour positively. This proven by the positive correlations between customer satisfaction and repurchase intentions and between customer satisfaction and reputation. • Higher customer satisfaction leads to higher customer revenue and costs, but no significant relationship was found between customer satisfaction and profit per customer
Wiersma (2008) *An exploratory study of relative and incremental information content of two non-financial performance measures: Field study evidence on absence frequency and on-time delivery*	Study: Single case, 27 branches Longitudinal, Internal company data Industry: Post Distributor, B2B and B2C, Holland Time period: 1995-1997, monthly data	Employee Absence Frequency, On-Time-Deliveries	Variable Costs, Revenues	CPI, Volume of Products Handled	Regression analysis	• There is little relative information content in operating variables when controlling for lagged financial variables for the cost and revenue models. • There is significant incremental information content in operating variables when controlling for lagged financial variables for the cost and revenue models. • On-Time-Deliveries decrease (future) costs and increase (future) revenues.
Ou et al. (2010) *A structural model of supply chain management on firm performance*	Study: Multiple case, 95 publicly listed firms, Survey data, Cross-sectional Industry: IT companies, B2B, Taiwan Time period: Not specified	Operational performance (measures not specified) and Customer Satisfaction	Financial Performance (measures not specified) and Customer Satisfaction	No control variables specified	Regression analysis	• Operational performance has a significantly positive impact on customer satisfaction and financial performance • Customer satisfaction correlates positively with financial performance.
Williams & Naumann (2011) *Customer satisfaction and business performance: A firm-level analysis*	Study: Single case, Longitudinal, Internal company data and publicly available data Industry: Service division in a manufacturing company. The service is mainly facility management, B2B, US Time period: 2001-2004	Customer Satisfaction, Repurchase Intentions, Willingness to Recommend	Revenue, Contract Renewals (account level retention rate), Net Income (net profit from a shareholder perspective)	No control variables specified	Cross-tabulation	• Customer satisfaction is positively related to customer retention, revenue per account and revenue growth. • There are positive correlations between Customer Satisfaction, Repurchase Intentions and Willingness to Recommend. • There is a significant positive relationship between revenue changes and changes in customer satisfaction. • There is a moderate positive relationship between net income changes and changes in customer satisfaction