3. Research Method

This chapter begins by the development of hypotheses and continues with the research methodology. It then presents sampling and data collection and the chapter ends by a short explanation of analysis method.

3.1 Development of Hypotheses

Lean is about increasing value to the customer and reducing waste. A successful lean implementation should lead to reduction in costs, increase in productivity and improved quality (Cooper, 1995; Liker, 2004; Karlsson & Åhlström, 1996; Monden, 1983). Lean will create both financial and non-financial advantages for the company. Lower inventory and less workspace should lead to a decrease in assets (Boyd et al., 2002). Inventory turnover should increase and reduction of waste should lead to lower costs, which implies a higher profit (Fullerton et al., 2003). Increased quality should result in lower production costs and higher customer satisfaction. A successful implementation means that the lower costs can be transferred to customers via a lowered price, alternative higher quality to the same price. Improvements in quality will lead to satisfied and loyal customers, which in turn lead to increased profit (Whiting, 1986).

Earlier research has found a mixed result of the relationship to financial performance, but much of the earlier research has not used lean

manufacturing as a total concept. The elements in the model created by Shah and Ward (2007) are inter-related, which means that they complement each other and creates synergistic effects. All elements, or constructs, are associated with improved performance, and together, as a complete set, they create competitive advantage.

This study aims to prove a positive relationship of lean implementation and firm performance through two testable hypotheses:

H1: Manufacturing companies that have implemented lean manufacturing will experience improved financial performance

H2: Manufacturing companies that have implemented lean manufacturing will experience improved non-financial performance

3.2 Research Methodology and Design

The intention of this study is to explain the nature of a relationship in order to predict an organisational outcome. A survey research design is used based on the need for quantitative, primary data, which is not available from existing sources. Data in this study is gathered just once and is thus a cross-sectional survey. Self assessment is used both for the independent and the dependent variable. According to Olsen (2004) the perceptual survey with multi-item

constructs has evolved during the last decade in the operations management research and “have demonstrated high validity and reliability in capturing and describing management practices” (p. 14). A risk of self assessment of performance is however that it may lack connection to the published financial data of the company (Olsen, 2004). Since this survey is anonymous, the only alternative was to use self assessment for the firm performance. To minimise the risk explained by Olsen, specific measures such as ROI and ROA was not included in the performance measures. Since the respondents were not expected to have to go back to the annual reports, but to answer the questions with their knowledge, more general measures were used, for example cost savings. This was expected to reduce the time and ease for answering the questionnaire, with the intention to increase the response rate.

This is a correlation study, given that it aims to explain if the implementation of lean manufacturing leads to enhanced firm performance. This means that a positive relationship is sought between the independent and the dependent variable. The research design is illustrated in Figure 3.2.1. The research is based on primary data gathered in September 2010.

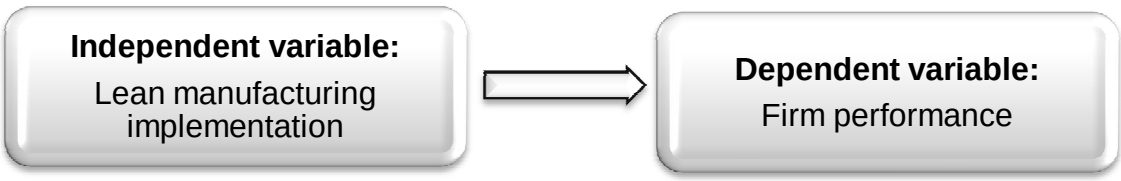

Figure 3.2.1. Research design

3.3 Survey Instrument

The survey instrument is an electronic questionnaire sent out via e-mail. The reason for this is that it is an economical way to gather data and it is fast, which helps due to time constraints. The disadvantage by using e-mails is the risk of low response rate (Saunders, Lewis & Thornhill, 2007). A cover letter was sent in the e-mail containing a link to the questionnaire, which was created using Google Docs, a free of charge program for creating questionnaires. After the questions for the dependent and the independent variable described below, the questionnaire ended with a section of demographics to collect information about the characteristics of the respondents and their companies. The items in the questionnaire are found in Appendix B.

3.3.1 Dependent Variable

Firm performance is measured by seven items based on Mia and Clarke (1999). The items measures both financial and non-financial performance indicators. The respondent was asked to indicate the changes in performance in the last three years on a seven point Likert scale ranging from (1) Decreased tremendously to (7) Increased tremendously, which is based on Jusoh and Parnell (2008). The items included productivity, cost savings, product quality, on-time delivery, sales growth, operating profit and market share.

3.3.2 Independent Variable

For the assessment of lean manufacturing implementation, an instrument developed by Shah and Ward (2007) is used. Shah and Ward developed the instrument to create a comprehensive measure for both internal and external parts of lean and the tool is recommended for future research, as it creates a common definition of lean production. By using an already tested instrument the internal consistency is established and Cronbach's Alpha has a value of more than 0.7 for all factors.

The independent variable lean manufacturing is composed by ten operational constructs of which three is related to suppliers, one to customers and six are internally related, see Figure 3.3.2.1.

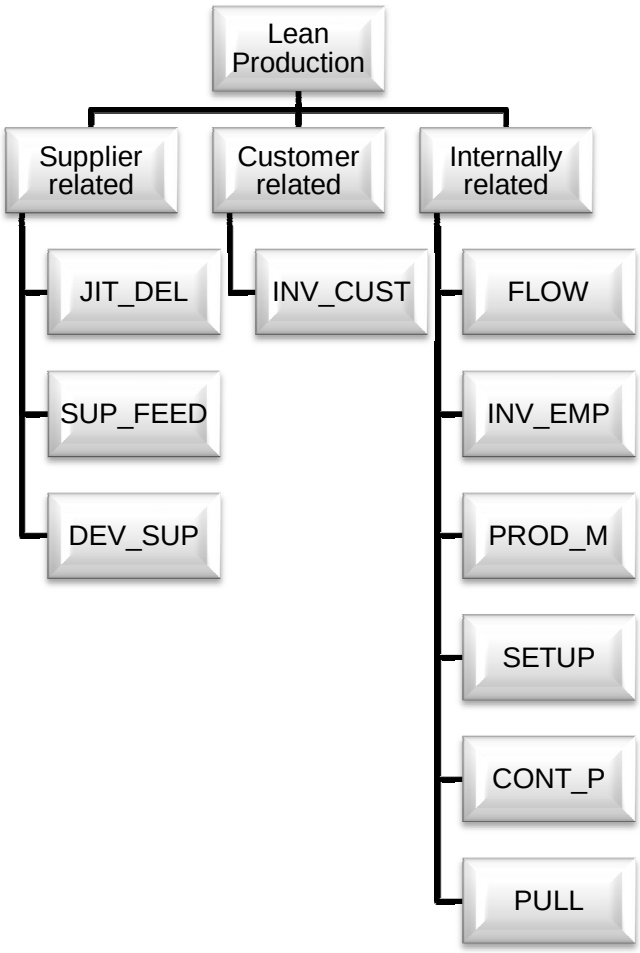

Figure 3.3.2.1. Instrument to measure implementation of lean manufacturing (based on Shah and Ward, 2007, p.799)

The operational constructs are related in the following way: involved customer (INV_CUST) is important for understanding the demand and customer's needs. Their feedback is vital for improvement.

The layout of the plant should be based on the product flow (FLOW) and equipment is grouped accordingly. This means that employees are responsible for different types of machines and are working in multi-functional teams, who can identify and solve problems (INV_EMP). Since the lean flow

of products are sensitive to disturbances, productive maintenance will ensure that the machines are running (PROD_M). In order to have small batches, the set-up time must be reduced (SETUP). To ensure the quality of the products, quality assurance reduces variability in the process (CONT_P). To be able to produce what is needed, in the right time and to the right quantity a pull system is used (PULL). Suppliers must deliver in time in order to create a lean flow (JIT_DEL) and they must receive feedback of their products and deliveries for improvement (SUP_FEED). The suppliers should be involved in the new product development (DEV_SUP), which is a part of the long term relationship (Shah and Ward, 2007).

The instrument has a total of 41 items and every item is evaluated on a five point Likert scale, ranging from (1) No implementation to (5) Complete implementation. No pre-test was conducted since the internal consistency was already established.

3.4 Sampling and Data Collection

Findings by Goyal and Deshmukh (1992), White, Pearson and Wilson (1999), Shah and Ward (2003), Wong et al. (2009) and Demeter and Matyusz (2010) imply that larger plants are more likely to implement lean practices to a greater extent than smaller plants. Therefore, only companies with more than 150 employees were aimed to be included in the study.

According to Statistics Sweden (SCB) there were 1,278 privately held companies with more than 200 employees in 2009. Of them, 689 had Swedish owners and 589 were foreign owned. According to statistics 2010, a total number of 433 companies were manufacturing companies with more than 200 employees.

Companies were identified and selected from an employers' organisation with membership of more than 3,500 technology companies in Sweden (www.teknikforetagen.se) and from a homepage with company facts (www.foretagsfakta.se) to identify companies from other industries as well. An attempt was made to cover companies from all industries within Swedish Standard Industrial Classification (SE-SIC) 2007, codes 10-32. The different companies' homepages were visited to be able to identify number of employees. Since this information was difficult to find in many cases, a control question was included in the demographics section of the questionnaire. This would make sure that only companies with more than 150 employees were included in the sample. When detailed information could not be found on Internet, calls were made to the companies to identify the production manager.

A total of 190 e-mails were sent out, with a short explanation of the survey and with a link to the questionnaire, which had to be translated into Swedish. Due to the fact that the questionnaire was anonymous, only one follow up e-mail was sent out after approximately one week. No second follow up e-mails

were sent out, since the questionnaire was anonymous and that would risk that respondents that already had answered the questionnaire would get two remainders. This *netiquette* was recommended by Saunders et al. (2007). 49 e-mails came back as undelivered, which means that 141 questionnaires were successfully distributed. A total number of 46 responses were received, which is an initial response rate of 32.6 percent. One respondent had only completed some parts of the questionnaire and ten responses came from companies with less than 150 employees. Thus 35 responses were used for the final analysis, giving a final response rate of 24.8 percent. The response rate is low, but is not uncommon in operations management research (see for example Shah and Ward, 2007: 13.5%; Wong et al., 2009: 12.6%; Olsen, 2004: 15.2% and in Sweden Poksinska et al, 2010: 16%).

3.5 Data Analysis Method

SPSS version 18 was used to analyse the data from the survey. Reliability was established by measuring Cronbach's Alpha. A Pearson correlation analysis was carried out to investigate the relationship between the variables. When the Pearson analysis indicated significant correlations between the variables, a regression analysis was made to test the hypotheses. The method and results are presented in more detail in the following chapter.

3.6 Summary of Research Method

A survey design was used to collect primary, quantitative data. An electronic questionnaire was sent via e-mail to manufacturing firms within different industries identified through information on Internet. The sample companies should have more than 150 employees, as earlier research had concluded that large firms had implemented lean practices to a greater extent than small firms.

The questionnaire contained three parts of which the first two were based on earlier research: assessment of lean implementation (ten constructs with 41 items), assessment of firm performance (seven items) and demographics. The lean constructs were JIT delivery, pull, productive maintenance, flow, developing suppliers, involved employees, involved customers, supplier feedback, controlled processes and set up. The firm performance was measured by productivity, cost savings, product quality, on-time delivery, sales growth, operating profit and market share.

A total number of 35 responses were gathered, which is a response rate of 24.8 percent.