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Developing a Model for Managing Production Performance of Small and Medium Enterprises in Sweden

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Abstract:

The study developed a model for production performance management of small and medium enterprises (SMEs) in Sweden. The developed model works for assessing, follow up and improvement in production performance. SMEs differ in size, structure, culture, competition, management practices, resource availability and lot more when compared with large organizations. SMEs also lack in effective performance management framework as most of the framework developed are designed for large organizations.

Production is core and critical value adding process especially for SMEs manufacturer for their survival and growth. SMEs are more motivated with doing rather than measuring it. Taking all these consideration a comprehensive model is developed which consists of four major steps. The model starts with studying of company's strategy, and then there are steps for design of production performance measurement which works for identifying details strategically aligned performance measures. Benchmarking step is included to compare performance with best practices, finally measurements results are analysed and improvement actions are taken to continuously improve the production performance.

Developed model based on literature study, multiple case study (three case studies) are being conducted to check model applicability. The result of case studies supports the applicability and formulated problem is also well-answered by developed model.

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List of Definitions

Performance:

Authors defined Performance differently like,

"*Number or series of activities directed toward an outcome*" (Harkema 2002, as cited in Ermolayev & Matzke, 2007).

"*The combination of competence in job skills and high level of productivity*" (Hall 2003, as cited in Ermolayev & Matzke, 2007).

"*Valued contribution to reach the goal of an organization*" (Melchert & Winter 2004 as cited in Ermolayev & Matzke, 2007).

Continuous improvements: ISO 14001 defined continuous improvement as a process that enhances the management system in organization to achieve improvements in performance.

Cost-effectiveness: is a measure that indicates how much the invested capital can be economically beneficial in long term (Al-Najjar & Kans, 2006).

Measurement: Help to assess the present situation or condition in accordance with set objectives (Amaratunga & Baldry, 2002).

Performance measurement: Provides an opportunity to investigate what has happened not why happened (Amaratunga & Baldry, 2002).

Performance management: Performance measurement results are utilized to improve the performance to achieved desired organizational goals (Amaratunga & Baldry, 2002).

Productivity: "*The relationship between the output generated by a production or service system and the input provided to create this output*" (Prokopenko, 1987).

Strategy: "*An organization strategy describes how it intends to create value for its shareholders, customers and citizens*" (Kaplan & Norton, 2004).

Strategy alignment: It means all the activities within company should help to achieve the strategic goals (Hudson & Smith, 2007).

List of Abbreviations

KPIs: Key Performance Indicators

OEE: Overall Equipment Effectiveness

PDCA: Plan Do Check Act

SMEs: Small and Medium Enterprises

TPM: Total Productive Maintenance

SMOs: Small and Medium Organizations

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1. Introduction

Introduction chapter highlights the importance of research area; it starts with background to motivate the readers, tells about performance measurements, and moves to problem discussion, presentation and formulation. The problem formulation leads to the purpose of the study. The chapter also includes relevance of the research problem, limitation / delimitation and in last the working schedule shows the planning made to conduct the study.

1.1 Background

Domestic and global competition has made companies to strive for better ways of operation (Krajewski & Ritzman, 1996). Working with challenges as opportunity, and make improvements in the current process will lead them to face the future threats (Krajewski et al. 2007). According to Eccles (1991) hard realities of competition have made the management to rethink their practices and develop effective system to measure the business performance. Neely (1999) adds that competition has made the companies to focus on their customer requirements, and it moved from cost driver to value addition. Meeting the customer requirements, organizations need to know their current performance level and customer expectation for competing in markets. Globerson (1985) stated organizations may find lack in their criteria to evaluate the organizational or individual performance, this made it difficult to manage and improve operations.

According to Gits (1992) production is one of the key and primary function of the organization. Huang et al. (2003) argued this requires the companies to be efficient, work to optimize, and improve the productivity level. Skinner (1974) adds production objectives clarity makes it possible to achieve desired goals. Muchiri & Pintelon (2008) are of the view that production losses lead to decrease in productivity due to an inefficient manufacturing process. According to Skinner (1974) low productivity and high cost problems could be tackled effectively by managing the processes. Globerson (1985) argued operational objectives will be achieved by meeting operational performance criteria. According to Ghalayini & Noble (1996) improvements in production technology shifted the performance measure to new variables; traditional performance measures mainly based on financial perspective no longer can represent the actual performance.

Losses identification and elimination in the production process require working with performance measurements to account for improvements in productivity (Muchiri & Pintelon, 2008). Performance measurement information reflects on the strength and weakness of production process (Bunse et al. 2011). Performance measurement supports the decision maker to improve the processes by providing the current status of the performance (Ron & Rooda, 2006). Performance management utilizes the results of performance measurement to assess, follow-up and improve performance in order to achieve the desired objectives (Amaratunga & Baldry, 2002). According to Neely (1999) linkage of financial measure with non-financial measure better represents performance measurement. Ghalayini & Noble (1996) adds profit can be a measure however it does not locate the area of improvements to work

with. Non-traditional measures have become essential to identify the lacks and work with continuous improvements to achieve strategic objectives.

There exists strong correlation between strategy and performance measures, and their alignment will ensure the execution of the strategic objectives (Neely, 1999). Bourne et al. (2000) stated performance measures could deviate from strategy provided the evaluation process of measure is not upgraded. There is a need of validation of measures with the strategy for avoiding the gaps and achieving the goals effectively. Neely (1999) adds that understanding of performance measure or the definition ambiguity can cause the disruption in the achievement of the objectives. Stapenhurst (2009) argued benchmarking provides an opportunity to improve performance by adopting best practices. In the view of Storey (1994) there are major differences between SMEs and large enterprises. Hudson et al. (2001) and Hudson & Smith (2007) have summarized these differences as competitive environment, organizational environment and management practices.

1.2 Problem Discussion

Statistic of European Commission (between 2004 and 2005) showed that Swedish SMEs are contributing more than lager companies for economic development and are providing employment opportunities. Garengo & Bititci (2007) argued that limited in-depth performance measurement's practical investigation has been made for SMEs. Hudson & Smith (2007) argued performance management in SMEs may be not as good as the large companies because of the limited resources and skill of an owner-manager, so there is a requirement of tools or model for assessing and improving the performance of SMEs.

Performance management provides an opportunity to investigate the implementation of plans, identify the lacks and work with them to make the plans as were desired (Atkinson et al. 1997). Hudson & Smith (2007) has pointed out that effectiveness of management in SMEs depends very much on the skills of owner-managers, limited resources and the adhocracies structure of SMEs. According to Hudson & Smith (2007) most of the current performance measurement frameworks are only suitable for large scale companies; they are not applicable for SMEs due to unique structure and culture of SMEs.

Veen-Dirks (2010) described importance of using performance measurement, and stated uses for performance measurement for company management. Bunse et al. (2011) argued production performance measurement works for providing information on the current situation of production, and the information can be used by company managers to improve their production processes. The research of Veen-Dirks (2010) indicates that sometimes the performance measurement is not used properly. The measurements should be comprehensive, comparable and properly used (Oechsener et al. 2003 and Veen-Dirks, 2010). Neely (1999) and Bourne et al. (2000) highlighted the importance of linkage between the strategy and practices at operational level, deviation between them results into performance decline. Hudson & Smith (2007) insisted on the strategic alignment of performance measurement for SMEs; the measurement designed in SMEs should reflect the performance with respect to company strategy, and it should also contribute to the achievement of strategic goals.

Amaratunga & Baldry (2002) argued performance measurement results provide the decision maker insights of the past to take appropriate actions for improving performance. Lebas (1995) stated accurate data and information will make it possible for a decision maker to improve performance. Denkena & Liedtke (2006) pointed out that some measurement results are only data in numbers, they need to be benchmarked in order to transfer the data into information. Some of the measurement results are not assessable because they lack benchmarking. Al-Najjar et al. (2004) stated benchmarking is an important tool for continuous improvement, and they also argued that some data resources for benchmarking could be: standards, historical data, other similar processes or companies. According to Denkena & Liedtke (2006) for SMEs sometimes the importance for benchmarking is not realized or it is difficult to find data to benchmark.

1.3 Problem Presentation

In manufacturing companies production is central and key function, the profit and growth of the manufacturing companies depend on the excellence of production function. Disturbances in the production process result into decrease productivity and low quality products and these factors finally results into low profit margin and growth for manufacturing companies. Al-Najjar (1996) also mentioned that disturbance detection and elimination causes reduction in wastages and leads to process improvement. Muchiri & Pintelon (2008) add more and argued detection and elimination of production gaps will ensure the improved productivity. Amaratunga & Baldry (2002) mentioned performance management make it possible to improve the performance while Hudson & Smith (2007) are of the view that SMEs have limited resources to work effectively with performance management as comparison to large enterprises.

Production performance measurements identify the current status of the production process. Work with improvements in production process requires taking corrective actions based on the results of performance measurements. According to Neely (1999) companies are using different tools based on their shortages in order to enhance their performance. Veen-Dirks (2010) also argued that assessing the current performance, the result should be properly used to get maximum outcomes of improvement; otherwise assessing performance without improvement is wastage of resource. Denkena & Liedtke (2006) stated there are difficulties for SMEs to measure their production performance, new measurements needs to be designed. Garengo et al. (2005) adds limited empirical investigation for performance measurements have been made.

Organizational strategy work for creating values and it guides different functions of the organization to work under the umbrella to achieve desired objectives. Organization strategy to compete in market requires production practices to be aligned. Neely (1999) adds that there requires an alignment of strategy with the practices in the company. There exist the practices which do not contribute to performance. In the view of Drucker (1992) focused performance measure leads to objective's achievements, while the diversification in performance measures could be misleading for achievement of desired objectives. Globerson (1985) argued an individual performance measure contributes to achievement of objective excellence. Stated by

Neely (1999) performance benchmarking provides a way to identify the lacks in practices. Denkena & Liedtke (2006) argued SMEs usually ignore the importance of benchmarking.

1.4 Problem formulation

The literature review and limited empirical investigations are conducted in the area of production performance measurements and management to formulate the problem as follows:

How can small and medium enterprises (SMEs) improve their production performance management?

The problem formulated looks for SMEs practices of assessing, follow up and improving production performance with respect to strategic alignment, shortages in production performance measurements, benchmarking and result utilization practices.

1.5 Purpose

The purpose of study is to develop a model for assessing, follow up and improving the production performance of Small and Medium Enterprises.

A comprehensive model will be developed based on the literature study and its applicability will be checked through multiple case study. The model for production performance management will work for assessing, follow up and improving the production performance.

1.6 Relevance

According to Neely (1999) organizations are forced to adopt changes, to enhance the performance of their practices and to provide better customer value at minimum possible cost. Marri et al. (2000) argued there is need to work more for SMEs to improve their performance for making them competitive. According to Garengo & Bititci (2007) limited literature and fewer empirical findings are available for performance measurements in SMEs.

Neely (1999) adds the determinants of the performance are required to work more as there is a need of latest development in this area. Garengo et al. (2005) stated that there exists literature on performance measurements in SMEs however it lacks in empirical investigation perspective. The reasons of limited practices of performance measurements have yet to be discovered by literature. There also exist gaps in theoretical development that could be supplemented by the empirical investigation.

The thesis will provide an opportunity for researchers and SMEs industry to assess and analyse current production performance and identify the areas of improvements. It will also be supplementing empirical investigation gaps that exist in SMEs literature.

1.7 Limitations/Delimitations

The main limitation includes SMEs of Sweden. The time limitation has made the study to focus with the task designed and giving less emphasis on other functions of SMEs. Production function is selected leaving all areas of SMEs like marketing, finance, human resource and etc. The delimitation includes the selection of case companies based on

accessibility and availability of companies during the study conducted. The developed model applicability is checked with a limited number of case companies. One of the constraints from the case companies was limited time for conducting each case due to their busy schedule.

1.8 Time Plan

Time is precious, to conduct and complete the research in the allocated time period. The following time schedule is made and followed as shown in table1.1.

Table 1.1 Gantt chart

Research Project activities	weeks																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Problem formulation	■	■																				
Problem presentation & approval			■																			
Literature review				■	■	■	■	■	■	■	■											
Case companies contact & visits								■	■	■	■											
Interviews								■	■													
Data collection & management								■	■	■	■	■										
Submission 1-4 chapters & Presentation												■	■									
Analysis													■	■	■	■						
Model formation													■	■	■	■						
Result, Conclusion & Recommandation													■	■	■	■						
Submission 1-7 chapters & presentation																	■	■				
Amendments & Review																			■	■		
Report writing (contineous process)				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Final research work submission																					■	
Final presentation																						■

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2. Research Methodology

In this chapter, the method for conducting the research is presented. The research is considered to use scientific approach in research design, research strategy and data gathering to ensure high validity and reliability.

2.1 Scientific Knowledge

There exist a difference in understanding of science; people look at science from their own context. Some see science as objective investigation of a phenomenon, some as a body of true knowledge and for some prestigious undertaking. The content of science is not permanent but changing, facts that are true today may not be correct tomorrow based on methodological consideration made by scientists. It could be argued that science has not been a particular body of knowledge but based on different methodology. The knowledge is gained through a number of approaches in addition to scientific knowledge like authoritarian mode, mystical mode and rationalistic mode (Frankfort-Nachmias & Nachmias, 1996). Globalization has increased the competition; the environment has become complex due to uncertainties in market conditions. International organizations are facing challenges; they are willing to adopt uncertainties by adopting the best practices and here the research supplements these objectives. SMEs needs to work more to identify and adopt optimal practices in order to face complex and changing environment (Gray, 2009).

The basis of the thesis work is based on the scientific knowledge rather than other mode of getting the knowledge. Appropriate methodology will be adopted to get the scientific knowledge. The uncertainties could be avoided by research through identifying and implementing the best practices. These best practices will be supplementing SMEs to compete in tough market conditions by improving and managing their production performance in a scientific way.

2.2 Scientific Approach

A researcher can adopt different research approaches like induction, deduction and abduction as argued by Ghauri & Gronhaug (2005). Deductive reasoning is based on logic that moves from generalization to specific cases (Zhang & Wu, 2010). Hypothesis is tested in deductive approach and this leads to approval, modification or cancelation of certain principle. The relationship between the concepts is checked based on the empirical investigation. The process requires the ideas or concepts to be measurable so to make the empirical investigation to validate or reject the hypothesis (Gray, 2009). Inductive reasoning moves from specific cases to generalization and can lead to discovery (Zhang & Wu, 2010). Patterns of the collected data are analysed in inductive approach to view relationships between the variables and these relationships leads to make generalization and even the development of theory (Gray, 2009).

There are several differences between inductive and deductive approaches: e.g. time duration, data collection, need of generalization, construction structure, etc. When implementation of only inductive or deductive approach cannot fulfil the requirement of designed research the combination of these research approaches could be applied (Saunders et al. 2007). Abductive

approach support to discover: new things, relationships and variables (Dubois & Gadde, 2002). Kudo et al. (2009) defined abduction as, *"reasoning process for providing a hypothesis that explains a fact in the given typical situation"*

Abduction reasoning uses both the induction and deduction. The scientific approach used in this study is abduction. Literature will be studied to develop a model and then that model applicability will be checked through empirical investigation from three different cases.
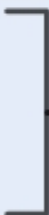
2.3 Research Strategy

Research strategy used for conducting the research is based on multiple case study.

Silverman (2005) defined the case study as a detail study of one or small number of cases with a specific purpose in order to understand the case and solve research question. Thomas (2011) describes the case study as a focus rather than a procedure or method. Yin (2009, p-18) defined the case study as: "*Investigate a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.*"

Thomas (2011) explains the case study has the possibility to cover a number of different approaches to research. He adds that there are four basic question which usually the researcher faced with: first w*hat's the situation?,* second *what's going on here?*, third *what happens when?,* and lastly *what is related to what?.* Case study could answer all these above questions. Silverman (2005) specified three types of case studies: intrinsic, Instrumental and collective case study. Intrinsic case study is a kind of particular case study, which only solves the problem inside single case. Instrumental case study is to examine a case provide inside of an issue or revise a generalization. Collective case study is for investigating general phenomenon or building theories, it requires study of numbers of cases. Thomas (2011) states the concept of multiple case study, the multiple case study is also called comparative case study. It is a numbers of case studies for investigation of phenomenon, population or general condition and multiple case needs comparing of different cases.

Gray (2009) states that case study provide an opportunity to gather data through different sources. It includes filed observation, document analysis, and possibility of conducting open, semi structured and structured interviews. Multiple measures of data collection help to ensure the construct validity concept. Thomas (2011) argued about collecting the data and evidence in case studies; data will make the information and evidence also based on data, but it will be leading to approve or disapprove of your proposal. Structured planning for the collecting information for proposal will make the data collection as the evidence for further studies. Data gathering tools supplement the purpose of the case study. He made a table 2.1 as shown below, showing different methods for collecting the evidence.

Table 2.1 Case study (Thomas 2011)

* Interview
  - Structured
  - Unstructured
  - Semi-structured
*Accounts
*Diaries
*Group interviews
*Focus groups
*Interrogating documents
	Mainly use words

* Questionnaires
* Observation
  - Structured observation
  - Unstructured observation
  - Participant Observation
* Image-based methods
	Use words, images and/or numbers

* Measurements and tests * Official statistics * Other numerical data	Mainly use numbers

As a case study provides a better opportunity to investigate the phenomenon, the strategy adopted in our research is multiple case study. Multiple case study are selected because it suits our research problem; as we have to check the applicability of the developed model that is based on the literature study. It will help us to look at the practices of SMEs and collect the data through multiple sources of evidence. In addition to other data collecting method's Interviews and observation will provide us to look at the real picture and observe utilization of the developed model. Thomas (2011) discussed four questions and these questions will be supplementing our research work, as we have to assess and improve the production performance of SMEs. Generally, the nature of our case study will be instrumental and collective.

2.4 Data Sources and Data Collection Methods

Ghauri and Gronhaug (2005) explained sources of data as a carrier of data or information, which mainly be classified as primary and secondary data. The research problem focus decides the data collection methods between quantitative and qualitative.

2.4.1 Data sources

According to Ghauri & Gronhaug (2005) data sources are the carriers and provide the opportunity to investigate the problem. The data sources could mainly be categorized as primary and secondary data. Primary data is the original data that is investigated or collected to meet the research objectives or problem by the researcher at hand. Primary data is directly targeted to research objectives and can better solve the problem faced, however it can requires the specialized tool to collect and analyse it. It can be costly and time taking process to collect

the required data, there may be the possibilities where the accessibility to data is not easy. Secondary data is defined as the data or information collected by other individuals for the same or other purpose. It provides better opportunity to understand and solve the problem. Secondary data includes book, journal and online data sources. It provides an opportunity to save time and cost, data from specialized sources have high quality and reliability. A researcher needs to look at the applicability and consistency of data to a particular research problem (Ghauri & Gronhaug, 2005).

2.4.2 Data collection methods

According to Ghauri & Gronhaug (2005) selection of data collection method depends on the research problem faced by a researcher. Research objectives will be a deciding factor for choosing the quantitative or qualitative method and both the methods are not mutually exclusive. Given (2008, p.713) argued quantitative research refers to *"approaches to empirical inquiry that collect, analysis, and display data in numerical rather than narrative form"*. In other words, quantitative research tries to describe the phenomenon by mathematic and statistic models.

According to Frankfort-Nachmias & Nachmias (1996, p. 280) qualitative research is *"a method of data collection and analysis derived from the Verstehen tradition,"* and it requires *"the researcher understanding the societal phenomena, recognize both the historical human behaviour and subjective aspects of human experience."* Gray (2009) argued that qualitative research has deep understanding of the context of study. The researchers often have to come into contact with individuals, groups and organizations for better understanding of the phenomenon. It requires much attention to collect accurate field data, so there is a need for better setting and researcher role to collect the data. Mason (2002) stated several data sources for gathering qualitative data: people, organizations, texts, environments, media products, events and etc. Silverman (2005) also specified some method for gathering data from these data sources such as observation, textural analysis, interviews and transcripts, and these methods can be further organized into research strategy like literature review and case study.

2.4.3 Collecting qualitative data

According to Gray (2009) qualitative data could be gathered through a number of sources, mainly the interviews and observations. Interviews could be qualitative or quantitative based on the structure of interview.

Frankfort-Nachmias & Nachmias (1996) defined interview as *"interpersonal role situation in which an interviewer asks respondents questions designed to elicit answers pertinent to the research hypotheses."* According to Frankfort-Nachmias & Nachmias (1996) and Thomas (2011) the personal interview can be classified into structured interview, unstructured interview and semi-structured interview by its flexibility. According to Thomas (2011) structured interview also called a questionnaire. The structured interview has least flexibility; it follows a set of fixed question. The advantages of the structured interview are that it is easily and fast to be conducted and coded. The unstructured interview is flexible, like a conversation. It does not have fixed questions but have a determined topic and agenda. In the view of Frankfort-Nachmias & Nachmias (1996) unstructured interview can provide free and

various topic and new question could be added during the interview. According to Tomas (2011) semi-structured interview has the benefits of both structured interview and unstructured interview. Semi-structured interview use a list of issues taking place of fixed questions so that it has good freedom and clear structure.

According to Frankfort-Nachmias & Nachmias (1996) observation is one of the direct ways to collect data for researchers. The data from observations come from the phenomenon under their real environment. Observation has many forms, and the observation can be applied even people unwilling to express themselves verbally. Gray (2009) argued field notes are the essence of qualitative data collection during the observation.

The data sources in the research work will be based on both the primary and secondary data. Scientific articles and books will be used for understanding of problem, finding the solution and developing a model for the study. Primary data will be collected during case studies visit though interviews and observations, while secondary data will be collected by case company's documents and their online resources.

Qualitative research methods will be basis of the study. This is due to the fact that the research problem identified needs the investigation of SMEs practices, which could obtain in a better way through qualitative research rather than quantitative research methods. The multiple case study strategy applied to research problem, which requires the data input through different qualitative ways like interview and observations. The developed model applicability could be checked in a better way through the qualitative research methods. Semi-structure interviews will be conducted during the case visit; the semi-structured interviews are selected due their good freedom and structure to deal with the problem and check the applicability of the developed model.

2.5 Scientific Credibility

Yin (2009) described four logical tests for testing the quality of case study: construct validity, internal validity, external validity and reliability.

Yin (2009) describes construct validity as "*identifying correct operational measures for the concepts being studied*" (Yin, 2009, p. 41). This tactic occurs in the data collection phase of social research. It appears that a set of operational measures cannot be established according to the original objective of a social research, or set of operational measures cannot support the original objective of a social research. To ensure the construct validity the researchers can follow two steps: first define the original objective in specific concepts and then identify the operational measures to match the concepts. It requires the researchers to use evidence from multiple sources, establish a chain of evidence Yin (2009).

According to Depoy & Gitlin (1998) defined internal validity as, "*Ability of the research design to accurately answer the research question*" the internal validity will ensure the outcomes based on the relationship of independent and dependent variables. Yin (2009) argued internal validity issue can be simply understood as concluding the casual relationship between factors without knowing other hidden factors. It may appear when researchers want to measure something that cannot be observed. The internal validity issue may happen in the

data analysis phase. In order to secure the internal validity issue the researchers need do pattern matching and explanation building Yin (2009).

External validity could be defined as, *"the capacity to generalize findings and develop inferences from the sample to the study population"* (Depoy & Gitlin, 1998). Yin (2009) defied it as *"defining the domain to which a study's findings can be generalized"* (Yin, 2009, p. 41). It demands the conclusion for one research should be generalizable on other cases within the same condition. This tactic should be well-consider when designing the research by using theory and replication logic in research Yin (2009).

Burns (2000) argued reliability is related to consistency, accuracy, stability, predictability and dependability. Reliability assures the stability of results obtained, if the process repeated will lead to same results as previous. Reliability could also be looked from accuracy perspective, which will ensure that the results obtain are true, accurate and reflects the actual status. Reduced error in results leads to more reliable results. Reliability and validity terms look quite similar, but these terms measure different aspects. Reliability assures the results are same if repeated while the validity looks how well measures are. Reliable results do not necessarily mean the valid results (Burns, 2000).

The research work ensures the scientific credibility of the study conducted. The data collected from both literature study and case studies is mainly qualitative. Construct validity is ensured by defining the objective of the case studies as to validate the developed model by checking the applicability and looking present practices of case companies. Operational measures are ensured by following the steps of the developed model during the interview in case studies. Internal validity is ensured through reviewing intensive literature study to develop the model that answers the problem formulation and the measures selected for model development also based on causal relationship. It is also ensured by interviewing with highly experienced personnel's to accurately answer the desired question seeing relationships between measures. External validity is ensured by developing the model from scientific literatures, which are already generalized theories and then the developed model is also revised by multiple case study in order to test the generalization of it. Reliability is ensured while collecting the data by making sure that same results will be obtained if repeated the tactic used here are the same questions asked through a number of ways.

2.6 Research Design

Blessing & Chakrabarti (2009) explained the design as documentation activities that will be supporting to fulfil the desires into realization taking care of the interest of customer and stakeholders. Research supplements the design process; research design improves the effectiveness and efficiency of formulation, and validation of theories and models. Design research methodology is defined as the, *"an approach and set of supporting methods and guidelines to be used as a framework for doing research design"* (Blessing & Chakrabarti, 2009, p. 9). Research authenticity depends on independence of the judgement of the researcher. Researchers need to be motivated to search the truth (According to Ramon y Cajal 1999 as cited in Blessing & Chakrabarti, 2009).

According to Flick (2009) qualitative research process requires making number of decision as one proceed in research, decisions like research question, data collection methods, analysis and lastly presenting the research work. A research design made help to conduct the research and decision made in research design affects the finding of the research.
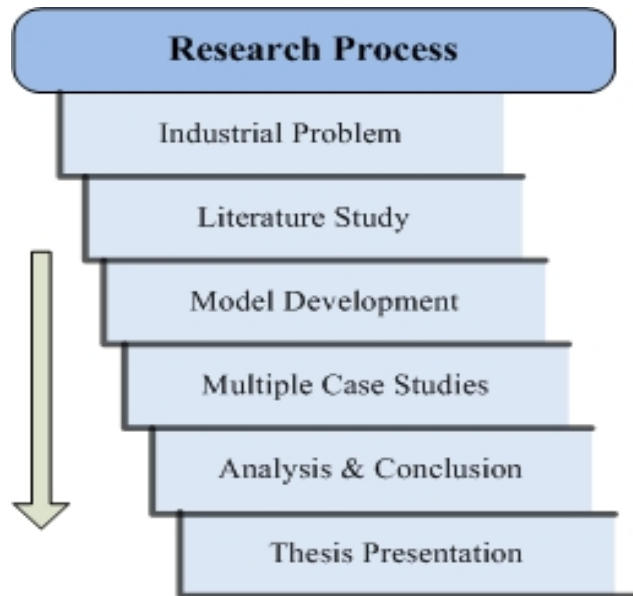
Figure: 2.1 Research process of thesis work

As indicated research design supplements the research objective's achievements in an efficient way. Different decision during the research process affects the authenticity and validity of research results. To achieve the research objectives in an effective way so that it could contribute to its stakeholders, the following research process will be followed as shown in above figure2.1. It started with identification of the industrial problem, which required doing literature study in order to know what investigation has been made by the researchers. Based on the literature study a comprehensive model will be developed. To check the applicability of the developed model it is required to work with multiple case study. Analysis and conclusion will be made based on literature study, model developed and empirical investigation form case companies. Finally, the findings will be presented to finalize the task. Selection decision of different methods and techniques will be on the basis of their best contribution to the research objectives rather than the interest of the authors of thesis work.

3. Theory

The theory chapter includes the result of literature study. The chapter includes the description of SMEs, strategic alignment, performance measurements, production and operation management, benchmarking, continuous improvements and result utilization, and finally different measurement perspectives.

3.1 Small and Medium Enterprises (SMEs)

SMEs stand for Small and Medium Enterprises. European Commission (2005) defined SME as:

> Micro Entities: companies that have less than 10 employees
> Small Enterprise: Companies that has less than 50 employees
> Medium Enterprise: Companies that has less than 250 employees

According to European Commission (between 2004 and 2005), there are 522'895 SMEs and 953 large enterprises in Sweden, which means 99.8% of Swedish companies are SMEs. Swedish SMEs take apart 63.2% of persons employed and 55.5% value added in Sweden. The enterprises in Sweden are mainly SMEs, and they contribute a lot to the economy of Sweden.

There are major differences between SME and large organization according to the study of Hudson et al. (2001, p.1105):

1. *Personalized management, with little devolution of authority*
2. *Severe resource limitation in terms of management, manpower and finance*
3. *Reliance on small number of customers, operating in limited market*
4. *Flat, flexible structures*
5. *High innovatory potential*
6. *Informal, dynamic strategies*

In addition to these differences, Hudson & Smith (2007) further described the factors that impact on performance measurement most: First, the organizational culture of SMEs is generally adhocracy i.e. they are flexible, dynamic and willing to take risks to succeed however SMEs lack in shortage of resources. Secondary, the competitive environment of SMEs are adaptable i.e. they can adopt market changes however they are not able to lead the market. Finally the management of SMEs is generally owner-manager, so it can lead to low strategic awareness and low planning activities. Argument et al. (1997) argued as cited in Hudson & Smith (2007) SMEs of the automotive sector have the less emphasize on the strategic development.

According to Lee et al. (2000) SMEs have the benefit for good coordination between management and employees. Improvement and innovation require the organizational learning while SMEs have the limited resources and constraints internally and externally. Hudson & Smith (2007) argued that SMEs due to their limited resources work less with strategically aligned performance measurements however on the other hand due to their simple structure they can better work with strategically aligned performance measurements. McAdam (2000) also talked about continuous alignment of performance measurements with SMEs strategy.

3.2 Strategy and Strategic Alignment with Performance Measurements

Bellgran & Safsten (2010) defined strategy as "*a pattern of decisions that together leads the activities in a specific direction.*" Najmi et al. (2005) argued strategies need to be clear as they determine the direction of the companies. Porter (1996) explained, "*The essence of strategy is choosing to perform activities differently than rivals do.*" According to Kaplan and Norton (1996a) strategy clarity makes the organizational members to look at their contribution towards the achievements of goals. The maximum gains could be achieved by showing the clear and big picture. The alignment of strategy with the operations needs the clarity of objectives. Organizations use different ways to link the strategy, like educational programs, management by objective and incentive plan to motivate the employees. According to Lee et al. (2000) organizational strategy focusing on the product and market only cannot compete without the consideration of core competencies.

Mills et al. (1998) argued manufacturing strategy can be seen as continuous process which takes input from different areas and keeps on improving, the input comes from the stakeholders, market conditions, present strategy and the organizational constraints. Kaplan & Norton (1996a) identified four barriers that make difficult to implement strategies effectively. First, the ambiguity of vision and strategies, this could lead management to understand them in inaccurate ways. Second the failure of strategies to link clearly the objectives of department, teams and individuals, this happens due to lack of translation of long term's goals into short terms. Third, the lack of linkage of resource allocation with strategies and lastly, the feedback focus to short term objectives than long term strategic implementation.

Neely (1999) talked about the importance of link between strategy and performance measurements, the information provided by performance measurements will also ensure the implementation of strategy. According to Bourne et al. (2000) there could be a deviation between strategy and the performance measures which can be eliminated by reviewing the performance measures. Najmi et al. (2005) state company strategy should be the basis for performance measures. Adler (2011) argued strategies are implemented effectively through performance management. Najmi et al. (2005) argued strategies provide direction to top and detailed level processes, which are being monitored by strategic and operational indicators.

According to Singh et al. (2008) company's core competences could be enhanced by limiting the variation in manufacturing practices with the strategic priorities. Johnston & Pongatichat (2008) found a lot of benefits in literature for strategy aligned performance measurements: performance measurement will ensure the strategy implementation in accurate direction. Continuous improvements and organizational learning make the processes integrated and efficient; the efforts made at operational level contribute to achievements of overall strategic objectives.

3.3 Performance Measurements

The meaning of performance in term of business management is what extent the certain operation fulfils the objective of customers' or market's requirements (Naimi et al. 2005). Santos et al. (2002) argued organizational success is related to the flexibility of the company to design and implement performance management. Evans & Lindsay (2005, p. 93) defined

the measurement as "*the act of quantifying the performance dimensions of products, service, processes and other business activities.*" Folan & Browne (2005) argued during the last 15 years, performance measurement has been seen as one of the most crucial tool for performance management and gets fast developed. Neely & Jarrar (2004) point out that decision makers need to be supported by information, and performance measurements are the tools to transfer data into valuable information.

Robson (2004) states that accurate performance measurement can provide guidelines and direction for improvements, it gives the opportunity of improve the production efficiency. According to Santos et al. (2002) the relationship between the performance measures is neglected by the organizations and literature still lack in highlighting the importance of this relationship. Neely & Bourne (2000) argued performance measurement failure could be the result of either poorly designed measures or lack of implementation. Slack et al. (2009) performance measurement provides the information to judge the status of operations. There are three important areas while working with performance measures. First there could be number of factors but what factors to include, second the importance of factors and third the detailed measures to work with. Folan & Browne (2005) are of the view that performance measurements are evolving and becoming complex due to wider focus on area of intra and inter organizational.

Meyer (2002) stated seven purpose of performance measurement: look ahead, look back, motivate, compensate, roll up, cascade down and compare. He also figured out that these seven purposes are critical to large and complicated organization. On the other hand for SMEs, only four purposes are needed: look ahead, look back, motivate and compensate (Meyer, 2002). The early strategic performance measurements for enterprise were focused on financial measures only (Veen-Dirks, 2010. and Hudson & Smith 2007). The production has become more and more complex today, using financial as the only dimension is not enough, it is important to introduce non-financial measurements to reflect the different dimensions of production (Veen-Dirks, 2010). Generally, the non-financial measures for SMEs can be more detailed specified into: quality, time, flexibility, customer satisfaction and human resource (Hudson et al. 2001).

3.3.1 Performance measurement frameworks
According to Folan & Browne (2005, p. 664) performance measurement recommendation is "*a piece of advice related to the discipline of performance measurements – its measures or its structure.*" Folan & Browne (2005) also argued performance measurement framework is a set of performance measurement recommendations that define performance measurement boundaries and dimensions. The performance measurement framework has two types: structural framework and procedural framework. Different performance measurement frameworks have been studied out of which four frameworks as explained in the following section.

Al-Najjar et al. (2004) developed a never ending improvement cycle for identifying detailed measurement variables to monitor and improve maintenance performance. The main steps of this model are starting with; selecting the area of improvements and gathering relevant data,

and then identify the relevant measures to reflect the performance. Finally the measurements variables are applied and calculated, the result is an analysis to provide the information for improvements. In the model, benchmarking is considered to be an important tool for optimizing the most cost-effective maintenance policy. The model also highlighted the importance of identifying and goals for selecting measurement variables. The authors highlighted the economic and technical measurement as well to cover different perspective in performance measurements.

According to Neely et al. (2000) the general performance measurement framework can be summarized as three major activities: First of all, looking at the company's strategy and determining how the strategy can be transferred to divisional goals. Secondly, selecting detailed measurement variables for a certain measurement framework that will be applied. Finally the measurements should contribute to improvement of performance. A measurement design framework by Wisner & Fawcett is described in the literature of Neely et al. (2000) and this framework is the typically follow the structure stated above. It includes more specified nine steps for selecting measurement variables however it still follows the structure of three major activities described above. The most interesting point in this framework is that the measurement design should periodically be refreshed as the object to measurement is improving.

Al-Najjar & Kans (2006) developed a top to down model for identification of relevant measurement variables. The model has eight steps and these steps are divided into four phases. The model defines cost effective maintenance decisions with the alignment of company's strategy. Then the relevant measurable variables are identified, after diagnose of equipment and identification of key measures. The model also gives the prerequisite, result and motivation of each step, this help the reader for better understanding of model.

The framework developed by Gomes & Yasin (2011) is a process-based approach for performance management. The framework is also a dynamic cycle, which means the continuous improvement cycle can close at any step of the framework. It has five steps; that starts with the diagnosis of product's competitive characteristics. In second step, the divisional performance objectives are identified, according to these objectives, the performance goals are established. Third step formulates definition of performance measures and fourth step works with negotiation of the goals to achieve win-win situation for all. Finally, the certain goals should be monitored by measurements, and the results of measurement should be analysed and benchmarked. The information provided by measurements guides the improvement to any steps in this framework.

3.3.2 Key performance indicators (KPIs)

Key performance indicators or performance indicators are "set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization" (Parmenter, 2007). It is the quantitative aspect or characteristic of performance (EN 115341, 2005). KPIs are the basic measuring activity of performance measurement, and through KPIs, the performance measurement can transfer companies' strategic goals into measureable objectives (Tsai & Cheng, 2011). The production

performance measurements need to be supported by clear and feasible KPIs. According to Slack et al. (2009) a well-defined policy will make the Key performance indicators clear and achievable at operational level. Al-Najjar & Kans (2006) also argued for the development of appropriate measurement policies for developed KPIs. Neely & Bourne (2000) argued properly defined measures reduces the ambiguity for their achievements.

3.4 Production and Operations Management

Production and Operation Management is defined by Nahmias (2009, p. xvii) "*is the process of managing people and resources in order to create a product or a service.*" Nahmias (2009) and Bellgran & Safsten (2001) stated the importance of production and called it among one of the important function for a company. It converts raw materials into products or services as a critical value-adding process that directly leads to profit. Chase et al. (2006) talked about the importance of operation management: first of all, operation management is a critical part of business; secondly, it is a systemic way to manage organizational process, lastly the tools and concepts of operation management can be applied to other areas of business.

Aswathappa & Bhat (2010) argued production and operation management terms are used frequently and resembles with each other. Production is understood as producing tangible goods, while operation is concerned with the managing the process for producing the goods or services. According to Bellgran & Safsten (2010) manufacturing has made the companies to earn profit, products produced base on customer desires attracts the potential customers. The influence and importance of production have attracted the attention of manufacturing companies since last century. Toyota Japan is playing a leading role for making the production system efficient and sustainable. Porter (1996) described operational effectiveness as, "*performing similar activities better than rivals perform them.*" According to Lee et al. (2000) the core competencies could be achieved through the organizational learning, focusing on key areas of manufacturing will ensure the core competencies to make the production process to compete. According to Bellgran & Safsten (2010) production systems have become complex due to customized products, number of variants and shorter product life cycle.

According to Tajiri & Gotoh (1992) and Rodrigues & Hatakeyama (2006) major losses in production are caused by poor decision in production and operation management. Chase et al. (2006) argued decisions in production and operation management mainly consist of long-term strategic decisions, intermediate-term tactical decisions, short-term operational planning and control decisions. Neely & Jarrar (2004) figured out that management and decision making needed to be support by information, which mainly comes from measurements. Melnyk et al. (2004) stated that effective measurements provide the necessary information to support improvements for operation management; it also transfers the strategy and mission of company to the tangible objectives or production goals.

According to Slack et al. (2009) gaps are the difference between the Current and desired level of performance. Improvements are required to overcome the gaps to reach at desirable level of operational performance. Improvements demand three important aspects to consider; measuring the current performance, to set the target level of performance and the systematic way to work with comparison of these two levels. Nakajima (1988) and Rodrigues &

Hatakeyama (2006) talked about total productive maintenance (TPM) and six major losses in production caused by low efficiency of equipment utilization and argued it could be improved by carrying out improvements in maintenance practices. McCarthy (2001) pointed out that losses can come from low utilization efficiency of any kind of a resource rather than equipment's, to overcome them production-wide even company-wide management efforts are required.

3.5 Benchmarking

Stapenhurst (2009) defined benchmarking as, *"Every time we compare data, we are benchmarking."* Kearns former CEO of Xerox corporation looks benchmarking as a continuous process and defined it as *"The continuous process of measuring products, services and practices against the toughest competitors or those companies recognised as industry leaders"* cited in Stapenhurst (2009). He also argues that benchmarking is planned research that helps to identify the area of process improvements by providing the ideas, information, and methods to strive for best practices. Stapenhurst (2009) described the benchmarking concept, as shown in the following figure 3.1.
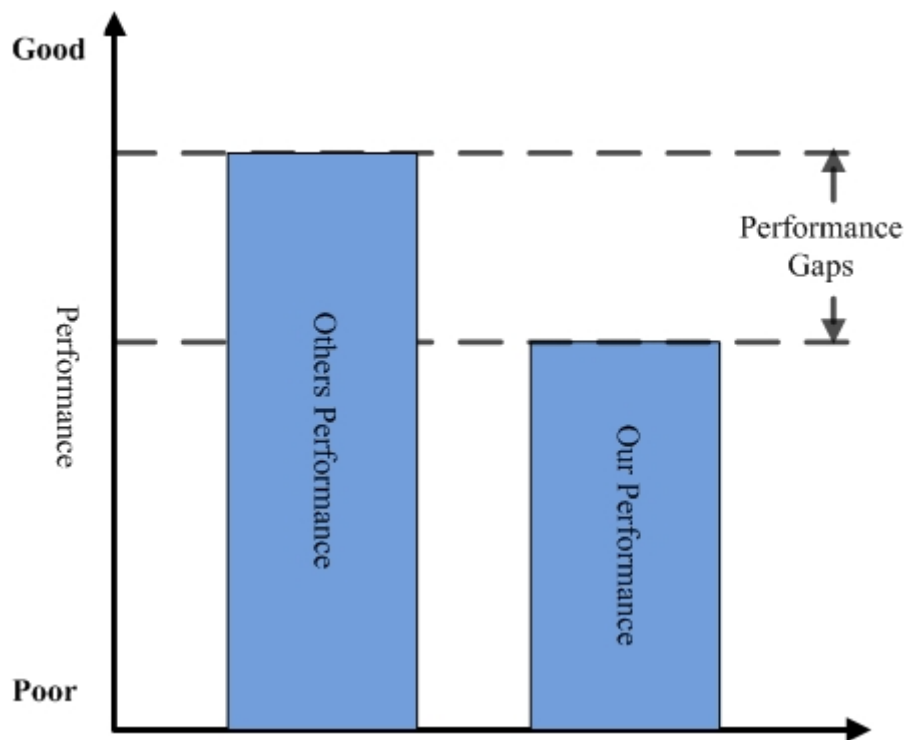
Figure 3.1 Benchmarking (Stapenhurst 2009)

Al-Najjar et al. (2004) is of the view that benchmarking provides an opportunity to compare performance with standards and competitors that lead to improvements. Cited in Stapenhurst (2009) benchmarking has become an important tool for organization to provide a number of benefits like testing ideas, budgeting, technical problem solving, performance improvement and lot more. According to Santos et al. (2002) performance limits could be set to check the performance level; upper limit could be set through benchmark and the lower limit will be indicating the lowest level of acceptable performance. Stapenhurst (2009) argued that there are number of the application area of benchmarking such as, product & service's

benchmarking, financial performance, functions, facilities, processes, specific problem and strategic benchmarking.

Neely et al. (1995) categorized the benchmarking from four different views; the internal, competitive, functional and generic benchmarking. According to Stapenhurst (2009) different types of benchmarking approaches could be applied to meet the desired objectives like internal benchmarking, competitive benchmarking, non-competitive benchmarking and cross industry benchmarking. Internal benchmarking is done within the organization so it is required that organization should have similar processes within to compare. Competitive benchmarking is done externally with the competitor within the same industry. Non-competitive benchmarking is the comparison with another organization with in industry however not competitor. Cross industry benchmarking works with comparison with organization in different industry and business.

3.6 Continuous Improvements and Result Utilization

ISO 14001 defined continuous improvement as a process that enhances the management system in organization to achieve improvements in performance. Al-Najjar et al. (2004) stated PDCA (plan do check act) cycle is a typical never ending cycle for continuous improvements. Oakland (2003) argued improvement is a continuous process that requires data, information to utilize them for improvements. The first step is to *record data* of measurements, second to *use data* if not used then the essence of measurement fails, third to *analyse data* basic tools could be used for analysis to give the data some patterns and lastly *act on results* without this step taken actions will not lead to improvements. Loch & Tapper (2002) discussed about learning and improvement's perspective as they found in literature, improvements could be done based on cause and effect and problem solving model. They also argued that evaluation could be linked with the incentives plans to motivate employees for performance improvements.

According to Santos et al. (2002) designing and implementing the accurate performance measure still will not be effective until the information gathered is not utilized effectively. The information requires the analytical tools to analyse and implement the required actions to improve performance. Effective analysis will highlight the area of a problem to cope with, human capacity to work with diverse information can cause a problem so specialized tools could be used. Neely & Bourne (2000) are of the view that performance measures implementation failure happens due to three main reasons, political, infrastructural and the loss of focus. Political failure of measure can happen due to cultural aspects. Infrastructural failure is the result of lack of the resources required to work with measure. Lack of focus is due to the reason of losing the motivation to work with performance measures on long run, as results are not apparent too early.

Neely & Bourne (2000) argued designing the successful measures require the map based on cause and effect diagram to identify clearly what parameters matter for the desired results. Globerson (1985) suggested a feedback loop to monitor performance deviation from their standards and the cause of deviation should be tackled to improve performance variation. According to Drongelen & Weerd-Nedehof (1999) as cited in Godener & Soderquist (2004) has discussed the usage of performance measurement results to diagnose the deviation of

objectives, reduced deviation leads to more accurate performance results. Lebas (1995) highlighted the importance of using measurement data to improve decision making for future success. Drongelen & Bilderbeek (1999) researched and developed four major categories at an organizational level for purpose of performance measurement results for new product development. These categories include purpose of performance measurement for; individual performance measurement, team performance measurement, departmental performance measurement and company level performance measurement.

3.7 Technical, Economical and Organizational Perspectives

Al-Najjar (1996) stated the reason of carrying out technical measurement is to assess the technical effectiveness of organization. Al-Najjar et al. (2004) mentioned technical measures are mainly used for monitoring the value-adding activity of plant. The technical measures consist of the variables that reflect the effectiveness of machines e.g. quality rate and overall equipment effectiveness (OEE).

The cost-effectiveness is a measure that indicates how much the invested capital can be economically beneficial in long term (Al-Najjar & Kans, 2006). The reason to involve the economic measurement is to evaluate the cost-effectiveness of the organization (Al-Najjar et al. 2004). Especially SMEs have limited resources and finance as well as management and manpower, the effectiveness of using limited budget is an important concept for them to be successful (Hudson et al. 2001). The economic measures are also important criteria for judging the economic situation of the company. In order to optimize balance between qualified product and cost to satisfy customers, stakeholders and society, the economic measurements should be involved (Al-Najjar et al. 2004).

According to Veen-Dirks (2010) every activity of a company should not be measured by only one dimension. In order to support the managers better, both economic measures and technical measures should be applied to get the performance measurement results that reflect to multi-dimensions. Al-Najjar (2004) also stated the importance of apply both technical and economic measures: to survive the strong competition, company needs to achieve the technical and economic effectiveness which is assessed by both economic and technical measurements.

According to Hudson et al. (2007) organizational culture of SMEs is loosely constructed; the organizational effectiveness depends a lot on the management style, which is personalized and authoritarian. According to Parhizgari & Gilbert (2004) organization effectiveness has a critical impact on the quality delivered to customers, so managers need to create measurements in the dimension of internal organization. EN 15341 (2006) standards considered the organizational dimension to have the same importance as economic and technical dimensions.

4. Model Development

The model development chapter presents a comprehensive model for production performance management. The model is categorized into three section; strategy, operation and performance management. Performance management is the area of concern which includes performance measurement design model, benchmarking and result utilization. The outcomes of result utilization steps are used for production performance improvements.

4.1 Introduction to Model

Intensive literature study has been conducted for SMEs and it is observed that there is a need of comprehensive model for production performance management. Researchers have talked about important areas, which can affect production performance in SMEs and each researcher has focused on specific areas of action. Hudson et al. (2001) through literature study highlighted importance of the difference of culture and structure between SMEs and big companies, and this difference leads to chances in performance measurement frameworks. Hudson & Smith (2007) talked about strategic alignment of performance measurements for SMEs. Hudson et al. (2001) identified in their survey results that SMEs differ in their performance measure selection and they were found to be deviating from their objectives. Some companies have very simple measures while some have too complex measures to work with them effectively. Feedback for improvements was also not found to be effective in SMEs. Denkena & Liedtke (2006) highlighted the importance of current situation of performance measurement and related it to benchmarking for SMEs. Veen-Dirks (2010) talked about application of performance measures for improving the performance and to support the decision making process.

Researchers have worked with specific areas that supplement performance improvements. The problem formulated and purpose of study has the focus that a comprehensive model should be developed that take account important activities necessary to improve production performance, easy to use and manage for SMEs. SMEs have limited resources and they are more motivated with the short term results. According to McAdam (2000) SMEs work more with doing the things rather than measuring it. The improvement activities should be based on short term outcomes than the long term; this will make SMEs management to work with the improvements McAdam (2000).

4.2 Literature Review

A systematic procedure has been adopted to search the scientific literature and to look what has been already done in the area of interest. Different data bases used for searching the literature like Google Scholar, Science Direct, Emerald and IEEE. Appendix I show the strategy used for searching the relevant literature with the delimitation made to narrow down the search results.

The developed model of production performance management for SMEs includes important concepts like: strategic alignment, measurement design, benchmarking and result utilization for continuous improvements. Following table 4.1 made, provide a review of the literature which has contributed more for developed model. The table could be categorized into two

aspects; first special requirements from SMEs perspectives, second existed literature for performance measurements and management design frameworks.

Table 4.1 Concepts of developed model

Concepts	Requirement from SMEs	Al-Najjar et al. 2004	Al-Najjar & Kans, 2006	Gomes & Yasin, 2011	Neely et al. 2000	Developed Model
Strategy						
Strategy Alignment	●	○	●	○	●	●
Measurement Design						
Identify Measurement Areas(diagnosis)	●	●	●	●		●
Multi Perspective	●	●	●			●
Multi Measurement Dimension	○					●
Detailed Measures Selection	●	●	●			●
Policy Selection	○		●			●
Benchmarking						
Internal and External Benchmarking	●	○		●		●
Result Utilization						
Continuous Improvement	○	●		●		●

● = Strong Correlation.   ○ = Week Correlation.

The developed model based on important concepts and these concepts are necessary from SMEs perspectives. It has been shown in table above that each concept is strongly or weekly correlated as found in literature studied and these are explained below. The developed model takes all the concepts with strong correlation.

Strategy alignment: Improvements require performance measurements for SMEs to be strategically aligned. Hudson & Smith (2007) argued that the structure and culture of SMEs are different from each other and with large companies. Strategy of company should be made cleared before measurements are designed and measurements should reflect the company strategies.

Identify measurement areas: The diagnosis of the situation identifies the measurement areas that may have been potential for improvements; therefore, better identification leads to more effective resource utilization of SMEs (Gomes & Yasin, 2011).

Multi-perspective measurements: According to Hudson & Smith (2007) first SMEs are limited in resources in terms of finance, manpower and management. Second SMEs normally

have lesser market share and rely on close customer relationship. Third, SMEs have a loose organizational structure which is a threat for organizational effectiveness. Al-Najjar et al. (2004) stated that technical measures e.g. quality rate and overall equipment effectiveness (OEE) focus on the efficiency of equipment while economic measures can highlight the performance impact in the terms of finance. The organizational measures should be applied to assess the organizational effectiveness of SMEs. Parhizgari & Gilbert (2004) argued the importance of organizational effectiveness in the terms of quality delivered and resource utilization effectiveness. It could be argued that organizational, economic and technical measures are required to be applied for SMEs.

Detailed measure's selection: For SMEs there is limitation when selecting the detailed measures because of the less availability of data. McAdam (2000) mentioned that measures should be kept minimized, but these should contribute to improve performance.

Internal and external benchmarking: According to Gomes & Yasin (2011) benchmarking is a critical step for continuous improvements. Especially for SMEs, it can produce efficient and reliable information on strengths and weaknesses of performance.

Multi dimension measurements: Hudson et al. (2001) stated the importance of multi dimension measurement: all the aspect of business can be covered by six major dimensions: quality, time, customer satisfaction, finance, flexibility and human resources. Dimensions should be chosen appropriately to reflect the company strategy.

Measurement policy establishments: The well-established policy for each KPI is an essential step for getting an accurate measurement results (Slack et al. 2009)

Continuous improvement: According to the concept of never ending improvement, the measurements and analysis of measurement results are to provide direction for improvements (Al-Najjar & Kans, 2006 and Oakland, 2003)

The second part of literature study in this research has been conducted on the existed performance measurement design frameworks and performance management frameworks as mentioned in table 4.1. The table shows different frameworks, each framework is described with respect to strong correlation or weak correlation of concepts used in developed model. The four mentioned frameworks are; 9 steps performance measurement design framework from Wisner & Fawcett (Neely et al. 2000), performance management process based approach (Gomes & Yasin, 2011), relevant measurement variable selection model for maintenance performance (Al-Najjar & Kans, 2006) and 10 steps framework for maintenance performance measurement design (Al-Najjar et al. 2004).

4.3 Model for Production Performance Management
The model developed in the study is comprehensive, based on all important concepts identified in 4.1 table and possible to implement in SMEs. It highlights the key areas that can help SMEs to improve the production performance management. Developed model works on continuous cycle that erases ineffectiveness from the production process due to strategic

alignment, appropriate measure's selection, benchmarking the practices and utilizing the performance measurement results for production performance improvements.

The Figure 4.1 below shows the structure of developed model for production performance management; which consist the activities of assessing, following up and improving production performance. The model is divided into three important functional areas: strategy, operations and performance management area. The performance management process flows across these areas. The company's strategy is upstream and belongs to the activity of top management. Production objectives and production process comes under operations, developed by the company according to the strategy. Assessing, follow up and improvement of production performance is the specified activity for company to manage their production performance.
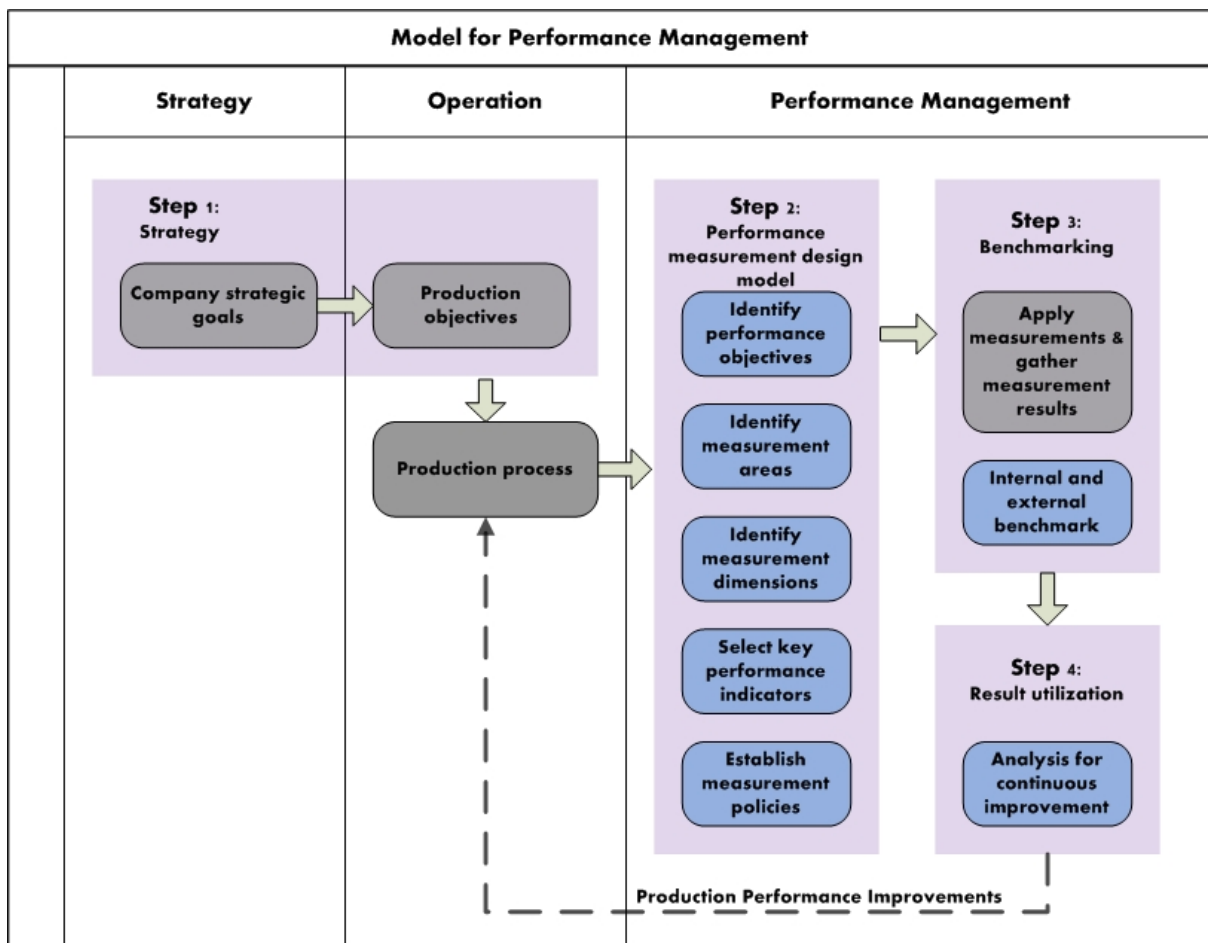
Figure 4.1 Developed model for production performance management

The model starts with step 1 strategy. This is a step for studying of companies' vision, mission, strategies and production objectives. Step 1 is necessary input for Step 2 and strategic alignment ensures the accurate translation of strategy into the actions. Step 2 is performance measurement design model that identifies the detailed measures and measurement policies for the production process. The detailed measures are applied in the production process to get improved measurement results.

Step 3 is benchmarking that sets internal and external benchmarks. The benchmarks of step 3 and measurement results are used as input for step 4 that is result utilization. Step 4 works with analysing, concluding and suggesting the improvement activities for continuous improvement of production performance. The model works as continuous process and tries to improve the production performance due to its comprehensiveness. The each step of the model is explained in the following section.

4.4 Detailed Steps of Model Application

The following section explains each step of the developed model for production performance management.

4.4.1 Step: 1 Strategy

The strategy section consists of company's strategic goals and production objectives. The general short-term strategic goals of companies are to earn profit while growth is a long term goal. Company's strategies are derived from the vision, mission, analysing the external environment and internal competencies. At strategic level organizations have number of functions and production is one of the important functions. The model assumes production objectives are derived from company's strategies. According to Al-Najjar & Kans (2006) divisional objectives are derived from company's strategies. There is a need for alignment between the strategies at strategic level and operation performed at production level. Hudson & Smith (2007) have highlighted that there exists the practices which do not contribute to achievement of the strategic objectives and those practices should be eliminated.

4.4.2 Step: 2 Performance measurement design model

The performance measurement design is the selection of suitable KPIs and measurement policies and it is the most important step in performance measurement as argued by Neely et al. (2000). The performance measurement design model takes input from the production objectives and feedback information from outcome of step 4 for measurement design improvements. The model has sub steps which work systematically and finally result into the detailed measures which are then transferred to production process for their implementation. Effective utilization of this model will ensure the clear guidelines for production process to work with. The sub steps of the performance measurement design model are discussed below.

4.4.2.1 Identify performance objectives

The first sub step is the identification of the performance objectives. The performance objectives are mainly based on the production objectives and information received from production processes. Production information is required to know what is really going on in production process and which area requires improvements to make accurate and desirable performance objectives. According to Gomes & Yasin (2011) the objectives should be flexible and based on market and internal environment of the SMEs.

4.4.2.2 Identify measurement areas

SMEs have unique competitive environment with limited resources and this requires working with accurate area of actions. Al-Najjar & Kans (2006) highlighted the importance of diagnosis that helps to identify the real cause of problem. Diagnosis will also help the

decision maker to identify the intensity of problem and the required corrective actions to work with.

Identify measurement area step in the model mainly looks at the disturbance area or root cause of the problem in the production process, which is causing the performance decline. This is an important step as the results of this step will be used to design the measurements based on the real problem in the production process.

4.4.2.3 Identify measurement dimensions

This step works for the identification of measurement dimensions. Dimension with which SMEs want to work could be obtained looking at previous steps like production objectives, performance objectives and result of identify measurement area steps. Folan & Browne (2005) and Hudson et al. (2001) stated number of dimension in different scales; six dimensions among them are important like quality, time, flexibility, finance, customer satisfaction and human resource. These six dimensions can measure the production performance from different view point.

The quality dimension for production includes measurement of products' quality losses, these losses lead to higher cost and lower profit in the terms of material waste. The time dimension measures the time waste in production. In the term of OEE, it includes both the time loss and speed loss. Flexibility dimension measures how flexible the production process is when needed to change the product. The high flexibility means low cost during change and SMEs needs to be flexible to face competitive environment. Customer satisfaction insists to work in the areas that are more concerned with the customer satisfaction like quality, reliability, cost and other related areas. The human resource dimension measures the production from the organizational perspective, which also has impact on production performance. Finance dimension looks the economic aspect of the production process. All these dimensions measure the production performance from different aspects and indicate different losses.

4.4.2.4 Select key performance indicators (KPIs)

The KPIs are the detailed measures for production process and the KPIs selected should follow the measurement dimension identified. Parmenter (2007) stated the rules for determine the KPIs: First, balancing the KPIs in different dimension, secondly limiting the number of organization-wide KPIs, thirdly permitting the improvement of KPIs and finally ensuring all the KPIs have the KPI characteristics. According to Al-Najjar & Kans (2006) key performance measures should be identified that are capable of mapping the production situation. The key performance measures then require setting up of limits for their acceptable and reject able region. The KPI can mainly be categorized by technical, economical and organizational perspectives. The KIPs selected should reflect the improvement in the production process.

4.4.2.5 Establish measurement policy

Establishing the measurement policies for KPIs will support to achieve the desirable objectives from KPIs. KPIs itself are only variables, there is a need to follow some rules for effective implementation of KPIs. Establishing measurement policy includes how the KPIs will be measured, how often the measurement will take place, what will be the upper and

lower limits, and which types of tools will be needed to measure the KPIs. The clear guidelines will make it possible to capture required data and information. Al-Najjar & Kans (2006) also talked about measuring policies while identifying relevant measuring variables. They explained three aspects how to measure, when to measure and using which tool to measure.

4.4.3 Step: 3 Benchmarking

The benchmarking step consists of two parts; first apply measurements and gather measurement results, second apply internal and external benchmarks. Application of design measurements and gathering of results is the logical step, while internal and external benchmarks are of concern for improvement activities.

4.4.3.1 Apply measurement and gather measurement results

Detailed KPIs and measurement policies identified in the last steps of performance measurement design model i.e. step 2 are needed to be implemented in the production process. It is due to the fact the measures designed but not implemented will not be of use. Measurement results are required for assessing and follow up production performance improvements. Loch & Tapper (2002) suggest a common database for having better analysis. Al-Najjar & Kans (2006) argued about the databases as the sources of data that make the decision maker to look at the historical data for making effective decisions. According to effective Lebas (1995) accurate data and accurate processing of data into information will make sure the improvements required.

4.4.3.2 Internal and external benchmarks

According to Gomes & Yasin (2011) small and medium organizations (SMOs) need to improve their expertise and it require meeting the best practices. Benchmark will re-engineer their practices and managing the performance benchmark internally and externally will make sure of appropriate practices. Neely et al. (1995) also categorises the benchmark as internal and external while Moriarty (2011) is of the view that internal and external benchmarks are only the administrative approach not theoretical. Gomes & Yasin (2011) argued internal benchmarks will ensure the internal strength of processes while external benchmarks will compete on competitive dimensions.

The model takes internal benchmarking objectives as the results of best practices within the organization and/or could be set based on a desired however realistic level of goals. The external benchmarks could be based on competitor performance and/or based on the best practices of cross industry as also discussed by Stapenhurst (2009). The model assumes benchmarking as the continuous process to make it realistic, achievable and meeting the dynamic demands of environment.

4.4.4 Step: 4 Results Utilization

Measurement results are analysed and compared with internal and external benchmarks. The analysis process will help to identify variations; these variations could be because of problems and weaknesses in production processes or due to lack of performance measurement design. Comparing the results with internal and external benchmarks will identify the area of improvements. Santos et al. (2002) argued objectives could only be achieved by eliminating

the real cause of operational performance decline and it requires a deep understanding of the system. According to Houben et al. (1999) performance analysis provides insight for strength and weaknesses of the processes. Identification of these strength and weaknesses will make it possible to see the actual picture and then to develop the strategies for improvements.

The whole process of result utilization step will provide accurate information to a decision maker to take appropriate actions that will be adding value to the processes and performance measurement design. According to Santos et al. (2002) an effective performance management provides valuable information to a decision make about present condition of performance and the deviation from the objectives. Lebas (1995) argued information obtained not reflecting the actual performance will make the decision making process ineffective.

Production performance improvement comes from the analysis of measurement results; the identified negative and positive aspects are worked here. Negative aspects like problems, lacks and weaknesses are discussed and corrective actions are suggested. These recommendations are related to technical, economical and organizational perspectives to improve production performance. Simons (2000) argued that feedback provides an opportunity improve performance. The feed feedback information obtained can be utilized to make the adjustments in the input or in the processes and resulting desired level of output. The cause and effect's relationship needs to be understood in order to control and improve performance.

The outcomes of step 4 are used for production performance improvements. The area of improvement identified and conclusion and suggestions made in the last step of the result utilization model are then transferred to production process so that the necessary adjustment could be made to make the production process efficient as it is a continuous process. Kennerley & Neely (2002) identified four categories of barriers, which affect the evaluation process of performance measurements that are process, people, system and the culture. Santos et al. (2002) argued effective performance measurement design can only lead to proceed further for objective achievement. An inappropriate measurement design will fail to grape the accurate area to work with. A continuous performance management process can better grape and work with the dynamics of the system.

5. Empirical Findings

Empirical finding chapter includes the findings of three case studies. The chapter is divided into two parts: part I gives the cases introduction while Part II includes the data gathered with respect to Developed Model.

Part: 1 Case Introduction

Part: I of the empirical findings describe each case with two major perspectives: case company description and their production process. Case company description presents introduction of case while production process heading gives the overview of the production process of the case company visited.

5.1 Case: 1

Case1 description and production process are explained below:

5.1.1 Case company description

The case is one of world leading company that produces logging machines and employees approximately 150 people. The case company has an annual turnover of approximately 400 million SEK. The main activities of case company include designing, manufacturing, spare parts warehousing, service and training. Some small components and major subsystems including engines, hydraulic pumps and electrical controlling systems are outsourced, and the rest of products are all designed, manufactured and assembled in house. The case company employees are satisfied with the management policies and employee's turnover rate is low. Each year employees get bonus based on profit earned, bonus amount is same for all employees no matter what position they belong to.
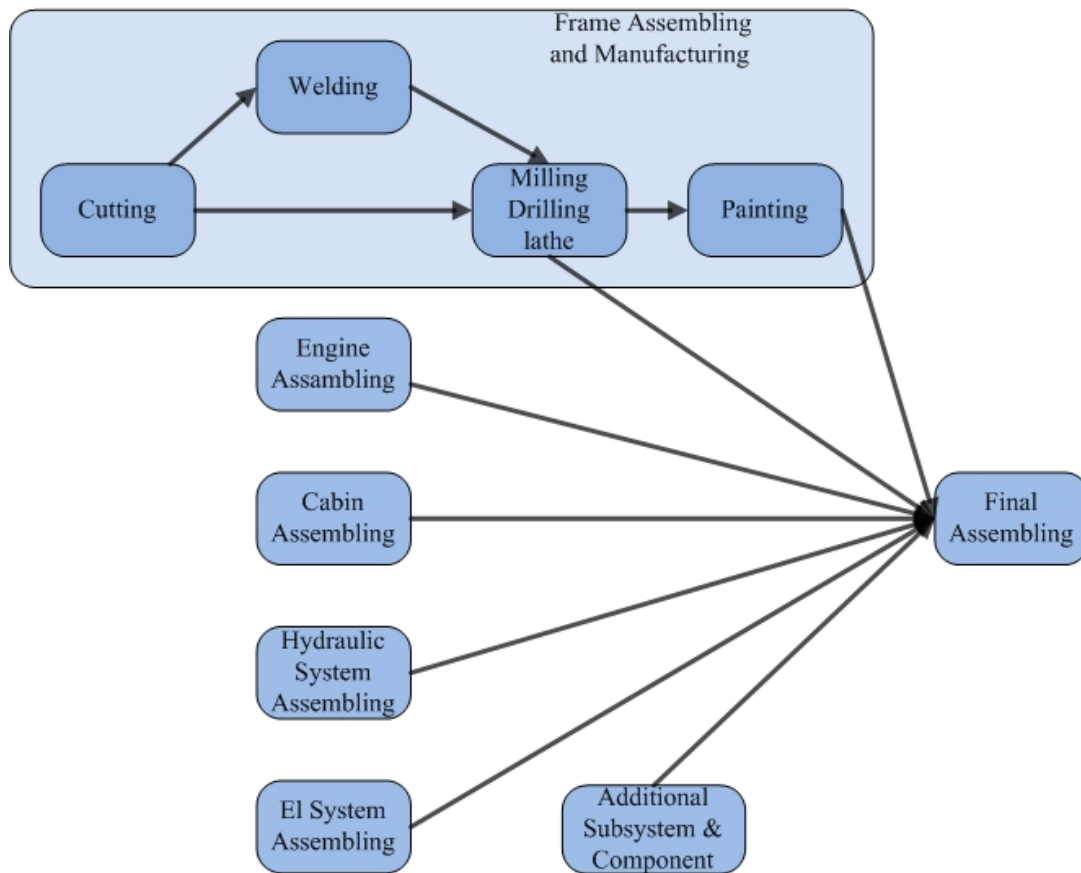
5.1.2 Production process

The production of different types of logging machine is carried out in batches and each batch differs in production process. The major production process could be represented in figure 5.1 below however the sequence of processes depends on flexibility of manufacturing. The manufacturing process is mainly focused on metal components for the frame of trailers, and there are some processes of cutting, pressing and folding of thin metal plate for the panels.

The raw materials for trailers frame components are steel plates of approximately 100mm thickness. They are cut by gas cutter into rough size. Production department plans cutting of raw material and try to avoid the wastages during the cutting process. The cutting process cuts the plates in rough size, bigger than the dimension required. The plates are then processed by machine to get accurate size. Some of the components need to be welded together before they go for mechanical processing, while the rest go to mechanical processing directly.

The components that require welding are mounted to a special holder to get precisely positioned. The welding is done mainly by manual process by very skilled operators. One welding robot is used for big component that requires lot of heat when to weld, and it is too hot for operators to work. Case company is not using X-ray device for inspection of welded components however the welding process is supervised by very experienced people, and

follows strict procedures. New type of component is given much importance and welding checks are performed to ensure that it is welded properly.

Figure 5.1 Production process of case 1

After cutting and welding, the components are sent for processing by machines like milling, lathe, drilling and etc. The case company is using the latest equipment for their production process. Generally, all machines are digitally controlled; operators for each machine are responsible for programming, operating and for basic quality control.

Some components need to be painted before they go to final assembling. Before painting the metal surfaces are sand textured first, in order to make paint stick strongly. The components are sent to dry oven to make the paint to dry faster. It takes only one night to dry up rather than three days if kept in normal condition. Additionally, there is only one colour for components if more colours required, they use sticker on that component to reduce the complexity of painting.

Before the finial assembling, the major subsystems need to be assembled first. The engines, cabins, hydraulic systems, electrical systems are assembled and tested individually. Then they are all assembled together and results into a final logging machine. Assembled logging machine are then sent to testing department and lastly delivered to customers as scheduled.

5.2 Case: 2

Case 2 description and production process are explained below:

5.2.1 Case company description

Case company has the specialities in processing of castings and providing their services for more than 50 years. The case company provides designing and manufacturing services to number of customers. The case company comes under small enterprise and has only 30 employees however working with highly technical expertise. 26 employee's works in plant and 4 persons look at administrative work. Three shifts work continuously five days a week. In 2009, there was a big decline in their sells however after words there are continuous increments in their sells. The budget set for year 2012 is 44 million SEK. The production is fully automated with latest Japanese machines like milling and turning machine. They are producing batch size customise products and also providing the designing services to their customers.

The company has a focus to follow international standards, for quality management they follow quality standards ISO 9001: 2008 and for environmental management system they follow ISO 14001; 2004. The quality philosophy mainly based on 5 key elements; strive to do right thing from start, continuously improve the quality, work for excellence and positive attitude of staff, participate in decision making process and continuously work with improvements of procedures and methods. The environmental policy has the focus to reduce waste, emissions and continuously work to improve the environmental effects. The company has the strategy to provide customers with best solutions at competitive price while focusing on providing high quality and better expertise. Proving best services to their customer the company is working as team production; they are working with each and every idea to improve their expertise in order to satisfy their customers.

5.2.2 Production process

The raw material for their production is the casted products or blanks which are then worked with finishing, drilling, shaping and assembly as desired by their customers. They are producing based on the customer orders, so frequently they are required to change setup for a new customer order. Planning for totally new assignment requires much development for setting the machines as compared to an old customer order which requires less setup time. Much of the development work is planned in the day shift while two other shifts mainly used for production purpose. Production layout is designed in a way that it provides flexible possibilities for production process. Production setup is equipped with fully automatic machines and robots, in addition to that they have semi-automatic machines to work with customer specific order. They try to maintain a good network with their suppliers to make their customers satisfied with high quality products. The raw material is stored in a systematic way to support the production process with minimum lead time.

5.3 Case: 3

Case 3 description and production process are explained below:

5.3.1 Case company description

The case company is a supplier of different parts and sub-assemblies to automotive industry. The case company approximately employees 180 people and 145 of them work as skilled operators in production facility. The case company has an annual turnover of 320 million SEK. The customers of the case company are world leading manufacturers and are producing heavy vehicles. The company has the certificate of ISO 16949 and ISO 14001 for quality and environment management. The case company has comprehensive production equipment's. It provides them a possibility to produce wide range of parts and sub-assemblies from raw materials to product in their facility without outsource any process. The case company approximately produces 100 types of different parts in their facility and they are proud to produce them.

5.3.2 Production process

The case company production process mainly based on processing of metals and their products are mainly for heavy vehicles. The main raw materials for production process are big size metal plates and casted parts, the metal plates are of different thicknesses. There are number of production processes performed based on the part requirements and the major processes include cutting, pressing, welding, surface processing, painting and assembling. The part decoupling point and different processes sequences vary however generally the production process follows the following procedure as shown in figure 5.2.
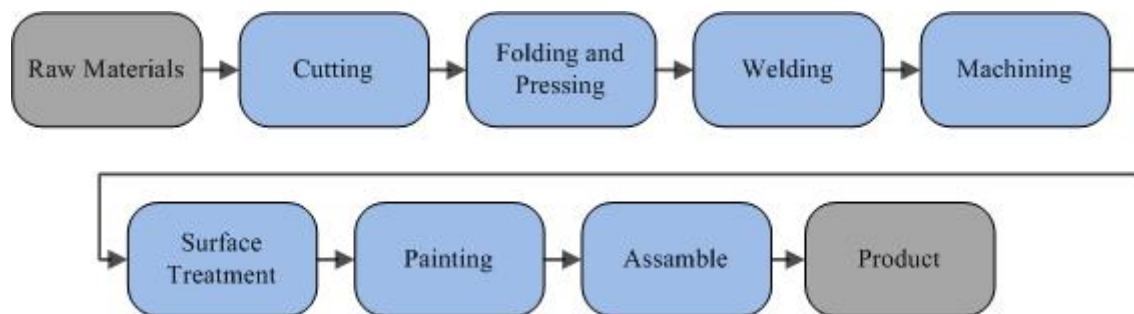
Figure 5.2 Production process of Case 3

The case company production process starts from the process of cutting. They have five cutters and four of them are laser cutter for cutting metal plates. Robots are programmed for feeding the laser cutter and for picking up finished parts. The design and control of cutting process is fully computerized it works on optimized cutting of metal sheet.

From the cutting section, the parts are then needed to be pressed or bent or fold into some sort of required shape. The case company has three hydraulic pressing machines which are operated by the operators. Welding is the next step performed to make joints of different shaped parts. Some of the welding processes are manual while heavy and specialized parts are welded by robot. Human factor some time may cause some variations in the welding process which may add up to scrap cost. Specialized attention is paid while welding the parts and they are placed into some sort of fixture to align them accurately. The welded parts are then

machined or shaped if required by part specifications. Surface treatment of welded and machined parts is required to remove the dirt and corrosion. It will clean and make the surface rough for paint to stick. The process is carried out in a special chamber, where the operator shoots sand at high speed on the components surface with a special gun which is driven by compressed air.

In the painting process there are several steps. The paint on the surface has many layers and each layer has its function. The metal components first come to this process, they should be pre-painted first. It is kind of paint with white colour and it can help the paint in later steps to stick stronger on the metal. Then the surfaces are painted with anti-corrosion paint to isolate the metal from air and humidity. After these two steps, the components with paint are heated to speed up the drying and make the paint merged stronger with the surfaces. If some parts need to be paint with colour, they will be carried out in the last step. The final process in the production process is assembly. Not all the component needed to be assembled however if required it will be carried out in this step.

Part: 2 Data Gathering

This part of empirical finding includes the data gathered during the case company visits with respect to the Developed Model. The semi structured interviews were conducted and Appendix II shows the interview guide used for data gathering. The same structure of Developed Model is followed in order to make the data gathering process consistent and easier to follow.

5.4 Case: 1

Data gathered form case 1 with respect to developed model is explained below:

Step: 1 Strategy

The case company has the mission of being one of the leading manufacturers of the sector, produce environment friendly machines and provide better customer support. The strategy includes producing environment friendly machines with high availability and maintainability with a trusted network of dealers. The production objectives include producing high quality machines to meet the customer requirements, on time delivery of the machines as scheduled and to reduce wastages in the production processes.

Step: 2 Performance measurement design model

Performance measurement design model mainly consists of following sub steps:

The performance objectives were presented as have good production quality, follow the production plan, and to reduce the wastages in production process. These performance objectives are directly transformed from the production objectives and have not further categorized to achieve performance in specific direction.

Identify measurement area based on feedback from final testing department and complaints from customers. Test for specialized parts were conducted when manufactured and there is a final test when logging machine assembled completely and it is before the delivery of machine. Most of the problems are identified during the test phase and solved if some problem happened due to the part outsourced then a claim is made to outsourcing company. During the warranty time of machine, the case company is responsible to make the adjustments to customers. Departmental weekly meetings of production, research and design, market and services are held to discuss the plans and to solve the existed problems.

The case company working dimensions consists on the aspect of quality, finance and time. The case company's measurement perspective involves technical and economic perspectives, while organizational perspective is not measured. The employees were satisfied and motivated with management policies.

The main KPIs discussed by the management were: total cost of each component, numbers of customer complain, number of failure in testing and production time for each process. Specialized measures for production process and production cost, while measures for equipment effectiveness were not observed.

Testing department works with set of measurement policies, each machine is tested for a specific time in the real environment and under real work load to check all the important functions of machine. The testing of each production process also has certain policy, tools and responsible person of tests are clarified. For KPIs like customers complain and total cost of each component, they have measurement policies however these policies are not well documented.

Step: 3 Benchmarking

Internal and external benchmarks were not observed during the case company visit. The case company has the idea of benchmarking however they have not set some benchmark to achieve. Experience of the personnel's for performing a specific task is somehow is used for other employees to perform the similar task and it is not well documented or followed continuously however compared when needed.

Step: 4 Result utilization

The case company believes in the importance of continuous improvement activities. The data gathered from product testing and customer complaints are analysed for finding the root causes and to fix the problems so no future threats. Quality problems have been given the importance as it affects customer satisfaction, delivery time is also kept at high priority level however there were lack of improvement in production cost measurement.

5.5 Case: 2

Data gathered form case 2 with respect to developed model is explained below:

Step: 1 Strategy

The company has the ambition to experience and knowledge to be among the very best in castings processing to Swedish industry. The case company refers to their strategy as business ideas to work with, business ideas are the written statements as below:

- Be a leader in the development of technical production and processing solutions.
- Being a full service provider of everything from design to customer-friendly delivery solutions.
- Maintain a consistent and exceptional quality in both products and services, by having committed and competent employees.
- Contribute to long-term value for our customers by constantly working on innovative and cost effective process improvement and quality assurance.

The case company has the strategy to maintain good coordination with their supplier in order to avoid variation and quality problem for their input blanks. Strive to get maximum customer satisfaction and look for potential customers to increase the profitability. No compromise on quality and work with optimal cost for production. The production objectives of case company mainly focused on high quality products as it leads to satisfy their customers. Utilize the resources in an effective way to improve the efficiency. Schedule the available time to produce efficiently to meet the customer deadlines. Minimize the process and time variation for new batch production process. Design and Implement three years plan to improve turn

over and profitability. Continuously improve the production process and improve the efficiency of equipment utilization.

Step: 2 Performance measurement design model

Performance measurement design model mainly consists of following sub steps:

The production objectives directly lead to production performance targets. The case company performance objectives mainly consist of: Improve product quality to achieve zero defects. Avoid variations in the production process to reduce the scrap cost. Avoid the disturbance and stoppages in production process and report it if takes more than 45 minutes. Utilize the equipment in an effective way by putting the right jobs at the right machine. Improve production cycle time by comparing theoretical time with the practices. Utilize the results obtained to work with continuous improvement. Maintain a good cooperation between three shifts to have consistency of work.

The case company is using Japanese latest fully automatic machines known for high reliability. The equipment's are very much automatized and reliable; problem mainly arises with machines when new batch production starts. Very few problems related performance of machines but the problem mainly caused by operators negligence, and from blanks that are used as input for production process supplied by suppliers. Specialized measurements for each type of products are used to identify the measurement area for individual product. Continuous feedback and close coordination between the employees and management help to identify the problem quickly. Meetings are scheduled to identify the root cause of the problem and take corrective actions.

The case company has a focus to work with quality and time dimensions, which are derived from their strategy. Quality standards ISO 9001: 2008 applied to ensure high quality working practices. Theoretical cycle time for producing a product is compared with actual time of operation. Time is planned efficiently and errors during the process are recorded. Delivery flexibility and cost are considered as second dimensions to work with. The case company provides delivery flexibility to their customers; deliveries are dispatched at the agreed time. Customers are informed in advance for any possible late delivery. Quality is not compromised for cost differentiation and cost is discussed with customers at the last stage when finalizing a new contract. They are working with technical and economic measures while the organizational perspective is missing in their measurements.

The case company has established numbers of KPIs to assess production performance under dimensions mentioned above. Production process and Product quality is ensured by process capability, number of defects, availability of machines, customer complaints, scrap cost, variation in dimensions of product, actual cycle time and lot more. The production cost is measured as traditional finical measures.

The measurement policy is established for each KPI. The process capability is measured frequently when a machine is just set up for new product in order to check the tolerance is under the control limits for quality product. There are more chances of error when new product production starts as the production continues the numbers of measurements are

reduced to one to two measurements each shift. Defective products are recorded and if it exceeds the limits then corrective action are taken. The defective product could be because of variable reasons, it is not necessary to investigate every defect however if there are too many defects at a time, it may be the problem related to setting up of machine. The availability is one important KPI, it reflects the production efficiency of equipment. Disturbance of 45 minutes is considered as major stoppage, it is reported and analysed to find the root cause. Customer complaints are considered as one of the alarming KPI, it is very rear to get customer complaint if received then immediate actions are scheduled. Scrap cost limits have been set, exceeding the limits is the indication of problems. Scrap of big blanks is of more concern than smaller blanks due to their cost and processing on them is also costly and it adds up the cost.

Batch production for each part is planned completely like setup time, theoretical cycle time, dimension of products to measure, how frequently to measure and lot more. The measurement policy depends upon the sensitivity of the parts like automotive parts are more sensitive to measurements than parts for pump.

Step: 3 Benchmarking

The main problem highlighted by them was lack of data resources available to benchmark. High variation and low volume batch production make it difficult to internally benchmark however they are benchmarking performance of similar machines. Measurements are designed, implemented and results are recorded for management use. Employee's experience is also being used as the input to benchmark their practices. Some of their customers have similar processes this provides them a possibility to compare their performance with them externally. Exhibitions and conferences also supplement them to look at their performance with the latest developments.

Step: 4 Result utilization

The case company has scheduled number of plate form to analyse the information obtained. Regular meetings on Tuesday, Wednesday and Thursday are scheduled to plan the production effectively and look at the progress made. The disturbances in production process and deviation in results are discussed to find out the root cause and fix the responsibility to tackle the problems. There are very limited problems related to reliability and performance of machines, the problems mainly occur due to human factor and input material for production process. Customer complaints are given the high priority to make them satisfy. Cross functional meeting of process honours are scheduled to look at the progress made and set future goals for achievements. The analysis results are used to improve the production performance. The root causes identified in meeting are then worked to improve it.

5.6 Case: 3

Data gathered form case 3 with respect to developed model is explained below:

Step: 1 Strategy

The case company has the strategy to satisfy their customers by providing them complete and comprehensive production of their required parts at appropriate cost. The case company has the pride to manufacture high quality parts or products for their customers with many operations under one roof. The strategy directly leads to the production objectives. They want to reduce the production cost by utilizing their equipment efficiently and reduce the wastages during the production process. They have the objective to produce 30% more with 30% fewer resources. Production should follow planned schedule and measures should be made to improve the quality of parts as it leads to satisfy customers.

Step: 2 Performance measurement design model

Performance measurement design model mainly consists of following sub steps:

The case company performance objective has the focus to improve the quality of parts to meet the customer satisfaction. They have the agreement with some customers based on customer demands of quality e.g. one of the customers requires maximum two quality problems. Production schedule is followed strictly to make delivery on time. Reduce the production wastages to minimize the scrap cost, shorter the production cycle time to improve production process effectiveness.

Cross functional meetings are scheduled weekly with production management, production technician and quality representative discuss the progress and problems to work with. The identified areas of improvements and root causes are then discussed within the department to make the required improvements. The management had a belief on contribution of operational staff and their point of view is given importance to work with improvements as they are close to production process. Quality problems are also being notified by their customers.

The case company mainly works with quality, time and finance dimensions. The KPIs of case company also reflect the measurement perspectives i.e. economic and technical perspectives. The cycle time for important processes is noted to know the human factor efficiency.

There are limited numbers of KPIs applied by the company to track the production performance. KPIs with which case company are working includes scrap cost, cycle time of some process, number of quality issues from customers and number of defects in some process.

The case company has measurement policies for developed KPIs like; the cost of each wasted part is measured, cycle time for important processes, number of quality issues each week during the production process, number defect in some particular process. First and last part of each batch is measured and root causes for each problem are investigated. The measurements for specialized components are carried out in desired atmospheric conditions like measuring the tolerance of component. The measurement is done in 20 degree centigrade to eliminate the

impact of temperature on component. The accident / injury and delivery issues are measured each week.

Step: 3 Benchmarking

The case company lacks in benchmarking the practices internally and externally. Little evidence was observed for internal benchmarks, where production performance of important similar processes was compared. Lack of data availability problem for benchmarking was highlighted by management.

Step: 4 Result utilization

Case company believes that improvement comes through continuously working with limiting the problems. Investigation made during cross functional and inter departmental meetings are utilized to work with improvements. Quality problems usually happen due to human errors which are difficult to eliminate fully however could be limited. Operators are motivated to work with improvements to make the production process effective and to reduce the wastages in the production process.

6. Analysis

In this chapter, the empirical data gathered in three case companies are analysed. The analysis is conducted following the structure of Developed Model. The analysis follows the structure as Strategy, Performance measurement design model, Benchmarking and Result utilization.

6.1 Case: 1

Analysis for case 1 with respect to developed model is presented below:

Step: 1 Strategy

The case company has clear mission, strategies and production objectives and there exist a correlation between mission, strategies and production objectives. Good correlation between strategies and implementation lead objectives achievement. Mainly, three production objectives identified i.e. high quality machines, schedule delivery and to reduce production losses. The detail measures needed to be designed for achieving production objectives. The measures case company is working are basic and it is difficult to control all the necessary information needed to achieve and improve the production process.

Step: 2 Performance measurement design model

There was no clear distinction found between production objectives and performance objectives, both of these terms were inter related with each other. The case company has identified certain performance objectives in accordance with production objectives; however they are not well quantified into specified direction.

Identify measurement area is based on feedback and departmental meetings and it is a good way to diagnose the problem in production process. Cross functional meeting provides better understanding of the problem and lead to agreed solution. Mainly, the meeting focuses on identification of problem from previous measurements, find solution of the problems, determine area to improve and this all lead to identify measurement areas.

The measurement dimensions are identified according to production objectives and performance objectives. The quality dimension is identified to ensure the quality of product, and the time dimension is identified to ensure the delivery time. The product quality and on time delivery are two factors that contribute to customer satisfaction. Additionally, the finance dimension is also identified to control the production cost which has an impact to company profit margins. Technical and economical perspectives are important for companies however organizational perspective has its own significance and that was lacking in case company. Case company has limited basic technical and economic measure with no organizational focus that may lead to ineffectiveness in production process.

The KPIs with which the case company is working are limited in numbers and there exists the possibility that limited number of KPIs may not reflect the actual production performance. Limited knowledge about the current level of performance makes it difficult to work with improvement activities.

Well established measurement policies make it easy to implement KPIs effectively. Most of the measurement policies for KPIs are well established as testing department set their measurement policies. There existed the evidence that certain measurement policies are not clear which can make the KPIs implementation less effective.

Step: 3 Benchmarking

Benchmarking provides a possibility to look at standards to improve the lacking areas. The benchmarking practices are not utilized in case company, so somehow it becomes difficult to compare current practices with the desired level or with competitor performance to identify the weak areas. Personal experience was not documented properly may not always be used for improvements. Factors like size of case company, lack of data and resources availability make it difficult to utilize benchmarking practices.

Step: 4 Result utilization

Analyse measurements, identify the real cause and do corrective actions is the essence of all the efforts made for improvements. The case company uses the performance measurement results for improvements in production process. Cross functional and production meeting are the way to analyse the progress and to work with continuous improvements.

6.2 Case: 2

Analysis for case 2 with respect to developed model is presented below:

Step: 1 Strategy

The case company has developed clear business ideas to work with. The case company has latest automatic machines and they are producing quite complex parts and providing their customers technical production and processing solutions. Complex products are produced based on the specialized requirement from their customers. The quality being at the priority for their products, special considerations are taken to improve the quality and maintain the customer expectations. ISO 9001: 2008 is being followed to improve the quality standards.

To ensure the business ideas are implemented and appropriate actions are taken continuous meeting are held to discuss performance. The case company has developed three years plan to achieve their business objectives. The case company is not using any type of tool to translate the business ideas into the detailed measures.

Strategy is being the origin of production objectives. The business ideas developed are being supported by production objectives. Customers are being satisfied by providing them their specialized technical requirements. Limiting the variation in the processes lead to high quality products and ensure delivery of products at the stated time.

Step: 2 Performance measurement design model

There exists a correlation between performance objectives and production objectives. Achieving the performance objectives will be a step to ensure the production objectives. The KPIs the case company has developed are an extension of performance objectives.

The case company has a good procedure to identify the measurement area. They have experienced that the problems can come mainly from the supplier blanks and human factor. Steps are been taken to avoid the low-quality input blanks and improve human factor by recording the data and providing required knowledge. New batch production disturbances happen due to setup and fixture's settings, once these matters are tackled properly the production continues with minimized disturbances. Root cause identified in scheduled meetings help to diagnosis the measurement area for potential problems.

The case company is not using the word of dimension and they have not categorized their KPIs based on the dimensions. Based on the discussion with the company representative, they mainly work with quality and time; quality makes their customers satisfied and time dimension improves their efficiency and effectiveness. Flexibility and finance are their major second dimensions of focus. Planning is made to fulfil the customer's promise of delivery, which makes the customer trust and reduces the lacks in processes. Quality is not compromised against the cost and this has made the company's product as quality differentiated. Additionally, among the existing measurement's perspective the case company mainly focuses on technical measures and has basic economic measures, while organizational measures have not been defined. It could be seen from measurement dimensions and KPIs developed.

The KPIs reflects the performance objectives and the measurement area identified for performance improvement in the production process. Though the case company has number of KPIs however they have not directly derived from performance objectives or dimensions. It may be because KPIs only reflects the important parameters which are of much concern for case company. KPIs set, needs to be applicable and the data required needs to be accessible in the case company which requires clearly identifying measurement areas and current situation of the case company.

The process of measurement policy identification basically considers the factors of effectiveness and reliability of measurements. Each KPI has measurement policy based on its requirement and importance for production performance. The persons responsible for the measurements, the tools for measurements and the frequency of measurements are selected based on product significance and expertise of personnel.

Performance measurement design model consists of five important sub steps. It starts with performance objectives, measurement area, dimensions, KPIs and measurement policy. The case company activities could also be categorized into these five sub steps. The case company has performance objective, works with measurement area, have the KPIs that comes under the dimension and have the measurement policy for each KPIs. These all activities are performed in case company but not in the same sequence or at the same plate form. The representative from the case company mentioned that the model steps are performed here however they are not well documented as in the developed model.

Step: 3 Benchmarking
The case company management is aware of the importance of benchmarking concept. Batch production of different type of parts requires individual measurement and measurement policy

based on part complexity. They are working to adopt internal and external benchmarks for improving their performance with the limited resources available to them. For internal benchmarks, the company has limited size; there is no other branch or site for them to compare with. The only internal benchmark that the case company applies is to compare the production performance between similar machines or processes. Limitation of external benchmarking comes from the inaccessible data of other similar companies however they are trying to benchmark externally.

Step: 4 Result utilization

The case company has developed comprehensive measurements based on their production process and strategy. The measurement results are well analysed and the problems identified by measurements are studied for finding the root causes. Improvement is a continuous process which requires continuous efforts to make production process to obtain high efficiency and effectiveness. As discovered in the case study, problems and root causes found are tried to improve, and outcomes of improvement are monitored for future measures.

6.3 Case: 3

Analysis for case 3 with respect to developed model is presented below:

Step: 1 Strategy

The case company has the facility and ability to produce the different type of parts with high quality and at appropriate cost for their customers. The quality and cost areas are focused from strategy to operations and production objectives are derived from that. The production objectives are not further categorized for their effective implementation, as producing 30% more with 30% fewer resources require appropriate strategies to achieve them. Improving the quality of parts is ensured by following quality standards and specific customer demands of quality.

Step: 2 Performance measurement design model

The performance objectives of case company directly come from the company strategy and production objectives. The performance objectives are general to guide for specific production activity effectively, like two quality problem for one of the customers need more clarification in production process as it is based upon number of interdependent activities. Minimizing the scrap cost, shorter production cycle time and production process effectiveness requires specific activities for their achievement.

Identify measurement area is an important step for case company to gather information to support their improvement decisions. Cross functional and production meetings provide them a platform to diagnose the real cause of a problem. The case company detailed measures not only based upon the production and performance objectives however they are also based on information from identification of measurement areas.

Quality, time and finance dimensions provide them a possibility to improve the production process from diverse areas of actions. Organizational perspective has not been given much importance and the measures are not designed accordingly. Human factor efficiency is

monitored for important processes however appropriate actions have not been taken to improve organizational effectiveness. The management is willing to design specialized measures to improve organizational effectiveness.

The KPIs in the case company can generally describe the production performance, and it contains the concept of multi-dimension measuring. The KPIs contribute to achievement of production and performance objectives somehow however still there seems a need of designing and implementing more number KPIs.

The measurement policy is developed according to each KPI. These policies clearly defined the responsible for measurement, tools for measurement, frequency of measurements.

Step: 3 Benchmarking

The case company only applies internal benchmarks for some of the processes and they do not have any accessible data for external benchmarks. To benchmark internally is also a demanding and difficult task for the case company i.e. due to less numbers of same type of equipment's and due to lack of expertise.

Step: 4 Result utilization

The investigation made and root cause analysed are then being used for improving the production performance. Quality and cost being one of the important dimensions that affects the production processes, which are directly related with human factor. Case company lacks in organizational measurements so human factor ineffectiveness could cause hurdles in production process. Different meetings held work for utilizing the resources in an effective way and feedback is considered an important input for production performance improvements.

6.4 Case Analysis Representation

Each case analysed in the above section is represented in the form of table 6.1 in the following section. Four symbols have been used to show the intensity of implementation of important concepts.

Table 6.1 Case analysis representation

Developed Model	Case 1	Case 2	Case 3
Strategy			
Strategic Alignment	◐	●	○
Measurement Design			
Identify Performance Objectives	○	●	○
Identify Measurement Areas (diagnosis)	●	●	●
Identify Measurement Dimensions	●	●	●
Identify KPIs	○	●	◐
Establish Measurement Policies	◐	●	●
Benchmarking			
Internal Benchmarking	×	○	○
External Benchmarking	×	○	×
Result Utilization			
Continuous Improvement	◐	●	◐
Measurement Perspectives			
Multi-perspective Measurements	○	○	○

●: Good Level Implementation   ◐: Medium Level Implementation
○: Poor Level Implementation   ×: No Implementation

7. Results

In this chapter, the results of case studies are presented based on research conducted. The commons and differences between the developed model and the case studies are discussed to prove the applicability of the Developed Model.

The empirical investigation made and analysis carried out with respect to developed model, the representation of that is shown in table 6.1. The table indicates the general concepts of the developed model; it also represents the extent of implementation of these concepts based on author's observations during comparative study of three cases.

The developed model applicability was checked in three case studies and it was found that SMEs are at different maturity level in terms of applicability of the model, which indeed requires improving maturity level by implementing the developed model. Different maturity levels in multiple case study also ensure validity and reliability of the developed model.

Strategic alignment ensures to developed clear strategies that will be translated into accurate KPIs for their effective implementation at operational level in the production process. Case 2 has developed clear and appropriate numbers of measurements that lead to achievements of strategic goals than case 1 and 3 comparatively. Lack of strategic alignment leads to develop deviated KPIs for production process and their poor level of implementation as indicated in table 6.1. It was also found that the KPIs developed were basic in nature and limited in numbers.

Cases were working with improving production performance; however they have not categorized performance objectives as in the developed model. Case 2 was clearer in their performance objectives than case 1 and 3, though all cases have KPIs that were contributing to performance objectives.

The KPIs developed in cases could be mainly categories into finance, quality and time dimension. Case 2 emphasized to work somehow with flexibility dimension while human resource dimension was neglected in three visited SMEs. The empirical investigation and analysis showed that mainly economical and technical measures are applied while SMEs lack in organizational measurements and it may lead to organizational ineffectiveness. The intensity of implementation of economic and technical measure was not seen at appropriate level.

Benchmarking concept is one of the important step for the developed model. It was found that SMEs lack in implementation of benchmarking as could be seen in table 6.1. Cases were aware of benchmarking contribution for improving their production performance. Lack of implementation was due to limited resources available to them as comparison with large organizations. The Case 2 was somehow working the internal and external benchmarks while case 1 and 3 set no benchmarks.

8. Conclusions

In this chapter the research is concluded. Firstly the formulated problem is answered by the developed model. Then developed model applicability is checked in multiple case study and thereafter multi perspective measurements is discussed. Finally the criticism is made for future research.

8.1 Problem Formulation and Developed Model

This section answers the formulated problem in Chapter 1. The problem formulated for the study as:

How can small and medium enterprises (SMEs) improve their production performance management?

The developed model in this study provides solution to the formulated problem through four aspects:

- Emphasize on strategy alignment of performance measurements to SME strategy.
- Select effective KPIs and develop appropriate measurement policies.
- Benchmark production performance and take account for effectiveness of improvements.
- Utilize measurement results and continuously improve production performance.

Strategy defines how SMEs can achieve their mission and goals. The production performance management should be one part of the SMEs activities that contribute to the company strategy. The developed model breaks down the production performance management into the activities of production performance measurements and production performance improvements. The concept of strategy alignment is emphasized in the developed model to design measurements reflecting the strategy. It can improve SMEs production performance management by better achieving of their strategic goals through strategic aligned measures.

According to developed model, the selection of KPIs for SMEs should be comprehensive, which means the KPIs should be multi-perspective and cover different measurement dimensions. KPIs should be appropriate in numbers and not too complex or too simple. At the same time, the KPIs should not be repetitive in order to reduce the resource consumption. It also requires developing appropriate measurement polices for each KPI. These principles of KPIs selection can improve the production performance management of SMEs by providing better production performance measurements.

The developed model also improves the production performance management of SMEs by applying the concept of performance benchmarking and effectiveness of improvement measures. Benchmarking of production performance is not proved by cases practices due to difficulties in finding data and lack of resources, however it is well-supported by literature. It can easily identify the strength and weaknesses in the production by comparing the performance internally and externally. It also provides a possibility to look at the effectiveness of improvement activities by comparing their outcome with the standards or benchmarks.

Production performance management is based on measurements and improvements as mentioned earlier. Improving production performance management for SMEs not only require designing accurate measurements however also to work with continuous improvements. The results obtained through measurements needed to be analysed, disturbances identified required to work with and further actions are needed to be planned by prioritizing the improvement activities.

8.2 Multiple Case Study and Model Applicability

The introduction chapter highlighted the purpose of the study as: "*To develop a model for assessing, follow up and improving the production performance of Small and Medium Enterprises.*" Intensive literature study has been carried out to develop a model meeting the requirements. The developed model possesses the capacity to assess, follow up and improve production performance of SMEs. SMEs differ in their culture, structure, practices and resources; to validate and generalize the developed model applicability has been checked through three different case studies. Two case companies were medium sized and one was small company under the big group that is operating in different business areas.

Al-Najjar & Kans (2006), Bourne et al. (2000), Neely et al. (2000), and Neely (1999) discussed the importance of strategically aligned performance measures. It has been observed during case studies that there exist the practices or some deviation for transforming the strategy into the accurate performance measures. These deviations could be seen from two perspectives, e.g. there exists the strategy but the performance measures have not designed or it could be the case that there are performance measures which do not contributes to strategy achievement. It has also been observed that SMEs were working with limited technical and economic measures while organizational measures have not been defined. It could be concluded that performance measure should be defined based on strategy and there is need of clear alignment between strategy and performance measures. The developed model step 1 gives emphasis on strategic aligned measures for Production process.

The performance measurement design step 2 of the developed model consists of five sub steps; performance objectives, measurement areas, measurement dimensions, KPIs and measurement policies. The purpose of the step 2 is to identify accurate KPIs and measurement policies that reflect the production objectives and lead to strategy. Cases were lacking in identification of accurate performance objectives and KPIs for improving the production performance. It was due to lack of specialized skills as SMEs faces this problem. Performance objectives narrow down the improvement area and this leads focus on specialized area and not to deviate from required results. Identification of accurate performance objectives will make the later steps easy to follow in the developed model and improve production process effectiveness. Slack et al. (2009) also emphasized on well-defined strategy for KPIs selection. It could be concluded that well developed performance objectives will make it possible to identify accurate KPIs.

Al-Najjar & Kans (2006) emphasised on diagnosis while Folan & Brown (2005) and Hudson et al. (2001) highlighted the importance of measurement dimensions. The cases were good in identification measurement areas and identification of measurement dimensions. Researchers

have identified six important dimensions however the cases were mainly working with two to three dimensions. KPIs are not seen well developed this was due to vague performance objectives, while the cases have measurement policies for developed KPIs. Parmenter (2007) and Al-Najjar & Kans (2006) argued for well implemented KPIs. Al-Najjar & Kans (2006) also argued for development of effective measurement policy. The five sub steps of measurement design model have effective role for improving production performance as checked in case studies and also highlighted by literature. It could be concluded that step 2 of the model is well developed and empirically applicable.

Internal and external benchmarking is one of the steps of the developed model. It provides an insight to compare the practices with the standards. Authors like Al-Najjar et al. (2004), Gomes & Yasin (2011), Neely (1999) and Stapenhurst (2009) highlighted the importance of benchmarking for performance improvements. Table 6.1 highlights that benchmarking practices were found to be weak in application as compared to other concepts, so it could not be assumed that benchmarking is not relevant for SMEs. Improving the production performance requires to benchmark the practices as it is identified in literature. Literature also highlights that SMEs have limited resources and are not specialized in skills. The case companies were aware of benchmarking however they were not implementing the benchmarking concept and according to them; it was due to lack of resources and data availability for them to benchmark. Benchmarking importance and data availability problem was also discussed by Denkena & Liedtke (2006). It could be argued that SMEs need to work with benchmarking even though they find it difficult for them to work with, so step 3 of the model have its worth to be the part of the developed model.

Result utilization step of the developed model works with the analysis and suggestive actions for continuous improvements. Production performance improvements require working with continuous improvement cycle to eliminate the ineffectiveness. Oakland (2003), Loch & Tapper (2002) and Santos et al. (2002) also insisted the importance of continuous improvement for improving the performance. Table 6.1 indicates a good correlation of continuous improvement concept in case companies visited. Continuous improvement focus also makes it possible for companies not to get demotivated and work continuously as Neely & Bourne (2000) argued the failure of performance measurement due to lack of focus. It could also be concluded that the result utilization step of the developed model has its importance for improving the production performance.

The model comprises of four step and each step applicability was checked in case companies and confirmed by SMEs practices with strong or weak correlation. The table 6.1 in analysis chapter indicates the intensity of important concept implementation. This ensures internal validity, external validity and reliability of the developed model.

8.3 Multi-Perspective Measurements

SMEs cases were mainly working with technical measures and to some extent economic measures while organizational measures were not being designed. It could be due to lack of specialized skills while comparing with large organizations, which have lot of resources available to train the human capital. SMEs are lack of organizational perspective and the contribution of it leads to improve the organizational effectiveness. Multi-perspective measurements were not proved by SMEs practices, still the demand of multi-dimension measurements are identified from cases. Al-Najjar et al. (2004) insisted on economic and technical measures while Parhizgari & Gilbert (2004) highlighted the importance of organizational measures. These perspectives assess the effectiveness from different area of actions and remove inefficiencies. It could be concluded that SMEs need to work with these perspectives; especially organizational perspective and appropriate measures required to be designed based on these perspectives.

8.4 Criticism and Suggestion for Future Research

It could be argued that the developed model applicability was checked at generalized level it does not go in details. Like benchmarking is one of the important step of the developed model it is said benchmarking practices should be utilized, however it has not been discussed how to work with benchmarking same with other steps of the developed model. The allocated time was used to check the applicability of developed model in three case studies to make it more generalized however the time could also be used to make this model applicable into one case study to see the specialized application and outcomes of developed model. It could be suggested that model could be tested practically in case study to identify the specialized applicability of the model. A large scale questionnaire could be conducted to get the idea about model steps and practices of SMEs with respect to developed model.

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Appendixes

This section includes two appendixes. Appendix I shows the strategy for searching the literature while Appendix II shows the guide for semi structured interview.

Appendix: I Strategy for Searching Literature

Appendix I below shows the strategy used for searching the literature in March 2012. It also shows the delimitations made to search for specific literature.

Database	Limitation	Search Term	Delimitation	Refine Term	Delimitation	Hit	Relevant
Google Scholar		Performance Measurement	Title			18900	
		Performance Measurement	Title	Production	Title	97	Some
		Performance Measurement	Title	SME & SMEs	Title	93	Some
		Performance Measurement	Title	Framework	Title	331	Some
		Performance Management	Title			37000	
		Performance Management	Title	Measurement	Title	1030	Some
		Performance Management	Title	Production	Title	234	Some
		Performance Measurement	Title	SME & SMEs	Title	131	Some
Database	Limitation	Search Term	Delimitation	Refine Term	Delimitation	Hit	
Science Direct	Journals	Performance Measurement	Title			1397	
		Performance Measurement	Title	Production	Abstract, Title, Key words	37	Few
		Performance Measurement	Title	SME & SMEs	Abstract, Title, Key words e	2	All
		Performance Measurement	Title	Framework	Abstract, Title, Key words	63	Some
		Performance Management	Title			928	
		Performance Management	Title	Measurement	Title	37	Few
		Performance Management	Title	Production	Abstract, Title, Key words	75	Some
		Performance Management	Title	SME & SMEs	Abstract, Title, Key words	7	Few
Database	Limitation	Search Term	Delimitation	Refine Term	Delimitation	Hit	
		Performance	Title			234	

Database	Limitation	Search Term	Delimitation	Refine Term	Delimitation	Hit	
		Measurement					
		Performance Measurement	Title	Production	Title, Abstract	0	
		Performance Measurement	Title	SME & SMEs	Title	1	No
Emerald	Journals	Performance Measurement	Title	Framework	Title	17	Few
		Performance Management	Title		Title	349	
		Performance Management	Title	Measurement	Title	27	Few
		Performance Management	Title	Production	Title	3	All
		Performance Measurement	Title	SME & SMEs	Title	9	
Database	Limitation	Search Term	Delimitation	Refine Term	Delimitation	Hit	
		Performance Measurement	Title			317	
		Performance Measurement	Title	Production	Title	0	
		Performance Measurement	Title	SME & SMEs	Title	0	
IEEE	Research Article	Performance Measurement	Title	Framework	Title	2	Some
		Performance Management	Title		Title	130	
		Performance Management	Title	Measurement	Title	1	All
		Performance Management	Title	Production	Title	0	
		Performance Measurement	Title	SME & SMEs	Title	0	

Appendix: II Interview Guide

*These questions are developed from literature study and through brainstorming. The purpose of these questions is to gather data of SMEs production practices with respect to developed model. The interviews are designed as semi-structured interview, and these questions are **only critical issues** to cover rather than a questionnaire.*

Strategy

What is company's vision and mission?

What is company's production strategy?

What is production department strategy?

What are production objectives?

What is the main area of focus in production?

What you want to achieve from production process presently?

What do you think which area of production requires improvements?

How you ensure that there is correlation between strategic goals and what is done at operation level?

Are you satisfied with production performance?

How management evaluate the production department performance?

How information is gathered for controlling and decision making?

Production information

What are the products you produce?

What are the main processes for product production?

Mainly where the problems exist in production process?

What are the main equipment's you are using in each process?

What are the major inputs for production process?

Are you satisfied with the out produced?

Do you get customer response frequently complaining the product?

Do you measure OEE, Availability, or Quality Rate?

Task: Draw figure for production process.

Task: Try to identify the problems in production process.

Performance measurement

Performance objectives

What are production performance objectives?

In which area of production there exist problems?

In which area you want to improve?

What objectives you have set?

Are you satisfied with performance objective set?

Is there any need of improvement?

On what basis you change performance objectives?

How you have established the performance target?

Task: Identify performance objectives.

Measurement dimensions

Which measurement dimension you work with?

How you have identified these dimensions?

Task: Identify measurement dimensions.

Measurement areas (Diagnosis)

What are the major problems in production process?

How you get information about these problems?

Task: Identify Measurement Areas.

Key performance indicators (KPIs)

Which Perspectives the KPIs consists of e.g. technical, economical and organizational?

Which Dimensions the KPIs consists of?

What are the major KPIs for production process?

How you have set these KPIs?

What are the shortages in current KPIs?

Task: Identify KPIs based on measurement dimensions and perspectives.

Measurement policy

Have you set measurement policies for each KPI?

What are the shortages in the current measurement policy?

Task: Identify measurement policies.

Benchmarking

Have you set any standards for achievement in production process?

What is the idea behind setting any benchmark?

What are your internal benchmarks?

What are your external benchmarks?

Task: Identify internal and external benchmarks.

Result utilization

What type of measurement result you get?

Do you have any data base for recoding the results?

How you analyse the results?

Do you use any type of tools for analysis?

What you think how you utilize the results?

What you think result utilization is necessary?

Do you do improvements based on the results obtained?

What you think about continuous improvements and how you are working with it?

Task: Discuss improvements based on result utilization.

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