Essays on manufacturing-related management accounting

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“A good decision is based on knowledge and not on numbers.”

Plato (427-347 B.C.)
ABSTRACT
In general companies continuously have to improve their operations to be able to survive in the global competition. They have to be better in utilizing their resources today compared to what they were yesterday. The production systems have changed during the 20th century and factories today do not look like they did hundred years ago. Focus has moved from mass production towards flexibility. The changes in production philosophy have not been followed by a corresponding change in different supporting functions. Research shows that many companies still use accounting methods that have not been developed since the 1930s.

The purpose of this licentiate thesis is to provide perspectives on some aspects concerning the relationship between manufacturing operations management and management accounting. This will increase the knowledge and understanding of how management accounting information supports manufacturing decision making.

This thesis reports findings from four studies designed to investigate the informational relationship between management accounting and operations management in companies. Results from this research shows that there are many factors to consider when choosing and designing an appropriate management accounting system. Contextual factors include market, manufacturing strategy, technology, and organization. This thesis also reports on the difficulties of making theoretically sound methods work in practice.

This thesis contributes with some explanatory aspects on the practical problem and investigates some potential ways forward concerning manufacturing-related management accounting.

Keywords: operations management, performance measurement, decision making.
SAMMANFATTNING
Generellt måste företag ständigt förbättra sin verksamhet för att kunna överleva i den globala konkurrenser. De måste bli bättre på att utnyttja sina resurser i dag jämfört med vad de var igår. Produktionssystemen har förändrats under 1900-talet och fabriker i dag ser inte ut som de gjorde för hundra år sedan. Fokus har flyttats från massproduktion till flexibilitet. Förändringarna i produktionssfilosofi har inte följts av en motsvarande förändring i olika stödfunktioner. Forskning visar att många företag fortfarande använder redovisningsmetoder som inte har utvecklats sedan 1930-talet.

Syftet med denna licentiatavhandling är att ge perspektiv på vissa aspekter som rör förhållet mellan produktionsstyrning och ekonomistyrning. Detta kommer att öka kunskapen och förståelsen för hur information ur internredovisning stöder beslutsfattandet inom tillverkning.


Denna avhandling bidrar med några förklarande aspekter på det praktiska problemet och undersöker några potentiella vägar framåt för produktionsrelaterad internredovisning.

Nyckelord: verksamhetsstyrning, prestationsmätning, beslutsfattande.
Acknowledgement

I have been going through many phases while working with this thesis, and through it all, there have been many who have supported me on the way.

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Gothenburg, January 2013

Andreas Myrelid
Thesis

This publication, entitled *Essays on manufacturing-related management accounting*, is a Licentiate thesis in Production Economics, written at Linköping University. The thesis comprises an introduction and following appended papers. All papers have been presented at scientific conferences.

Appended papers

**Paper 1**

Manufacturing decision-making based on product costing and management accounting information – a critical review  
*Myrelid, A. and Olhager, J.*  
A previous version of this paper was presented at the 6th EIASM Conference in Performance Measurement and Management Control, 7-9 September, 2011, Nice, France

**Paper 2**

Applying lean accounting and throughput accounting in an advanced manufacturing technology company  
*Myrelid, A. and Olhager, J.*  
A previous version of this paper was presented at the 11th Manufacturing Accounting Research Conference, 13-15 June, 2012, Helsinki, Finland

**Paper 3**

Performance measurement system for inventory management – a case study  
*Myrelid, A. and Lidestam, H.*  
This paper was presented at the 4th Production and Operations Management World / 19th EurOMA Conference, 2-4 July, 2012, Amsterdam, The Netherlands

**Paper 4**

Managing change in performance measures: a case study on practice and challenges  
*Salloum, M. and Myrelid, A.*  
This paper was presented at the 4th Production and Operations Management World / 19th EurOMA Conference, 2-4 July, 2012, Amsterdam, The Netherlands
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Appended papers

Paper 1. Manufacturing decision-making based on product costing and management accounting information – a critical review

Paper 2. Applying lean accounting and throughput accounting in an advanced manufacturing technology company

Paper 3. Performance measurement system for inventory management – a case study

Paper 4. Managing change in performance measures: a case study on practice and challenges
Definitions

In this thesis we will use the following definitions of the key terms. These are further discussed in the frame of reference.

*Management accounting* is the part of the management process that is focused on adding value to organizations by attaining the effective use of resources in dynamic and competitive contexts (Sharman, 2003). Management accounting consists of both cost accounting and performance measurement. It contains all the information which is officially gathered to support the decision making in production. It is used for internal purposes and therefore different from financial accounting which is used for reporting for external stakeholders.

*Cost accounting* is the process of accumulating and accounting for the flows of costs in a business. It is defined as a technique or method for determining the cost of a project, process, or thing through direct measurement, arbitrary assignment, or systematic and rational allocation. The appropriate method of determining cost often depends on the circumstances that generate the need for information (Swamidass, 2000). This can be information such as material cost, production cost, product cost, investment calculations, and budget.

*Performance measurement* is the process of quantifying actions, where measurement is the process of quantification and performance is the result of action (Slack, 1997). These measurements show how well the production is performing in categories such as quality, delivery precision, service level, time per operation, set up time and so on.
1 Introduction
In companies with complex products and complex production systems it is hard to see economic consequences of activities made in production. In order to create a financially successful company there is a need to understand the economic consequences of decisions and actions in production. Consequently, there is a need for good transparency between the production and accounting/finance functions. The research project, of which this thesis is a part, is a cooperation between Linköping University in Sweden and GKN Aerospace Engine Systems. The research project started with Volvo Aero Corporation as a research partner but during the process the ownership of the company has changed to now be a part of GKN Aerospace and thus also the name has changed. Further on in this thesis the company will be referred to as GKN. The research project is concerned with the informational relationships between management accounting and operations management of manufacturing firms, particularly advanced manufacturing technology companies.

1.1 Practical background
As a result of the financial crisis in 2008 with the following downturn it became harder and more expensive for companies to get credit from banks and other investors. It then became more crucial for companies to use their own capital more efficiently. GKN is a company in the aviation and aerospace industry, which develops and manufactures advanced mechanical products. In cooperation with the world’s leading aviation and aerospace companies, GKN develops and manufactures components for aircraft engines as well as rocket engines. The aviation and aerospace engine industry is characterized by being capital intensive. When entering as a partner in new engine programs, companies pay high entry costs for research and development of new components and it is known that it will take several years to generate profit. Furthermore the aviation and aerospace industry requires expensive manufacturing equipment. Moreover, when production has started, it is usually with long lead times which also is a characteristic of the aviation and aerospace industry. This, in combination with costly input materials, results in high levels of tied up capital. High levels of tied up capital are expensive and prevent the capital to be used for other value-adding purposes. For those reasons, it is especially important for companies in e.g. the aviation and aerospace industry to reduce their tied up capital, one challenge that GKN has realized.

One way to reduce tied up capital is to negotiate more favourable contract models with customers and suppliers. By agreeing upon longer time to pay suppliers and shorter time to get paid from customers the time the company tie up capital can be reduced. Another way to reduce tied up capital is by reducing the lead time between incoming delivery and outgoing delivery. The lead time between incoming goods and outgoing products is something that the manufacturing can influence on its own. GKN has realized that there is a great potential in reducing the manufacturing lead time in order to release tied up capital.
The manufacturing lead time is to a high degree influenced by the decisions made in production. For managers in production, the lead time is however not their main concern. It is more likely that a manager will make a decision which will lower the department’s operational costs with the consequence to lengthen the production lead time. The opposite decision is then less likely to happen even though it might be the better decision on an aggregated level and in the end cost less for the company. One reason for this scenario is that the management accounting system and the production control system are not in harmony. An excellent management accounting system will not by itself guarantee success in today’s economy – ultimately, success depends on products that meet customers’ needs, on efficient production and distribution systems, and on effective marketing efforts. But an ineffective management accounting system can undermine superior product development, process improvement, and marketing efforts (Johnson and Kaplan, 1987). Consequently the problem is not specific for the case company but is a challenge for manufacturing companies in general.

For example product cost is linked both to the management accounting system and production control, and the way it is calculated today at GKN creates an unnecessary focus on cost per hour. Product cost is traditionally determined by the cost of materials, labour cost, material handling, facilities, management overhead and other additional costs. Some expenses can be directly linked to a certain type of product, while other indirect costs are distributed over the product range through some type of allocation factor. How this cost distributor looks like depends partly on the company’s overall strategy. In general, the way the product cost is calculated is linked to the kind of management accounting system that is used at the company. At GKN standard cost is used to calculate the product cost. In the budget process it is calculated how many hours that will be needed to produce what is forecasted for the upcoming year. In Table 1 below the effect on the cost of production depending of a higher and lower forecast is illustrated. As seen the calculated cost per unit is reduced when the forecast is high. If the forecast later is shown to be too optimistic, the cost will actually be higher than initially calculated. This will be reported as variances in the profit and loss report.

<table>
<thead>
<tr>
<th>Production = 1,000 units</th>
<th>Production = 1,300 units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calculation</td>
</tr>
<tr>
<td>Material</td>
<td>$ 500*1,000</td>
</tr>
<tr>
<td>Labour</td>
<td>$ 150*1,000</td>
</tr>
<tr>
<td>Overhead</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td></td>
</tr>
<tr>
<td>Cost per unit</td>
<td></td>
</tr>
</tbody>
</table>
The strategy and selected management accounting system affect the set of performance measurements that are used and also the decisions made by employees at different levels. At GKN today, the performance measurements used in manufacturing encourage higher utilization of the equipment, such as machines. By measuring the cost per working hour for a machine, the performance measurement triggers the use of more working hours to be able to divide the fixed costs by more working hours. As shown in Table 2, there can be a positive effect on the net income if production produces more than necessary. When more products are produced, the cost of goods sold will become lower when all the costs are divided among more products. Whether the products are sold or not does not matter in this kind of calculation. These performance measurements encourage a push system creating excess inventory of work in progress even though a pull system may be more beneficial. This leads to sub-optimization in manufacturing and unfavourable decisions, which for example includes creating unnecessary queues in manufacturing. This behaviour leads to inefficient use of manufacturing equipment with significant extensions of time to market. Except for reduced time to market, effective utilization of resources also enables reductions in product costs, increasing competitiveness and thereby access to new business opportunities. It is therefore important to study the effect of GKN’s management accounting system today, and how the company's strategy best can be taken into consideration in its management accounting system. A review of these incentives can also affect vital parts such as decision support for new business, make/buy-decisions, choice of production concept and estimations of profitability for products and equipment.

<table>
<thead>
<tr>
<th>Units produced</th>
<th>Production &gt; Sales</th>
<th>Production = Sales</th>
<th>Production &lt; Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units sold</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Revenue</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>Cost of goods sold</td>
<td>$5,000</td>
<td>$6,000</td>
<td>$7,000</td>
</tr>
<tr>
<td>Gross profit</td>
<td>$5,000</td>
<td>$4,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Operating expenses</td>
<td>$1,500</td>
<td>$1,500</td>
<td>$1,500</td>
</tr>
<tr>
<td>Net Income</td>
<td>$3,500</td>
<td>$2,500</td>
<td>$1,500</td>
</tr>
<tr>
<td>Inventory change</td>
<td>Up</td>
<td>No change</td>
<td>Down</td>
</tr>
</tbody>
</table>

GKN has in the last years started to implement some of the ideas from the lean philosophy in its manufacturing process. This, for the company, new philosophy and the application of new technologies has further increased the misalignment between the management accounting system and the production system. When a company develops, the performance measurements have to be adjusted to the new situation. The management accounting
system is considered to be insufficient and leading to sub-optimal decisions. Consequently, there is a need for a new systematic approach for linking management accounting systems with manufacturing decisions.

In general, management accounting is used within management teams as support in their decision making, in a large variety of situations. Atrill and McLaney (2009) list examples when management teams need supportive information to be able to make decision when it comes to:

- Development of new products and services
- Changes in price or volume for existing products and services
- Taking loans to finance the business
- Changes in capacity within operations
- Changes of methods in purchasing, production, or distribution

Atrill and McLaney (2009) also identify four areas within strategic decision making where management accounting information is needed for support:

- Planning and development of targets: Financial planning can be used for better evaluation of different strategies and gives support when choosing among several.
- Performance measurement and management control: Management accounting is used to measure performance and to control the operation.
- Allocation of resources: Management accounting can be used to allocate scarce resources in the most beneficial way.
- Weight costs versus income (or other strategic benefits): Calculations of cost can show if the company should produce a new product, offer a service, or shut down a department.

The calculations given to the decision makers must show both relevance and reliability. This means that the information has to be trust-worthy and relevant for the decision (Atrill and McLaney, 2009). Zimmerman (2003) lists a few characteristics that characterize “good” management accounting systems:

- Provide the information necessary to identify the most profitable products and the pricing and marketing strategies to achieve desired volume levels.
- Provide information to detect production inefficiencies to ensure that the proposed products and volumes are produced at minimum cost.
- When combined with the performance evaluation and reward systems, create incentives for managers to maximize firm value.
- Support the financial accounting and tax accounting reporting functions.
- Contribute more to firm value than it costs.
1.2 Theoretical background
This part will describe the theoretical background leading to the practical problem today. There will be an historical description how the development of management accounting has come to be what it is today.

Management accounting originated from the 19\textsuperscript{th} and 20\textsuperscript{th} century together with the industrial revolution. Systems to track costs became needed as decision support for the managers when the industries started to grow to become large scale and more complex to run (Johnson and Kaplan, 1987). The companies grow and come to be funded by external investors which lead to the development of traditional financial accounting systems to be the base for performance measurement in manufacturing (Swamidass, 2000). In 1987, Johnson and Kaplan wrote that more or less all the management accounting practices used at that time stopped their development in 1925. The manufacturing environment as well as the competitive environment has changed since then and the traditional way of managing the operations were not suitable in this new environment (Johnson and Kaplan, 1987; Swamidass, 2000). It seems to be like Johnson and Kaplan started a movement after the publication of their book in 1987. This seems to have been some kind of wakeup call. During the following 25 years up until today much has happened. New ways of doing things have been investigated and developed and the most mentioned methods will be further described separately in the next chapter.

Every day, in every operation in a manufacturing company, decisions have to be made regarding what to do and what not to do, i.e. what orders to start producing and which machines to use. These kinds of decisions should preferably be in line with, and support, the company’s general strategy. There are many systems supporting this decision making process, but one of the most crucial is the company’s internal management accounting system (Hutchinson, 2007). The management accountants, using the management accounting system including the performance measurement system, support manufacturing and influence the manufacturing decisions in order to align them with the company’s general strategy (Anthony, 1989; Sharman, 2003).

Early versions of management accounting systems have been used since the 18\textsuperscript{th} century and what today is considered to be the traditional one were basically developed as is today in the 1920s (Johnson and Kaplan, 1987). The traditional management accounting system was developed in a period in time dominated by the philosophy of scientific management (Taylor, 1911) and mass production. Companies and their production systems have developed since then and today flexibility and customer focus is more important than it was hundred years ago. Just consider the famous quote of Henry Ford, the founder of Ford Motor Company: “Any customer can have a car painted any colour that he wants so long as it is black” (Ford, 2007). Customers of the 21\textsuperscript{th} century would probably not be fully satisfied if that was still the case today.
Even though a management accounting system is supposed to assure that manufacturing work according to the company strategy, this has not been the reality in many companies. It has been known for many decades that management and production systems used in manufacturing have not developed in harmony. This misalignment is a reason for why unfavourable decisions are encouraged in manufacturing (Skinner, 1971; Kaplan, 1984a).

When reviewing publications regarding management accounting systems, it is obvious that the interest in the topic has grown in recent years. Already in 1992, Spicer meant there were two factors for the increased interest that has been seen both among practitioners and academia. One factor is the globalization, where increased competition and accelerated pace of technological change have led to new conditions in how to manage operations. The other factor is the research done by Robert Kaplan, presented in a series of publications during the 1980’s (Kaplan, 1983; Kaplan, 1984a; Kaplan, 1984b; Kaplan, 1986; Johnson and Kaplan, 1987). In this series, Kaplan presents three arguments for why there is a need to put more focus on management accounting systems:

1. Practitioners in management accounting have failed to keep pace with the changes in manufacturing and competition.
2. Researchers know little about how these changes affect in practice.
3. Commonly used economic theories are too limited and not suitable for the new environment.

In the 1980s, Kaplan realized the importance for companies to work with aligning their management accounting systems and production systems. Later, other researchers (e.g. Hughes and Paulson Gjerde, 2003; Grasso, 2005; Radnor and Barnes, 2007; Maskell et al., 2012) have confirmed that the problem still exists since management accounting systems still do not provide sufficient and relevant information to manage and control manufacturing according to the company strategy. One reason for this is that management accounting systems have been developed to support financial accounting, instead of for manufacturing decision making (Johnson and Kaplan, 1987). “There is no value to integrating the management accounts and the financial accounts. Each is serving a different purpose, and linking them is irrelevant. The management accounts should not be driven by the needs of the financial accounts. Instead, they should be driven by the needs of the manufacturing people and the customers” (Maskell, 2009, p. 86). Moreover, the data in management accounting systems is on a too aggregated level and compiled too late to be able to support manufacturing decision making (Johnson and Kaplan, 1987). Since this problem is still a reality, it is important for both practitioners and academia to understand how management accounting systems effect manufacturing decision making in the production systems and what kind of data and performance measurements that are appropriate to use.
1.3 The research project

The research project behind this thesis is funded half by the company GKN and half by the National Aviation Engineering Research Program (NFFP) which is a cooperation program with the Swedish Governmental Agency for Innovation Systems – Vinnova. The research project will investigate the considerations that need to be taken in order to link management accounting systems with production systems, to support manufacturing decision making. This investigation will increase the understanding of how different management accounting systems affect the decisions in manufacturing at GKN and other similar companies. Better understanding makes it possible to identify opposing elements and analyse so that future manufacturing decisions are not based on financial accounting information. This can be achieved by developing new performance measurement but also by developing new links between the management accounting system and the production system.

As stated earlier, one intention of this research is to increase the knowledge and understanding at GKN. Taking the position in the contingency theory which in operations management research claims that there is no best way to organize, manage, and make decisions in companies. Instead it is contingent (dependent) on the context in which the company operates (Sousa and Voss, 2008). The research presented in this thesis has to be valid both for GKN and other practitioners and for the academic society. The research project started out from a practical problem at the company with no good solution to be found in the theory. Instead, as shown in previous chapter, the problem has been well known among researchers the last two decades and there is an on-going discussion which this research will contribute to. While there is good understanding of the problems, there is not widespread understanding of the solutions (Maskell and Baggaley, 2006). The research project is not only interesting for practitioners. It is also well aligned to other international research within the interface of operations management and management accounting area (e.g. Durden et al., 1999; Mia, 2000; Gerdin, 2005; Fullerton and Wempe, 2009). It will thereby contribute to academia as well as to practice through the close cooperation with GKN.

This research is a cooperation between GKN and Linköping University with GKN as the base where the researcher has the position as an industrial PhD student. The research has mainly been taking place at GKN but there have also been additional activities at the division of Production Economics at the department of Management and Engineering at Linköping University. An industrial PhD student is a member of the organization he or she is studying which raises the issue of objectivity. Complete objectivity has been recognized as impossible in business research (Bryman and Bell, 2011). Lincoln and Guba (1985) suggest that the researcher should have as objective to establish conformability. This means that the researcher should show that he or she has not more than usually allowed personal values or theoretical preferences affect the research and the findings.
1.4 Thesis outline
This thesis consists of six chapters. This first chapter is the introduction to the thesis subject and the research project. The second chapter describes the scope of the study, the purpose leading to the research questions as well as the delimitations. Chapter 3 is the frame of reference where the literature and the concepts relevant for the research are presented. In the fourth chapter the applied research methodology is explained. Chapter 5 presents the appended papers and how they are connected with each other. The results presented in the papers as well as the results of this thesis are also presented in this chapter. The last chapter discusses how the research project will continue with further research as well as suggests other possible research.
2 The research area
This chapter will describe the scope and purpose with the research. This will lead to the research questions and also the delimitations for this research.

2.1 Research scope
The research area can be summarized as in Figure 1. Decisions are made in production regarding what and how to produce orders. The decision making is supported by the information in the management accounting system. The information, illustrated by arrows in the figure, flow into and out from the management accounting system. The information is initially compiled both from production/manufacturing and accounting/finance departments. From production, the information is mainly consisting of performance information while the information from the finance department primarily consists of cost accounting and product costing information. The upper arrows illustrates the information coming from finance into and out from management accounting system while the lower arrows illustrate the information coming from production. The researchers in this project are interested in the connection between the management accounting systems and Production/Manufacturing which is illustrated by the two bolder arrows in the figure. It is not possible to explain the misalignment between these without also mentioning that the management accounting system in general is closer connected to, and managed by the Accounting/Finance department which in the figure is illustrated by that it is shorter distance between these two. However the later connection is not in focus in this study and therefore the arrows is thinner and dashed.

The decision making in production is influenced from all possible kinds of input and not exclusively by the management accounting system. But in this research project it is the management accounting system and the information connected to it that is the object of interest to study; how it can influence the decisions made in production.
2.2 Purpose

The purpose of the research project is to improve the decision support for the control of production based on information from the management accounting system, with a particular focus on advanced technology products and manufacturing systems. It is assumed that improved decision support can improve the control of production, which then can lead to improved profitability. The purpose of this licentiate thesis is to provide perspectives on some aspects concerning the relationship between production and management accounting. More aspects and a synthesis will be added to the research for the doctoral thesis. Thus, the licentiate thesis does not fully cover all aspects.

2.3 Research questions

Different management accounting systems seem to be needed for different types of manufacturing systems. For a management accounting system to be utilized to its full potential to support the manufacturing decision making it needs to be used in the right context for which it has been developed. The more traditional accounting systems worked as support for decision making in more traditional manufacturing context. The management accounting system should therefore be designed to fit the organizational context. Two research questions can be formulated for the research of this thesis, related to Figure 1.

As illustrated in Figure 1 the management accounting system is considered to consist of two parts, the cost accounting system and the performance measurement system. The information from the cost accounting has immediate influence on the production. As with the management accounting system in general there are contextual factors to consider for the cost accounting system as well, leading to the first research question:

RQ1. What contextual factors need to be considered when designing a cost accounting system for organizations with advanced technology products and manufacturing systems?

Different management accounting systems can include different sets of information from the performance measurement systems. This is the way for accounting/finance to get feedback from production/manufacturing to compile and create new decision supporting information in the cost accounting system. As with the management accounting system in general there are contextual factors to consider for the performance measurement system as well, leading to the second research question:

RQ2. What contextual factors need to be considered when designing a performance measurement system for organizations with advanced technology products and manufacturing systems?

Figure 2 illustrates the different research questions that are addressed in this thesis and how they are related to the study object presented earlier.
2.4 Delimitations
This research is interested in the decision making in production in companies and thereby no considerations are taken to how different management accounting systems would affect other processes such as marketing or research and development functions within a company. The research presented in this thesis is limited to large multinational manufacturing units. The empirical data comes mainly from GKN Aerospace Engine Systems head quarter and the collocated manufacturing unit with about 2000 employees. One case study has been conducted at another multinational company within the automotive industry.
3 Frame of reference
This chapter presents the frame of reference upon which this thesis is founded. It is meant to present and give better understanding of the different management accounting systems and what kind of information they can provide in decision making processes.

3.1 Management accounting
Management accounting is an essential part of the operations management process and distinctly adds value by continuously looking into whether resources are used effectively and efficiently by organizations in creating value for the company and its customers.

There is no generally accepted definition what is really meant when talking about management accounting. In early research the term cost accounting was often used, coming from the central purpose of providing cost information for economic decision making (Chenhall and Smith, 2011). Chenhall (2003) describes management accounting system as the systematic use of management accounting, which includes practices such as budgeting or product costing, in order to achieve goals. The role of management accounting systems is for planning, resource allocation, decision making, acting, monitoring, and improving operations, essentially for supporting decisions and solving problems (Atkinson et al., 2012).

Atkinson et al. (2012) describe management accounting as the process of supplying the managers and employees in an organization with relevant information, both financial and non-financial, for making decisions, allocating resources, and monitoring, evaluating, and rewarding performance. Examples of financial management accounting information are the expense report of an operating department and cost of producing a product. Nonfinancial management accounting information can for example be process quality and timeliness, customer satisfaction and employee motivation (Atkinson et al., 2012).

Decisions are based both on financial measurements, which in this thesis is included in the cost accounting terminology, as well as on non-financial measurements, here found in the performance measurement system.

3.1.1 Management accounting versus financial accounting
Accounting systems take two forms, management accounting and financial accounting, and can be tightly linked through the use of standard costing common to both. However, the functions of these two forms of accounting are quite different: management accounting is focused on monitoring and analyzing the effect of management decisions, financial accounting is focused on short-term, external reporting (Fry et al., 1998).

Management accounting and financial accounting are often mixed up (Sharman, 2003). Financial accounting has an external purpose for external stakeholders and should not be used for internal decision making in the daily operations management. A company may do as much or as little management accounting as it wants (Maskell, 2009). Financial accounting has to be done by law and has to follow generally accepted accounting principles.
(GAAP) to be transparent enough and understandable for shareholders, authorities and others who might have an interest in the financial situation at the company. This means it involves compliance with common and standard rules and regulations established by external authorities, maintaining official records, preparing reports responding to questions defined by external bodies, and coordinating and responding to audits. Financial accounting also deals with managing financial transactions and valuations such as balance sheet valuation as well as processing cash interactions with suppliers, customers, tax, and other authorities (Sharman, 2003). They are similar in the way that they are both based on financial information and non-financial quantitative information about the operations (Atkinson et al., 2012). But as shown in Table 3 there are some important differences.

### Table 3. Financial accounting vs Management accounting (Source: Atkinson et al., 2012)

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Financial Accounting</th>
<th>Management Accounting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrospective</td>
<td>Summarizing the financial result of past decisions and transactions.</td>
<td>Both retrospective and prospective – Both providing feedback of past operations and help to plan for future events.</td>
</tr>
<tr>
<td>Role</td>
<td>Report to external stakeholders such as shareholders, investors, creditors, and tax authorities.</td>
<td>Help employees and managers internally in their decision making in how to run the operations.</td>
</tr>
<tr>
<td>Content</td>
<td>Has to follow external standards (GAAP) for how to be developed and presented.</td>
<td>No prescribed regulations. Can contain and be presented in any way found suitable for the purpose of manage the operations.</td>
</tr>
</tbody>
</table>

It is required by authorities for a company to do financial accounting while there is nothing saying that a company has to spend resources on doing management accounting at all. It is up to each and every one how they manage their operations, if at all. Other characteristics for financial accounting are that it looks at the business as a whole and is an end in itself, while management accounting also focuses on parts and is a means to the end, which is to support manufacturing decision making.

### 3.1.2 Cost accounting

Cost accounting is concerned with calculating costs for inventory valuation, product costing and to determine the cost of goods sold for the plant income statement for internal monthly or quarterly profit measurement requirements (Johnson and Kaplan, 1987; Drury, 2007).

There are different kinds of cost accounting methods. The purpose with traditional cost accounting and activity-based costing is to calculate the product cost. These methods are further described in chapters 3.2 - 3.4. Lean accounting and throughput accounting are
more focused on creating the cost of goods sold. The latter two methods are further described in chapters 3.5 and 3.6.

3.1.3 Performance measurement

The direction of which an organization is heading is influenced by the chosen performance measures. The attention is given to what is measured, sometimes on the cost of more important criteria that are not being measured (Swamidass, 2000).

Performance measurements can also be extended to be used as a system and can then be called to be a performance measurement system. There is therefore also a need to clarify what is meant when talking about this system. In a paper (Franco-Santos et al., 2007) with the purpose to open a debate of the definition of performance measurement system over 300 publications were studied and there were 17 different definitions of the term identified. According to Franco-Santos et al. (2007) the reason for not finding more than 17 definitions in that many publications is explained to be that most authors do not bother to define what they mean when writing about performance measurement system.

In the study Franco-Santos et al. (2007) describe a performance measurement system out of three characteristics; features, roles, and processes, and describe what is common in all the found definitions into these three characteristics.

When it comes to features there could be argued that there are only two necessary: “performance measures” and “supporting infrastructure”. While the first one can be seemed obvious to be needed, the dimension of what kind of measures to use and the balance between different dimensions are not as obvious. The supporting infrastructure can vary in its procedures from very simplistic manual recording of data to usage of very advanced information systems for managing data in different ways.

Franco-Santos et al. (2007) argue that although they found several roles for a performance measurement system the only role necessary is to “measure performance”. This role is so obvious that it is seldom mentioned when reading studies. Also the process of designing the performance measures is argued to have a role of adding value despite the utilization of them in later phases (Neely et al., 2000).

There are three processes argued to be necessary by Franco-Santos et al. (2007) even though they found twelve in their analysis. The ones they consider to be the necessary ones are: “measure design and selection”, “data capture”, and “information provision”. Without the process of selecting, capturing and distributing the results it is argued not to be a performance measurement system.

Franco-Santos et al. (2007) point out researchers have to bear in mind that by using greater number of features, roles, and process when specifying what to consider to be a performance measurement system, the more difficult it will be to distinguish from other
management processes. But already with the few specifications they mention it is included in what in this research is considered to be part of a management accounting system.

3.2 Traditional costing systems
Traditional costing systems are widely used by about 75% of manufacturing companies but only appropriate for some specific manufacturing environments (Fry et al., 1998). Traditional costing systems are often used where there are standardized processes, limited number of products which are similar, and direct costs are high (Kaplan, 1983; Fry et al., 1998). Earlier in the 20th century the total production cost consisted of 70-80% of direct costs such as labour and material (Seed, 1984; Turk, 1990; Friedl et al., 2005). Then it seemed logical for the management to use direct labour as their allocation key by which to allocate other overhead. Logical or not, misapplication did not really matter since overhead was such a negligible part of the total production cost (Ruhl and Bailey, 1994). Today most manufacturing companies consist of a totally different cost structure compared to when traditional costing systems developed. Overhead cost today is often the single largest part of the total cost. It is to a large extent driven by large investments in advanced manufacturing technologies, more of indirect activities such as planning, quality control, maintenance and research and development. The development to a more modern and advanced production has led to that the overhead is no longer proportional to production volume. Practices used in traditional costing systems use incentives for overproduction since managers feel a need to maximize standard labour hours to spread out the overhead (Hutchinson, 2007). Due to the allocation of the overhead by direct labour it influences managers to focus on the direct labour variances to control the allocation of overhead to the products, not control of the direct labour costs (Fry et al., 1998).

3.2.1 Absorption costing
In the more traditional cost accounting developed during the early 20th century the costs of direct material, direct labour and overhead are allocated and “absorbed” by the products according to some allocation keys assigned by the management. Direct material and direct labour are rather easy to allocate to the products but the overhead is divided and allocated by using some kind of key. Typically this allocation key can be based on something known as direct labour hours or direct machine hours. By using this way of cost absorption on products all costs in the company can be allocated to products and paid for by the customers (Andersson, 2008; Atrill and McLaney, 2009). Figure 3 illustrates how manufacturing overhead is allocated to products.
3.2.2 Variable costing

It is also possible to consider the variable cost separately from the fixed cost and then the method is called variable costing where the contribution margin is of interest instead of complete product cost. In variable costing, in contrast to absorption costing, the cost of manufacturing is divided into fixed costs, which are independent of the volume manufactured, and variable costs, which are dependent on the volume manufactured. Figure 4 illustrates how the variable factory cost ends up in what is called the variable cost of goods sold. Fixed factory cost together with selling cost and administration is included in the period cost and not allocated to any product. These costs then have to be covered by the margin between the cost of goods sold and the income from selling them in order to a financial sound operation.

3.3 Grenzplankostenrechnung

While the earlier traditional cost accounting mentioned in the literature developed mainly in American companies the German speaking part of the world developed and used what they were going to call Grenzplankostenrechnung which in Anglo-Saxon literature often is translated to flexible standard costing, flexible margin costing or even marginal planned cost, (Sharman, 2003; Friedl et al., 2005; Smith, 2005). Friedl et al. (2005) describe how grenzplankostenrechnung was developed during the 1950s and 1960s by Plaut and Kilger,
one practitioner and one researcher, who focused on creating a cost accounting system to support the decision making. Companies that use grenzplankostenrechnung make a significant effort to identify cost behaviour, traceability, relevance to decision making, and cost period measurement (Smith, 2005).

Friedl et al. (2005) describe grenzplankostenrechnung as consisting of four important elements; cost-type accounting, cost centre accounting, product cost accounting, and contribution margin accounting. They describe the differences compared to traditional accounting as more about short-term decision support instead of long-term, marginal costing instead of full costing, and cost centres instead of activities and processes. To avoid what is described as incorrect short-term decisions regarding products and production grenzplankostenrechnung is not allocating fixed costs to products unless for mid- and long-term purposes (Friedl et al., 2005).

Krumwiede and Suessmair (2008) claim it is hard to really give a working definition of what really is to be considered grenzplankostenrechnung since each application is different. But by consolidating earlier literature (Sharman, 2003; Friedl et al., 2005; Krumwiede, 2005) they are presenting a list of common practices in grenzplankostenrechnung:

- Using contribution accounting
- Analyzing variances by cost centre
- Using planned (standard) costs for most costing purposes
- Analyzing the consumption (total demand) for each cost centre
- Having at least one output measure for each cost centre
- Separating fixed and proportional costs for each cost centre
- Assigning indirect costs based on many cost centres and a network of cost assignments
- Transferring costs from support cost centres to primary cost centres while maintaining distinction between fixed and proportional costs
- Identifying and computing the cost of idle capacity
Grenzplankostenrechnung uses two types of cost centers, primary cost centers and final cost centers which are illustrated in Figure 5. The primary cost centers cover activities further away from the manufacturing process compared to the final cost centers. Primary cost centers can be for example production management which cannot be directly related to any product. Final cost centers are more closely connected to the manufacturing process. The variable costs from the primary cost centers are assigned to the final cost centers. The variable costs from the final cost centers are then assigned to products to calculate product cost. Grenzplankostenrechnung applies the marginal costing principle and only allocates variable costs to products (Friedl et al., 2005).

Grenzplankostenrechnung cost center criteria lead to systems with a vast number of cost centers—400 to 2,000 cost centers in a typical system. There are even descriptions of companies with over 40,000 cost centers. Setup costs, identifying cost centers, classifying costs, are substantial in this kind of system (Grasso, 2005).

### 3.4 Activity-based costing

Grenzplankostenrechnung is about marginal costing, resource centers, and short-term decision support. Another method structured in a similar way but with focus on full costing, activities and process, and long-term is activity-based costing (ABC) (Friedl et al., 2005). ABC was one of the first new methods developed and suggested to replace old-fashioned traditional costing systems. Higher ratio of manufacturing overhead created needs of something that better could reflect the cost structure. This led to the introduction of ABC by Cooper and Kaplan (1988). Both practitioners and researchers became interested in the new
suggested method rather fast. According to ABC all activities in an organization exist to support manufacturing and distribution of goods and services. The resources classified as manufacturing overhead are consumed by the activities and the products then consume the activities as seen in Figure 6. Example of an activity can be purchasing or sales. Some products might be more complex with more components than others and need more resources in one or the other activity. This adds an extra step for allocating and distributing costs to products compared to traditional costing system. The extra step creates the possibility to use more specific and individual cost drivers instead of one single and generic cost driver. In the new manufacturing paradigm the single and generic cost driver often also is irrelevant, such as direct labour or machine hours. Many have the opinion that ABC is superior to traditional costing systems because the more truthful and consistent method to calculate the costs for manufacturing the products (Andrade et al., 1999). The outcome of this more detailed method is a more accurate cost calculation which might better show the driving costs in manufacturing (Kee and Schmidt, 2000).

ABC as concept does not differ radically from traditional costing system and is easy to understand and appear to be logical. Many organizations introducing ABC during the years have been considered to failed in their implementation (Argyris and Kaplan, 1994; Kaplan and Anderson, 2007) The ability to fully, or at least to large extent, allocate overhead costs accurately remains a big issue when implementing ABC in an organization. As with grenzplankostenrechnung, there is a large effort needed to identify and construct the model of all the individual cost-driving activities found in manufacturing and supporting functions. In theory ABC seems to be a good way to manage a company’s resources but in practice it has been shown that the implementation is too time consuming and expensive considering what the organization get out of the process of doing it.

![Figure 6. Activity-based costing](image-url)
3.5 Lean accounting

These days many companies can be considered to be in what could be called a “lean transformation” where a more modern production philosophy is implemented. This philosophy is initially based on the Toyota Production System (TPS) (Liker, 2004), but was introduced as lean production by Krafcik (1988) and become well-known when his colleagues released the book *The Machine that Changed the World* (Womack et al., 1990). Stenzel (2007) writes “Anyone involved in a lean transformation inevitably bumps up against the vagaries of the accounting systems that reward overproduction and waste and seem to punish true improvement.” As an answer of the development in the production what has come to be called lean accounting has developed since the early 1990s (Maskell et al., 2012). In lean production there is much focus on flow in the physical operations and the new system must reflect this (Huntzinger, 2007). Åhlström and Karlsson (1996) describe how a company in lean transformation changed their management accounting system and the first thing to change was the productivity measure to include also the ratio of indirect tasks. This measure was seen as the most important one and it was important to know it measured the right things. This is just one example of how a company had to adapt their management accounting system.

Maskell and Baggaley (2006) present a list to companies implementing lean containing problems in traditional costing systems that could be avoided by implementing lean accounting.

- The processes are large, complex, and wasteful and require huge amounts of non-value work.
- Provide measurements and reports like labour efficiency and overhead absorption that motivate large batch production and high inventory levels.
- The financial impacts of lean improvements are not identified. On the contrary it can show bad things when very good lean changes are being made.
- The reports from the accounting system are used to make important decision but very few people really understand them.
- Standard product costs are used and they are misleading for many kinds of decisions where this is used.

There are almost as many definitions what is really lean accounting as there are researchers in the area. Maskell and Baggaley (2006) have tried to briefly describe what has been developed within the subject up until that time. They list five principles upon which lean accounting are consisting: lean and simple business accounting, accounting processes that support lean transformation, clear and timely communication of information, planning from a lean perspective, and strengthen internal accounting control. Each principle will be further explained below.
The first principle, lean and simple business accounting means that the management accounting process in itself also has to be lean just as the manufacturing process it is supposed to support. The accounting process has to be free from non-value adding processes. The unnecessary work has to be minimized and tools applied in lean manufacturing can also be applied in the management accounting process to continuously reduce the waste. To use terminology related to lean this means to eliminate waste from transaction processes, reports, and accounting methods in the entire company. Tools to be used for this can be value stream mapping, continuous improvements (kaizen), and the Plan-Do-Check-Act (PDCA) problem-solving approach.

Lean accounting is supposed to support lean manufacturing companies in their operations management. The accounting process has to support the lean transformation in the company. This means helping the other processes in the company in their work with lean. The information in the reports and the methods to present them in lean accounting should give energy and directions in what to do. Lean manufacturing is about creating value stream flow and focus on value for the customer. Lean accounting will reflect the overall value stream flow and not individual products or processes. Lean accounting supports the customer orientation by measuring and creating understanding the value created for the customers and uses the information for improvements in customer related issues.

The third principle mentioned by Maskell and Baggaley (2006) is that lean accounting provides reports which are easy to read and understand for everyone at the company. There is no reason to use a terminology only understood by accountants themselves and the information is presented in a way not more complicated that a household budget. This will change the questions from “What does this mean?” to, “What should we do?”. Both financial and non-financial information has to be visualized.

Important in lean accounting is also to plan from a lean perspective. There are different kinds of plans to do and lean accounting information supports these planning processes. There is the long term strategy planning which often is done annually from top executive management down to first line management and their value streams. In each step there is a discussion between a manager and the subordinates resulting in an agreement of achievable goals. For short- and medium term planning in sales and operations planning (SOP) lean accounting also provides valuable information.

In the lean philosophy is it not the goal to maximize profit through full utilization of capacity but to maximize the flow through the value stream (Maynard, 2008). In Figure 7 two separate value streams are illustrated with totally separated resources making it easy to distinguish the cost for each value stream. Each product is produced in separate value streams with no or few charged resources. It is preferred to have several similar resources, one for each value stream, instead of one larger resource capable of serving several value streams. In this way it is easy to calculate costs for the value streams when allocation of common resources is necessary.
3.6 Throughput accounting

In the 1980s Goldratt introduced Optimized Production Technology (OPT) which later developed and became known as Theory of Constraints (TOC) (Corbett, 1998). The concept was introduced in the book The Goal (Goldratt and Cox, 1984).

Albright and Lam (2006) describe TOC as a production-flow management system developed by Goldratt and Cox. The logic behind TOC is that there is at least one constraint in a company hindering it from better performance relative its goal. Examples of constraints could be market, resources, or policies. TOC is intended to help the company approach, identify, and address these constraints and help the management to make better decisions in line with the company overall goal (Goldratt, 1990).

Throughput accounting is a management accounting system which has been developed to be as fair as possible for companies working with TOC. Throughput accounting was first mentioned in print 1988 by a colleague of Goldratt named Waldron who together with Galloway wrote a series of four articles introducing throughput accounting (Hutchinson, 2007). Probably the top executive team of a company has the target to raise the profit as their idea when utilizing TOC and focus on the constraints which in a manufacturing environment often is the so called bottlenecks. The bottleneck is the constraining resource which is setting the limit for how much it is possible to produce during a specific time unit e.g. minute, hour, day, or week. The bottleneck is seen as the weak link in the chain and only by strengthens this link will the chain become stronger. By using TOC the bottleneck is identified in a system and thereafter structure the organization around this. Throughput accounting also intend to show results which are easy to understand and are possible to use in many different kind of decisions (Bragg, 2007).

According to TOC an organization has to decide what the main goal is and then create a system which clearly defines the main constraint hindering the organization from maximizing this goal (Bragg, 2007). Goldratt describes how this is done through three operational concepts (Albright and Lam, 2006):
- **Drum**: The drum is the element in the organization which is the constraint for maximizing the goal.
- **Buffer**: The drum has to be able to work without any stop and problems upstream cannot be allowed to interfere with the drum and therefore there is a need of a buffer in front of the drum.
- **Rope**: There is an imaginary rope which links the drum with upstream operations to secure that the raw material will reach the drum in time. The length of the rope is the time it takes for the material to reach the drum.

To be able to make any conclusions from TOC it is not enough with the three operational concepts above. Therefore Bragg (2007) also explains the need for definition of some financial terms, which is the foundation for throughput accounting:

- **Throughput**: The contribution margin of a product when the totally variable costs are reduced from the price.
- **Totally variable expenses**: The cost for producing a product. Only costs directly connected to the product are considered. In general this includes only material costs. That is, no overhead costs are allocated.
- **Operating expenses**: The total cost of the company excluding the costs included in totally variable costs. In general this is all costs which exist independently of if there is any production going on for the moment.
- **Investments**: The capital which is added to the system to increase its capacity. Special emphasis is put on the working capital (inventory). Not including capital put into overhead or labour.
- **Net profit**: Throughput minus operating expenses.

Throughput accounting focuses on three main elements: throughput, operating expenses and investments. Out of these three, throughput is the most important one since the goal is to create a high throughput. This is not the top priority in the same way in other accounting methods where profit margin is used instead. The result of using throughput accounting is a broad product mix when only products with costs of raw material higher than the income are excluded. In throughput accounting the analysis is made much easier since fixed costs and semi-fixed costs are gathered in what is called operating expenses. Only a few formulas are needed which are presented below:

- Throughput = Revenue – Totally variable expenses
- Net profit = Throughput – Operating expenses
- Return on investment = Net profit / Investment

“A key concept of throughput accounting is the use of profitability analysis at the system level instead of gross margin analysis at the product level” (Bragg, 2007, p. 9)
When proposals about changes in revenue, expenses or investment are about to be evaluated three questions should be answered:

- Will it increase throughput?
- Will it reduce operating expenses?
- Will it improve return on investment?

If the answer is yes to any of these questions the proposal should be implemented. Most important is it to increase throughput since there is no upper limit for how much an organization can produce. A reduction of operating expenses should get lowest priority since it is only possible to reduce these to a certain extent. There is a risk when reducing the operating expenses that the capacity for the entire system will go down and thereby also reduce throughput (Bragg, 2007). By considering operating expenses as fixed costs it is possible to avoid overhead costs to be allocated to the products. Sometimes overhead allocations lead to misleading calculations which are hard to understand. Throughput accounting only measures performance in a few specific operations in the system which makes it easier to see the effect of different decisions on the entire system. In Figure 8 a product value stream is illustrated with 4 separate resources. Resource 2 is the bottleneck in this value stream and in throughput accounting it would be the point of interest to measure and to improve in order to get higher throughput. The other resources are not of equal interest since improvements on those would not contribute to higher throughput.

It is not considered valuable within throughput accounting to track down and allocate costs to the products. This means that there is no product cost calculations.

![Figure 8. Illustration of throughput accounting with bottleneck as the constraining resource](image)

### 3.7 Comparison between methods

All the different methods have their advantages and disadvantages and are more or less suitable for different companies depending on the context in which they operate. Table 4 summarizes the key characteristics. The first four are product costing methods while the two latter are accounting methods. Still all methods are concerned with manufacturing costs.
The more traditional methods, absorption costing and variable costing, might be easier to use but less accurate and sometimes even harmful to the business by generating information supporting wrong decisions. Grenzplankostenrechnung and ABC have their advantages in using a more structured way of allocating costs. But instead the work to setup the methods, keeping the structure up-to-date, and classifying costs can be demanding and using many resources. Lean accounting supports the modern production philosophy and is created to be easy to use and to give better information for manufacturing decision making. But to be really useful the organization has to be organized according to the lean philosophy with clear product value streams with no or few common resources. For a company considering using throughput accounting it is also of importance to have a clear view of the flow and also the constraints in the organization.

<table>
<thead>
<tr>
<th>Method</th>
<th>Key characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption costing</td>
<td>Overhead allocation</td>
</tr>
<tr>
<td>Variable costing</td>
<td>Contribution margin</td>
</tr>
<tr>
<td>Grenzplankostenrechnung</td>
<td>Marginal costing with focus on resources</td>
</tr>
<tr>
<td>Activity based costing</td>
<td>Full costing with focus on activities</td>
</tr>
<tr>
<td>Lean accounting</td>
<td>Value streams</td>
</tr>
<tr>
<td>Throughput accounting</td>
<td>Constraining resources</td>
</tr>
</tbody>
</table>

GKN is in this sense a regular company which, as the majority of companies, uses a traditional costing system with its absorption costing. Influences of ABC can be seen which can be the result of an earlier intention to change to this method. One mission with this research project is to look into these different methods to decide how they can contribute to the organization.
4 Methodology

In this chapter the applied methodology of the research presented as well as the research process in general. It is also in this chapter the discussion regarding the validity and the reliability of the research results will take place.

4.1 Research process

The research process for the licentiate thesis consisted of a literature review followed by three case studies as seen in Figure 9. GKN realized the misalignment between the manufacturing decisions made and the overall strategy of the company. One reason for this misalignment was found in the management accounting system and the decisions it encouraged manufacturing to make. To really find the root cause for this misalignment in this research project it has been essential to have a deep understanding of the company context and conditions regarding organization, culture, and processes. This to be able to find out what the key issue at this company is and what can be done to solve the problem. In order to reach this understanding the researcher has spent most of the time situated at the company.

4.2 Literature review

First in the research process, seen in Figure 9, was to perform the literature review on management accounting and product costing and their relationship to manufacturing decision making. The purpose of literature review was to create an understanding of cutting-edge research and provide the necessary basic knowledge in relevant theory for the research field.

To be able to perform research within a subject it is necessary to be informed of the existing knowledge within that area and by that also identify what will be the contribution of the research (Rowley and Slack, 2004). A literature review summarizes a topic and is used to identify and develop sharp and profound research questions (Yin, 2009). By performing a literature review there will be an increased understanding of the concepts and terminology
used. It will also facilitate the building of a useful bibliography as well as being input regarding useful methods and how to analyze the results (Rowley and Slack, 2004).

Rowley and Slack (2004) describe how the process of creating a literature review involves a few stages. It starts with the scanning of literature found in different places such as library catalogues, search engines to find useful web pages, and on-line databases to get access to journals and scientific articles. This stage will give some insights in key themes. Next thing is to make notes and highlight what is thought to be of more interest. This will be followed by structuring the literature review and organize it to specific key themes. This ends up in the last stage which to write the literature review. In parallel to the four stages as an always ongoing process is the building of the bibliography. This is done throughout the entire process.

4.3 Case studies
Data collection for this project has mainly been done through three focused case studies.

There was also a further problem description with mapping and analysis of the problem at the GKN to deeper understand the scope and impact, which resulted in a clearer description of the current research problem which were used as a foundation for further work. To complement the studies at the GKN a case study at another company also was carried out. The intention with this was to gain bigger understanding of the problem and to create a reference case to compare with.

As a methodology case research can be used in a number of different research areas such as psychology, economics, and management (Yin, 2009). In the field of operations management case research has been addressed as one of the most powerful methods (Voss, 2009).

Mainly qualitative research methods have been used for data collection. By participating in meetings and interact with the people in the organization an understanding and explanation for why things are done as they are has been built up.

To gain better understanding in the processes the researcher has participated in education and meetings with topics such as budgeting and controlling held by the finance/accounting department for production managers. The researcher has also been a member in projects teams with different purposes in improving manufacturing.

Besides the immediate participation in the work at GKN there have also been some focused activities such as case studies to gain deeper understanding in some areas. These activities have ended up in written papers which will be presented in the following chapter. Initially there was a need to review the literature to understand the current position in the body of knowledge. This was followed by a study were two different management accounting systems were applied on the company to be able to get an understanding of their advantages and disadvantages compared to the existing one. Two case studies with more on
the performance measurements were also carried out, one at GKN concerning the design of the entire performance measurement system, and one at another company focusing only at the performance measurement related to inventory management.

Research quality can be discussed in terms of reliability and validity. Yin (2009) describes four tests suitable for case studies; construct validity, internal validity, external validity, and reliability.

**Construct validity** concerns using correct operational measures on the phenomena being studied (Stuart et al., 2002). In the case studies in this research multiple sources of evidence have been used in forms of several people being interviewed to create redundancy of information. The planned semi-structured interviews have been recorded to decrease the risk of missing important information. Besides the interviews archived documents and data have been as sources for information. The key persons have been given the possibility to read transcripts of their interviews and there has been continuous communication to minimize misinterpretations. These procedures should lead to construct validity according to Yin (2009).

**Internal validity** is mainly a concern for explanatory studies seeking to establish a causal relationship and focuses on that the studied relationship can be explained by the studied factors and not by other, unknown factors (Yin, 2009). The causal relationships have been found through explanation-building and pattern matching where empirically based patterns have been compared to predicted ones.

**External validity** concerns whether the findings in the study can be generalized in other cases. This study is designed to fit the context of GKN considering the contingency theory (Sousa and Voss, 2008) holds that organizations adapt to their contextual factors. The findings in this study can be of interest and generalized to other organizations within the same context as the case company.

**The reliability** of the research is concerned with if other researcher would get the same result if they repeat the study. Other researchers can look at research notes, documented data, transcriptions, and recordings of the semi-structured interviews to get most of the information used in this research. In case of repeating the study from the beginning with new collection of data, the result might differ to some extent due to the fact that the research partly consisted of human interaction which is hard to copy.
5 Summary of papers and thesis contribution

There are four papers appended to this thesis and in this chapter there will be a brief summary of them. In the end of the chapter there is a description of how the four papers are related. Figure 10 below illustrates how the research questions are in focus in the different studies and in which paper it is possible to read about which study.

As seen in Figure 10, both research questions are addressed in two studies each. The literature review and case study A are looking into issues connected to research question 1 and the results of the studies can be found in Paper 1 and Paper 2. These two studies are concerned with comparisons between different management accounting methods and the contextual factors in which they are operating. Both case study B and case study C are focused on research question 2. These studies treat the performance measurement system but from different perspectives. Case study B focuses on the design and management of the performance measurement system as such while case study C is more into specific performance indicators and studies the effect of their usage.

5.1 Paper 1

*Manufacturing decision-making based on product costing and management accounting information – a critical review*

The research project started by doing a review of existing literature within the research area to get a better understanding of what was the status of already existing research. When searching for literature it was decided to have the year of 1987 as the limit of how far back to go. This due to that the book *Relevance lost* (Johnson and Kaplan) was published this year and basically started the era of questioning the old way of management which initiated many new ways of thinking. The literature review resulted in this, the first, paper where a classification scheme of the literature is presented and discussed. The publications were classified in one of three categories; factors to consider, description of a single management accounting system, and comparisons between different management accounting systems. Based on this review, a conceptual model is proposed for the relationships among
contextual factors, the choice and design of management accounting systems and performance. Finally, we identify some research areas for further consideration.

Both authors contributed equally to this paper in all stages: literature search, paper analysis, and classification. The writing of the paper was a joint effort.

5.2 Paper 2

Applying lean accounting and throughput accounting in an advanced manufacturing technology company

From the initial literature review and the insight from the company a study was initialized and carried out to look deeper into and compare lean accounting and throughput accounting. In recent years, lean accounting and throughput accounting have emerged as viable options for management accounting in manufacturing firms, replacing traditional accounting systems and activity-based costing (ABC) systems. In this paper the applications of lean accounting and throughput accounting to GKN are analyzed, as potential systems replacing the existing system. It was found that neither of the two systems can fully replace the current accounting system, but both lean and throughput accounting can offer some advantages and can be more viable in the future. Since the company is currently incorporating some lean initiatives, lean accounting can become more relevant in the future. Also, since bottleneck management is becoming more important for the company, throughput accounting can become relevant in the near future.

The idea of this study came from the findings in paper 1 where a similar comparison was found to be missing. Both authors contributed with the theoretical part. Myrelid collected the empirical data. The writing of the paper was a joint effort.

5.3 Paper 3

Performance measurement system for inventory management – a case study

This paper presents a case study about performance measurement in inventory management executed at a component manufacturing company within the automotive industry with sites all over the world. The objective is to study how a company structure their performance measurements related to inventory management. It is shown that the company uses the performance measurements proposed in the literature but not in the right way. At the case company it is seen that the different functions and different sites have variances of the measurements making it less useful for both comparison and aggregation.

Myrelid collected the empirical data, and did most of the writing of the paper. Lidestam took part in discussion about the content of the paper as well as how to structure the paper.
5.4 Paper 4

Managing change in performance measures: a case study on practice and challenges

The purpose of this paper is to outline how GKN works to incorporate the overall strategy through the entire organisation and how the strategy also can be seen in the design of the performance measurement system. Compared to paper 3 presented above, this paper has a wider view and looks into the performance measurements system overall design. The empirics presented have been collected through a case study. The findings display that the organisation deploys two processes for developing the performance measurement system. There is one top-down approach with the starting point in the business plan and another more bottom-up approach within an operational development program. Several challenges are highlighted relating to the IT-system, culture and involvement. The paper concludes that even though the processes are theoretically sound, the scarcity of time and focus in practice derail their purposes.

Salloum had done a similar study earlier in another company, and with some addition to his original setup there was cooperation among the authors ending up in this paper. Salloum contributed with much of the theoretical framework reused from earlier work while Myrelid arranged the collection of empirical data from the company. The analysis was carried out together, and the writing of the paper was a joint effort.

5.5 Thesis contribution

This thesis is a summary halfway through a research project with the final intention to create a framework for how to choose a suitable management accounting system to be able to support manufacturing in making decisions in line with the company strategy. The papers presented above all look into pieces of the research area, addressing the two research questions.

RQ1. What contextual factors need to be considered when designing a cost accounting system for organizations with advanced technology products and manufacturing systems?

As shown in paper 1 and 2 there is a lot to consider when choosing which management accounting system to apply in a company. Paper 1 brings up some contextual factors, such as market, manufacturing strategy, technology, and organization. Paper 2 contributes with a comparison of lean accounting and throughput accounting where they are applied in a real manufacturing company. It is shown that neither lean accounting nor throughput accounting can be fully applied due to the existing context. Both lean accounting and throughput accounting have elements that can be useful and provide useful information for decision making in manufacturing in the case company. Although the results may be limited to the case company, companies with similar products and manufacturing systems may experience similar problems. A traditional accounting system is not automatically wrong, but it is not automatically correct either just because it has been working for the last
decades. The structure of the company as well as the production philosophy is most likely not the same as it used to be. Using a management accounting system from an old era can cause more damage than it does good.

RQ2. What contextual factors need to be considered when designing a performance measurement system for organizations with advanced technology products and manufacturing systems?

Two separate case studies, presented in paper 3 and paper 4, show that what seems to be theoretically sound may well have limitations when applied in practice. Paper 3 brings up and describes how unclear definitions of performance measures cause problems. Paper 4 explains how 2 processes to design a performance measurement system can be well thought through in theory but hard to apply in practice. This shows that it is not strange that the problem with misalignment between production and management accounting systems still exists. After more than 20 years where both practitioners and academia have spent resources into the problem and suggesting development of existing management accounting systems as well as to introduce new management accounting systems the problem is not solved. This shows that the problem might not be in the theories themselves, but among practitioners not implementing and using them as initially intended by the researchers developing them.

This thesis has some implications for practice. It shows that market, manufacturing strategy, technology, and organization aspects should be taken into account when selecting and designing a management accounting system. Lean accounting and throughput accounting adds some perspectives concerning value streams and bottlenecks. The thesis also shows that there might be appropriate performance measurements used, but lack of standardization regarding definition and phrasing can cause disinformation in the decision-making process. The IT system, employee involvement, and the culture have to be considered when designing a performance measurement system. While this thesis does not provide the full view on how to link management accounting and manufacturing decision making, it provides some explanatory aspects on the practical problem and investigates some potential ways forward.
6 Ideas for further research

This thesis is just a step on the way in a longer research project aiming to improve links between manufacturing and the management accounting system in order to get manufacturing decisions to be more in line with the company strategy. It is not possible to claim that this thesis will contribute with the solution but only with pieces. There has to be a holistic view and understanding in the research project and this thesis is one step towards this.

The aim of the entire research project is to develop models and methods for analyzing and integrating manufacturing decisions and the management accounting system. It is also expected that new performance measurements for manufacturing are developed and implemented. This implementation is expected to lead to significant reductions in tied up capital and in general better performance in the manufacturing.

Outside this research project there is a need for more research regarding different contextual factors mentioned in paper 1. There is room for research that combines several of the factors, explores their interrelationships and evaluates their relative impacts as well as compares different kinds of management accounting systems with different contextual factors.
References


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