# The Future of ABC at Sandvik Tooling

\- Incorporating ABC with information systems in order to drive business development from a cost point of view

Jenny Andersson
Camilla Salomonsson

Department of Automatic Control
Lund Institute of Technology
Box 118
SE-221 00 Lund
Sweden

Department of Business Administration
Lund University School of Economics and Management
PO-Box 7080
SE-220 07 Lund
Sweden

# Abstract

**Title:** The Future of ABC at Sandvik Tooling – Incorporating ABC with information systems in order to drive business development from a cost point of view.

**Authors:** Jenny Andersson and Camilla Salomonsson.

**Supervisor:** Charlotta Johnsson – Department of Automatic Control, Lund University.

Carl-Henric Nilsson – Department of Business Administration, Lund University.

Mats Jacobsson – Tooling Supply Finance, Sandvik Tooling.

**Core Issue:** Many companies have not been successful with their implementation of the ABC model. The number of companies using the ABC model for allocating overhead cost is still low. Companies who once used the ABC model have abandoned it. The ABC model has also been accused of not capturing the complexity within a company, causing information system, and other information systems such as Excel, to exceed their capacity.

**Purpose:** The purpose of this thesis is to examine how a company based ABC model corresponds with the theoretical model, in order to give feedback to theory from a practical case and vice versa. The relationship between ABC models and information systems will also be evaluated in order to find means to optimize the link between them. Points for evaluating information systems from an ABC point of view will be presented.

**Methodology:** An abductive approach and a qualitative method have been used for this study. Information has mainly been gathered through interviews in order to build the empirical chapter. Secondary sources such as academic articles have been used for the theoretical framework.

**Conclusions:** A conclusion we have drawn is that complexity is a villain when it comes to designing ABC models and the relating information systems. The compatibility of Sandvik Tooling's information systems in terms of ABC is deemed as inadequate. We recommend the development of an ABC module to the existing information systems. In order to make it possible to develop/design and implement system supporting ABC, standardization of the terminology, as well as parts of the calculation making up the standard cost, is necessary.

**Keywords:** Activity Based Costing, ABC, Cost Allocation Process, Overhead Cost, Sandvik Tooling, Information System, Transactions.

# Acknowledgements

# Table of Contents

# 1  Introduction

*This chapter presents an introduction to the chosen subject for the thesis, as well as the core issues. At the end of the chapter the purpose and the demarcation will be presented.*

## 1.1  Background

Due to technological change, global competition, and system development the demand for cost systems has changed. Even so, the overall goal of businesses is to meet customer needs in a profitable manner and at the same time, deliver the highest attainable level of quality. In order to conduct business, a company needs information regarding:[1]

- What factors matter to customers
- True costs of services or products
- Possible improvements
- Action taken in order to achieve all of the above

From a historic point of view, direct labor and direct material have been the most important production factors within manufacturing. The cost of direct labor and direct material were easily traced back to an individual product. Throughout time, manufacturing has changed from being done by hand to being automated.[2] The latter has caused a drastic decrease in labor costs and, at the same time, an increase in the overhead costs, in both size and importance.[3] Overhead cost is the gathered amount of direct and allocated cost for manufacturing, excluding the cost for direct labor and purchased materials.[4]  Today the direct labor costs only make up a fraction of a company's total cost.[5]

The traditional cost account model allocates costs based on direct labor and direct material.[6] These factors are closely related to the production volume[7]. This way of

---

[1] Forrest, Edward *Activity Based Management – A Comprehensive Implementation Guide* (1996), p. 299.

[2] Stålh, Jan-Eric *Industriella Tillverkningssystem – Länken mellan teknik och ekonomi* (2007), p. 8.

[3] Daing Nasir Ibrahim and Ruhanita Maelah "Factors Influencing Activity Based Costing (ABC) Adoption in Manufacturing Industry" (2007), p. 113.

[4] Miller, Jeffrey G. and Vollman, Thomas E. "The Hidden Factory" (1985), p. 1-5.

[5] Cooper, Robin and Kaplan, Robert S. "Measure Costs Right: Make the Right Decisions" (1988), p. 1.

[6] Ainsworth, Penne "ABC overhead analysis beats traditional approach" (1995), p. 1.

allocating overhead costs thereby relies on the assumption that overhead is driven by volume, but not all overhead cost can be related to the product in this manner.[8] The practical use of the traditional cost account model has thereby been questioned, since most of the overhead costs are non-manufacture related. Criticism against the traditional cost account model regards whether it can provide managers with accurate, relevant and timely information.[9]

During the same time as criticism against the traditional cost account model arose, the *Activity Based Costing* (ABC) model was introduced.[10] The ABC model was first mentioned in a publication in 1987 by Robert S. Kaplan and William J. Bruns.[11] Since then there has been a countless number of books and articles published regarding ABC, all describing the power of the model and promising a solution on how a company can improve its performance.[12] Despite promises of finding the pot of gold at the end of the rainbow, the number of companies using the ABC model for allocating overhead cost is still low; many companies still use the traditional cost account model.[13] Companies who once used the ABC model have abandoned it because it took too long to implement and the implementation and maintenance costs were too high. The ABC model also failed to capture the complexity of company's operations and activities.[14]

There may be other reasons for companies not being successful with their implementation of the ABC model, such as limits in organizational capacity. Only a fraction of companies are taking advantage of the full potential of cost management. The reason may be that companies need integrated information derived from multiple sources in order to realize the full potential of cost management, an integration only provided by an *Enterprise Resource Planning* (ERP) system. The installation of an ERP system is made at a considerable expense; therefore, companies must be aware of the limitations.[15]

---

[7] Daing N. I. and Ruhanita M. (2007), p. 113.
[8] Ainsworth, P. (1995), p. 1.
[9] Daing N. I. and Ruhanita M. (2007), p. 113.
[10] Ibid.
[11] Bruns, William J. and Kaplan, Robert S. *Accounting and Management – A Field Study Perspective* (1987).
[12] Frost, William *ABCs of Activity Based Management – Crushing Competition Through Performance Improvement* (2005), p. ix.
[13] Daing N. I. and Ruhanita M. (2007), p. 113.
[14] Anderson, Steven R. and Kaplan, Robert S. "Time-Driven Activity-Based Costing" (2004), p. 1.
[15] Cooper, Robin and Kaplan, Roberts S. *Cost and Effect – Using Integrated Cost Systems to Drive Profitability and Performance* (1998), p. viii-x.

Over the years, Sandvik Tooling's ABC model has become out-of-date and updates concerning for instance activities are hard to do. Sandvik Tooling has multiple manufacturing sites situated all over the world, all working differently with ABC and having different degrees of implementation. This makes site to site comparisons difficult. The attitude towards ABC at other sites is unclear. Each site receives recommendations from headquarters on how to work with ABC, but it is unclear to which extent they are used. This, combined with unique systems at each location, renders several takes on for example calculating costs and activities.[16]

## 1.2   Core Issue

Despite tons of literature arguing that ABC better captures the economics of manufacturing process and provides costing data of better quality compared to the traditional cost account model,[17] companies still struggle to implement the model.[18] Many companies have also abandoned the model as a result of rising costs and increasing irritation among the employees.[19]. How is it possible that companies are steering away from this model that seems to capture the problems of allocating costs? The model is even said to be superior to the traditional cost account model[20]. It seems that there might be a missing link between the theoretical model, which seems to be a great way for a company to manage their limited resources in a school classroom environment, and the practical usage of the ABC model. This poses an interesting question: How do theoretical ABC models coincide with practical models? What feedback may be taken from theory in order to develop a practical model or vice versa?

The ABC model has also been accused of not capturing the complexity within a company. Assume a company using the activity "ship order to customer" has a fixed cost per order shipped. Say the company wants to increase the level of details by dividing the activity into fully loaded truck, less than fully loaded truck, and the use of commercial carrier or overnight express. This extension of the model requires new activities and cost drivers to be added, which increases the complexity of the ABC model, finally resulting in an ABC system, and other systems such as Excel, to exceed their capacity.[21] It seems as if there is a gap between the purpose of the theoretical ABC model and what is actually desired in terms of features by the companies using the model. What separates the theoretical ABC model from the

---

[16] Jacobsson, Mats, Business Controller, Interview 011708.

[17] Banker, Rajiv D.,Bardhan, Indranil R. and Chen, Tai-Yuan "The role of manufacturing practices in mediating the impact of activity-based costing on plant performance" (2008), p.3.

[18] Frost, W. (2005), p. ix.

[19] Anderson, S. R. and Kaplan, R. S. (2004), p. 1.

[20] Ainsworth, P. (1995), p. 1.

[21] Anderson, S. R. and Kaplan, R. S. (2004), p. 2.

practical use of the model and what feedback may be gained from this comparison? Which features are necessary or desirable for an information system that interacts with an ABC model?

Cost management, in its full potential, promises companies an increase in profitability and performance. Despite appealing promises, as mentioned before, companies have not successfully implemented ABC to its full potential. The key success factors, such as advantageous information technology and different cost management models like ABC,[22] are within arms' length, and all that is left to do is link the pieces together. This has not been done since the ABC model was first introduced in the mid-1980s[23]. It is of interest to see how well the model has evolved and whether it has seen any updates during the last 20 years. A company that would stand still during this time period may have a performance worth an audit. An update of the theoretical model is, therefore, of interest and with the aid of feedback from a practical case at Sandvik Tooling, the question is; are there other means of usage for the ABC model?

An observation made at Sandvik Tooling is that a set of systems makes up a unique system environment and that this environment is not inclined to change because of its complexity. The high initial cost of implementing a new system also puts further strain on the system environment[24]. Companies are implementing ERP systems to gain integrated information from different sources. An installation made to a considerable expense.[25] It is therefore of interest to see how well adapted a system of scale is adapted to the demands of an ABC model.

Just a glance at the vast supply of system vendors and the solutions they offer raises the question that these systems might standardize information too much. It is also questionable whether these systems make life easier for the user or if it just adds to the complexity of the organization. Does implementing an ERP system help to solve problems? Robert S. Kaplan and Robin Cooper argue in *Cost and Effect – Using Integrated Cost Systems to Drive Profitability and Performance* that installing ERP system might not be the solution to a company's problems [26]. Is this plausible? The question is which system should be chosen. In terms of ABC, it would seem advantageous to choose a system that is designed for meeting the requirements set by the ABC model. It is therefore of interest to look into the systems at Sandvik Tooling and see how well they are adjusted to the practical usage of ABC. On what criteria should a system be evaluated regarding ABC?

---

[22] Cooper, R. and Kaplan, R. S. (1998), p. viii-x.
[23] Ibid., p. viii.
[24] Ibid., p. 11-12.
[25] Ibid., p. vii-viii.
[26] Ibid., p. viii.

12

Sandvik Tooling has dozens of in-house software systems that make up the system environment.[27] This unique system environment limits Sandvik Tooling in the number of new systems that can be implemented and to what extent the new systems can be utilized, but also to what extent the old systems can be updated and changed.[28] The generated ABC information is dependent on the systems and thereby the choices regarding activities and cost drivers are limited. The problem with a limited system environment lies in the difficulties to find measurable activities and cost drivers.[29] The limitations in the systems hinder old activities and cost drivers to be replaced by new ones or new activities and cost drivers to be added to the model.[30] The cost drivers that seem best in theory may not work in practice.[31]

## 1.3 Purpose

The purpose of this thesis is to examine how a company based ABC model corresponds with theoretical models. This examination will render feedback as to how the ABC model works in practice at Sandvik Tooling as well as how it coincides with the theoretical ABC model. The relationship between ABC models and the information system environment will also be evaluated in order to find means to optimize the link between them. Furthermore, points for evaluating systems from an ABC point of view will be presented.

## 1.4 Demarcation

The focus of this study will be limited to looking at the theoretical models concerning ABC and seeing how well they coincide with practical models. The study of the topic in practice will be done at Sandvik Tooling, limited to the Sandvik Tooling division and the manufacturing sites in Gimo, Sweden, and Mebane, North Carolina, USA. Furthermore, the business area for the manufacturing of tools will be in focus and in some cases, when in depth investigation is required; the product group milling cutters will be the subject of study. We have also limited the thesis to looking at standard products.

The ABC model at Sandvik Tooling is part of the process of determining the standard cost. Therefore, the study will present the process of calculating the standard cost, both in Gimo as well as in Mebane, in order to get a cross-site comparison and to be able to provide useful feedback of how multiple sites work with ABC. Furthermore

---

[27] Jacobsson, M. 012208.
[28] Lindberg, Tomas, Project Leader, Interview 031808.
[29] Kennedy, Cindy, Controller, Interview 031908.
[30] Lindberg, T. 031808.
[31] Ibid.

the information system for ABC and standard cost calculation used in Mebane will be the object of study.

## 1.5   Abbreviations and Definitions

**Systems:** Term *system* used in Chapter *1 Introduction* and *3 Theoretical Framework* is the equivalent of what we refer to as information system throughout the thesis.

The abbreviations uses in the thesis is presented in the Table 1.1.

**Table 1.1 Table of abbreviations.**

| Abbreviation | Translation |
|---|---|
| ABB | Activity Based Budgeting |
| ABC | Activity Based Costing |
| AOU | Allocation from Other Units |
| CAS | Cost per Assortment |
| CCtr | Cost Center |
| CMH | Cost per Man-hour |
| CWO | Cost per Work Order |
| DC | Distribution Center |
| DCH | Direct Cost per Hour |
| DHR | Direct Hourly Rate |
| ED | Ejector Drill |
| EOQ | Economic Order Quantity |
| ERP | Enterprise Resource Planning |
| FG | Flow Group |
| GSS | Group Supplier System |
| HT | Cost per Heat Treatment per Piece |
| MES | Manufacturing Execution System |
| R&D | Research and Development |
| Standard Pk | Standard Produktionskostnad (The Standard Cost of Production) |
| Std Pk$_{ABC}$ | Standard Pk Activity Based Costing Cost |
| Std Pk$_{direct}$ | Standard Pk Direct Cost |

| Std Pk$_{mtrl}$ | Standard Pk Direct Material Cost |
|---|---|
| TDABC | Time-Driven Activity Based Costing |
| OV | Cost for Outside Vendor |
| WO | Work Order |

# 2 Methodology

*Methodology is a systematic approach for the gathering and processing of data.*[32] *This chapter is devoted to describing the course of action taken for the thesis. Initially, the tools and techniques when gathering information will be presented, along with why they have been chosen and what effects they might have on the end result. This chapter will end with a discussion regarding the criticism of sources.*

## 2.1 Mode of Operation

The first standpoint we had to take was deciding which strategy we would have for getting a grip on the issue presented to us by Sandvik Tooling. Since deciding the core issue for the thesis was an iterative process, we had to enter this project with an open mind. Being open minded was important because we did not want to overlook important information in the beginning, just on the basis of having a clear mindset where we wanted to end up with the thesis.

During the initial stage of the thesis, we had to go back and modify the core issue in order to assure that all stake holders were satisfied with the journey we were about to embark on. We have chosen to go back and question our choices, and in some cases, re-work our drafts in order to assure that we were on the right track, as well as assuring that we were working in line with our core issue. We believe this strengthens our result because we have not made any hasty decisions and we have continually questioned our findings. The data we have collected has been continually reviewed in order to assure that it met our, as well as our supervisors', requirements.

The abductive approach is a combination of induction and deduction. This approach is commonly used within case studies and was deemed suitable for our thesis. In accordance with the inductive approach, the author has a starting point in empirical data but at the same time does not discard from the theoretical perspectives, which is closer to the deductive way of working.[33] For our thesis, the collection of the empirical data thereby had to be done parallel with the research for building up the theoretical framework. An abductive approach was determined superior to a sole inductive or deductive way of working because, we could combine the benefits of induction and deduction. We also felt that we wanted to bring an update to the academic theories, as well as give theoretical insight concerning ABC to Sandvik Tooling.

---

[32] Rienecker, Lotte and Jörgensen, Peter Stray *Att skriva en bra uppsats* (2002), p. 158.
[33] Alvesson, Mats and Sköldberg, Kaj *Tolkning och reflektion – Vetenskapsfilosofi och kvalitativ metod* (1994), p. 42.

When our core issue had been agreed upon, we decided to look further into the academic theories regarding ABC. We wanted to test how well a theoretical ABC model worked in practice. Therefore, the data concerning the core issue was first gathered at Sandvik Tooling site in Gimo, and then applied to relevant academic theories and models. However, because the thesis was of a comparing nature, and took place at two sites, we had to start from scratch when we arrived in Mebane in order to get a clear picture of how they worked with ABC. This was then followed by putting the data to the test by comparing it to academic theories. Because we were going to look into how the information systems handle ABC data, we chose to include academic theories regarding information systems. To add a third aspect to the theoretical framework, theories regarding transactions were also included. The foundation for the theoretical framework is further presented in Chapter *3.1 Introduction to Theoretical Framework*.

## 2.2   Gathering Data

Having an explorative issue will require choosing a method that will generate several nuances.[34] It also requires a demarcation within the study, for example, a selected number of units. This is in line with the *qualitative* method.[35] A qualitative method was chosen for this thesis because we did not have a predetermined core issue when we started working, which is in line with the qualitative method[36]. The core issue took its shape along the way and finally resulted in being explorative. We wanted to find a new angle to approach the issue from the academic, as well as the practical side, of the thesis. Because the issue was broad, we chose to have clearly determined demarcations. We have limited ourselves to two studying two production sites and we have made further demarcations within these sites.

Since we had access to the key employees who work in relation to our core issue, we decided that we would perform interviews. We felt that interviews, if conducted correctly, would allow our information providers to supply nuanced data. A qualitative method allows the information given by the employees to have few limitations.[37]

Because we did not enter into this project with a topic set in stone, and our knowledge of the area was limited, we started out by doing interviews that gave us information

---

[34] Jacobsen, Dag Ingvar *Vad, hur och varför? – Om metodval i företagsekonomi och andra samhällsvetenskapliga ämnen* (2002), p. 55-57.
[35] Holme, Idar Magne and Solvang, Bernt Krohn *Forskningsmetodik – Om kvalitativa och kvantitativa metoder* (1997), p. 79.
[36] Jacobsen, D. I. (2002), p. 145.
[37] Ibid., p. 142-146.

on a broader scope. This was done because we wanted to understand the Sandvik Tooling organization and how an ABC model might be related to other departments, for example, the interaction between finance and production. Along the way, we found out who the key people within ABC were. We found that the case with ABC at Sandvik Tooling was that, although it is a large organization, there were only a number of people who have key information within our issue. In Mebane, for instance, there is only one controller. The key employees within ABC were the focus of our interviews. Although, the risk with us singling out employees is that we might have gotten influenced by the information provider. We acknowledged this risk and put a lot of effort into verifying the results from our empirical findings with other key employees who might have knowledge within the area.

The negative aspect with having done all these interviews is that it has been a time-consuming process. The interviews have in most cases required follow-up conversations and because we have re-located between sites, some of the conversations have been limited to e-mail correspondence. This has given us responses in written form obtained straight from the source.

## 2.3  The Nature of the Data

Primary data is when the author obtains information straight from a source.[38]

### 2.3.1  Interviews

We have chosen to use individual and open interviews as primary data. This was deemed appropriate because we only had a few information providers who could be subjected to interviews. An individual and open interview is characterized by an open conversation between the author and information provider. The interview can be conducted over the telephone or face–to–face. The conversation is open and there are no limits to what the information provider can say. The down side with using open individual interviews is that we might have been influenced by the information provider, as well as getting their individual opinions as part of their answer. [39] We have tried discarding individual opinions, and instead, we have focused on developing our own opinions regarding the issue in preparation for the conclusion of the thesis. This has been done by repeatedly documenting our key findings and discussing it without the influence of others.

We prepared our individual and open interviews thoroughly and made sure they were of an open character. The questions were, in most cases, sent to the information

---

[38] Lundahl, Ulf and Skärvad, Per-Hugo *Utredningsmetodik för samhällsvetare och ekonomer* (1999) , p. 52.
[39] Jacobsen, D. I.(2002), p. 160-167.

provider in advance so that all parties were prepared for the interview. We have encouraged the information provider to speak freely, and we only interrupted the information provider when we sensed the interview was beginning to stray off topic. Throughout the telephone interviews and e-mails conversations, we have posed questions which encouraged the information provider to give an open answer. In order to strengthen the credibility of the interview, we chose to document the responses given by the information provide in written form. After an interview, we have cross-referenced our notes. A recording device was ruled out as an option because we felt this might prevent the information provider from talking freely. It may also have made the information provider decline our request for an interview.

Data that is not obtained straight from the source is secondary data to the author. Information, in this case, is based on someone else's opinion. It is also common that the secondary data is gathered with a different purpose for the research.[40] To prevent this outcome, we chose not to use secondary data that is entirely used from one source. Academic articles, making up the theoretical framework, have been cross-referenced with articles addressing the same issue. We have throughout the thesis, questioned the credibility of the data from secondary sources since it may have been manipulated to suit its context.

The secondary data that has been used in this report is made up by academic articles and journals. Academic books have also been used. The reason that this type of secondary data has been used was to get a broader view and to look outside the company to gain inspiration from the academic world.

We have chosen to not use company internal sources because the data is confidential and limited to Sandvik Tooling employees. Since further study might be done within this field, but within Sandvik Tooling's walls, we have chosen to not use these sources. Media articles regarding Sandvik Tooling were not of interest for this report because we had insight into the company and access to people working with our topic in practice. We decided that Sandvik Tooling related information would best be obtained internally.

## 2.4  Validity and Reliability

The empirical data has to meet two requirements despite the nature of the data. The first one is *validity* and the other one is *reliability*. Validity means that the empirical data has to be both relevant and valid; meaning measuring the data that is of value for

---

[40] Jacobsen, D. I. (2002), p. 153.

the author. Reliability aims to explain whether the empirical data is reliable and credible.[41]

Throughout our thesis, we have had check points with the information providers at Sandvik Tooling concerning our empirical findings. This was done in order to ensure validity for our readers. Several information providers have read the report at different times in order to assure that our empirical findings have evolved correctly. This was especially relevant since we have mapped the process of calculating standard cost; a very detailed series of steps. We also questioned our findings regularly in order to assure that the data corresponded with the thesis' problem and purpose.

Reliability is a prerequisite in order to achieve validity.[42] During interviews it is common that the information provider is affected and influenced by the interviewer.[43] We felt that this phenomenon may have an affect on the end result; rendering it distorted. We have encouraged the information providers to answer freely with open questions. The information providers have also been given time to prepare with questions that have been dispatched in advance. We have also let the information provider read drafts of the thesis in order to verify the contents.

[41] Jacobsen, D. I. (2002), p. 21.
[42] Lundahl, U. and Skärvad, P-H.(1999) , p. 152.
[43] Jacobsen, D. I. (2002), p. 269- 271.

# 3 Theoretical Framework

*This chapter will present the academic theories in order to help address the thesis's issue and to fulfill the purpose. As presented in the initial chapter, the link between ABC and information systems will be addressed in order to seek possible means for achieving cost performance improvement. The theoretical framework will be made up by a triangulation between ABC, and academic theories regarding transactions and technical solutions for information systems.*

## 3.1 Introduction to Theoretical Framework

In order to analyze the true cost of manufacturing, the ABC model will be presented. This chapter will include background with the traditional cost allocation model to provide the readers with an insight into the strengths and weaknesses of the ABC model for the upcoming chapters of the thesis. Because the assignment required a study of ABC process at Sandvik Tooling, it was deemed necessary to present how an ABC model might be designed according to academic theory. This will provide adequate information of how the process of allocating costs might be designed in practice, and furthermore, provide data for comparing theory with practice. ABC at Sandvik Tooling is part of the calculation of standard cost and, therefore, a section about Activity Based Budgeting (ABB) will be presented. ABB is a way to ensure an increase in the accuracy of presenting costs[44], which coincides with the standard cost process at Sandvik Tooling.

It was considered interesting to look at manufacturing costs from a transaction perspective and to see if it could be linked to activities. An additional reason for looking at costs from this point of view was to see if a pattern for determining why manufacturing costs occur could be found. The fact that transactions are an exchange in information lead to believe that there might be a link between information systems and the flow of information or transactions. It was also believed that this academic theory could help to develop a model of information system evaluation.

Academic theories to support the link between ABC, transactions, and technical solutions regarding information system handling will be presented. This is done in order to prove a link between ABC, transactions and information systems, and with an optimized link between the three areas performance improvement could be achieved.

---

[44] Cooper, Robin and Kaplan, Robert S. "The Promise – and Peril – of Integrated Cost Systems" (1998), p. 1-7.

The technical solutions and information system related theories are presented in order to see how informational hierarchies can be designed. This will lead to a discussion whether the information at a given level is adequate or abundant for its purpose. This hierarchy of activities/information of the information system and cost model will help to decide the level of detail necessary for the information system. As part of the discussion regarding technical solutions, the ISA95 standard will be presented because of its ability to declare activities significant for decision making within the functional hierarchy levels[45]. It is therefore of interest to see how well an information system environment copes with the demands from the ABC model. This will make up a foundation for designing a model of evaluating information systems from a cost perspective. The study of ABC, transactions costs and information systems is done to bring additional input to the development of an evaluation model. The transaction analysis will further help the discussion whether one information system or several is the optimal case. Transactions could make it possible to see where there is a redundancy in transactions/activities/information.

The theoretical framework for this thesis will be constituted by a triangulation between academic theories regarding ABC, transactions and technical solutions through information systems (Figure 3.1). The theoretical framework will be illustrated by the circles and show how the theoretical field has been narrowed down to the chosen topic for the thesis (Figure 3.2, Figure 3.5 and Figure 3.6). At the end of this chapter, a summation of the theoretical framework will be presented (Figure 3.8).
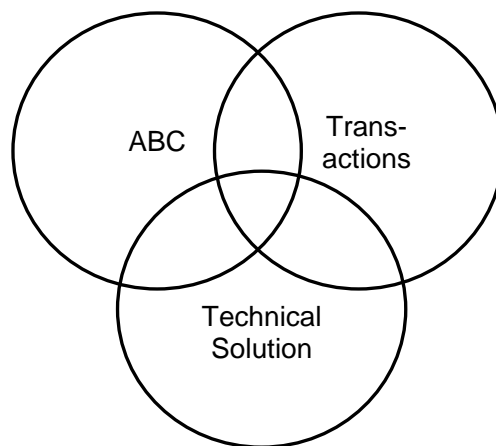


**Figure 3.1 The theoretical framework making up the thesis.**

---

[45] ISA-95.00.01-2000 "Enterprise-Control System Integration, Part 1: Models and Terminology" (2000).

## 3.2   Activity Based Costing
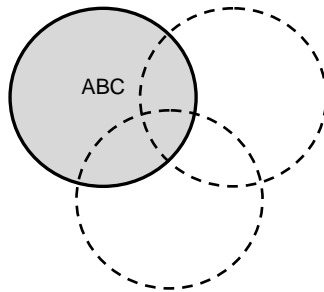


**Figure 3.2 The theoretical framework in terms of ABC.**

Cost accounting models have, throughout time, provided managers with cost information upon which important decisions can be made.[46] These decisions could be made regarding long-term strategic decisions concerning service or production mix, the lowering of prices, sourcing issues, and make or buy options.[47]

The traditional cost account model – allocating resources and costs by the base direct labor (hours or dollars) and direct material[48] – were introduced when direct costs, such as labor, still made up a large part of a company's manufacturing cost. The model has since then become out-of-date, and managers within multiple product assortment companies are facing problems with having distorted cost information. The increase in overhead costs have resulted in that only a fraction of the total manufacturing cost is made up by direct labor.[49]

In the middle of the 1980's, a new cost accounting model, by the name *Activity Based Costing* (ABC), was introduced. This model offered an alternate and more accurate way of allocating costs;[50] especially for companies facing the problem with rising overhead costs. The theory behind the ABC model is that all the activities within a company exist to support the product.[51] The ABC model aims to show the amount of overhead resource consumed, as well as how much unused capacity costs.[52]

---

[46] Cooper, R. and Kaplan, R. S. (1988), p. 1.

[47] Forrest, E. (1996), p. 298.

[48] Ainsworth, P. (1995), p. 1.

[49] Cooper, R. and Kaplan, R. S. (1988), p. 1.

[50] Raab, Carola and Mayer, Karl J. "Exploring the Use of Activity Based Costing in the Restaurant Industry" (2004), p. 85.

[51] Cooper, R. and Kaplan, R. S. (1988), p. 1-2.

[52] Raab, C. and Mayer, K. J. (2004), p. 85.

### 3.2.1   Designing ABC

The outlay of an ABC cost accounting model is made up by three guidelines. The first rule is to focus on costly resources, meaning finding the resources where the new cost system or method could have a vast impact. For example, if a company whose total manufacturing cost is mainly made up by factory costs, the focus will be on trying to trace manufacturing overhead to products.[53]

The second and third rule put together aims to find the resources that are distorted under the traditional cost account system. These resources are uncorrelated with the traditional cost allocation basis – direct labor and direct material. An additional question to ask oneself is which consequences affect the cost structure once the company increases its assortment, as well as makes it more diversified, or increases its customer base, market channels or the processing technology.[54]

The ABC model is made up by two steps.[55] The first step is to allocate cost of resources to activities, and in the second step costs are further allocated to the product.[56] The process for allocating cost of resource to activities is made by resource cost drivers. The next step, allocating cost of activity to product, is made by activity cost drivers.[57] In order to make it possible to separate the two allocation processes, the allocation base in the first step is referred to as *resource cost driver* and in the second step *activity cost driver*. The hierarchy in the model is done to avoid unnecessary cost allocations (Figure 3.3).[58]

---

[53] Cooper, R. and Kaplan, R. S. (1988), p. 3, 5-6.

[54] Ibid.

[55] Raab, C. and Mayer, K. J. (2004), p. 81.

[56] Thyssen, Jesper, Israelsen, Poul and Jorgensen, Brian "Activity-based costing as a method for assessing the economics of modularization – A case study and beyond" (2006), p.3-4.

[57] Higgins, Brian K. and Young, S. Mark "Improving operations: Not as simple as ABC" (2001), p. 19.

[58] Thyssen, J., Israelsen, P.l and Jorgensen, B. (2006), p.3-4.

**Activity Based Costing**

Resources

Resource Cost Driver

Activities

Activity Cost Drivers

Product 1          Product 2          Product 3
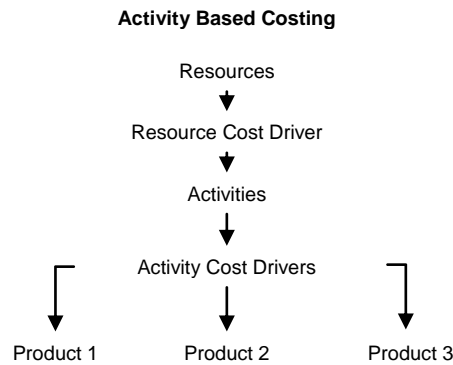
**Figure 3.3[59] Illustration of the flow of Activity Based Costing (ABC).**

Designing an ABC cost model also requires the accurate gathering of information regarding direct material and direct labor, as well as the insight that cost allocation cannot be done with flawless accuracy. The accuracy may have to make room for complexity, since an increase in accuracy often generates a large number of cost drivers,[60] which renders high complexity.[61]

There are also two cost types that should not be included in the ABC cost allocation model; parts of the *Resource and Development* (R&D*)* costs and *the costs of excess capacity*. The R&D costs can be divided in two parts, *R&D costs related to modification and improvements of existing products and lines* and *R&D cost related to entirely new products*. R&D costs related to modification and improvements of existing products and lines are R&D costs allocated to the product in mind and are to be allocated to the product. The second R&D category – R&D cost related to entirely new products are related to development and should not to be included in the ABC cost allocation model.[62]

The cost of excess capacity should not be included in the ABC allocation model, and should furthermore not be linked to individual products. Say for example a plant's total annual cost is 5 million dollars and the full capacity is 1 million products; the ABC cost will then be 5 dollars per product (5 million dollars divided by 1 million products). But if the following year's manufacturing turns out to be worse and the volumes only exceed to 500,000 products, the ABC cost per product would be 10 dollars. The products will then be hit with a different ABC cost because of the change in volume, even though the capacity of the machines and workers has not changed.

---

[59] Cooper, R. and Kaplan, R. S. (1998), p. 6.
[60] Homburg, Carsten "A note on optimal cost driver selection in ABC" (2001), p. 1.
[61] Anderson, S. R. and Kaplan, R. S. (2004), p. 1-7.
[62] Cooper, R. and Kaplan, R. S. (1988), p. 3, 5-6.

Allocating cost to a product in this way will generate a fluctuating ABC cost, which may lead to a negative spiral. The cost system reports a higher cost, which encourages the managers to increase the price. The change in price will generate a decrease in demand and this will render a volume drop, which once again will lead to an increase in the ABC cost.[63]

### 3.2.2 The Conceptual Framework of ABC

**Activity:** An *activity* is a procedure or process that allows work to be carried out. All activities consume resources. ABC shows activities which are being performed along with the cause and whereabouts. The consumption of resources can then be related to activities and also services and products.[64]

**Activity Cost Driver:** The *Activity Cost Driver* measures how much of the activity the product has consumed.[65] The activity cost driver generates an *activity cost driver rate*, which is used for allocating the costs to the product. The activity cost driver is calculated by the total cost of activity divided by the unit volume for the activity cost driver.[66]

**Resource Cost Driver:** The resource cost driver is the percentage generated by the cost of resource consumed for the activity. Say you have two activities and the cost of resource is 1,000,000 dollars. The resource cost driver is then the percentage used for splitting the cost of resource and allocating the costs to the activities. Assume the cost of resource is to be spilt 50-50 between the two activities; the resource cost driver will be the two percentages 50 percent and 50 percent.[67]

### 3.2.3 Activity Based Budgeting – Operational Control

*Activity Based Budgeting* (ABB) allows managers to determine a resource's future supply and practical capacity. The resource's budgeted expenses and quantity can then be used as feedback to the operational control system, which has information regarding actual spending in opposition to the budget.[68] ABB has the purpose of linking budgets and activities. A strong link is important because adjustments can be made if a fluctuation in demand were to come. [69] An integrated system makes ABB possible for managers from a practical point of view. As pointed out by

---

[63] Cooper, R. and Kaplan, R. S. (1988), p. 5-6.
[64] Forrest, E. (1996), p. 300.
[65] Raab, C. and Mayer, K. J. (2004), p. 85.
[66] Higgins, B. K. and Young, S. M. (2001), p. 19.
[67] Ibid., p. 19.
[68] Cooper, R. and Kaplan, R. S. (1998), p. 1-7.
[69] Serritzlew, Sören "Lining Budget to Activity: A Test of the Effect of Output-Purchase Budgeting" (2006), p. 101-120.

Figure 3.4, [70] ABC traces the cost of a resource down to product level. ABB on the other hand goes the reverse direction, tracing the cost of a product to activities and resources.[71]

**Activity Based Budgeting**

Resources

▲

Resource Driver

▲

Activities

↑

Activity Cost Drivers

Product 1          Product 2          Product 3
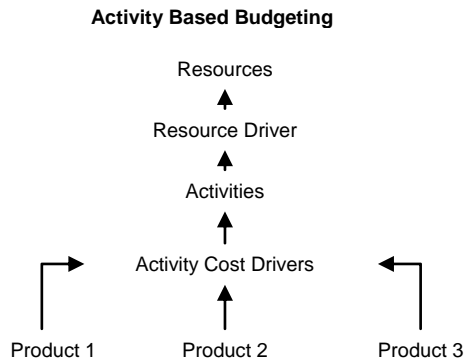
**Figure 3.4 Illustration of the flow for Activity Based Budgeting (ABB).**

ABB allows the manager to have an increase in control over the cost structure, and more particular, it offers the possibility to transform fixed costs into variable costs.[72] Managers will also have the ability to get authorized spending on the resources that are linked to the activities in the upcoming periods.[73] Therefore, it will be possible to make decisions regarding supply when the budget is done. ABB is done in a series of sequential steps:[74]

1. Estimate the upcoming volumes for production and sales
2. Forecast the activity demand
3. Calculate the demand for the resource
4. Establish the resource supply in actual terms
5. Establish activity capacity

ABB requires more details than conventional budgeting. Figures regarding spending; supply; capacity; demand production and sales in terms of activities are required. A successful implementation of ABB allows managers to meet the future demand of a resource with supply as well as eliminate idle capacity.[75]

---

[70] Cooper, R. and Kaplan, R. S. (1998), p. 1-7.
[71] Frost, W. (2005), p. 99.
[72] Cooper, R. and Kaplan, R. S. (1998), p. 1-7.
[73] Frost, W. (2005), p. 101.
[74] Cooper, R. and Kaplan, R. S. (1998), p. 1-7.
[75] Ibid.

### 3.2.4 Time-Driven ABC

There is an alternative to performing ABC the traditional way and it does not require a total abandonment of the model. It is rather a simplified version of the ABC model, called *Time-Driven ABC* (TDABC).[76] The TDABC model is a method for overcoming the costs for implementing and maintaining the traditional ABC model.[77] With this approach, the manager estimates the resources that a product, a transaction, or a customer might demand as opposed to splitting resource cost into activities, followed by customers or products.[78]

TDABC requires two parameters for each resource; supplying capacity in terms of cost per time unit and consumption of capacity by product, service and customer in terms of unit time. An alternate unit of measures than time could for example be cost per cubic meter. The TDABC allows the user to use time-equations and the information for the equations can easily be imported from an ERP system. This makes the model easy to maintain and update.[79] The job left for the managers are not to survey how much time an employee spends on different tasks, but it is rather a job of estimating the practical capacity of resource supplied in putting it in relation to theoretical capacity.[80]

The process of determining TDABC can be illustrated by the following example (Table 3.1). Say that a company has a customer service department consisting of 28 employees. One person has a theoretical capacity of supplying 31,680 minutes a quarter, assuming the person works 8 hours a day and 22 days a month (8 hours multiplied by 22 days and multiplied by 60 minutes renders 10,560 minutes a month. Multiplied by 3 months; 31,680 minutes a quarter). Practical capacity would then be 80percent to 85 percent (an estimation considered as a rule of thumb for the model) of the theoretical capacity. The common way of estimating a person's practical capacity is to set it as 80 percent of the theoretical capacity, and as for a machine's practical capacity it will be 85 percent of the theoretical capacity. This renders approximately 25,000 minutes a quarter (or 700,000 minutes in total for the entire department), in practical capacity supplied from this person. The cost of capacity supplied – the overhead cost – can then be divided by the unit of practical capacity in order to obtain the cost per minute when supplying capacity. If overhead cost would for example

---

[76] Anderson, S. R. and Kaplan, R. S. (2004), p. 1-7.

[77] Varíla, Mikko, Seppänen, Marko and Suomala, Petri "Detailed cost modeling: a case study in warehouse logistic" (2007), p. 187-188.

[78] Anderson, S. R. and Kaplan, R. S. (2004), p. 1-7.

[79] Varíla, M., Seppänen, M. and Suomala, P. (2007), p. 187-188.

[80] Anderson, S. R. and Kaplan, R. S. (2004), p. 1-7.

amount to 560000 dollars, and divided by 700,000 minutes, then this would render a rate of 0.8 dollars per minute for supplying capacity.[81]

The next assignment for the manager is to estimate how long it takes to perform an activity, for example how long it takes to process an order, handle an inquiry and carry out credit checks. Suppose it is determined to 8 minutes for processing and order, the cost driver rate will be 6.4 dollars (8 minutes multiplied by 0.8 dollars a minute). The activities handling an inquiry would be estimated at 44 minutes and carrying out credit checks would be estimated at 50 minutes, rendering the cost driver rates 35.2 dollars and 40 dollars. This rate is then used for calculating the actual outcome for processing an order, quantity multiplied by cost driver rate or quantity multiplied by unit time. The actual outcome for processing an order is then compared to the practical supplied capacity to determine where possible unused capacity may be found. According to the Table 3.1, there is an unused capacity amounting to 106,400 minutes and 85,120 dollars.[82]

**Table 3.1[83]Table showing the actual operational outcome for the customer service department. TDABC has been applied. The quantities for processing and order, handling a customer inquiry and carrying out a credit check have been estimated. The example indicates that there is an unused capacity of 85,120 dollars. Possible savings or improvements could be made with this information at hand.**

| Activity | Quantity | Unit Time (minutes) | Total Time Used (minutes) | Cost-Driver Rate (dollar/activity) | Total Cost Assigned |
|---|---|---|---|---|---|
| Process Order | 51,000 | 8 | 408,000 | $ 6.4 | $ 326,400 |
| Customer Inquires | 1,150 | 44 | 50,600 | $ 35.2 | $ 40,480 |
| Credit Checks | 2,700 | 50 | 135,000 | $ 40 | $ 10,8000 |
| Total Used | | | 593,000 | | $ 474,880 |
| Total Supplied | | | 700,000 | | $ 560,000 |
| **Unused Capacity** | | | **106,400** | | **$ 85,120** |

---

[81] Anderson, S. R. and Kaplan, R. S. (2004), p. 2-4.
[82] Ibid.
[83] Ibid., p. 4.

The way the traditional ABC model is constructed is often considered as the main problem. Using the previous example, with the traditional ABC model (Table 3.2), the activities processing an order, handling customer inquiries and carrying out credit checks are built up by number of steps. The first assignment for the manager is to survey the employees regarding the time they spend on the activity. For example, the result would amount to 70 percent of time for processing orders, 10 percent for handling customer inquires and 20 percent for carrying out credit checks. This would render an estimated percentage that would be used when assigning a department's expenses. If the overhead yet again amounts to 560,000 dollars, then the activity of processing an order would answer for 70 percent of the overhead costs, 392,000 dollars. The cost driver rate assigns the costs to the products that use the department's services. The cost driver rate is calculated by dividing the assigned cost with activity quantity. The same example as presented above, but doing the TDABC way, is presented in Table 3.3.[84]

**Table 3.2[85] Table illustrating the traditional way to perform a quarterly ABC model for the customer service department. With the aid of the activity quantities, it is possible to assign costs to products with the cost driver rate. The cost driver rate will represent how much of the department's resources are consumed by the product.**

| Activity | Time Spent (%) | Assigned Cost | Activity Quantity | Cost Driver Rate |
|---|---|---|---|---|
| Process Order | 70% | $ 392,000 | 49,000 | $ 8 per order |
| Customer Inquires | 10% | $ 56,000 | 1,400 | $ 40 per inquiry |
| Credit Checks | 20% | $ 112,000 | 2,500 | $ 44.8 per credit check |
| **Total** | **100%** | **$ 560,000** | | |

---

[84] Anderson, S. R. and Kaplan, R. S. (2004), p. 1-7.
[85] Ibid., p. 1.

**Table 3.3[86] Table illustrating the TDABC way to perform a quarterly TDABC model for the customer service department. The rates are based on a practical capacity of 700,000 minutes. The table illustrates that there is unused capacity, 17 percent (462,800 dollar divided by 560,000 dollar), within the customer service department.**

| Activity | Unit Time (minutes) | Quantity | Total Minutes | Cost Driver Rate | Total Cost |
|---|---|---|---|---|---|
| Process Order | 8 | 49,000 | 392,000 | $ 6.4 per order | $ 313,600 |
| Customer Inquiries | 44 | 1,400 | 61,600 | $ 35.2 per inquiry | $ 49,280 |
| Credit Checks | 50 | 2,500 | 78,600 | $ 40 per credit check | $ 100,000 |
| **Total** | | | **578,600** | | **$ 462,800** |

A lot of companies are steering away from traditional ABC because it increases operational complexity, requires costly investments, is difficult to maintain, and takes a long time to implement. In some cases, the implementation may even lead to an increase in cost and dissatisfied employees. The cost of updating a system may also be too high, and, therefore, updates are done infrequently and subsequently render a process that is out of date. The increase in complexity of the ABC process, with an increase in the level of detail in the activities, increases the demand for systems that process and store the data. This makes traditional tools such as Excel inadequate in terms of its capacity.[87]

---

[86] Anderson, S. R. and Kaplan, R. S. (2004), p. 3.
[87] Ibid., p. 1-7.

## 3.3   Focusing on Transactions
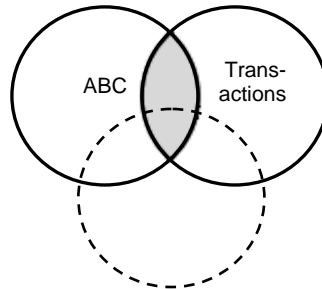


**Figure 3.5 The theoretical framework narrowed down to ABC and Transactions.**

Manufacturing is responsible for the largest sum of overhead costs;[88] being driven by transactions.[89] A transaction is defined as an exchange of information and/or material that is required to push production along; a process not necessarily resulting in a physical product. It is rather a gathering of the entire product that is offered to the customer, meaning the total transactions that a responsible for quality, variety, on-time delivery and superior design.[90] The transactions that cause costs to occur are closely linked to how complex the plant's operations are. The complexity of a plant is said to increase when the number of products increases.[91]

Conquering overhead cost is a constant battle for manufacturing managers,[92] but understanding the transactions related to resource consumption may help to identify the area for cost reduction as well as product and process improvement.[93] Profitability and competitiveness are closely linked with manufacturing overhead and if it is of a substantial amount, the impact may be great. Furthermore, managers have to be equipped to manage the costs they are held responsible for in an effective manner. Today, productivity is more likely to be achieved by a manager if overhead is cut as an alternative for direct labor.[94]

Managers tackle the problem of controlling overhead costs and what causes them to occur. Direct material and direct labor, and what drives them, is easier to grasp but

---

[88] Miller, J. G. and Vollman, T. E. (1985), p. 1-5.

[89] Banker, Rajiv D., Potter, Gordon and Schroeder, Roger G. "An empirical analysis of manufacturing overhead cost drivers" (1995), p. 1.

[90] Miller, J. G. and Vollman, T. E. (1985), p. 1-5.

[91] Banker, R. D., Potter, G. and Schroeder, R. G. (1995), p. 2.

[92] Miller, J. G. and Vollman, T. E. (1985), p. 1-5.

[93] Johnson, Thomas H. "Activity-Based Information: A blueprint for World-Class Management Accounting" (1988),  p. 23-31.

[94] Miller, J. G. and Vollman, T. E. (1985), p. 1-5.

what drives the overhead costs is more complicated. Models regarding this problem exist, but they explain how costs are allocated rather than explaining how they actually occur. The bill of material, for example, relates the costs in terms of number of products produced. Unit output does normally correlate with overhead costs, but it is important to bear in mind that unit outputs may not always render overhead costs. This may lead to a distorted focus among managers when it comes to determining activities that cause overhead; focusing on measures regarding direct labor or output.[95]

Increasing productivity through automation has led to a decrease in labor costs, but an increase in overhead costs.[96] Maintaining and supporting automated equipment also renders an increase in overhead costs. Automation is the most commonly acknowledged way to reduce transaction costs. Transactions can be automated with the aid of integrated systems that only require information to be entered a single time. Although, having "sub-systems" is a common scene, it often renders a surplus in transactions. With integrated systems, it is possible to increase effectiveness, improve understanding and accuracy. Having the same information at different organizational levels may result in transactions that are superfluous. A computer system that is successfully implemented should result in having transactions occur only once. The management of overhead costs can be done effectively in the following steps:[97]

1. Analyze transactions to see which are necessary and then improve the way they are carried out
2. Increase operational stability
3. Rely on automation, as well as the integration of systems

If, in fact, overhead costs are driven by transactions, then managers must take control of the key transactions. These should be evaluated in terms of whether or not they are suitable or if they could be carried out more effectively. Improving transaction cost derived from overhead can also be done by adjusting the detail of the data reported into the systems. The data could then be evaluated on how fine and frequent it is. Abundant data is not necessary.[98]

---

[95] Miller, J. G. and Vollman, T. E. (1985), p. 1-5.
[96] Daing N. I. and Ruhanita M. (2007), p. 113.
[97] Miller, J. G. and Vollman, T. E. (1985), p. 1-5.
[98] Ibid., p. 1-5.

## 3.4   Technical Solution
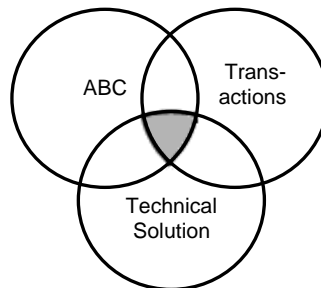


**Figure 3.6 The theoretical framework narrowed down to ABC, Transactions and Technical Solution.**

One of the great perils when implementing an ABC system is finding the appropriate cost drivers to allocate the activity cost to products.[99] An *Enterprise Resource Planning* (ERP) system is an information system used for planning the resources needed to make, ship, as well as account for a customer order. An ERP system allows information to flow between different business functions and offers a structure when building a database of the necessary data for performing the business operations and decision making.[100]

An ERP system can help with increasing the information regarding the cost drivers' reliability and availability. A popular feature is the integration of functions, such as cost and management accounting, materials management and production planning. The relational data allows functions to share information without duplicating it.[101]

*Manufacturing Execution System* (MES) is implemented to support a company's production process. It is furthermore used to close the gap between the ERP system and the lower system levels, for example, those addressing equipment control. MES could provide information between the higher level systems and lower level systems and act as means for decision making between the two. (The term operational control system, as discussed in Chapter *3.4 Technical Solution*, is regarded as the same MES by the authors of the thesis)[102]

---

[99] Baxendale, Sidney J. and Jama Farah "What ERP Can Offer" (2003), p. 54-57.
[100] Singh, Mohini and Waddel Di *E-Business Innovation and Change Management* (2004), p. 121.
[101] Baxendale, S. J. and Jama F. (2003), p. 54-57.
[102] Chung, Sheng-Luen and Jeng MuDer "Manufacturing Execution System (MES) for Semiconductor Manufacturing" (2002), p. 1.

### 3.4.1 ISA95[103]

The ISA95 standard is made up of a set of standards. Part 1 of the standard provides standard terminology and models describing the interface between enterprise activities and control activities. With the aid of standardized terminology, and a consistent number of models and concepts aiming to integrate control systems and business systems, an increase in communication can be obtained. The outcome rendered from this optimization may lead to the reduction of costs.

The standard defines a hierarchical model, consisting of three, different levels of decision making (Figure 3.7). The levels within the model are: *Business Planning and Logistics*, *Manufacturing Operations and Control, Batch Control, Continuous Control* and *Discrete Control*. The interface between business planning and logistics and manufacturing operations is the focus of this standard. The interface is normally the link between plant production and scheduling and operation management, as well as plant floor coordination. Each level includes a number of activities.

**Business Planning and Logistics**

**Level 4**

**Manufacturing Operations and Control**

**Level 3**

Batch Control

Continuous Control

Discrete Control

**Level 2, 1, 0**
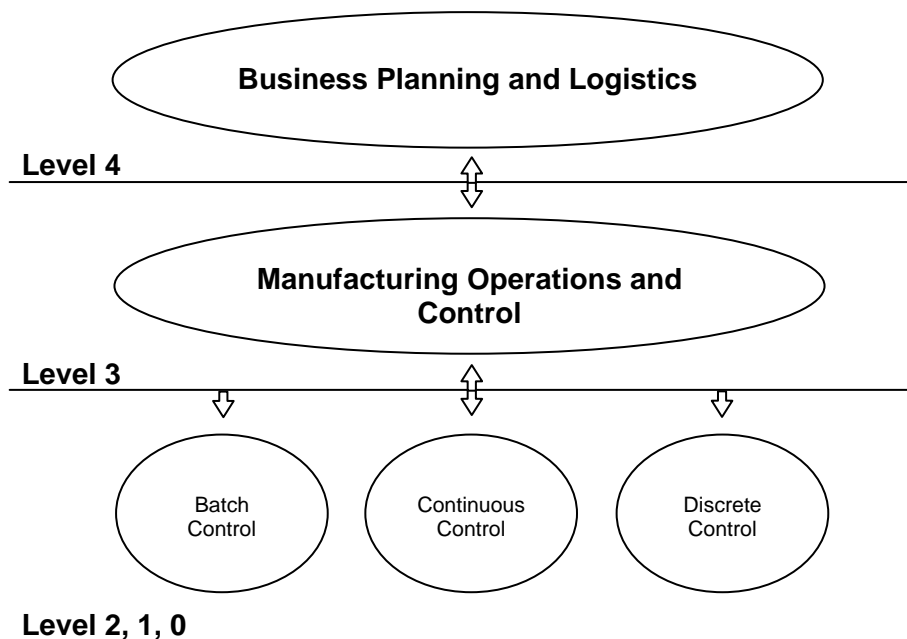
**Figure 3.7 Illustration of the hierarchical model.**

Enterprise systems and control systems have to inter-operate and integrate. The standard may therefore be used upon the implementation of new product offerings. The objective is to reduce cost, risk and other factors related to implementation.

---

[103] ISA-95.00.01-2000 (2000).

### 3.4.2   Linking ABC to systems[104]

Today's executives have a countless number of sources concerning cost and financial information. Operational control systems and ABC systems have different functions and are separated for good reasons. Operational control systems offer financial feedback regarding process effectiveness. An ABC system, on the other hand, offers a view on customer and product profitability, as well as areas where possible improvements can be made. It is important to acknowledge that the two systems have different purposes, provide different information and are different in terms of requirements regarding timeliness and accuracy. Integrating these two systems can only be done partially and it must be done thoroughly. An unsuccessful integration may result in a single system that cannot execute neither system's operation. The systems should interact with each other and trade information about efficiency and the use of capacity.

Operational control systems work in accordance with efforts to achieve continuous improvements. Data must, therefore, be accurate and timely, as well as traceable to a work group. A system tends to incorporate non–financial information such as scrap, defects and cycle time. These are recorded on a daily basis and on batch level to offer employees the necessary feedback on how efficient the process is. The operational systems accumulate some financial information, regarding cost of the resources that are used within the process. These resources include material, people, energy, and machines.

ABC systems offer the managers a strategic overview of the business. The system allows costs to be traced from resources, for example machines, to processes and activities and then further on to a service, a product or a customer. The gathered cost of resources can then be included in the overall strategic cost of customers and products. This offers an insight into the organizational hierarchy and profitability at different levels.

---

[104] Cooper, R. and Kaplan, R. S. (1998), p. 1-7.

### 3.4.3    Measuring Systems[105]

The integration of cost and performance measurement systems, from a financial point of view, can be done in a four-stage model. The four stages building up the model are:

1.  Stage I Systems – *Inadequate for Financial Reporting*
2.  Stage II Systems – *Financial Reporting-driven*
3.  Stage III Systems – *Specialized*
4.  Stage IV Systems – *Integrated*

Most companies have systems characterized by Stage II Systems, but some company's systems can still be classified as not working, in other words Stage I Systems. These companies can easily acquire and install an ERP system taking them to the next stage. The first step using the model is to identify at what stage the systems is located before it can be taken to the next stage.

The most characterizing feature for Stage I Systems is inadequacy in terms of financial reporting. The systems, with inferior internal actions for recording transactions, either have transactions recorded incorrectly or not recorded at all. Stage I Systems are also characterized by letting the allocation of overhead cost be done with incorrect algorithms.

The Stage I Systems are often found in newly emerging companies that lack the time and resources to upgrade their financial systems, or mature companies that have continued to use their so called legacy systems. A system installed a decade ago is based on obsolete technology and is nearly impossible to maintain, there are undocumented updates and changes that together have resulted in a system where no one understands the logic of the system along with the fact that the designers of the system have left the company years ago. Even so, the system cannot be eliminated since it is the only system keeping track of the financial transactions. The Stage I Systems can also exist in industries that once had adequate systems for financial reporting, but over the years has become inadequate as a result of acquisitions.

The characteristics for Stage I Systems can be summarized as:

1.  Requiring an extensive amount of resources and time to consolidate reporting units within the company and to close the books
2.  The occurrence of unexpected variances when reconciling physical inventory against book values

---

[105] Cooper, R. and Kaplan, R. S. (1998), p. 11-24, 286.

3. Having large inventory write downs after external and internal audits
4. Having several postclosing adjustments done to the financial accounts
5. Lacking auditability and integrity

The Stage II Systems, compared to Stage I Systems, are adequate for financial reporting, but not for allocating costs to products. Overhead cost and other indirect cost to products may be aggregate on a financial account level, but faults occurring at product-unit level eliminate each other and make the system inadequate for cost allocation. Many of the Stage II Systems are also still using direct labor as a base for cost allocation. A base for overhead cost allocation that made sense 50-80 years ago, when direct labor was still a high fraction of total manufacturing costs.

Today many companies with Stage II Systems have tried to update their systems by adding machine hours as a new base for allocating overhead cost or creating a cost pool, where overhead costs are collected and allocated by a percentage markup. Some companies have also defined additional cost centers to match the increased diversity of machines and production processes in their plant. Despite these improvements, the underlying economics of companies with diverse customers, multiple products and complex processes are still not being reflected. The assumption made when using additional bases is that overhead cost varies with volume or number of units, and not by a wide selection of products the plant has capacity to produce.

Another flaw within Stage II Systems is the way the systems only allocate factory cost and other manufacturing cost to the product. Other costs such as selling, marketing, distribution, and R&D are not being assigned to a cost object. This way of allocating cost is, however, adequate for financial reporting, but not for decision making. The Stage II Systems' structure build for supporting financial reporting also hinders a company's continuous learning and improvement by not supplying managers and employees with the accurate information and feedback.

Stage II Systems characteristics are summarized by:

1. The systems fulfill requirements for financial reporting
2. The costs for Stage II Systems are collected by responsibility centers and not by business processes and activities
3. Stage II Systems report distorted product and customer costs. Some Stage II Systems do not have customer cost at all
4. Feedback to employees and managers are provided by Stage II Systems, but the feedback is reported too late and is too financial

38

Stage III Systems are made up of three different financial systems. One is the traditional financial system, classified as Stage II Systems. Two is an activity based cost system collecting data from both the traditional financial systems and from other information systems to measure the costs of products, processes and activities more accurately. The third system making up Stage III Systems is an operational feedback system, supplying employees with accurate, financial and non–financial, timely, information. Both the ABC system and the operational feedback system collect data from Stage II Systems and, therefore, the leap going from Stage II Systems to Stage III Systems does not have to be costly when investing in new computer hardware and software.

The one thing to keep in mind when developing Stage III Systems is that ABC and operational feedback systems differs in the level of detail and reporting. For example, an ABC system generates feedback of the resource demands by product, customer and service, and not how the demands are met. This feedback on effectiveness is generated from the operational feedback system. Therefore, two systems are recommended to be developed, one that meets the requirements for an ABC system and one for operational feedback, not a combined system.

The fourth and final stage is the Stage IV Systems, constituted by both concepts, theory, data, and information supplied by Stage I-III Systems. The Stage IV Systems are also characterized by an integrated ABC and operational feedback system providing the foundation for external financial statements, but also designed to provide a foundation for maximizing the benefits for decision-making both for managers and employees.

The Stage IV Systems is the final stage in reaching the full potential of cost management. It can, therefore, be tempting for companies to skip one or more steps. An action not to be recommended since the success of reaching full potential is based on knowledge retrieved from all previously presented steps.

## 3.5   Summation of the Theoretical framework

The triangle at the crossing point of the three circles holds the summation of our theoretical chapter. A summation of the academic theories is presented below in (Figure 3.8). We have chosen to illustrate the overhead costs by the outer triangle. The overhead costs are fed into three points of the triangle and go through a series of steps in order to reach the product. The steps presented are, according to us, the most important and significant when designing or developing a correct cost allocation process.
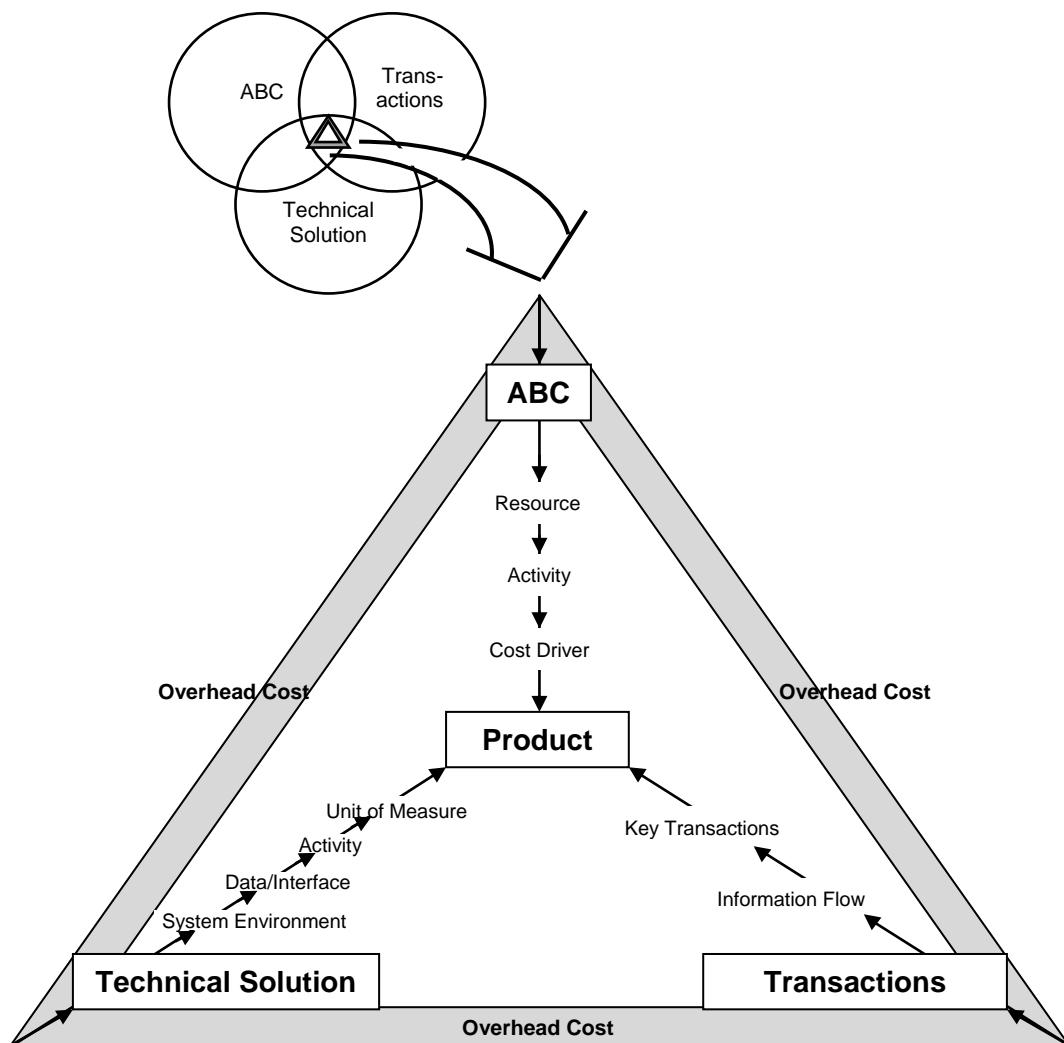


**Figure 3.8 Summation of the theoretical framework.**

40

# 4  Empirical Foundation

*This chapter presents Sandvik Tooling's cost allocation process at two sites. The subjects of the empirical study have been the manufacturing plant in Gimo, Sweden and Mebane, the United States. The cost allocation process in total is presented in order to illustrate for the readers how the ABC model, as part of the total process, is used in practice. A mapping of the information systems used for the cost allocation process is also presented.*

## 4.1  Background

Sandvik is divided into three divisions; *Sandvik Mining and Construction*, *Sandvik Materials Technology* and *Sandvik Tooling*. Sandvik Tooling is composed of a number of independent brands specializing in metal cutting, super abrasive components and wear parts. The products consist of cemented-carbide, high-speed steel, cubic boron nitride, synthetic diamond and special ceramics. Sandvik has a total of 42,000 employees and in part 15,000 belonging to Sandvik Tooling. The main office is located in Sandviken, Sweden.[106] The manufacturing layout for units producing tools at the sites in Gimo and in Mebane are grouped by flow group.[107] (See Appendix I for a theoretical definition of different manufacturing layouts.)

## 4.2  Introduction to ABC at Sandvik Tooling

The first ABC model within Sandvik Tooling was established in 1991 in Gimo, Sweden. The model has since then been implemented worldwide, but in different degrees. To date, ABC is not entirely used within the Sandvik Tooling organization.[108] The ABC model in Gimo and Mebane is used as part of the calculation of the estimated cost of production of a piece/product to be manufactured, *Standard Produktionkostnad* (Standard Pk).[109]

The Standard Pk is the method used by Sandvik Tooling to calculate the full cost of production, including both indirect production costs and administration costs charged to production.[110] A Standard Pk is made up of three parts: direct material costs (Std $Pk_{mtrl}$), direct costs (Std $Pk_{direct}$) and ABC costs (Std $Pk_{ABC}$). The three costs in total make up the estimated cost of production for each product that is set to be

---

[106] Sandvik AB, home page, http://www.sandvik.com, 012008.

[107] Jacobsson, M. 012408./Kennedy, C. 031108.

[108] Jacobsson, M. 011608.

[109] Jacobsson, M. 011608./Kennedy, C. 031108.

[110] Andersson, Karin, Head of Finance Department, Interview 020108.

manufactured (Equation 4.9 and Equation 4.20).[111] The purpose of the Standard Pk is to estimate the real costs of manufacturing as accurately as possible[112], and to compare the real cost of production against the budget.[113]

The cost allocation process to determine the Standard Pk consists of a series of steps, starting out with the estimation of the budgeted cost of production.[114] The process of allocating ABC costs is part of a larger allocation model. The model starts out with having a sum of budgeted costs that are split into cost groups. Initially, these costs are not affected by ABC, but throughout the cost allocation process, some selected costs will go through the Sandvik Tooling ABC model. The study of ABC at Sandvik Tooling will, therefore, include their entire cost allocation process.[115] Allocating costs to the Standard Pk for the plant in Gimo and in Mebane is presented in detail in Chapter *4.3 Mapping of ABC in Gimo* and *4.4 Mapping of ABC in Mebane* along with an illustrated overview for each site in Figure 4.1 and Figure 4.6. The theoretical term overhead cost is at Sandvik Tooling equal to the term indirect cost, and is therefore throughout Chapter *4 Empirical Foundation* and *5 Comparisons* referred to as indirect cost.

### 4.2.1 The Conceptual Framework of Sandvik Tooling

**Allocation Key**: *Allocation Key* is defined as the basis for splitting costs from one location to another, such as Cost Center to Cost Center.[116]

**Cost Center:** A *Cost Center* is a location for collecting costs. The Cost Center can be classified into three major types *Direct Cost Center, Indirect Cost Center* and *ABC Cost Center*. All of these types are made up of several Cost Centers, holding detailed information on how and to whom the costs are to be allocated. Throughout the thesis, in the equations and tables, the Cost Center specification will be referred to as *CCtr*.[117]

**Cost Driver:** A *Cost Driver* is defined as activity related to the production process.[118]

**Flow Group Cost Center:** A *Flow Group Cost Center* is defined as Cost Center that is made up of a product or product family and not by machine type.[119]

---

[111] Kennedy, C. 031908.
[112] Lindberg, T. 031808.
[113] Ibid. 020708.
[114] Andersson, K. 020108./ Kennedy, C. 031108.
[115] Gauffin, Veronica, Cost Accountant, Interview 012508.
[116] Jacobsson, M. 042308.
[117] Kennedy, C. 031408.
[118] Giardino-Gray, Norma, Financial Manager Tooling Supply NAFTA, Interview 042908.
[119] Ibid. 042808.

**Indirect Cost:** The term *indirect cost* is equal to the theoretical term overhead cost.

**Rate:** *Rate* is defined as the cost per Cost Driver unit. An example of a Cost Driver unit is *Number of Articles* if the Cost Driver is *Assortment*.[120]

**Standard Pk:** The *Standard Pk* is the result of the process of allocating budgeted costs to the budgeted production volume. The Standard Pk aims to present, as accurately as possible, a cost per product, as well as to cover all manufacturing costs.[121]

## 4.3   Mapping of ABC in Gimo

The cost allocation process for determine Standard Pk starts out with an update of last year's data, concerning for instance the material price, the operational time of production and volume. The budgeted cost is then estimated, and split into three parts: *direct material cost*, *direct cost* and *indirect cost*. The direct material costs are allocated directly to the Standard Pk, and the direct costs and indirect costs are allocated through Cost Centers. The Direct Costs Centers and Indirect Cost Centers are also charged with allocated costs from other internal units, *Allocation from Other Units* (AOU).[122] The process of allocating of direct material cost, direct cost and indirect cost are described in detail in Chapters *4.3.1 Direct Material Cost*, *4.3.2 Direct Cost Center* and *4.3.3 Indirect Cost Center*, and by Figure 4.1. The disposition of the sub–chapters is made from the boxes and the arrows in Figure 4.1. The introduction to each sub-chapter is made by a figure based on Figure 4.1. The boxes and arrows in figure Figure 4.2, Figure 4.3, Figure 4.4 and Figure 4.5 mark the part of the allocation process that is addressed and is highlighted with a dark frame. The boxes and arrows that are not addressed in the process are shaded

---

[120] Jacobsson, M.  042308.
[121] Ibid.
[122] Andersson, K. 021908.
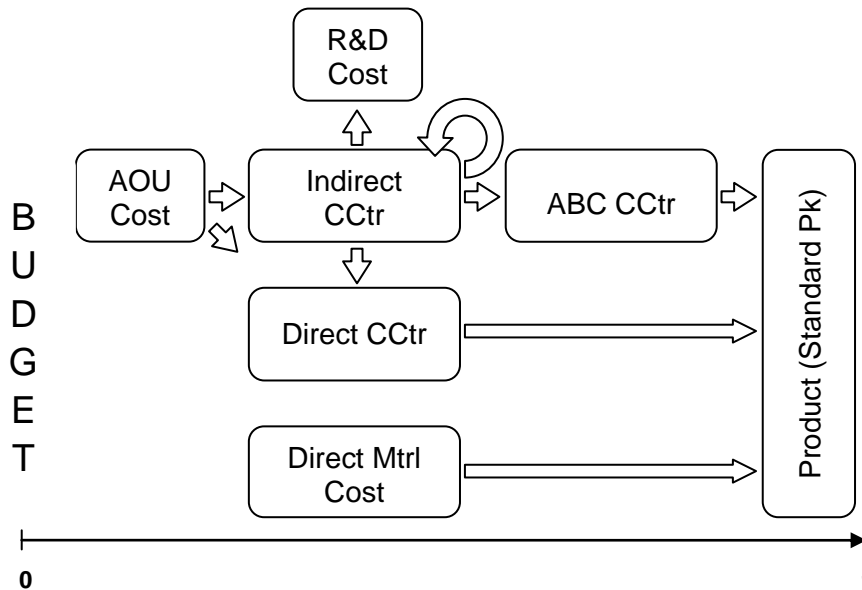
**Figure 4.1 Illustration of the cost allocation process for the plant in Gimo. The groups of Cost Centers, AOU costs, R&D costs, direct material costs and Standard Pk are illustrated by boxes. The arrows portray the flow of cost allocation over time to product/Standard Pk. The value of the x-axis is time.**

### 4.3.1   Direct Material Cost
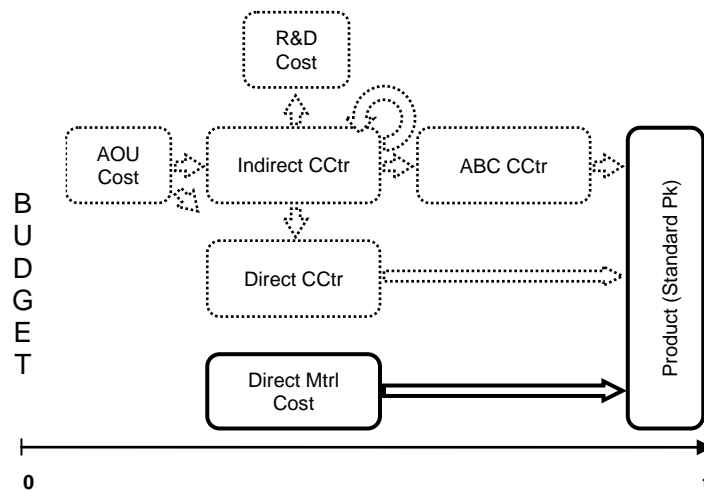


**Figure 4.2 Illustration of the cost allocation flow for direct material cost.**

The direct material cost is allocated directly to the Std $Pk_{mtrl}$, as illustrated in Figure 4.2. In Equation 4.1 the formula for calculating the Std $Pk_{mtrl}$ is presented. The Std $Pk_{mtrl}$ is calculated by the sum of cost of material consumed by the product multiplied by the material price for each type of material consumed. The material price is updated on an annual basis, estimated by forecast or the material price and historic

44

data. In the Equation 4.1 the amount of consumed material is referred in as $m_i$ and the material price as $p_i$.[123]

$$Std\ Pk_{mtrl}\ =\ \sum_{i=1}^{n} m_i \cdot p_i$$

**Equation 4.1 Formula for calculating the Standard Pk material (*Std Pk_mtrl*). The constant $m_i$ (unit of measure: kg or percentage of a piece) stands for the amount of consumed material and $p_i$ (unit of measure: kronor/kg or kronor/piece) is the material price that stems from the $m_i$. The variable of counter $n$ is the number of different material used for the actual manufacturing of the product.**

### 4.3.2 Direct Cost Center
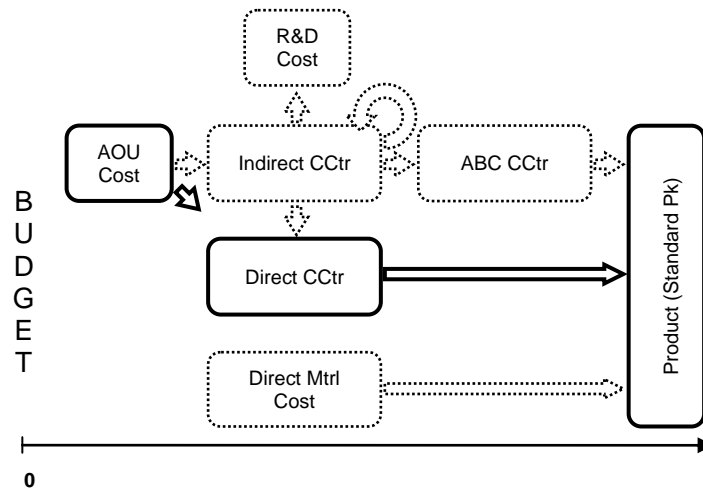


**Figure 4.3 Illustration of the cost allocation flow for the Direct Cost Centers.**

The process of allocation direct costs, in Gimo, is made through Direct Cost Centers as illustrated in Figure 4.3. The Direct Cost Centers are grouped by *Flow Group*.[124] As presented in the figure AOU costs are allocated and added to the Direct Cost Centers. The Direct Cost Centers are made up by both direct cost and indirect cost. The indirect costs are allocated through Indirect Cost Centers to the Direct Cost Centers as presented in the Figure 4.4.[125] The direct costs are then allocated to Std Pk_direct by the cost per hour; *Direct Cost per Hour* (DCH). The DCH varies among Cost Centers and is thereby calculated as presented in Equation 4.2. The DCH are in the unit of measure man-time.[126]

---

[123] Andersson, K. 021908.
[124] Jacobsson, M.  280408.
[125] Gunnarsson-Wahlund, Annika, Cost Accountant, Interview 040108.
[126] Lundahl, Dan, Production Controller, Interview 032508.

$$DCH = \frac{Total\ Direct\ Cost_{CCtr}}{Total\ Nbr\ of\ Direct\ Hour_{CCtr}}$$

**Equation 4.2 Formula for calculating Direct Cost per Hour (*DCH*). The *Total Direct Cost$_{CCtr}$* (unit of measure: kronor) is the total budgeted direct cost allocated to a Direct Cost Center. The *Total Nbr of Direct Hour$_{CCtr}$* (unit of measure: man-hour) is the estimated number of direct hours per Direct Cost Center.**

The Std Pk$_{direct}$ is also made up by a cost for outside vendor. The cost for outside vendor is an external cost charged to the product for operations made on the product by external parties.[127] The Std Pk$_{direct}$ is calculated by: DCH multiplied by the total time of manufacturing as well as the total set-up time added by the cost for outside vendor, and summed up to the Std Pk$_{direct}$. The generalized formula is illustrated by Equation 4.3. In the equation the time of operation for manufacturing is referred to as $t_i$ and the set-up time as $s_i$. The cost for outside vendor is abbreviated as OV.[128]

$$Std\ Pk_{direct} = DCH_i \cdot \sum_{i=1}^{n} (t_i + s_i) + OV$$

**Equation 4.3 Formula for calculating Standard Pk direct (*Std Pk$_{direct}$*). The constant $t_i$ (unit of measure: hour) and $s_i$ (unit of measure: hour) are the operation time for manufacturing as well as the set-up time per manufactured product for the operation *i*. DHC$_i$ is the DHC for the operation *i*. The variable of counter *n* is the number of different operations for the actual manufacturing of the product. The cost for outside vendor is represented in the equation by the constant *OV* (unit of measure: kronor).**

---

[127] Gunnarsson-Wahlund, A. 042308.
[128] Lundahl, D. 032508.

### 4.3.3   Indirect Cost Center
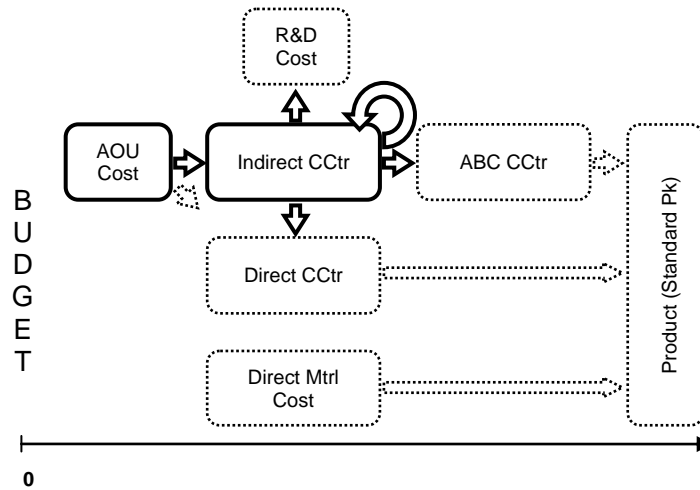


**Figure 4.4 Illustration of the cost allocation flow for the Indirect Cost Centers.**

The Indirect Cost Centers are grouped by *function*.[129] As presented in Figure 4.4, the costs making up the Indirect Cost Centers are both budgeted indirect costs and AOU costs. The process of allocating indirect cost down to Std $Pk_{direct}$ and Std $Pk_{ABC}$ are made in several steps, which are presented, step by step, throughout this chapter. The indirect costs are allocated to Direct Cost Centers, ABC Cost Centers, R&D costs and/or back to Indirect Cost Centers by Allocation Keys. This flow of allocating costs is illustrated in Figure 4.4 by arrows flowing out from the Indirect Cost Centers. The Allocation Keys used for allocating the indirect costs are: *Employees, Staff, Worker* and *Own Cost*. The Allocation Keys are defined as:[130]

- Employees is the number of employees in total, meaning the total number of Staff added by the total number of Worker
- Staff is the total number of staff
- Worker is the total number of workers
- Own Cost is the total direct cost added by the indirect cost of buildings

The four Allocation Keys – Employees, Staff, Worker and Own Cost – are the Allocation Keys in general used for allocating the indirect costs but some of the Indirect Cost Centers use other Allocation Keys to split and allocate the indirect costs. These other Allocation Keys has been given the umbrella term *Other Allocation Keys*. The Indirect Cost Center *Finance* and *Building* is an example of Cost Centers that are allocated by an Allocation Key classified as Other Allocation Keys. The Allocation

---

[129] Jacobsson, M.  042808.
[130] Gunnarsson-Wahlund, A. 021808.

Key for allocate the costs of Finance is *Assortment* and the Allocation Key for allocation the costs of Building is *Space*. A summation of all the Allocation Keys are presented in Table 4.1.[131]

**Table 4.1 Table of Allocation Keys.**

| Allocation Key |
| --- |
| Employees |
| Staff |
| Worker |
| Own Cost |
| Other Allocation Keys (Assortment, Space etc.) |

The Allocation Keys generate a percentage that is used to split the indirect cost. Different Indirect Cost Centers allocate by different Allocation Keys. Which allocating key/keys to use is/are decided by the Indirect Cost Center. The percentages for allocating the indirect costs could also be decided by the person responsible for the Cost Center. The method for calculating the percentages varies from person to person. Some people use methods or directives to calculate the percentages and others based their percentages on an estimate. The accuracy of the percentages varies therefore depending on the people whom are head of the Cost Center.[132] The same percentages used the year before is often used the following year. This loop can be traced back several years. The reason the head of the Cost Center does not change the percentages is because changes to the business have not occurred during their time as the head of Cost Center. The percentages are looked over on a yearly basis.[133]

An example of a cost allocation flow through an Indirect Cost Center is building cost, located at the Indirect Cost Center *Building*, which including heating costs, electricity costs and maintenance costs. The building costs are looped several times and through several Cost Centers. The costs of Building are first split by the Allocation Key Space and are allocated to both Direct Cost Centers and Indirect Cost Centers. The buildings costs, which are allocated to the Indirect Cost Centers, are then allocated by the percentage generated by the Allocation Keys to Direct Cost Centers, ABC Cost Centers and back to Indirect Cost Centers. The building costs are then allocated further through the Cost Centers, and eventually allocated to the Standard Pk.[134]

---

[131] Gunnarsson-Wahlund, A. 021808
[132] Ibid.
[133] Andersson, K. 030408.
[134] Gunnarsson-Wahlund, A. 043008.

### 4.3.3.1 Allocating by Direct Cost Center

As previously described, the Indirect Cost Centers allocated to four different types of Cost Centers/larger groups of costs; one of these types is the Direct Cost Centers. The indirect costs are split by the Allocation Keys presented above and allocated to the Direct Cost Centers, and then further down to Std Pk$_{direct}$ as described in Chapter *4.3.2 Direct Cost Center*. As presented above the costs of buildings are an example of indirect costs that are allocated, by Allocation Key Space, to the Direct Cost Centers.[135]

### 4.3.3.2 Allocating by ABC Cost Center
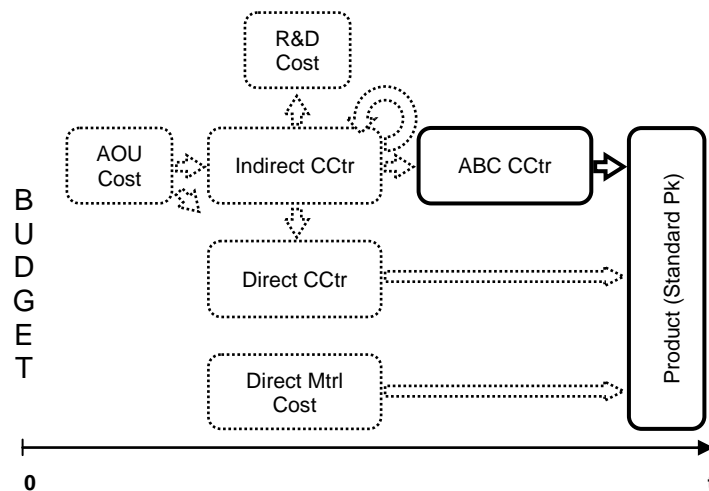


**Figure 4.5 Illustration of the cost allocation flow for the ABC Cost Centers.**

The ABC model is used as a part of the process for allocating indirect costs to the Std Pk$_{ABC}$. The allocation process of allocation is made through ABC Cost Centers (Figure 4.5), which are grouped by *Cost Drivers* and *products*.[136] The Indirect Cost Centers allocate indirect costs to the ABC Cost Centers, that further allocate the indirect costs to Std Pk$_{ABC}$. The indirect costs that are allocated to ABC Cost Centers are referred to as ABC costs. The ABC Cost Centers use Cost Drivers and Rates to allocate the ABC costs to the Std Pk$_{ABC}$. The Std Pk$_{ABC}$ is calculated as presented in Equation 4.8.[137]

The Cost Drivers and their Rates for allocating ABC costs are: *Man-hour* and *Cost per Man-hour* (CMH), *Assortment* and *Cost per Assortment* (CAS), *WO* and *Cost per*

---

[135] Gunnarsson-Wahlund, A. 021808.
[136] Jacobsson, M. 280408.
[137] Andersson, K. 021908

*WO* (CWO) and *Volume* and *Direct Cost Mark–Up*. These for Cost Drivers and their Rates are presented in Table 4.2. The formulas for calculating the Rates – CMH, CAS and CWO and Direct Cost Mark–Up – are presented in the equations below (Equation 4.4 – Equation 4.7).[138]

**Table 4.2 Table of the Cost Drivers and their Rates.**

| Cost Driver | Rate |
| --- | --- |
| Man-hour | Cost per Man-hour |
| Assortment | Cost per Assortment |
| WO | Cost per WO |
| Volume | Direct Cost Mark–Up |

$$CMH = \frac{Total\ ABC\ Cost_{CCtr}}{Total\ Nbr\ of\ Hour_{CCtr}}$$

**Equation 4.4 Formula for calculating Cost per Man-hour (*CMH*). The CHM is calculated by the summation of all ABC costs allocated to the ABC Cost Center (*Total ABC Cost$_{CCtr}$* in the unit of measure: kronor) divided by summation of the total number of hours for the ABC Cost Center (*Total Nbr of Hour$_{CCtr}$*, in the unit of measure: man-hour).**

$$CAS = \frac{Total\ ABC\ Cost_{CCtr}}{Total\ Nbr\ Variety\ of\ Product_{CCtr}}$$

**Equation 4.5 Formula for calculating Cost per Assortment (CAS). The CAS is calculated by the summation of all ABC costs allocated to the ABC Cost Center (*Total ABC Cost$_{CCtr}$*, in the unit of measure: kronor) divided by summation of the total number variety of product for the ABC Cost Center (*Total Nbr Variety of Product$_{CCtr}$*, in the unit of measure: piece).**

$$CWO = \frac{Total\ ABC\ Cost_{CCtr}}{Total\ Nbr\ of\ WO_{CCtr}}$$

**Equation 4.6 Formula for calculating Cost per WO (CWO). The CWO is calculated by the summation of all ABC costs allocated to the ABC Cost Center (*Total ABC Cost$_{CCtr}$*, in the unit of measure: kronor) divided by summation of the total numbers variety of WOs for the ABC Cost Center (*Total Nbr of WO$_{CCtr}$*, in the unit of measure: nbr).**

---

[138] Lundahl, D. 032508.

$$DirectCostMarkUp = \frac{Total\ ABC\ Cost_{CCtr}}{Total\ Direct\ Cost_{CCtr}}$$

**Equation 4.7 Formula for calculating Direct Cost Mark–Up (DirectCostMarkUp). The Direct Cost Mark–Up is calculated by the summation of all ABC costs allocated to the ABC Cost Center (*Total ABC Cost<sub>CCtr</sub>*, in the unit of measure: kronor) divided by summation of the total direct costs for the ABC Cost Center (*Total Direct Cost<sub>CCtr</sub>*, in the unit of measure: kronor).**

The Cost Drivers and thereby the Rates vary by ABC Cost Center, meaning each ABC Cost Center just uses one Rate to allocate costs to the Std Pk$_{ABC}$, but the four Cost Drivers and their Rates are used by more than one ABC Cost Center.[139] The ABC Cost Centers follow rules on how to allocate and which Rate to use.[140] An ABC Cost Center can also allocate to multiple products. This renders, since the Allocation Keys vary by ABC Cost Center, that the product may not be hit by CMH, CAS, CWO or Direct Cost Mark–Up (The constant CMH, CAS, CWO or Direct Cost Mark–Up are set to zero in Equation 4.8). The Standard Pk$_{ABC}$ is calculated by adding: the CHM multiplied by the sum of the total time of manufacturing and the total set-up time, the Direct Cost Mark-Up multiplied by the Standard Pk$_{direct}$, the CAS divided by the estimated number of pieces corresponding to the yearly volume, and the CWO divided by the number of pieces per WO.[141]

$$Std\ Pk_{ABC} = CMH_i \cdot \sum_{i=1}^{n}(t_i + s_i) + DirectCostMarkUp_i \cdot Std\ Pk_{direct}$$
$$+ \frac{CAS_i}{Nbr\ of\ Piece_i} + \frac{CWO_i}{Nbr\ of\ Piece\ WO_i}$$

**Equation 4.8 Formula for calculating Standard Pk ABC (*Std Pk<sub>ABC</sub>*). The constant *t<sub>i</sub>* (unit of measure: hour) and *s<sub>i</sub>* (unit of measure: hour) are the operation time for manufacturing as well as the set-up time per manufactured product for the operation *i*. The variable of counter *n* is the number of different operations for the actual manufacturing of the product. *Nbr of Piece* (unit of measure: piece) is the total number of pieces that correspond to the yearly volume. *Nbr of Piece WO* (unit of measure: piece) is the number of products per WO.**

The Standard Pk is made up by three parts as described earlier. The last part in the cost allocation process is thereby to sum up the three parts. The summation of the Standard Pk is made as presented in Equation 4.9.[142]

---

[139] Andersson, K. 021908.
[140] Lundahl, D. 032508.
[141] Ibid.
[142] Andersson, K. 021908.

$$Std\ Pk = Std\ Pk_{mtrl} + Std\ Pk_{direct} + Std\ Pk_{ABC}$$

**Equation 4.9 Formula for calculating Standard Pk (*Std Pk*).**

### 4.3.3.3 Allocating to R&D Cost

The indirect costs for R&D are allocated to the larger group of cost *R&D Cost*. These indirect costs are not allocated to the Standard Pk and are thereby not presented further.[143]

### 4.3.3.4 Allocating by Indirect Cost Center

As presented by the circular arrow in the Figure 4.4, the Indirect Cost Centers allocate indirect costs back to Indirect Cost Centers. The loop – Indirect Cost Centers to Indirect Cost Centers – loops back multiple times, but the indirect costs are eventually allocated to the Standard Pk through the Direct Cost Centers and/or ABC Cost Centers. The indirect costs may also be allocated to the larger group of cost R&D Cost. The process of allocating indirect costs through Indirect Cost Centers is described in Chapter *4.3.3 Indirect Cost Center*.[144]

## 4.4 Mapping of ABC in Mebane

The first step of the cost allocation process in Mebane is to estimate the number of products that will be manufactured within each Flow Group, during the upcoming year. This renders an estimated quantity, and, together with historical data, a base for estimating budget costs will be achieved. The estimated budget is then split into three groups*:* direct material cost, direct cost and indirect cost. Then, it is allocated to the product by Cost Drivers and Rates through Cost Centers. The direct material cost is allocated directly onto the product. Direct costs and indirect costs are split to Direct Cost Centers and Indirect Cost Centers.[145]

The Indirect Cost Centers are partly constituted by budgeted costs and AOU costs and are furthermore directed to Direct Cost Centers, ABC Cost Centers, R&D costs and Indirect Cost Center. This renders the result that ABC Cost Centers are built up by indirect costs. Each Direct Cost Center is linked to each individual Flow Group and the operation heat treatment.[146] The allocation model for Mebane is presented in Figure 4.6. As in Chapter *4.3 Mapping of ABC in Gimo* the disposition of the sub-chapters are made by the boxes and arrows in Figure 4.6. The introduction to each sub-chapter is made by a figure based on Figure 4.6. The boxes and arrows in figure

---

[143] Andersson, K. 021908.
[144] Gunnarsson-Wahlund, A. 021808.
[145] Kennedy, C. 031108.
[146] Ibid.

Figure 4.7, Figure 4.8, Figure 4.9 and Figure 4.10 mark the part of the allocation process that is addressed and is highlighted with a dark frame. The boxes and arrows that are not addressed in the process are shaded.
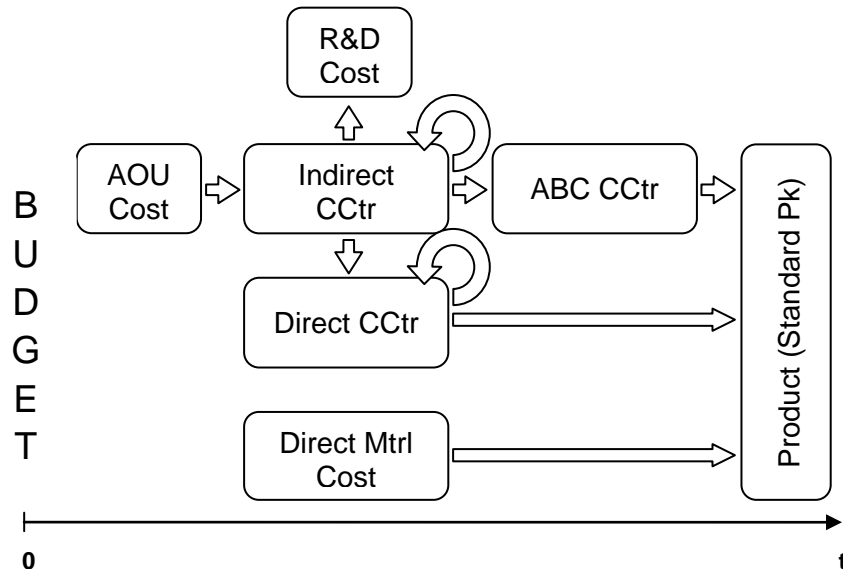


**Figure 4.6 Illustration the cost allocation flow for the plant in Mebane. The groups of Cost Centers, the budgeted costs, the AOU costs, the R&D costs, the direct material costs and the Standard Pk are illustrated by boxes. The arrows portray the flow of cost allocation over time to product/Standard Pk. The value of the x-axis is time.**

## 4.4.1 Flow Group

The manufacturing layout within the Mebane plant is of a so called flow based layout. Five different product categories are manufactured, and the layout of the manufacturing area is divided into five Flow Groups. The Flow Groups for standards are Boring Bars, Milling, Turning and Ejector Drill, all named after the product category manufactured within the Flow Group. The fifth Flow Group is for specials.[147] Each Flow Group is also linked to a Direct Cost Center, summing up all direct costs for each specific Flow Group. The collected costs at each Direct Cost Center are direct costs and some indirect costs, such as building costs and depreciation and ABC costs.[148]

---

[147] Barber, Jon, General Manager TSUS/M, Interview 022908.
[148] Kennedy, C. 031108.

## 4.4.2 Direct Material Cost
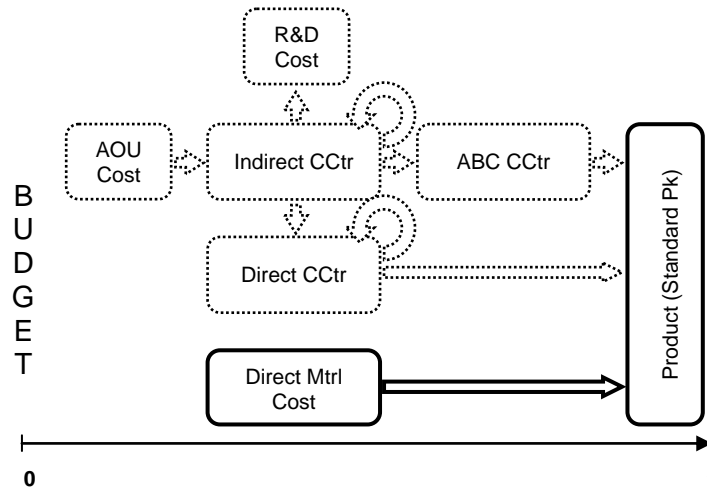


**Figure 4.7 Illustration of the cost allocation flow for the direct material cost.**

The direct material cost is made up by the cost of material and the cost of any work performed by an outside vendor. These costs are estimated with the aid of historical data from the previous year's costs, added to the estimated price change in material and in outside vendor. The estimated cost of direct material is multiplied by the material consumed when manufacturing the product and added by the cost of outside vendor. This collected cost makes up the Std Pk$_{mtr1}$ (Equation 4.10). The allocation of material cost is presented in Figure 4.7. [149]

$$Std\ Pk_{mtrl} = \sum_{i=1}^{n}(m_i \cdot p_i) + OV$$

**Equation 4.10 Formula for calculating the Standard Pk material (*Std Pk$_{mtrl}$*). The constant *m$_i$* (unit of measure: pound or percentage of a piece) stands for amount of consumed material and *p$_i$* (unit of measure: dollar/pound or dollar/piece) is the material price stem from the m$_i$. The cost for outside vendor is presented by the constant *OV* (unit of measure: dollar).**

---

### 4.4.3  Direct Cost Center



**Figure 4.8 Illustration of the cost allocation flow for the Direct Cost Centers.**

The Direct Cost Centers are constituted by direct costs and indirect costs. The Direct Cost Centers can be divided into two major groups, *Cost Center by Flow Group* (Flow Group Cost Center) and *Cost Center by operation*. The Cost Center by operation, *Heat Treatment*, is the only one of its kind and is allocated back to the Flow Group Costs Centers. This is illustrated by the circular arrow in Figure 4.8.[150]

The total cost allocated to Heat Treatment (*Total Cost of Heat Treatment*) is split and allocated to each Flow Group Cost Center. The Total Cost of Heat Treatment per Flow Group is then allocated equally to each individual product that uses the operation (*Cost of Heat Treatment per Piece*). The allocation could also be done by splitting Total Cost of Heat Treatment equally among all products that use the operation, independent of Flow Group. The calculation of Cost of Heat Treatment per Piece is presented in Equation 4.11, and is abbreviated as HT in the equation.[151]

$$HT = \frac{Total\ Cost\ of\ HT}{Total\ Nbr\ Pieces\ Heat\ Treated}$$

**Equation 4.11 Formula for calculating the Cost of Heat Treatment per piece (*HT*). The Total Cost of Heat is presented by *Total Cost of HT* (unit of measure: dollar). *Total Nbr Pieces Heat Treated* (unit of measure: piece) is the estimated total number of pieces to be heat treated.**

---

[150] Kennedy, C. 031108.
[151] Ibid. 031308.

The direct costs that are allocated directly to the Flow Group Cost Centers, and the indirect costs that are allocated to the Flow Group Cost Centers, are flowed down to the product by the Rate *Direct Hourly Rate* (DHR). DHR is the direct average cost Rate by the hour per Flow Group, calculated by Equation 4.12. DHR varies between the Flow Group Cost Centers.[152] In the equation Flow Group is shorted as FG. The estimated number of hours per Flow Group is the estimated time (unit of measure machine-hour) it takes to manufacture the estimated number of pieces within the Flow Group.[153]

$$DHR = \frac{Total\ Direct\ Cost_{FG} - Total\ Cost\ of\ HT_{FG}}{Total\ Nbr\ of\ Hour_{FG}}$$

**Equation 4.12 Formula for calculating the Direct Hourly Rate (DHR). The DHR per Flow Group is calculated by the total direct cost (*Total Direct Cost$_{FG}$*, in the unit of measure: dollar) subtracted by the total cost of heat treatment (*Total Cost of HT$_{FG}$*, in the unit of measure: dollar) and divided by the estimated number of hours (*Total Nbr of Hour$_{FG}$*, in the unit of measure: hour).**

The Std Pk$_{direct}$ is made up by the total costs of manufacturing per piece, added by the Cost of Heat Treatment per Piece (Equation 4.13). To obtain the total cost of manufacturing per piece, the sum of the total time of manufacturing and the total set-up time is multiplied by the DHR. In Equation 4.13 the operation time of manufacturing is referred to as $t_i$ and the set-up time as $s_i$.[154]

$$Std\ Pk_{direct} = DHR_i \cdot \sum_{i=1}^{n} (t_i + s_i) + HT$$

**Equation 4.13 Formula for calculating the Standard Pk direct (Std Pk$_{direct}$). The constant $t_i$ (unit of measure: hour) is the operation time for manufacturing and $s_i$ (unit of measure: hour) is the set-up time per manufactured product, for the operation *i*. DHR$_i$ is the DHR or the Flow Group i. The variable of counter *n* is the number of different operations for the actual manufacturing of the product. The Cost of Heat Treatment per piece is represented by the constant *HT* (unit of measure: dollar/piece).**

---

[152] Kennedy, C. 031308.
[153] Ibid. 031908.
[154] Ibid. 031308.
56

### 4.4.4 Indirect Cost Center



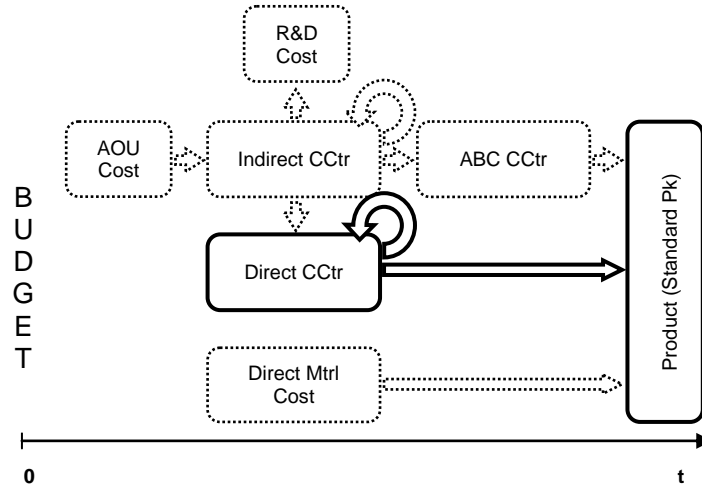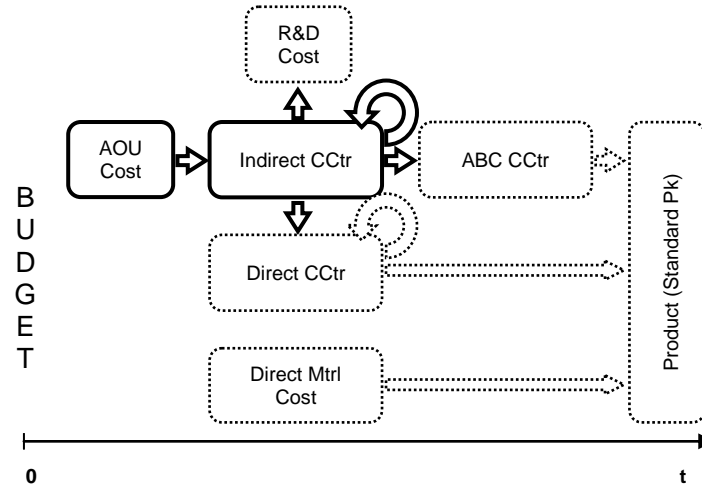**Figure 4.9 Illustration of the cost allocation flow for the Indirect Cost Centers.**

The Indirect Cost Centers are grouped by *function and serviced provide to each Flow Group*.[155] The costs making up the Indirect Cost Centers are both budgeted costs and AOU costs. AOU Cost is made up by costs allocated to Mebane from example the Fair Law office or from Sandvik in Sweden. The Fair Lawn office takes care of Mebane´s financial process because the Mebane plant does not have its own financial department. Sweden charges Mebane with, for example, the costs of IT support.[156]

The allocation of indirect costs is made up in two steps (Figure 4.9). First the indirect costs are allocated to Direct Cost Centers, ABC Cost Centers, R&D cost and/or Indirect Cost Centers with the Cost Drivers presented in Table 4.3. The Cost Drivers generate a percentage that is used to split the indirect cost. In a second step the indirect costs are flowed down to Standard Pk by the allocation method used for each Cost Centers/larger group of costs – Direct Cost Centers, ABC Cost Centers, R&D costs and Indirect Cost Centers.[157]

---

[155] Kennedy, C. 042908.
[156] Ibid. 031108.
[157] Ibid.

**Table 4.3** Table of the Cost Drivers.

| Cost Driver |
| --- |
| Space |
| Machine Value |
| Product Assortment |
| Expendable Supplies and Mtrl Cost Budget |
| Repair and Maintenance Budget |

### 4.4.4.1 Allocating by Direct Cost Center

The arrow in Figure 4.9, pointing from the Indirect Cost Centers to the Direct Cost Centers, indicates that some of the indirect costs are being allocated to the Direct Cost Centers. These indirect costs are included in the DHR. An example of indirect costs that are allocated to the Direct Cost Centers is the building costs (includes costs such as cost of buildings, cost of electricity and cost of heating). The building costs are allocated by the Cost Driver *Space*.[158]

Another example of indirect costs that are allocated to the Direct Cost Centers is the indirect costs, located at the Cost Center *Personal Property Tax*, which is allocated with the Cost Driver *Machine Value*. Each Cost Center by flow is charged by the value of the machine.[159] The Personal Property Tax is the tax on the machines and equipment that Mebane is charged by the state of North Carolina.[160]

---

[158] Kennedy, C. 031108.
[159] Ibid. 031908.
[160] Ibid. 031408.

### 4.4.4.2    Allocating by ABC Cost Center
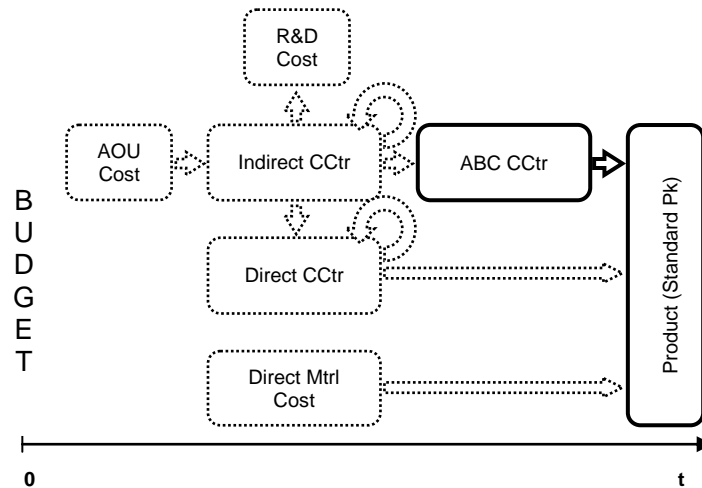


**Figure 4.10 Illustration of the cost allocation flow for the ABC Cost Centers.**

The Indirect Cost Centers allocate indirect costs to ABC Cost Centers by a percentage.[161] The process of allocating indirect costs through ABC Cost Centers is presented in Figure 4.10. The indirect costs, which are allocated to ABC Cost Centers, are referred to as ABC costs.  The ABC costs are allocated to Std Pk$_{ABC}$ by *Method of Charging Cost to Standard Pk*, presented in Table 4.4. *The Method of Charging Cost to Standard* also makes up the grouping of the ABC Cost Centers. The five ABC Cost Center thereby are named: *Piece Charge – ED*, *Piece Charge – Other*, *WO Charge – ED*, *WO Charge – Other* and *Pk Mark–Up*. [162]

**Table 4.4 Table of the ABC Cost Centers and their Method of Charging Cost to Standard Pk.**

| ABC CCtr | Method of Charging Cost to Standard Pk |
|---|---|
| Piece Charge – ED | Fixed Charge per ED Piece |
| Piece Charge – Other | Fixed Charge per Other Piece |
| WO Charge – ED | Fixed Charge per ED WO |
| WO Charge – Other | Fixed Charge per WO Other |
| Pk Mark–Up | Pk Mark–Up |

---

[161] Giardino-Gray, N. 022708.
[162] Kennedy, C. 042908.

The ABC cost is allocated differently depending on the ABC Cost Center. The ABC costs are split and allocated either between the Ejector Drill (ED) products or the other standard products put together (*Other*). The manufacturing of the ED product is highly man intensive compared to the rest of the Flow Group within standard products, having a fully automated manufacturing. This is the reason for splitting the ABC costs between the ED and Other.[163]

The ABC costs related to the ED Flow Group are allocated by *Fixed Charge per ED Piece* and *Fixed Charge per ED WO*. The Other ABC costs are allocated by the Method of Charging Cost to Standard Pk *Fixed Charge per Other Piece* and *Fixed Charge per WO Other*. These four Methods of Charging Cost to Standard Pk generate fixed amounts, which are calculated annually. The formulas used to calculate the Method of Charging Cost to Standard Pk are presented in Equation 4.14 – Equation 4.17. Fixed Charge per ED Piece and Fixed Charge per Other Piece are calculated by the same formula, like for Fixed Charge per ED WO and Fixed Charge per WO Other.[164]

$$Fixed\ Charge\ per\ ED\ Piece = \frac{Total\ ABC\ Cost_{Piece\ Charge-ED}}{Total\ Nbr\ of\ ED\ Piece}$$

**Equation 4.14 Formula for calculating the *Fixed Charge per ED Piece*. The *Total Cost$_{Piece\ Charge\text{-}ED}$* (unit of measure: dollar) is the summation of all ABC amounts allocated to the ABC Cost Center Piece Charge – ED. *Total Nbr of ED Piece* (unit of measure: piece) is the total number of ED pieces.**

$$Fixed\ Charge\ per\ ED\ WO = \frac{Total\ ABC\ Cost_{WO\ Charge-ED}}{Total\ Nbr\ of\ ED\ WO}$$

**Equation 4.15 Formula for calculating the *Fixed Charge per ED WO*. The *Total Cost$_{WO\ Charge\text{-}ED}$* (unit of measure: dollar) is the summation of all ABC amounts allocated to the ABC Cost Center WO Charge – ED. *Total Nbr of ED WO* (unit of measure: nbr) is the total number of ED WO.**

$$Fixed\ Charge\ per\ Other\ Piece = \frac{Total\ ABC\ Cost_{Piece\ Charge-Other}}{Total\ Nbr\ of\ Other\ Piece}$$

**Equation 4.16 Formula for calculating the *Fixed Charge per Other Piece*. The *Total Cost$_{Piece\ Charge\text{-}Other}$* (unit of measure: dollar) is the summation of all ABC amounts allocated to the ABC Cost Center Piece Charge – Other. *Total Nbr of Other Piece* (unit of measure: piece) is the total number of Other pieces.**

---

[163] Kennedy, C. 031108.
[164] Ibid.

$$Fixed\ Charge\ per\ WO\ Other = \frac{Total\ ABC\ Cost_{WO\ Charge\ -Other}}{Total\ Nbr\ of\ Other\ WO}$$

**Equation 4.17 Formula for calculating the *Fixed Charge per WO Other*. The *TotalCost$_{WO}$ $_{Charge-Other}$* (unit of measure: dollar) is the summation of all ABC amounts allocated to the ABC Cost Center WO Charge – Other. *Total Nbr of Other WO* (unit of measure: nbr) is the total number of other WO.**

The Std Pk$_{ABC}$ is then calculated by equations presented in Equation 4.18. The products classified as ED are calculated by the fixed amount generated by Fixed Charge per ED Piece and Fixed Charge per ED WO. In other case the fixed amounts generated by Fixed Charge per Other Piece and Fixed Charge per WO Other are used as the Cost per Piece (Fixed Charge$_{Piece}$) and Cost per WO.[165]

$$Std\ Pk_{ABC} = Cost\ per\ Piece + \frac{Cost\ per\ WO}{Nbr\ of\ Piece\ WO}$$

**Equation 4.18 Formula for calculating the Standard Pk ABC (*Std Pk$_{ABC}$*). Depending on which category – ED or Other, the product belongs to, the constant *Cost per Piece* is replaced by either the fixed amount calculated by *Fixed Charge per ED Piece* or *Fixed charge per Other Piece*. The same rules are applied on *Cost per WO*, but instead the constant is replaced by the fixed amount *Fixed charge per ED WO* or *Fixed charge per WO Other*. *Nbr of Piece WO* (unit of measure: piece) is the total number of pieces within a WO.**

The final step in calculating the Standard Pk for a product is to sum up all costs related to the Standard Pk – Std Pk$_{mtrl}$, Std Pk$_{direct}$ and Std Pk$_{ABC}$ – and then multiply the sum by the percentage Pk Mark–Up. The calculation of the total Standard Pk is presented in Equation 4.20. The formula of calculation the Pk Mark–Up is described in Equation 4.19.[166]

$$PkMarkUp = \frac{Total\ Cost_{Pk\ Mark\ -UP}}{Total\ Production\ Cost}$$

**Equation 4.19 Formula for calculating the Pk Mark–Up (*PkMarkUp*). The *Total Cost$_{Pk}$ $_{Mark-Up}$* (unit of measure: dollar) is the summation of all ABC amounts allocated to the ABC Cost Center Pk Mark–Up. The *Total Production Cost* (unit of measure: dollar) is the sum of all cost – direct material cost, direct costs, indirect costs.**

$$Std\ Pk = (1 + PkMarkUp) \cdot (Std\ Pk_{mtrl} + Std\ Pk_{direct} + Std\ Pk_{ABC})$$

**Equation 4.20 Formula for calculating the Standard Pk (*Std Pk*).**

---

[165] Giardino-Gray, N. 041608.
[166] Kennedy, C. 031908.

### 4.4.4.3 Allocating to R&D Cost

The indirect costs for R&D are allocated monthly to Sandvik in Sweden. The indirect costs that are allocated back to Sweden are costs for new product development or start up cost, for setting up new manufacturing process or concept. The reengineering cost, on the other hand, is not allocated to the R&D costs, but is allocated within the plant.[167]

### 4.4.4.4 Allocating by Indirect Cost Center

As preened in Figure 4.9 by the looped arrow, Indirect Cost Centers allocate indirect costs back once to Indirect Cost Centers. These indirect costs are then allocated to the product through ABC Cost Centers, described in detailed in Chapter *4.4.4.2 Allocating by ABC Cost Center*. The only costs looped once within the Indirect Cost Centers are the building costs. These indirect costs are allocated to both Direct Cost Centers and to Indirect Cost Centers by the Cost Driver Space. The building costs that are allocated to the Indirect Cost Centers are in a second step allocated to ABC Cost Centers, and then allocated to Std $Pk_{ABC}$.[168]

## 4.5 Technical Solution

The last stage within the cost allocation process is to calculate the Standard Pk in an information system. This process is referred to as the *Standard Pk process*. The information system used for calculating the Standard Pk in Mebane is the *Group Supplier System* (GSS). The GSS is a Sandvik Tooling in-house built information system used for reporting and planning.[169] GSS is a data source and acts as an umbrella for a number of modules. These modules gather and store data concerning the product's journey from WO (work order) start-up until the WO is closed and sold to the customer. The modules in GSS are as follows: *Carin*, *Skeleton*, *Pk–Module*, *GSS MIS*, and *Production Follow-Up*.[170] The user of GSS cannot modify it to meet personal preferences. The information system comes only in an English language version.[171] In Gimo, GSS is likely to be implemented. They are currently running Zenith, Carin, Sopic and Skeleton and an information system equivalent to GSS MIS. The Standard Pk process is done in *Pre-Calculation Program* (a translation of the Swedish name of the information system Förkalkyleringsprogrammet).[172]

---

[167] Kennedy, C. 031408.

[168] Ibid. 031108.

[169] Giardino-Gray, N. 022508.

[170] Ibid. 041608.

[171] Ögren, Thomas, Process and System Co-Ordinator, Interview 020808.

[172] Jacobsson, M. 042808.

The flow of the WO, from set-up to finished good, starts when the customer places an order. In the case of Sandvik Tooling's manufacturing, there is only one customer, the *Distribution Center* (DC). *Sopic–P*, the ordering information system, takes the order and passes it on to *Zenith* (Zenith is the information system for inventory control, finished goods and production stock, and acts as the database for checking material requirements). The order will be checked in Zenith to see whether the product is in stock or if it has to be manufactured. Zenith feeds information into the GSS modules used in Mebane.[173]

## 4.5.1   GSS Module

Carin is a database of products. Carin also controls information regarding the article and the parameters of how it should work in the other information systems. When data is added or changed in Carin, it will be passed on to the connecting information systems. For example, if a new article code has to be generated, it will be done in Carin and then this product code populates the other information systems. Also, if a change is made to an *Economic Order Quantity* (EOQ) in Zenith, then Carin must be updated.[174] At the product level, Carin is a copy of Zenith, but it contains a date function for holding the Standard Pk date before going live in the information system, and then release it to Zenith and Sopic–P.[175]

The Skeleton module holds the instructions on how to make the product. This information is provided by the engineers, who build the Skeleton. Skeleton provides information for the yearly calculation of the Standard Pk, during which a copy of the live Skeleton database is sent to the Pk–Module. The engineers can then make any required changes to the Skeleton, for the upcoming year, without touching the live data base. If requested, the Standard Pk may be copied back in to Skeleton live module, but after the Standard Pk calculation is completed.  The Skeleton module sends the current "instructions" to GSS MIS when a work order is printed.[176]

The GSS MIS module is used for reporting within the shop floor. GSS MIS holds the DHR and the Method of Charging Cost to Pk – Fixed Charge per ED Piece, Fixed Charge per Other Piece, Fixed Charge per ED WO, Fixed Charge per WO Other, and Pk Mark-Up. GSS MIS provides the DHR and the Method of Charging Cost to Standard Pk to Pk–Module during the Standard Pk process. When the order to make a product in placed in Zenith, the production planner gets a notification about a WO suggestion. This then gets approved or disapproved. If approved, the WO is opened in GSS MIS. The information system checks "instructions" from Skeleton as to how the

[173] Giardino-Gray, N. 012808.
[174] Kaminski, Bernard, Production Manager, Interview 041608.
[175] Giardino-Gray, N. 041608.
[176] Kennedy, C. 031308.

product should be produced.[177] Time and material used on the shop floor is reported into GSS MIS. The actual WO cost is calculated by GSS MIS, taking the DHR multiplied by the labor hours reported, material used in the WO multiplied by the current cost of material in Carin, the cost of any reported rejected material is calculated with the above costs up to the point of the rejection, and the occurrence of cost drivers multiplied by the Method of Charging Cost to Standard Pk.[178]

The Pk–Module holds information and calculates new Standard Pk for standard products only. The Standard Pk process is done yearly. The Pk–Module can be re-run several times throughout the Standard Pk process, allowing the user to review the costs until satisfactory before going live in the information system and updating Carin with the new year Standard Pk. The Pk–Module consists of four parts; *new EOQ*, *costs of material*, *DHR and Method of Charging Cost to Standard Pk,* and *Skeleton input*.[179]

New EOQs are calculated based on sales forecasts, run times, etc., by the Materials group. The EOQ is loaded into Carin and then to the Pk–Module. The DHR and Method of Charging Cost to Standard Pk are based on the budget, and are calculated in an Excel spread sheet. The DHR are keyed in manually into the GSS MIS or Pk–Module, and Method of Charging Cost to Standard Pk is keyed into GSS MIS.[180] The calculation of Std $Pk_{mtrl}$, Std $Pk_{direct}$ and Std $Pk_{ABC}$ in the information system cannot be changed because it is locked in the information system. These formulas were determined about a decade ago. The calculated DHR and Method of Charging Cost to Standard Pk, on the other hand, are adjustable.[181]

New costs of material are updated in Pk–Module by two methods. If the raw material is sourced by Sandvik Tooling, Zenith updates Pk–Module, and freight and duty factors can be added. If the material is externally sourced, the new cost of material is manually entered into Pk–Module. The Pk–Module receives a copy of the live Skeleton database from Skeleton. The Pk–Module receives and sends information to Carin, which holds the product master.[182]

The Production Follow-Up information system presents daily/weekly/monthly reports of the data entered into GSS MIS. Business Objects, IC, GSS Follow-Up are the reporting information systems collecting data from GSS and putting it into databases,

---

[177] Giardino-Gray, N. 012808.
[178] Ibid. 050208.
[179] Ibid. 041608
[180] Ibid.
[181] Ögren, T. 020808.
[182] Giardino-Gray, N. 041608.

reports are predetermined in GSS follow up, user created in the other information systems.[183]

## 4.5.2 Standard Pk Process in GSS[184]

As discussed in the Chapter concerning ABC mapping in Mebane, determining the Standard Pk is made up by a series of steps. This cost allocation process in carried out on Excel spread sheets as well as in the different modules within the GSS modules. The cost allocation process to determine the Standard Pk is done in the last quarter of the year and after the budget is set.

1. The Standard Pk process starts out when the DHR are supplied to the logistics department in order for them to calculate the EOQ.

2. The minimum and maximum order quantities are reviewed in Carin. This is done throughout the year by the production group, and will give an indication of the capacity at hand. If for instance an EOQ exceeds the maximum quantity, then the order will not go through. In Mebane, the maximum quantities are set in order to prevent machines from getting tied up. Minimum quantities are not used in Mebane because the product's nature allows order quantities be small. A customer may for instance order a single Milling Cutter. Minimum order quantities can be used at other production locations.

3. The engineers enter/review the instructions on how to make the product in Skeleton. This information will include a product's planned set-up time and run-time.

4. Rates for duty and freight of raw material, such as steel ordered from Sweden, will be entered into GSS MIS.

5. Skeletons are updated and sent to the Pk–Module.

6. Zenith sends the transfer prices for raw material ordered from Sandvik Tooling. New year standard costs for external sourced raw material are entered manually into PK–Module.

7. EOQ are loaded into Carin by the logistics department, and then sent to Pk–Module.

8. DHR and Method of Charging Cost to Standard Pk are entered into the Pk–Module and/or GSS MIS. The DHR and Method of Charging Cost to Standard Pk are calculated in an Excel spread sheet.

9. The Pk–Module gets updated with all of the information provided by modules within the steps above. The Pk–Module processes the information and then sends it back to the other modules when requested.

10. Final calculation of Standard Pk is completed in Pk–Module.

---

[183] Giardino-Gray, N. 041608.
[184] Giardino-Gray, N. 041608. /Kennedy, C. 031308.

11. The Pk–Module will send the calculated Standard Pk to Carin. Carin will in turn send it to Sopic–P on the go-live date because Sopic–P lacks a date function. Sopic–P will use the Standard Pk in order to determine the Supplier Unit Price (SUP). This is done in Sopic–P by applying a markup percentage to the Standard Pk. The SUP will be sent to Zenith. Zenith sends an SSP (Stock to Stock Price) to affiliate DCs', and a transfer price to Sopic–S for stock being sold to an external customer. With the provided information, a suggested sales price will determined. This is based on what the market will bear.

12. GSS is updated in live with the Standard Pk, costs of material, the year's DHR, the year's Method of Charging Cost to Standard Pk and updated skeletons.

# 5 Comparisons

*This chapter will present the key differences separating the cost allocations process used in Gimo and in Mebane*

## 5.1 ABC Comparison

The cost allocation model used in Gimo and in Mebane is illustrated in Table 5.1. The dark arrows in the figure mark the differences between the cost allocation model used in Gimo, compared to the model used in Mebane. The arrows marking the differences represent the allocation of AOU Cost to Direct Cost Centers, Indirect Cost Centers to Indirect Cost Centers and Direct Cost Centers to Direct Cost Centers. The remaining flow of cost allocation is similar.

**Table 5.1 Comparison of the cost allocation process in Gimo and in Mebane. The cost allocation process used in Gimo is presented at the top in the figure. The cost allocation process used in Mebane is presented at the bottom. The differences between the two cost allocation processes are marked with dark arrows. The value of both x-axis is time.**
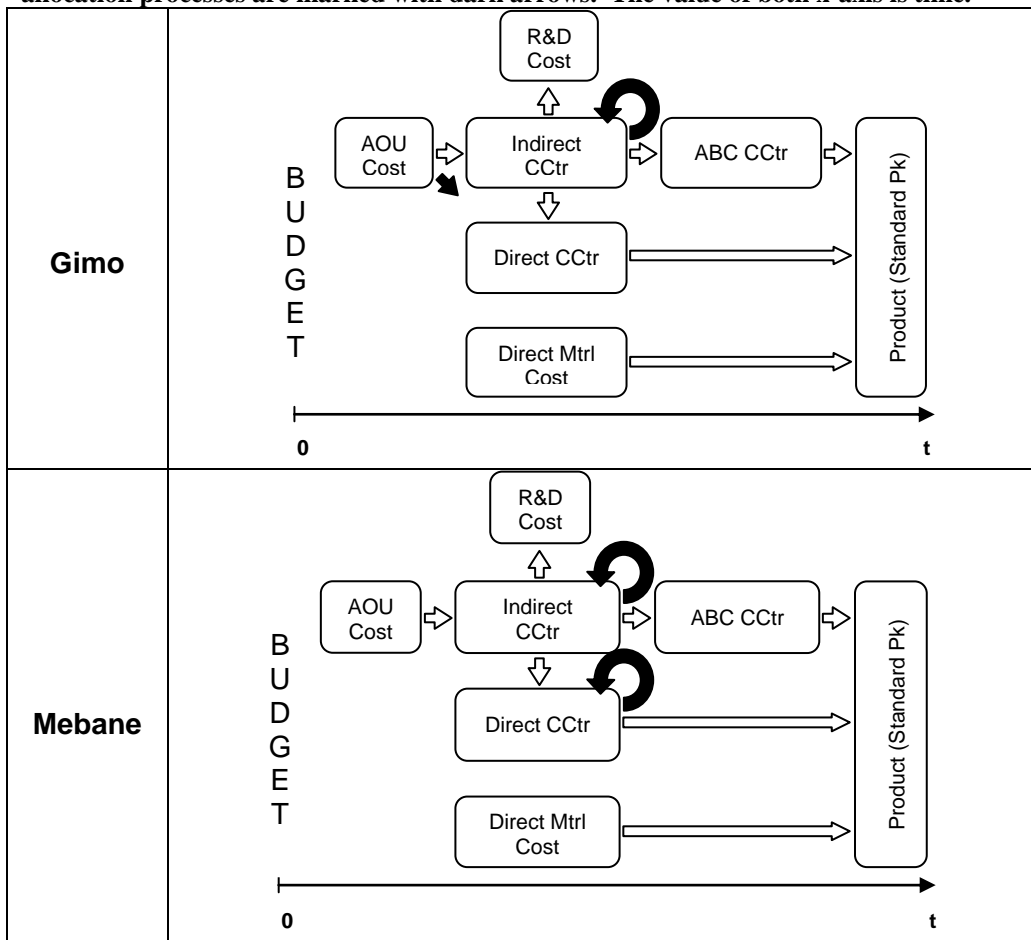
### 5.1.1 Direct Material Cost

The allocation of the direct material cost, both in Gimo and in Mebane, is made in similar ways. The price of material is estimated by historical data and with forecasts regarding changes in the material price during the upcoming year. The direct material costs are allocated to the Std $Pk_{mtrl}$ by the calculation of estimated amount of consumed material multiplied by the estimated price of material. The unit of measure, for instance kilos versus pounds, may differ since the system of measurement separates the two countries. One additional thing separating the two processes of allocating direct material costs is the cost for outside vendor, which is added to the Std $Pk_{mtrl}$ in Mebane, but not in Gimo. The two formulas for calculating the Std $Pk_{mtrl}$ in Gimo and in Mebane is presented, side by side, in Table 5.2.

**Table 5.2 Comparison of Std $Pk_{mtrl}$. The equation used to calculate Std $Pk_{mtrl}$ in Gimo is presented to the left in the table. The formula used in Mebane is presented to the right.**

| Gimo | Mebane |
|---|---|
| $$Std\ Pk_{mtrl} = \sum_{i=1}^{n} m_i \cdot p_i$$ | $$Std\ Pk_{mtrl} = \sum_{i=1}^{n} (m_i \cdot p_i) + OV$$ |

### 5.1.2 Direct Cost Center

The Direct Cost Centers are grouped, both in Gimo and in Mebane, by Flow Group, with the exception of one Direct Cost Center in Mebane that is group by operation. This Direct Cost Center allocates its direct costs to the Flow Group Cost Center and this loop – Direct Cost Center allocating to Direct Cost Center – separates the two allocation processes in Gimo and in Mebane. Otherwise, both processes of allocating direct costs through the Direct Cost Centers are made directly to the Std $Pk_{direct}$, containing both direct costs and indirect costs. The Direct Cost Centers in Gimo are also made up by AOU costs.

The allocation of the costs, located at Direct Cost Centers, to Std $Pk_{direct}$ is made by DCH or DHR. Formulas for calculating both DCH and DHR are presented in Table 5.3. DCH and DHR are calculated alike, but with the difference in the unit of measure. The DCH is in the unit of measure man-hour compared to the DHR which is in the unit of measure machine-hour. The Std $Pk_{direct}$, for both sites, is also calculated in a similar way. The DCH/DHR, is multiplied by total time of operation, plus the total set-up time, added by a constant. The one thing that separates the two formulas is the value of the constant. In the formula used in Gimo, the constant is made up by cost for outside vendor. In Mebane the constant added to the Std $Pk_{direct}$ is the cost of heat treatment. The comparison of the two formulas is presented in Table 5.4.

**Table 5.3 Comparison of hourly cost rate. The equation used to calculate the hourly cost rate in Gimo is presented at the top in the table. The formula used in Mebane is presented at the bottom.**

| Gimo | $DCH = \dfrac{Total\ Direct\ Cost_{CCtr}}{Total\ Nbr\ of\ Direct\ Hour_{CCtr}}$ |
|------|--------------------------------------------------------------------------------|
| Mebane | $DHR = \dfrac{Total\ Direct\ Cost_{FG} - Total\ Cost\ of\ HT_{FG}}{Total\ Nbr\ of\ Hour_{FG}}$ |

**Table 5.4 Comparison of Std Pk_direct. The equation used to calculate Std Pk_direct in Gimo is presented at the top in the table. The formula used in Mebane is presented at the bottom.**

| Gimo | $Std\ Pk_{direct} = DCH_i \cdot \sum_{i=1}^{n}(t_i + s_i) + OV$ |
|------|----------------------------------------------------------------|
| Mebane | $Std\ Pk_{direct} = DHR_i \cdot \sum_{i=1}^{n}(t_i + s_i) + HT$ |

### 5.1.3  Indirect Cost Center

The Indirect Cost Centers in Gimo are grouped by function. In Mebane the Indirect Cost Centers are grouped by function and service provided to each Flow Group. The indirect costs, located at Indirect Cost Centers, are allocated at both sites to Direct Cost Centers, ABC Cost Centers, R&D costs and Indirect Cost Centers. The indirect costs are, in the cost allocation process used in Gimo, allocated by Allocation Keys. In Mebane the indirect costs are allocated by Cost Drivers. A summation of the Allocation Keys used in Gimo and the cost drivers used in Mebane is presented in Table 5.5.

**Table 5.5 Comparison of the mean used to split indirect costs. In the Gimo, it is done by Allocation Keys, which are presented to the left in table. In Mebane, Cost Drivers are used, which are presented to the right in the table.**

| Allocation Key (Gimo) | Cost Driver (Mebane) |
|---|---|
| Employees | Space |
| Staff | Machine Value |
| Worker | Product Assortment |
| Own Cost | Expendable Supplies and Mtrl Cost Budget |
| Other Allocation Keys (Assortment, Space etc.) | Repair and Maintenance Budget |

### 5.1.3.1    Allocating by Direct Cost Center

The process of allocating indirect costs to Direct Cost Centers in Gimo and in Mebane is done in similar ways, with a slight difference in the mean of splitting the indirect costs. In Gimo, the indirect costs are allocated by Allocation Keys, and in Mebane, indirect costs are allocated by Cost Drivers. The indirect costs for both sites are included in DCH or DHR and allocated to Std Pk$_{direct}$. The process of allocating through Direct Cost Centers to Std Pk$_{direct}$ is described in detail in Chapter *5.1.2 Direct Cost Center*.

### 5.1.3.2    Allocating by ABC Cost Center

The process of allocating indirect costs to Std Pk$_{ABC}$ is made through ABC Cost Centers.  The ABC Cost Centers are, in Gimo, grouped by Cost Drivers and products and in Mebane the ABC Cost Centers are grouped by Method of Charging Cost to Standard Pk. The ABC costs are allocated to the Std Pk$_{ABC}$ by Cost Drivers and their Rates, as well as by Method of Charging Cost to Standard Pk.  A summation of the Cost Drivers and their Rates as well as the Method of Charging Cost to Standard Pk is presented in Table 5.6.

**Table 5.6 Comparison of the mean for allocating ABC costs. In the Gimo the ABC costs are allocated by Cost Driver and their Rates, which are presented to the left in table. The allocation used in Mebane is presented to the right in the table. This is done by Method of Charging Cost to Standard Pk.**

| Cost Driver (Gimo) | Rate (Gimo) | Method of Charging Cost to Standard Pk (Mebane) |
|---|---|---|
| Man-hour | Cost per Man-hour | Fixed Charge per ED Piece |
| Assortment | Cost per Assortment | Fixed Charge per Other Piece |
| WO | Cost per WO | Fixed Charge per ED WO |
| Volume | Direct Cost Mark–Up | Fixed Charge per WO Other |
| | | Pk Mark–Up |

The calculation of Std Pk$_{ABC}$, for both sites, is presented in Table 5.7. As presented in the table, the Std Pk$_{ABC}$ is calculated by the amount generated by the Cost Driver and their Rates, as well as by Method of Charging Cost to Standard Pk. The Cost Driver and their Rates, and Method of Charging Cost to Standard Pk differs between the two sites and thereby the terms for calculating Std Pk$_{ABC}$ differs, except for the term Cost per WO which both sites have in common.

**Table 5.7 Comparison of Std Pk$_{ABC}$. The equation used to calculate Std Pk$_{ABC}$ in Gimo is presented at the top in the table. The formula used in Mebane is presented at the bottom.**

| | |
|---|---|
| **Gimo** | $$Std\,Pk_{ABC} = CMH_i \cdot \sum_{i=1}^{n}(t_i + s_i) + DirectCostMarkUp_i \cdot Std\,Pk_{direct} + \frac{CAS_i}{Nbr\,of\,Piece_i} + \frac{CWO_i}{Nbr\,of\,Piece\,WO_i}$$ |
| **Mebane** | $$Std\,Pk_{ABC} = Cost\,per\,Piece + \frac{Cost\,per\,WO}{Nbr\,of\,Piece\,WO}$$ |

The formula for calculating Cost per WO, for both Gimo and Mebane, is presented in Table 5.8. As illustrated in the table, in Gimo, the Cost per Order is dependent on ABC Cost Center, and thereby all products may not be hit by the Cost of Order. In Mebane the Cost of WO is split in two and calculated for two product groups, the ED and Other. The products belonging to the ED Flow Group are hit by the Cost of Order generated by Fixed Charge per ED WO and the remaining products are hit by the

Cost of Order generated by Fixed Charge per WO Other. In other words all products in Mebane are hit by a Cost of Order.

**Table 5.8 Comparison of Cost per WO. The equation used to calculate Std Pk$_{ABC}$ in Gimo is presented at the top in the table. The formula used in Mebane is presented at the bottom.**

| Gimo | $CWO = \dfrac{Total\ ABC\ Cost_{CCtr}}{Total\ Nbr\ of\ WO_{CCtr}}$ |
|---|---|
| Mebane | $Fixed\ Charge\ per\ ED\ WO = \dfrac{Total\ ABC\ Cost_{WO\ Charge-ED}}{Total\ Nbr\ of\ ED\ WO}$ <br><br> $Fixed\ Charge\ per\ WO\ Other = \dfrac{Total\ ABC\ Cost_{WO\ Charge-Other}}{Total\ Nbr\ of\ Other\ WO}$ |

After calculating the three groups of costs making up the Standard Pk – Std Pk$_{mtrl}$, Std Pk$_{direct}$ and Std Pk$_{ABC}$ – the Standard Pk is calculated. These groups of costs are the same at both plants, but they are built up differently as presented in Chapters *5.1.1 Direct Material Cost*, *5.1.2 Direct Cost Center* and *5.1.3 Indirect Cost Center*. The Standard Pk is also calculated differently; as presented in Table 5.9. The calculation of Standard Pk in Gimo is obtained by summing up of the three parts and in Mebane the three parts are first summed up and the multiplied by the Pk Mark–Up.

**Table 5.9 Comparison of Std Pk. The equation used to calculate Std Pk in Gimo is presented at the top of the table. The formula used in Mebane is presented at the bottom.**

| Gimo | $Std\ Pk = Std\ Pk_{mtrl} + Std\ Pk_{direct} + Std\ Pk_{ABC}$ |
|---|---|
| Mebane | $Std\ Pk = (1 + PkMarkUp) \cdot (Std\ Pk_{mtrl} + Std\ Pk_{direct} + Std\ Pk_{ABC})$ |

### 5.1.3.3 Allocating to R&D Cost
The Indirect Cost Centers, at both sites, allocate indirect costs to R&D costs. These costs are not allocated to the Standard Pk, and are thereby not described further.

### 5.1.3.4 Allocating by Indirect Cost Center
The Indirect Cost Centers allocate indirect costs back to Indirect Cost Centers. This is the case for the cost allocation process used both in Gimo and in Mebane. The loop – Indirect Cost Center to Indirect Cost Center – is in the case of Gimo looped multiple times, and in Mebane the loop is just looped once. The cost allocation process through Indirect Cost Centers is presented in Chapter *5.1.3 Indirect Cost Center*.

# 6 Discussion

*This chapter will discuss the empirical finds and relate them to the theoretical framework of the thesis.*

## 6.1 Activity Based Costing

The cost allocation process at Sandvik Tooling could be compared to the theoretical ABC model, if demarcations are made to only including the process of allocating indirect costs through Indirect Cost Centers and further through ABC Cost Centers. The cost allocation model at Sandvik Tooling has similarities to ABB, combined with ABC (Figure 6.1). The first step in both models – Sandvik Tooling's cost allocation process and ABB model – is to estimate the upcoming volume. The next four steps in the ABB model regard the estimation of the activity demand and resource demand, as well as establishing the resource supply and activity capacity. The next step in the cost allocation process at Sandvik Tooling is to estimate the budget and start the cost allocation process. The cost allocation process is made in a similar way as in the ABC model, except in Sandvik Tooling's cost allocation process Cost Centers are used instead of resources and activities.

Cost Allocation Process
(Gimo)

Building (Indirect CCtr)
↓
Space (m$^2$)
↓
Indirect CCtr
↓
Allocation Key
↓
ABC CCtr
↓
Cost Driver/Rate

Product 1          Product 2          Product 3

Cost Allocation Process
(Mebane)

Building (Indirect CCtr)
↓
Space (sqr ft)
↓
Indirect CCtr
↓
Cost Driver
↓
ABC CCtr
↓
Method of Charging Cost to Standard Pk

Product 1          Product 2          Product 3
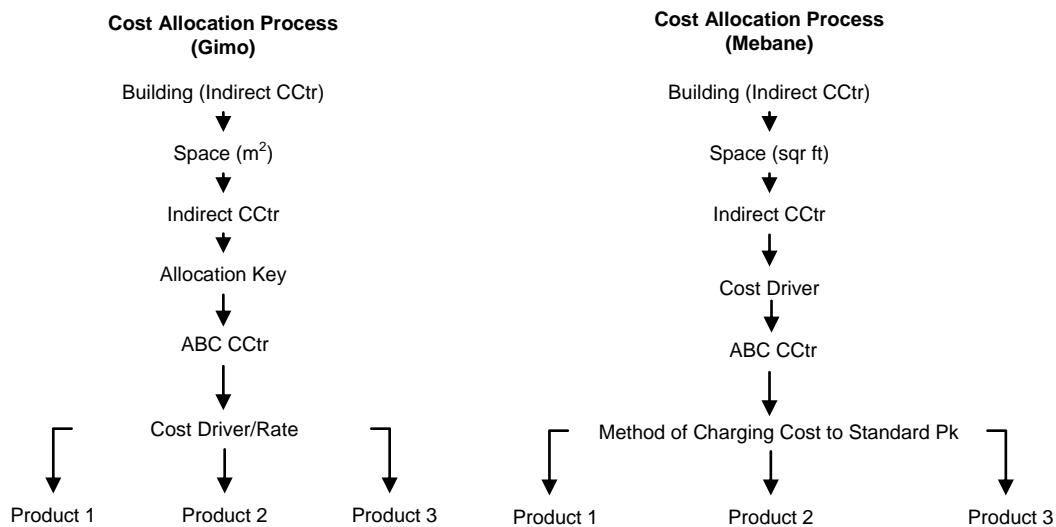
**Figure 6.1 Illustrations of the cost allocation process at Sandvik Tooling according to the theory of ABB/ABC. The cost allocation process in Gimo is presented to the left and the cost allocation process in Mebane is presented to the right.**

The combination of different models – ABB and ABC – may be an indicator of the complexity of a cost allocation process. The ABC model has been criticized for not capturing the complexity of a company. For example in Sandvik Tooling's cost

allocation process costs are allocated in several steps – costs are allocated through Indirect Cost Centers, ABC Cost Centers and Direct Cost Centers. In the theoretical ABC model costs are first group by resources, then allocated to activities and further down to the product. This few levels of allocation may not be possible to implement in practice without an increase in the number of cost drives, leading to an increase in complexity. A combination of the theoretical model and the practical use of it might render the best result; limiting the number of cost drivers combined with a minimization of the levels of allocations. Today the three parts making up the Standard Pk are calculated differently as well as for the Standard Pk in total. A standardization of the calculations is probably the first step in order to get a more standardized process.

According to theory, transactions and complexity are closely linked to each other. Several levels of allocations may be a source for the increase in transactions, for example the looping within Sandvik Tooling's cost allocation process, as well as their use of several cost drivers. If the number of transactions is limited, it may be easier to trouble shoot. There are advantages and disadvantages with having several allocation steps and cost drivers. One thing to take into consideration is where to draw the line in the terms of number of allocations and cost drivers. Instead of having a 1,000 mediocre transaction, it may be better to indentifying the 100 most important transactions, and understand how they occur, where come from and where they go. This clarity will with the trouble shooting process.

There is an additional risk with making the ABC model too complicated; the risk of leaving people out of the model. Say an employee working on the shop floor starts out by working only day shifts. Along the way, the same employee starts putting in overtime and working night shifts. This will complicate the ABC model because there are different pay checks to be given to the employee. Add in the time factor as well; each hour for overtime or regular time has to be documented. The level and amount of information is easy to acquire, but is all this information really necessary? At some point the level of detail in the information has to start working against the company rather than being useful.

Assume the same employee has a cost responsibility. Another way of testing if the model is too complicated is checking if the employee knows why his or her division is hit by the current amount of allocated costs. If the employee gets 50 percent of a cost allocated to its unit, how should the employee check this percentage? This could require a time consuming process, as pointed out earlier, a process of troubleshooting that may be too complicated to fulfill. It may be a good idea to allow the employee in this case to check if the amount allocated costs are reasonable, but if the process only flows one way, then this result is not likely to be obtained.

### 6.1.1 Terminology

The terminology within Sandvik Tooling is not consistent with theory. However, inspiration could be taken from theory in order to develop standardized terminology. Allocation Key (Gimo) and Cost Driver (Mebane) could be seen as the practical equivalent of a resource cost driver. Cost Driver (Gimo) and Method of Charging may be regarded as activity cost driver. Lastly, Rate (Gimo) may be considered as an activity cost driver rate.

The same term may have two meanings, for example the Cost Driver Assortment (Gimo) and Product Assortment (Mebane). Assortment stands for the variety in the product assortment, in other word numbers of articles. Product Assortment on the other hand split the costs between the two groups, ED and Other; groups constituted by several articles. A more correct name of the Cost Driver Product Assortment may instead be Product Group. Having differences in terminology or using the terms with different meanings may hamper the standardization of Sandvik Tooling's cost allocation process.

A standardized ABC model, used in a standardized information system, would lead to taking a step further towards having comparable manufacturing sites. This would also render the possibility to benchmark. But the question is how do you turn two sites that are different in size, located at different sides of the world, that have different traditions, cultures, unit of measures, into comparable units in terms of ABC? A company is built up by resources and activities that make each unit unique. Should the price for obtaining comparability be at the loss of uniqueness and flexibility? The process of standardizing should be done in small steps and not to full extent. It is important to point out that standardization should not be at the loss of uniqueness. If say an idea about a new cost driver where to come up at a unit, it is important to evaluate whether it could benefit the unit locally or even the gathered total of units. Therefore it is important to constantly question, renew and update the ABC model.

In the case of the site in Mebane, we found that there were ideas concerning customized cost drivers. Unfortunately, GSS could not be modified to meet this demand. If the factors for tweaking an old information system to meet the requirements, say for a new cost driver, the information system has an effect on how the ABC model should be designed. Should the case not be the reverse? The information system should meet the demands of the ABC model and not the other way around. In the case of GSS, the modules are not well suited for ABC. Excel spread sheets are used frequently when applying ABC to the Standard Pk. An additional risk with trying to obtain comparable units, in terms of ABC data, is that if

information is too standardized that it may not be advanced enough to provide reports.

## 6.2  Technical Solution

### 6.2.1  GSS Compatibility with ABC

Because GSS is built up by a number of modules, all having a part in the calculation of Standard Pk, there is not an actual module with the sole purpose of calculating ABC. The process of calculating the rates (such as DHR and Method of Charging Cost to Standard Pk) for the Standard Pk is done in Excel spread sheets. The downside with using Excel spread sheets, when working with ABC, is that there is room for entering incorrect calculations. For example, if a rate has to be entered manually into an information system, like the case with the DHR and Method of Charging Cost to Standard Pk in GSS, then there is a risk that an incorrect value may populate the information system, as well as the adjoining information systems. This fault may in fact be corrected easily, but the process of trouble shooting may be time consuming because the root problem might be located in several information systems or even in an Excel spread sheet.

Entering rates into an information system may also lead to the manipulation of data. If guidelines are sent out regarding how to construct the calculation of ABC costs, then there is a risk that this kind of standardization will meet its purpose. Say the rates are calculated outside the information system, in an Excel spread sheet, then the way the rates have been calculated might have been tampered with in order to get a satisfactory result that can be presented to supervisors. We are not saying that this is the case in Mebane or at any other Sandvik Tooling facility, but for the sake of the discussion this was deemed necessary to point out. It is important to see what operations may exist behind an information system, especially if this information system is old and not equipped to handle updated ABC models.

The diversified information system environment with GSS, and its adjoining information systems, has lead to a lot of different takes how one information system actually works in relation to one another and even their importance compared to each other. When trying to map the information system environment at Sandvik Tooling , depending on who we talked to, an information system could incorrectly be put at the center of focus. In the case of Zenith and GSS, we found that depending who we talked to; GSS could be a module within Zenith or an information system by itself. It seems that, depending on the area in which an individual works and in which information system, then the individual's information system will be at the center of focus. Although, this is a natural outcome since information systems or modules have different functions and users, but there is a risk with not having a clear understanding

of how the information systems are intertwined. A change in one information system, may affect another information system, and furthermore the user and his or her work.

The trouble with having a lot of transactions is that they might cause more trouble than actually help. The issue with having several information systems that talk to each other, like the case with GSS, is that a lot of transactions are created. Data is passed from one information system to another. As pointed out with having a large number of information systems building up the information system environment, this data affects other employee's work. When minimizing the number of transactions, and identifying the key transaction, then the possibility of increasing traceability would be obtained. It is important that everybody knows where the information they provide is heading, and where the information they are getting comes from. Furthermore it is important to understand what affects a change may have in one information system, and what affect may have in another information system. Is a change automatically rendered in the adjoining information systems if one information system is changed?

In terms of transactions, it is also important to question which information is actually necessary for each individual to do their job. With a centralized control unit, that wants to standardize other units, it is important to evaluate what information is actually necessary and should be required of the unit. Some information may not even be useful for reports. Given a high level of detail in an information system, then the sky is limit to what information can be derived from the information system.

The positive aspect with GSS is that it is an in house built information system, and the knowledge to support and maintain it lies within Sandvik Tooling's walls. If in fact an adjustment needs to be done, external consultants do not need to be contracted. Furthermore, the fact that GSS is built up by several modules makes it more flexible than one large information system, for example an ERP system.

An ERP system on the other hand has the advantages of the way it interacts with control systems. If the ISA95 standard is used upon implementation, risks may be avoided and costs may be lowered. However, this is, by our belief, only in theory. A vast ERP system has to in the case at Sandvik Tooling be able to interact with several in-house built information systems. These information systems might need further modifications in order to be able to communicate with an ERP system. This may contradict the ISA95 standard and its promise to lower costs. However, the standard talks about the importance of having standardized terminology. As pointed out earlier, a set of standardized terms in terms of ABC would be a valuable tool for Sandvik Tooling.

The smaller modules can be tailored to meet the users' demands, say for instance the engineers' needs in Skeleton versus the production managers' needs in GSS MIS. Further customization and updates need to be done to GSS concerning ABC, but these changes may coincide with having to update the Standard Pk process.

A module for calculating ABC would allow the process of calculating the rates to be more automated, rather than by doing it manually in Excel. Having these calculations done in a separate module would help with populating the adjoining information systems with the correct rates. If the rates are calculated in a standardized ABC module, with standardized formulas, then the opportunity of benchmarking and comparing units from all over the world may increase. The reports deriving from this information would then be more focused, and the origin of the data could easily be traced. A positive feature with GSS is also the possibility of "faking" the date for going live with the Standard Pk. This encourages a more thorough process of presenting the costs in as accurate terms as possible.

In the day of the computer era, there is also the possibility of making the ABC model too complicated. Maybe it is more advantageous to do the calculations in Excel? It would render a process that is less complex and it would keep things simple. Sometimes the simplest answers may have the greatest impact. Doing the calculations in Excel would also avoid the costs of investing in a new information system, if in fact they are too old to be adjusted to newer ways of working. Having the ABC calculations entirely done in Excel would give the individual calculating the rates an increase in control. It would also offer the advantage of being able to customize the calculation to meet local needs. Having the calculations done in Excel may also indicate that the information systems are not equipped to handle the calculations of ABC costs. The information systems could have become out of date and need an update.

### 6.2.2   Practice versus Theory

The theoretical ABC model addresses the issue of making the model too complex to implement or even to handle. Although, the academic theories regarding the model seldom talk about having the features of the information system affect the complexity, a practical ABC model is dependent on the information system environment. If the information system is not updated, then the ABC model will not become state of the art. The question is then, who controls who and who should calls the shots? One measure that might be taken is to do to a wide spread information system update and scrap all outdated information systems. Depending on the routines of the company, say for example the cost allocation process at Sandvik Tooling, it may not be as easy as it seems to start over from scratch. With a new information system the business may be put at risk, employees will have to be trained, or there might be internal

political related issues hindering the change. It is important to realize that changing information systems, and its adjoining processes, for instance a cost allocation process, is a growing process. The trick is staying updated and not getting stuck in the old ways of working.

An additional issue with the ABC model is that it does not address the issues with having multiple sites, all having their own unique features, and how this should be maintained. Companies that are present in multiple countries have to take into consideration the differences among culture, traditions or more simple things like terminology and unit of measure. A modern ABC model has to be flexible enough to meet local needs. Academic theories seldom talk about this issue when designing the ABC model. Having multiple information systems also renders an information system environment where there are multiple flows of information. This flow stems to a final source. It is therefore hard to troubleshoot and find the location of a problem since the source of the information flow may come from multiple information systems.

TDABC is slightly less suitable for larger companies, where it is hard to do the estimations that the model requires. The biggest risk with the model is that the estimations may re-occur year to year, solely because the employees lack the knowledge or willingness to evaluate the times they provide to the manager. If this is the case, then the purpose of the model is not met. TDABC model could therefore render results that are not all as reliable as the authors of the article leads the readers to believe. We also believe that there might be a risk of, contrary to what the authors might say, the model increasing complexity within a company after being implemented for a number of years. In the case of Sandvik Tooling, and their allocation processes with several loops, there might be a risk that TDABC may not lead to decreasing complexity in the long run.

## 6.3   Merging ABC with Information Systems

### 6.3.1   Taking It to the Next Level

The more data that is entered into the information system, the more data needs to be processed. This is a time consuming process. As mentioned earlier the academic theories seldom talk about the risk of making the ABC models too time consuming in relation to the information systems. They do talk about making them too complex in terms of ABC variables, but in the day of the computer era, information systems may do whatever you want them do to. The difficulty is to get the interaction between ABC and information systems to interact in a way that prospers the other. The difficulty is not to enter information into the information system; the difficulty is to enter the correct information. Having the correct information attainable makes it

possible to process reports with relevant information. This information could then be as the basis for decision making.

If employees are allowed to brain storm freely, the chances are that abundant variables can be entered into the ABC model and the information systems. Everybody may have their own personal preferences on what they want an information system to do. For instance, a 1,000 cost drivers could be identified, but it is more difficult to identify 100 that are the most crucial and important ones. This is linked to the importance of finding the key transactions within the organization. A simple ABC model, which is built up thoroughly with relevant information along with an information system, may be a simple solution, even for a big company.

Sandvik Tooling's information system environment can according to theory be classified as Stage II Systems. GSS alone can be classified as Stage II Systems. The first step of reaching next stage – Stage III Systems – is to implement an ABC system. Implementing an ABC module/information system in a worldwide company with multiple sites, requires, a standardized cost allocation process. How should standardization be performed? We believe the first step should be the standardization of the terminology used at Sandvik Tooling's manufacturing sites. This might be a complicated transformation because of the differences between units; each site has its own history and way of working. Changing routines and starting all over with say a new set of standardized terminology may be a slow and unsuccessful process that beats the purpose. The less amount of standardization may on the other hand offer each site an increase in control. This would not benefit taking ABC one step further and using it for other means, such as benchmarking.

### 6.3.2 Points for Evaluating the Information System from an ABC Point of View

When deciding whether to invest in a new ABC, there are a certain number of factors that should be taken into consideration. First and foremost, the existing information system's capacity and features should be mapped. The first standpoint to take is to evaluate whether the information system fulfills its purpose and if it does what it is supposed to do. The question whether a new information system is necessary should also be posed since Excel may be an adequate tool. It should also be clearly specified what the user wants the information system to do. Other standpoints that should be taken into consideration are:

**Extend existing information system** – it may or may not be necessary to develop an entirely new information system or module. The feature for building a new information system may already exist within another information system.

**Link to internal information systems** – the new information system should be able to communicate with existing information systems and have a working interface with them. I should be possible to link data, in other words import and/or export data. This link should be reliable.

**Link to an external source** – the information system should be able to import/export data to Excel.

**An information system by itself or a module within a larger information system** – this is important to consider because it might lead to eliminating redundancy in information. The same information is not always necessary at multiple locations.

**Be built in-house or purchased externally**

**Maintainable** – the costs and resources of maintaining the information system should not be at a great expense. The information system should also be easy to update.

**Support updates** – the information system should be able to be updated if a new ABC model is introduced.

**Customized features** – the information system should have the option to customize the features within the information system.

**Accessible information** – the information system should provide all parties working within the information system with the information they need. The level of detail should be relevant to the user.

**User friendliness** – It is important to evaluate whether the information system will require a lot of training for the user.

**Manual operation** – rates could be entered manually into the information system

**Calculate** - ABC costs, indirect cost, direct cost and material cost

**Provide reports** – These reports should include information such as historic data and valuable ABC information.

**Traceable information** – the information provided by the information system should be traceable if it comes from another source

**Multiple languages** – not everybody speaks or is used to speaking/reading in English.

## 6.4   Summation of the Discussion

Figure 6.2 illustrates a summation of the cost allocation process at Sandvik Tooling. Like the theoretical triangle presented in Chapter *3.5 Summation of the Theoretical framework*, the overhead costs, or the indirect costs as they referred to at Sandvik Tooling, are fed into the three points of the triangle. The dots within the ABC flow illustrate that there is a loop going back to the previous steps. The transaction flow is divided into several transactions that have not been singled out to being key transactions. The technical solution is made up by an Excel solution that generates a rate that is entered into GSS. This flow is presented in a lighter color because it is not a solution that is tailored to meet the demands of an ABC model.
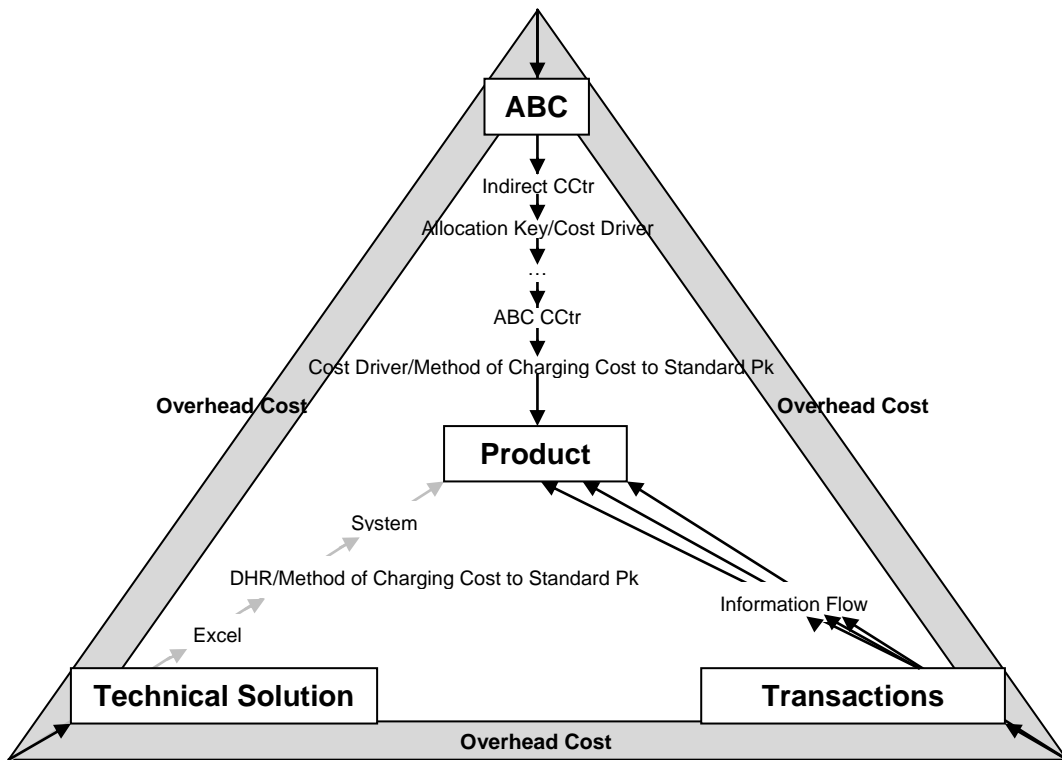


**Figure 6.2 Summation of the Discussion.**

# 7 Conclusions and Recommendations

*This chapter will present the conclusions and recommendations according to our discussion, empirical findings and theoretical framework.*

The conclusions we have been able to draw regarding the information systems environment at Sandvik Tooling is that it is crucial to keep the information systems updated. It is also important provide the employees information about how the information system environment is built up. This would facilitate the trouble shooting process. We found that there are many views on how the information system environment is built up. In the case of Sandvik Tooling, the old information systems have too much control. If an information system is too old, then the case with developing an ABC model is that it will be adjusted to the information system. We believe it should be the reversed scenario – the ABC model sees few limits with the possibilities of development in the information system.

The compatibility of GSS in terms of ABC is deemed as inadequate. If GSS is to be installed in Gimo, we would recommend the development of an ABC module. This module should be able to communicate with the adjoining modules of GSS. Another alternative is to develop more advanced Excel spread sheets and then linking them to the GSS modules. Either course of action should be done internal within Sandvik Tooling's walls.

An additional conclusion is drawn regarding the standardization of units. In order to make it possible to develop/design and implement ABC modules, standardization of the terminology, as well as parts of the calculation making up the Standard Pk, is necessary. Standardization of the terminology may also facilitate the communication between units, as well as for benchmarking purposes in the future. Inspiration for new terminology may be found in the theoretical framework presented in this thesis. Suggested terminology is as follows:

1. Renaming Allocation Key (Gimo) and Cost Driver (Mebane) to *resource cost driver*
2. Renaming Cost Driver (Gimo) and Method of Charging Cost to Standard Pk (Mebane) to *activity cost driver*
3. Referred to the Rates (Gimo) as *activity cost driver rate*

A conclusion we have drawn, with our theoretical framework and our empirical foundation, is that complexity is a villain when it comes to designing ABC models and the relating information systems. As we have pointed out earlier, we believe the

key to success is identifying the 100 most important transactions, resources/activities or cost drivers, instead of having a 1,000 that are not used. We believe it is important to do this cut, and then provide information that can be used by each production site. This would create a clear picture of the organization, as well as being in line with benchmarking. It would also increase traceability and facilitate trouble shooting. As pointed out earlier, it is important that employees are familiar with the design of the information system environment and ABC model. This would facilitate the process of knowing who to contact if a problem were arise.

# List of References

## Printed Sources

Alvesson, Mats and Sköldberg, Kaj (1994) *Tolkning och reflektion – Vetenskapsfilosofi och kvalitativ metod* Studentlitteratur, Lund.

Bruns, William J. and Kaplan, Robert S. (1987) *Accounting and Management – A Field Study Perspective* Harvard Business Scholl Press.

Cooper, Robin and Kaplan, Roberts S. (1998) *Cost and Effect – Using Integrated Cost Systems to Drive Profitability and Performance* Harvard Business School Press.

Forrest, Edward (1996) *Activity Based Management – A Comprehensive Implementation Guide* McGrawy-Hill.

Frost, William (2005) *ABCs of Activity Based Management – Crushing Competition Through Performance Improvement* iUniverse.

Holme, Idar Magne and Solvang, Bernt Krohn (1997) *Forskningsmetodik – Om kvalitativa och kvantitativa metoder* Studentlitteratur, Lund.

Jacobsen, Dag Ingvar (2002) *Vad, hur och varför? – Om metodval i företagsekonomi och andra samhällsvetenskapliga ämnen* Studentlitteratur, Lund.

Lundahl, Ulf and Skärvad, Per-Hugo (1999) *Utredningsmetodik för samhällsvetare och ekonomer* Studentlitteratur, Lund.

Rienecker, Lotte and Jörgensen, Peter Stray (2020) *Att skriva en bra uppsats* Liber.

Stålh, Jan-Eric (2007) *Industriella Tillverkningssystem – Länken mellan teknik och ekonomi* Lund Universitet.

## Academic Articles

Ainsworth, Penne (1995) "ABC overhead analysis beats traditional approach" *The Practical Accountant* Volume: 28 Issue: 7 Page: 49-55.

Anderson, Steven R and Kaplan, Robert S. (2004) "Time-Driven Activity-Based Costing" *Harvard Business Review* Volume: 82 Issue: 11 Page: 131-138.

Banker, Rajiv D.,Bardhan, Indranil R. and Chen, Tai-Yuan (2008) "The role of manufacturing practices in mediating the impact of activity-based costing on plant performance" *Accounting Organization and Society* Volume: 33 Issue: 1 Page: 1-19.

Banker, Rajiv D., Potter, Gordon and Schroeder, Roger G. (1995) "An empirical analysis of manufacturing overhead cost drivers" *Journal of Accounting & Economics* Volume: 19 Issue: 1 Page: 115-138.

Baxendale, Sidney J. and Jama Farah (2003) "What ERP Can Offer" *Strategic Finance* Volume: 85 Issue: 2 Page: 54-57.

Chung, Sheng-Luen and Jeng MuDer (2002) "Manufacturing Execution System (MES) for Semiconductor Manufacturing" *Systems, Man and Cybernetics,2002 IEEE International Conference on* Volume: 4 Page: p. 7-11.

Cooper, Robin and Kaplan, Robert S. (1988) "Measure Costs Right: Make the Right Decisions" *Harvard Business Review* Volume: 66 Issue: 5 Page: 96-104.

Cooper, Robin and Kaplan, Robert S. (1998) "The Promise – and Peril – of Integrated Cost Systems" *Harvard Business Review* Volume: 76 Issue: 4 Page: 109-119.

Daing Nasir Ibrahim and Ruhanita Maelah (2007) "Factors Influencing Activity Based Costing (ABC) Adoption in Manufacturing Industry" *Investment Management and Financial Innovations* Volume: 4 Issue: 2 Page: 113-124.

Higgins, Brian K. and Young, S. Mark (2001) "Improving operations: Not as simple as ABC" *Journal of Corporate Accounting & Finance* Volume: 12 Issue: 3 Page: 15-34.

Homburg, Carsten (2001) "A note on optimal cost driver selection in ABC" *Management Accounting Research* Volume: 12 Issue: 2 Page: 197-205.

ISA-95.00.01-2000 (2000) "Enterprise-Control System Integration, Part 1: Models and Terminology"

Johnson, Thomas H. (1988) "Activity-Based Information: A blueprint for World-Class Management Accounting" *Management Accounting* Volume: 69 Issue: 12 Page: 23-31.

Nilsson, Carl-Henric (1994) "Methodological Reflections, Extended Version" Working Paper: Dep of Industrial Engineering, The Faculty of Engineering at Lunds University and School of Economic and Management at Lunds University.

Miller, Jeffrey G. and Vollman, Thomas E. (1985) "The Hidden Factory" *Harvard Business Review* Volume: 63 Issue: 5 Page: 142-151.

Raab, Carola and Mayer, Karl J. (2004)"Exploring the Use of Activity Based Costing in the Restaurant Industry" *Haworth Press* Volume: 4 Issue: 2 Page: 79-96.

Serritzlew, Sören (2006) "Lining Budget to Activity: A Test of the Effect of Output-Purchase Budgeting" *Public Budgeting & Finance* Volume: 26 Issue: 2 Page: 101-120.

Thyssen, Jesper, Israelsen, Poul and Jorgensen, Brian (2006) "Activity-based costing as a method for assessing the economics of modularization – A case study and beyond" *International Journal of Production Economics* Volume: 103 Issue: 1 Page: 252.

Varíla, Mikko, Seppänen, Marko and Suomala, Petri (2007) "Detailed cost modeling: a case study in warehouse logistic" *International Journal of Physical Distribution & Logistics Management* Volume: 37 Issue: 3 Page: 184.

## Electronic Sources

Sandvik AB, home page, http://www.sandvik.com, January 20 2008.

Singh, Mohini and Waddel Di (2004) *E-Business Innocation and Change Management* Hershey.

## Information providers

Andersson, Karin, Head of Finance Department, Interview February 1, February 19 and March 4 2008.

Barber, Jon, General Manager Tooling Supply US/Mebane, Interview March 29 2008.

Gauffin, Veroni, Cost Accountant, Interview January 1 2008.

Giardino-Gray, Norma, Financial Manager Tooling Supply NAFTA, Interview February 7, February 25, April, 16, April 28, April 29 and May 2 2008.

Gunnarsson-Wahlund, Annika, Cost Accountant, Interview February 18, April 1, April 23 and April 30 2008.

Jacobsson, Mats, Business Controller, Interview January 16, January 19, January 22, January 24, April 23 and April 28 2008.

Kaminski, Bernard, Production Manager, Interview March 16 2008.

Kennedy, Cindy, Controller, Interview March 11, March 13, March 14, March 19 and April 29 2008.

Lindberg, Tomas, Project Leader, Interview February 7 and March 18 2008.

Lundal, Dan, Production Controller, Interview March 25 2008.

Ögren, Thomas, Process and System Co-Ordinator, Interview February 8 2008.

# Appendix I

## Plant Layout[185]

Different elements decide the positioning of the manufacturing machines and the layout of a plant. The layout may be determined by the manufacturing process, in other word the handling of material within the value added process of manufacturing or by the machines physical location. The plant layout may have three categories: Layout by Operation, Flow Based Layout, and Layout by Product. Which one to choose, is often made by the volume of manufacturing, or the flow of product through the manufacturing plant.

## Layout by Operation

A Layout by Operation is a layout where the machines, within the manufacturing plant, are positioned by operation. The Layout by Operation is best suitable for a wide product assortment, since the operational sequences can be modified to follow an individual product's needs. The downside is a complicated flow of handling of material, long internal transports and the rise of queue lines in front of the machines. The Layout by Operation is illustrated in Figure 0.1.



**Figure 0.1 The Layout by operation. The figure illustrates an example of a plant layout, where the machines are arranged by operation. Each machine is presented by a symbol – triangle, circle or square and different manufacturing operations are illustrated by different shapes of symbols; a triangle is equal to drilling, a circle turning and a square is equal to the manufacturing operation, milling. The manufacturing process, for a product, is illustrated by the line with arrow showing the direction through the plant.**

---

[185] Stålh, J-E. (2007), p. 22-23.

## Flow Based Layout

In a Flow Based Layout the machines are position by operational sequence for a product, and not by the operation of the machines. The favorable side of this type of layout, is that it generates a high speed throughout the manufacturing. The downside on the other hand, is the many fixed setups. The manufacturing types most suitable for the Flow Based Layout, are mass production and products consisting of several manufacturing operations. The Flow Based Layout is illustrated in Figure 0.2.
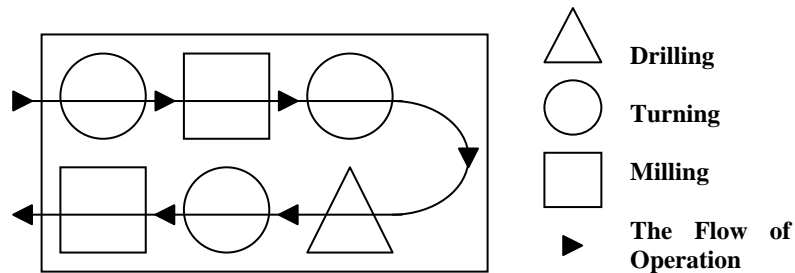


**Figure 0.2 The Flow Based Layout. The figure illustrates an example of a plan layout, where the machines are positioned by the operation flow of sequence for a product. As for the Figure 0.1 the machines are illustrated by symbols – triangle equals drilling, circle equals turning and square equals milling. The manufacturing flow through the plant is presented by a line and arrows.**

## Layout by Product

The characteristic of the third category, Layout by Product, are different operations, For example, operations such as processing and assembling takes place in one spot because of the size or the weight of a product manufactured within the manufacturing area which makes moving of the product difficult. Example of products, using Layout of Product, are airplanes, ships and houses.