UNIVERSITY OF LJUBLJANA
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MASTER'S THESIS

DESIGNING A MANAGERIAL COSTING CONCEPT FOR A SMALL METAL PROCESSING ENTERPRISE

Ljubljana, October 2013 EVA WAGNER

AUTHORSHIP STATEMENT

The undersigned Eva Wagner, a student at the University of Ljubljana, Faculty of Economics, (hereafter: FELU), declare that I am the author of the master's thesis entitled "Designing a Managerial Costing Concept for a Small Metal Processing Enterprise", written under supervision of Metka Tekavčič, PhD.

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1 INTRODUCTION

Management accounting aims to provide relevant information for decision-making within a company, data with which organizations are actually run. In contrast to financial accounting it is not mandatory, meaning that a company is completely free to do as much or as little as it wishes. There are no regulatory bodies or other outside agencies that specify what is to be done or whether anything is to be done at all (Seal, Garrison, & Noreen, 2009, p. 8).

An accounting system is a formal mechanism for gathering, organizing and communicating information about a company's activities. Some organizations use a general-purpose accounting system that attempts to meet the needs of both external and internal users, in order to reduce costs and to simplify matters. However, there are important differences between management accounting information and financial accounting information (Horngren, Sundem, Stratton, David, & Schatzberg, 2011, p. 25). Management accounting enables linking an organization's resources, activities, products and services to an economic value expressed in monetary terms. The focus is on internal operations and meeting the needs of managerial costing's clients – the organization's internal management. Managerial costing is therefore relevant for financial planning and analysis within a company (Cokins, Thomas, Templin, & Huntzinger, 2012, p. 13).

Historically management accounting has been more important to companies in German-speaking countries, such as Germany, Austria and (part of) Switzerland, than to - for example - companies in the United States (US). This can be attributed to the fact that external accounting rules of German-speaking countries put the interests of creditors before those of shareholders (Friedl, Küpper, & Pedell, 2005, p. 56). Consequently external accounting rules are subject to the principle of prudence, much more than in other countries. As a result financial accounting and management accounting are much more diverse in German-speaking countries.

This leads to the fact that financial accounting provides little guidance for management decision-making and pricing. Therefore a sophisticated cost accounting system explicitly for management decision-making is required (Friedl, Küpper, & Pedell, 2005, p. 56).

1.1 Problem Statement

The relevance of cost information for management decision-making has been a central issue in cost accounting. Arguably decision-making is the most important objective of a cost accounting system (Boyd & Cox, 2002, p. 1879). Tung et al. (in Guerreiro, Cornachione Jr., & Kassai, 2012, p. 1) noted that the most effective way for a company to reach maximum profits is by being able to correctly establish its price. Especially for manufacturers of customized goods the selling price, respectively quotation price is a very meaningful factor in attracting orders in the industry.

In a competitive, common-product environment the market price is already set and the company must determine target costs. But in a less competitive environment, the company may be able to set its own price. If this is the case, price is typically a function of the cost of the product or service. In line with this, Guilding et al. (in Guerreiro, Cornachione Jr., & Kassai, 2012, p. 2) classifies firms as either price makers or price takers. **Price-takers** are usually companies that are competing with the market leaders. In these companies market forces essentially determine prices and managers attempt to optimize production and sales using prices that are obtained from market references. **Price-makers** in contrast are market leaders or – as in the case of the underlying firm – companies with highly customized products or services. In these companies managers who are responsible for price decisions develop prices on the basis of internal company data.

The common approach to set the price of the goods or service of a company is called **cost-plus pricing**. It basically involves establishing a cost base and adding to this cost base a mark-up to determine the target selling price (Weygandt, Kimmel, & Kieso, 2010, p. 341). This thesis deals with the former, the determination of a cost base for adequate pricing.

The general purpose of the project for the underlying company, *Staudinger Metallbau GmbH* (hereafter *SMG*) - which will be explained in detail in Chapter 4 - is therefore to calculate **hourly wage rates** as well as **overhead burden rates** thoroughly, based on the different divisions within the company. To determine the cost of the products and services being produced and sold by a company actually represents one of the most important roles of managerial accountants. These projected hourly wage rates and overhead burden rates will determine the cost of the products or services by means of overhead costing. For that reason, a **sophisticated cost accounting system** has to be developed, including different cost centres, which displays the corporation as accurate but also as simple as possible. The system must have to be easily adaptable and maintainable in the future, taking its cost benefit into consideration. Hence, a direct collaboration with the management of the corporation throughout the whole creation process is essential. The benefits must outweigh the resources that will have to be engaged in future maintenance activities.

At present *SMG* uses adapted hourly wage rates based on the calculation of the chamber of commerce and price rates for different operations in the laser-cutting department as bases of their price calculations.

The ultimate aim of this work is to provide the *SMG* with adequate hourly wage rates and overhead burden rates for submitting quotes. It does not overcome the issue of difficulties in estimations. Almost all orders require the submission of a quote. Therefore most of the calculations have to be carried out in advance. The planning of material and time needed to calculate the binding price for such an offer beforehand, is an important issue in job production. Estimates that are too high make the product too expensive so the customer might not place the order, however estimates that are too low could lead to considerable losses. Therefore the matter of making proper estimations plays an important role. Here it needs to be

emphasized that the improvement of estimations beforehand, is not part of this work. In fact cost accounting cannot overcome problems with such advanced estimations.

1.2 Methodology – Proceeding

The thesis starts with an introduction to management accounting to reveal the importance of the topic in comparison to financial accounting. It also delivers a slight insight into the reasons of the greater importance of management accounting in German-speaking countries, which will be described elaborately in the second Chapter.

The second Chapter represents the **theoretic part** of the thesis and starts by outlining the topic of management accounting and its German controlling approach. It distinguishes management and financial accounting and draws attention to the differences between cost accounting and managerial costing. Moreover the second Chapter deals with the differences of traditional cost accounting in general, the specific German form of it, called *Grenzplankostenrechnung (GPK),* activity-based costing (ABC) and the modified approach time-driven activity based costing (TDABC). In the third Chapter the theoretical part covers the use of cost accounting in practice particularly with regard to Small and medium-sized enterprises (SME) and the metal processing industry as well as make-to-order (job-order production) business models. The third Chapter is – in a way - an introduction to the practical application of the beforehand handled theory.

The **practical part** of the thesis - described in the fourth Chapter – shows the designing and implementation process of managerial costing for the company, *SMG*. It starts with a detailed description of the company and its business model. The basis of this project within the thesis is the analysis of the concrete processes, activities and workflows to develop appropriate cost centres in order to accurately display the whole corporation. This finally resulted in a **holistic managerial accounting concept**, specially adjusted to the underlying corporation. The aim was to use the most suitable accounting practices for the specific case. The practical work involved the conversion from expenditures to costs (from financial accounting to management accounting) and the planning of costs for the present year. Furthermore, it also involved the appropriate allocation of costs to the predefined cost centres, the calculation of the hourly wage rates and overhead allocation rates for a concrete price calculation of the production orders. The workflow analysis of the operational sequences revealed potential within one division (laser-cutting), where an ABC approach is applicable and its implementation led to a more accurate allocation of costs to the costs objects (production orders). Where ABC is applicable, the more recently developed time-driven ABC approach (TDABC) could potentially increase these improvements even more.

The results of the practical work are shown in the Appendix in an extract of the cost allocation sheet and concrete Examples of job-order calculations, using the previously existing rates and scheme, the newly developed traditional costing system, as well as the application of ABC in one division. To comply with the sensitive nature of such cost information, the data showed in this work is multiplied by a certain factor.

2 THEORETICAL FOUNDATIONS TO MANAGEMENT ACCOUNTING

The objective of this section is to provide an introduction to management accounting and the German approach, referred to as controlling. First both terms are defined according to professional institutions. This is followed by a consideration of differences between financial and management accounting. The next part is dedicated to the examination of the role of cost accounting and its differences to managerial costing as defined by the International Federation of Accountants (IFAC) and the Institute of Management Accountants (IMA). In addition, the basic cost terms and fundamental concepts that are used in the management accounting literature are described.

2.1 Management accounting versus Controlling

Management accounting is a fairly broad term, which typically includes cost accounting as a central element as well as other topics such as budgeting, sales analysis, investment measures and much more (Taylor, 2000, p. 3). The Institute of Management Accountants (IMA, 2008, p. 1) has established a clear definition for management accounting in the Statement of Management Accounting No. 1: "Management accounting is a profession that involves partnering in management decision-making, devising planning and performance management systems, and providing expertise in financial reporting and control to assist management in the formulation and implementation of an organization's strategy".

The field of management accounting has evolved considerably from a transaction and compliance orientation to that of a strategic business partner, a steward of corporate performance management. It involves providing risk management, internal control and financial reporting as well as expertise in cost management methods that help the organization become more competitive and successful. However, most of the definitions and descriptions concerning the role of the management accountant do not reflect the move to strategic business partner that is evolving (IMA, 2008, p. 1).

In German-speaking countries management accounting themes appear under the term *Internes Rechnungswesen* or *Interne Unternehmensrechnung* (literally internal accounting) but recently most commonly under **controlling** a term borrowed from the English language (Ewert & Wagenhofer, 2007, p. 1036).

Controlling extended the boundaries of management accounting well beyond traditional cost accounting, including the usage of costs for management purposes, such as planning and budgeting, management control and decentralization issues. However, apart from that it was initially nothing more than a trendier name for management accounting departments. Later the demand from practice for controllers grew, due to the growth and internationalization of firms. Universities reacted by establishing professorships in controlling and research began studying themes that were considered to be part of controlling. A broader view sees controlling as the coordination of the management system of the firm, including planning,

control, information, human resources and organizational function with the role of supporting all of the firms' objectives whatever they may be. The narrower view believes that controlling focuses on planning, control, and information production with a clear earnings-oriented objective and thus, has a management support function (Ewert & Wagenhofer, 2007, pp. 1037-1038). The International Group of Controlling (IGC, 2002) formulated a mission statement, which includes the design and support of management processes such as identifying goals, planning and directing, thus shouldering some of the responsibility for accomplishing these goals. According to the German-based International Controller Association (ICV) the interaction between managers and controllers constitutes controlling. Above all controllers assure transparency of business results, finance, processes and strategy and thus contribute to higher economic effectiveness (Gänßlen, Losbichler, Niedermayr, Schäffer, & Weber, 2012, pp. 4-6).

The comparison of both terms shows that the topics covered in controlling and in management accounting overlap to a great extent. Controlling tends to extend somewhat more into special applications in firms' functions such as research and development logistics, marketing and human resources as well as in different industries. Ewert & Wagenhofer (2007, p. 1037) disclose that controlling might be more in the direction of strategic management accounting. The evolving strategic element of management accounting might not have found its way into theoretical definitions of the topic yet, but as stated above, the Institute of Management Accounting has already pointed out that management accounting (in Anglophone countries) is also moving towards a strategic direction. Controlling may often be regarded as an equivalent term for management accounting but at the same time there have been considerable efforts to establish controlling as a discipline of its own. Messner, Becker, Schäffer & Binder (2008, p. 129) declare that this identity discourse may be interpreted as a strategy of controlling researcher to achieve cognitive and socio-political legitimacy of their discipline.

However, practice has usually been quite unimpressed by the academic discussion that focuses on the definition of controlling rather than on the instruments that can be used to improve performance (Ewert & Wagenhofer, 2007, p. 1037). What has been perceived as more important is how management accountants reacted and which internal measures have been taken in order to deal with or counteract turbulent economic times. During the crisis, forecast uncertainty had an especially significant impact on the core business tasks of management accountants, since they are responsible for coordinating key value-creating tasks such as the optimization of working capital, cash-management, accounts receivable, debt, or equity (Weber, Rehring, & Voussem, 2011, p. 38). A longitudinal study showed that the economic crisis had a severe impact on management accountants in Germany. Weber, Rehring & Voussem (2011, p. 47) determined the negative outcomes such as an increased workload but also the positive results. Due to the crisis core functions such as planning and monitoring are in heavy demand by other actors and departments within the organization and especially by the top-management. Management accountants provide essential services for decision-makers in times of crisis and therefore play a powerful role when it comes to

managing organizations in volatile environments. It is concluded that the impact of the crisis established the role of management accountants as critical counterparts of managers (Weber, Rehring, & Voussem, 2011, p. 47).

In contrast to the broad term controlling related to the concept of management accounting, the term controlling used in Anglophone literature is much narrowly defined, meaning implementing the plans and evaluating operations by comparing actual results to the budget which helps evaluate performance (Horngren, Harrison Jr., & Oliver, 2009, p. 793).

A clear aspect of boundaries though is, that financial and management accounting is strictly separated in German-speaking countries. Therefore controllers are not actively involved in financial accounting, reporting and tax planning tasks, which contrasts the functions of accountants in firms in the US (Ewert & Wagenhofer, 2007, p. 1037).

2.2 Management versus Financial accounting

Accounting can be described as a language that communicates economic information to people who have an interest in an organization, such as managers, shareholders, potential investors, employees, creditors and the government. Managers inside the company require information that will assist them in their decision-making and control activities, for example prices, costs, demand, competitive position and profitability of various products and/or services that are provided by the organization. Shareholders require information about the value of their investment and the income that is derived from their shareholding. The target of accounting is to provide adequate information to meet the various needs of their clients. The examination of the users of accounting information shows that they can be divided into two categories. **Internal parties** within the organization on the one hand and **external parties** such as shareholders, creditors and regulatory agencies, outside the organization on the other hand (Drury, 2006, p. 7). The distinction between managerial and financial accounting according to its prospective clients might be considered as the most important. While financial accounting reports are prepared for the use of external parties such as shareholders and creditors, managerial accounting prepares information for managers inside the organization. This contrast in basic orientation results in a number of major difference, even though both often rely on the same underlying financial data (Seal, Garrison, & Noreen, 2009, p. 6).

Another major difference is that financial accounting is mandatory and subject to accounting regulations, such as the International Financial Accounting Standards (IFRS), United States Generally Accepted Accounting Principles (US-GAAP) or the *Unternehmensgesetzbuch* (*UGB*), respectively the *Einkommenssteuergesetz* (*EStG*) and *Körperschaftsteuergesetz* (*KStG*), specifically for Austria. Management accounting in contrast, is entirely optional, meaning that a company is completely free to do as much or as little as it wishes. There are no regulatory bodies or other outside agencies that specify what is to be done or whether anything is to be done at all (Seal, Garrison, & Noreen, 2009, p. 6).

Management accounting aims to provide relevant information for decision-making within the company, data with which organizations are actually run on. Information should be produced only if it is considered that the benefits from the use of the information exceed the cost of collecting it (Drury, 2006, p. 7). While financial accounting data is expected to be objective and verifiable, management accounting data lies on relevance and timeliness. Managers want information that is relevant even if it is not completely objective or verifiable. If a decision must be made, a manager would rather have a good estimate now than wait a week for a more precise answer. Moreover, precision is costly in terms of both time and resources. Therefore management accounting places less emphasis on precision than financial accounting (Seal, Garrison, & Noreen, 2009, p. 6).

Financial accounting reports what has happened in the past, while management accounting is concerned with future information as well as past information. Decision-making is concerned with future events and management, which requires details of expected future costs and revenues (Drury, 2006, p. 8). Overall, a management accounting information system should be flexible enough to provide whatever data is relevant for a particular decision.

The explicit divorce of cost accounting from financial accounting is a characteristic feature of German management accounting. Almost every introductory cost accounting textbook starts with a careful distinction of costs, expenses, expenditures and cash outlays and practice follow that distinction (Ewert & Wagenhofer, 2007, p. 1038). This is due to the fact that accounting rules are much more subject to the prudence principle since the protection of creditors stands above the interests of shareholders. This is, for example, expressed by the rule that valorisation above the acquisition value is strictly forbidden and profits can just be allocated stringently after their generation. Furthermore, accounting rules in German states are connected with tax law, meaning that financial accounts are the basis for taxation. This tax conformity rule, also known as the authoritative principle (*Maßgeblichkeitsprinzip*), is a characteristic of financial statements in German-speaking countries. The idea was to avoid that companies need to prepare a second set of accounts for tax purposes and instead use their financial statements for that purpose. The drawback, however, is that the financial statements became instrumental in the firms' tax management and firms had an incentive to understate their accounting income to reduce current income for taxing purpose (Ewert & Wagenhofer, 2007, p. 1039). According to the *Maßgeblichkeitsprinzip*, tax law principles rely on accounting principles if there is no other regulation in the tax law, meaning that the treatment followed for book purposes must also be adopted in the tax balance sheet (Falk, 2008, p. 54). This leads to companies exploiting latitudes for tax optimization purposes, if there is a legal choice option.

At the same time, financial accounting regulations increase considerably due to various scandals. Therefore the regulation prescribed strongly conservative accounting to limit the distribution of dividends to protect creditors. International accounting standards are much more oriented towards providing decision-relevant information for investors than accounting standards in German-speaking countries. They include less conservative accounting rules that are more in line with the management accounting purposes. Moreover international

accounting rules require detailed segment reporting and risk reporting (Ewert & Wagenhofer, 2007, p. 1040). In addition, Johnson & Kaplan (in Boyd & Cox, 2002, p. 1879) claimed that the relevance of product costs in traditional cost accounting systems was lost when accountants began focusing on the allocation of overheads to value inventory for financial reporting purposes. They claim that this allows for very rough allocation methods and results in the inclusion of costs that are not relevant for management decision-making. Therefore they contend that traditional cost accounting often fails to provide cost information that is useful for the decision-making process.

All of these developments decrease the usefulness of accounting figures for management purposes. On these grounds, financial accounting does not provide sufficient information for the management of an organization, particularly not if the company reports under German-based accounting principles. Thus, there is a need for a sophisticated cost accounting system, more concretely for management decision-making (Friedl, Küpper, & Pedell, 2005, p. 56). Therefore, companies began to develop their own management accounting systems that differed from financial accounting. These cost accounting systems were developed explicitly in response to the financial accounting system that is highly defined by government reporting requirements but is not very helpful to managers in supplying information needed to manage the business. In fact, in many (bigger) companies in Germany and German-speaking countries, there is a clear organizational distinction between the department responsible for financial accounting and the one responsible for controlling (Sharman, 2003, p. 31).

2.3 Cost accounting versus Managerial costing

The history of cost accounting dates back to the 19th century with the upcoming of large enterprises such as textile mills, railroads, steel companies and retail companies. The increasing need for measuring efficiency and determining cost of manufacturing gave rise to the upcoming management accounting systems. The term management accounting is often interchangeably used with the term cost accounting, which is actually just part of the former, broader term management accounting (Taylor, 2000, p. 3). Historically, cost accounting has been the main function of management accounting. It involves the calculation of actual costs of products and services for stock valuation, control and decision-making purposes (Dyson, 2007, p. 284). German cost accounting in particular was designed with the explicit objective to support management decision-making in relation to which products or services to offer, how to price them and how to plan and control operations (Sharman, 2003, pp. 30-31).

The International Federation of Accountants (IFAC) and the Association of Accountants and Financial Professionals in Business (IMA) identifies the term **cost accounting** as discipline to calculate the valuation of inventories, determination of transfer pricing amounts (for tax optimization purposes) and segmental reporting. Such specific uses are more commonly mandated by jurisdictions and regulatory authorities especially where cost assignment affects taxation or the determination of regulated pricing structures. Therefore the IMA determines the term **managerial costing** to distinguish between these two terms. According to the IMA, the term cost accounting is used for inventory valuations and product/service costs in

accordance with jurisdictions or regulatory authorities and managerial costing for providing information for performance evaluations and analysis as well as for planning and decision support within the company (Cokins, Thomas, Templin, & Huntzinger, 2012, p. 8).

This thesis aims to provide exactly that kind of information and on these grounds the term managerial costing should be used throughout the paper. However, in practice and within the subject-specific literature the term cost accounting, managerial accounting and perhaps managerial costing are often used synonymously. Thus, I hereby emphasize that the following work is not subject to any regulation, neither law nor any regulatory authorities, regardless if the term cost accounting or managerial costing is used. Information provided through this work is produced for the internal use for the managers and employees of the organization, only. It is information that not only does not need but must not conform to any standards established for financial accounting and financial reporting. The underlying reason for this is that the models based on external financial reporting have clear biases and limitations.

2.4 Terminology and fundamental basics of Management accounting

Organizations must understand costs in order to interpret and act on accounting information. There are a variety of cost concepts and terms manager need to understand to effectively use the information provided. This Chapter discusses cost concepts and terms that are the basis of accounting information used for internal and external accounting. The aim of this Chapter is to provide an understanding of how costs are accumulated and assigned to cost objects.

2.4.1 Actual cost accounting, Normal cost accounting, Standard cost accounting

An important issue of cost accounting is the type of costs that flow into the system. The different types of the systems differ according to their time-reference. There are three alternatives including: actual costs, normal costs and standard costs (Coenenberg, Fischer, & Günther, 2007, p. 41).

Actual costs refer to historical costs that have actually incurred in the past and have been recorded. That means that historical costs of a previous period are used for cost accounting purposes. Cost accounting based on these actual costs determines which costs occurred and why they incurred but only after the end of the period. Information concerning the future of the company is not gathered (Bogensberger, Messner, G. Zihr, & M. Zihr, 2008, p. 12). It is in the nature of things that historical cost information is not qualified for decision making and pricing.

Normal costs, in contrast, are historical actual costs but based on the average costs of several periods. The advantage of normal costs is that it smoothes outliers and seasonal fluctuation, which increases comparability. A concrete example for the reasonable use of normal costing is the loss of receivables (Coenenberg, Fischer, & Günther, 2007, p. 41). The determination of loss of receivables based on the previous years can be a useful and a fairly simple way to deal with future losses of receivables for cost accounting purposes. Also, expenses for warranties

are commonly based on an average rather than actual claims in the period and, thus are smoothed over periods (Ewert & Wagenhofer, 2007, p. 1039).

If future costs should be considered for decision-making and for pricing (in particular submission of quotations), **standard (planned) costs** should be used instead of actual historical costs. Using standard costs as a basis for the managerial costing system demands estimating future costs. Instead of the actual price, the estimated or planned cost is used to charge out the cost of manufacturing (Dyson, 2007, p. 295). The planning of costs might be complex and uncertain but essential for control and decision-making purposes. In addition, it enables the comparison between historical and standard costs to discover deviations at the end of the planning period (Bogensberger, Messner, G. Zihr, & M. Zihr, 2008, p. 12).

In practice, however, normal costing might be also used in an actual costing or standard cost accounting system. Some examples are the already mentioned loss of receivables, cases of damages as well as the use of depreciation (Bogensberger, Messner, G. Zihr, & M. Zihr, 2008, p. 13), where averages of the previous years are used to estimate future costs.

The costing system for the company will be based on standard cost to the extent to which standard costs are projectable and conveniently applicable. However, these projected costs are very often based on the experience of one or more periods of the past.

2.4.2 Variable costing versus Absorption costing

Variable and absorption costing are two approaches that are used in manufacturing companies for costing products for the purposes of valuing inventories (Garrison, Noreen, & Brewer, 2009, p. 276) but also for decision-making and/or pricing purposes.

The typical exchange of views is that if prices are set using only variable costs, low prices will lead to high sales. However, the firm will not recover its fixed costs, which will inevitably lead to a loss in the long run. Reversely, using full costs, meaning variable plus unit fixed costs, every order will cover its portion of fixed costs. However, the higher prices may reduce orders to the point where the firm again loses money in the long run (Banker & Hansen, 2002, p. 33).

The separation of fixed and variable costs (which will be described in more detail later on) helps to provide relevant information about costs for making decisions. Relevant costs are required for a variety of short-term decisions, such as whether to make a component internally or to purchase externally. Thus, an estimation of costs for different levels of activities (for example as part of a strategic growth plan) needs the distinction of variable and fixed costs (Drury, 2008, p. 237). Another reason is - and this is an important one for the *SMG*– to have a short-term bottom price for economically weak times.

Generally, absorption costing assigns both variable and fixed costs to products, whereas variable costing focuses on cost behaviour and just assigns variable costs to a particular cost object (Garrison, Noreen, & Brewer, 2009, p. 276). In detail **absorption costing**, also called

full costing, assigns all manufacturing costs, direct materials, direct labour, variable overhead and a share of fixed overhead to each unit of product. In this way, each unit of product absorbs some of the fixed manufacturing overhead in addition to the variable costs incurred to manufacture it (Guan, Hansen, & Mowen, 2009, pp. 676-677). Absorption cost systems include both job order and process cost systems (see Chapter 2.4.5). These systems can be used to absorb all manufacturing costs into the product costs, meaning that all the costs incurred by the firm are absorbed by products or services. Some complaints about these systems arise from their full absorption character. In particular, it is claimed that absorption cost systems create incentives to overproduce. This is due to the fact that an overhead rate is lower when the quantity of the specific allocation base (e.g. labour hours) is greater. This could lead to more units being produced than sold, so that some of the fixed costs are inventoried. With more fixed costs in inventory, fewer fixed costs are transferred to the income statement, leading to higher income independent of whether the goods can be sold or not. Therefore a major criticism of absorption costing is, that it creates incentives for mangers to overproduce and build unnecessary or unsellable inventory (Zimmermann, 2006, p. 535). This criticism is not a drawback that *SMG* needs to deal with, since they are not producing on stock but rather on customer demand.

Fixed costs are incurred to build capacity for production. Excess capacity, regardless of which form indicates costs spent for possible future benefit in terms of facilitating growth and meeting additional market share. The extent of unused capacities in the firm's resources depends on their goals, strategies but also under-usage or wastage due to inefficient operation (Balanchandran, Li, & Radhakrishnan, 2007, p. 21).

Normally, the higher cost should be taken in order to cover all of the costs (Gazely & Lambert, 2006, p. 19). However, if for example parts of the company are not used to capacity (underemployment), it will be worth accepting a job, which do not cover all the cost but cover more than the variable costs. Everything above the variable cost absorbs parts of the fixed costs. Accepting an order lower than the variable cost of a product, leads to losing money with every single unit or hour of production.

In contrast **variable** or **direct costing** only charge the variable manufacturing costs to the product and all the fixed costs (including fixed manufacturing costs) are charged to expense (Siegel & Shim, 2006, p. 148). In theory, under a direct costing system, product costs include only variable manufacturing costs. Here it must be emphasized that, in practice, direct labour is often considered a variable cost, whether it is a variable cost or not (Boyd & Cox, 2002, p. 1880). In the basic variable costing system, all fixed costs are written off against income in the year they are incurred. Product costs only contain the variable components. Thus, the main difference between the two systems is the treatment of fixed costs. As a result, profits cannot be increased by overproducing and thereby spreading these fixed costs over more units. However the use of variable costing introduces another element of discretion into the managerial accounting system: the difficulty of classifying costs as fixed or variable (Zimmermann, 2006, p. 541). The breakdown of costs into its variable and fixed portion is called cost splitting, which will be examined in more detail in Chapter 2.4.9.

Over the long run, of course, all costs are variable. Therefore, fixed costs are treated as if they were variable by assigning some to each unit of production (Guan, Hansen, & Mowen, 2009, p. 676). However, in the case of underemployment, absorption costing could lead to the instance that customer offers are rejected due to the requirement that all orders need to cover all the costs. In fact it could be beneficial to work for a lower price (but over the variable costs) to at least partially cover the fixed costs instead of none.

In summary, the main difference between variable and absorption costing is in the treatment of fixed costs. Under absorption costing fixed costs are treated as product costs, and under variable costing they are treated as period costs (Siegel & Shim, 2006, p. 148).

2.4.3 Expenses versus Costs

The term cost is distinguished, as used in managerial accounting from the term expense, as it is used in financial accounting. Managerial accounting primarily deals with costs, not expenses (Maher, Stickney, & Weil, 2011, p. 12).

The distinction between expenses and costs is the result of a long history of conceptual thinking about costs. Accounting developed from the desire of firms to keep track of the production of products and the transactions with other parties as well as the periodic determination of the profit from the activities (Ewert & Wagenhofer, 2007, p. 1039). The reasons for differences between costs and expenses are drawn from various sources. These are similar to the differences between financial and managerial accounting already mentioned in Chapter 2.2, which deals with differences between international accounting principles and rules in German-speaking countries. These differences may result in an even higher degree of deviation between the expenses in the income statement and the cost used for decision-making purposes of the companies within a German-speaking country, as in any other country.

The common definition of **cost** is the monetary value of goods and services used for a particular purpose in an accounting period. The term particular purpose is referred to as the basic business of the firm (Ewert & Wagenhofer, 2007, p. 1038) such as metal-processing in case of the *SMG*. Costs can also be seen as a resource sacrificed or forgone to achieve a specific objective (Drury, 2006, p. 27). **Expenses,** as recorded in financial accounting, differ from costs in that the latter exclude neutral expenses and include other imputed costs and may differ in measurement. Neutral expenses are expenses that relate to other periods and extraordinary expenses (Ewert & Wagenhofer, 2007, p. 1038). Another difference derives from the fact that generally accepted accounting principles and regulations (such as the income-tax laws) specify when the firm must treat cost as expense. This is done so that they are classified as operating expense and are therefore tax-deductible (Maher, Stickney, & Weil, 2011, p. 12). A particular example would be deprecation. Financial accounting regulation limits the useful life of many fixed assets that is used for depreciation purposes, which may not conform to the economic useful life. The strong link between financial and tax accounting (especially in German-speaking countries) causes firms to select the shortest useful life,

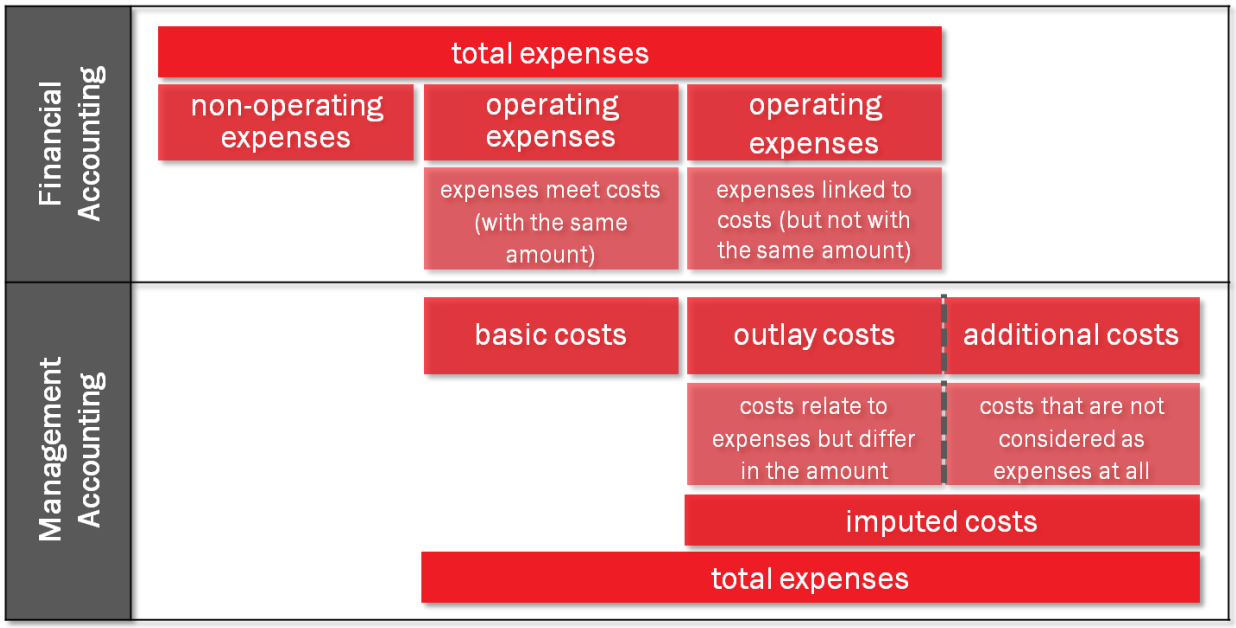
permitted by tax law, in order to increase their expenses to reduce the present value of their income tax burden (Ewert & Wagenhofer, 2007, p. 1039).

In contrast to management accounting, financial accounting is an overall, holistic approach, where the profit of the whole company is determined (Coenenberg, Fischer, & Günther, 2007, p. 25). This leads to the fact that financial accounting includes expenses that are not related to the main business of the company, expenses that relate to other periods and extraordinary expenses (Ewert & Wagenhofer, 2007, p. 1039). German-speaking standard economics literature distinguishes between **external expenses** (e.g. donations), **expenses relating to other periods** (e.g. supplementary payment of taxes for previous periods) and **extraordinary expenses** (e.g. loss due to fire damage). All these three cases are referred to as neutral expenses or non-operating expenses and are not considered as costs since they are not related to the particular purpose of the company. Costs, which are accompanied by expenses in the same amount, are called basic costs. If costs relate to expenses but differ in the amount, such as the above mentioned depreciation example, these costs are called outlay costs.

Additional costs are costs that, according to accounting rules, must not be considered as expenses. An example would be interest on equity (Coenenberg, Fischer, & Günther, 2007, p. 26). Outlay costs and additional costs are building the group of imputed costs (Tanne, 2007, p. 12). The inclusion of additional costs results from opportunity cost thinking, with the argument that if the resources were provided by a party other than the owner, they would incur expenses and costs, or the owner could gain more profit when providing it for another party (Ewert & Wagenhofer, 2007, p. 1039).

The exclusion of other period and extraordinary expenses is due to the desire to shield the determination of costs from events that, as per definition, are not related to the production process in the period. An example of this would be loss of accounts receivables or warranties. These costs are commonly based on averages rather than actual claims in the period and are thus smoothed over periods (Ewert & Wagenhofer, 2007, p. 1039). Figure 1 graphically displays the different types of costs and expenses.

Figure 1. Cost and Expense Classifications



Source: M. Tanne, *Kostenrechnung*, 2007, p. 12.

2.4.4 Cost allocation principles

Costs should be allocated to the cost centre, product or order that has caused them. To enable costs to be accurately assigned, causality should be analysed in order to avoid the end results being arbitrary. Costs calculated based on causality can help produce more cost effectiveness. It helps to see the relationship between products and/or services they deliver and the financial impact they have on the organization. Understanding causality is not only beneficial but also necessary for accurate price setting (Monitor, 2013, p. 13).

The principle within which costs are assigned to cost objects based on causation is called **principle of causation.** However, where costs and cost object do not have an obvious relationship, costs need to be alternatively allocated. This is the case when overhead costs are just indirectly related to the production process. In this situation the costs need to be proportioned via reference parameters. This is called the **cost average principle.** An example of costs being proportioned is the deprecation over the useful life of equipment (Coenenberg, Fischer, & Günther, 2007, p. 40). If none of these principles are applicable, sometimes the so-called **cost viability principle** is executed. In this case, costs are allocated to cost objects to the extent of the bearing capacity of the cost object (Bogensberger, Messner, G. Zihr, & M. Zihr, 2008, p. 27). An example within traditional cost accounting would be the percentage share of material handling and storage overheads. A product or order with a higher amount of material costs can carry a higher amount of these storage overheads than one with a low share of material, even though the handling (picking and storing) might be similar.

2.4.5 Product costing systems

Companies use different product costing systems to accumulate, track and assign the costs of production to the products and services produced, just as they use different techniques to manufacture products or provide services (Jackson & Sawyers, 2001, p. 63).

Job costing or **job-order costing** is a costing system that is required in organizations, where each unit or batch of output of a product or service is unique. This creates the need for the cost of each unit or order to be calculated (accumulated, tracked and assigned) separately. The term job thus relates to each unique unit or batch of output. Job costing systems are used in industries that provide customized products or services (Drury, 2008, p. 37). The common approach of job-order costing is to identify direct costs of the job, then determine a basis for allocating indirect costs and finally identify indirect costs associated with each cost allocation base (PAIB, 2009, p. 38). Job-order costing operations begin when a company decides to produce a specific product for stock or – as it is the case at *SMG* – in response to an order for a custom product (Jiambalvo, 2001, p. 39). *SMG* for example provides customized products (to a minor extent even services) for clients with each client requiring products and, or services that consume different quantities of resources. In German literature this costing system is referred to as *Zuschlagskalkulation* (translated as overhead costing), which can be either single or multi-level. Within the **single-level overhead costing** system, all overheads are allocated with one single overhead burden rate. Allocation base are direct costs, which are, either material or labour direct labour costs. **Multi-level overhead costing** in contrast uses several overhead burden rates. Therefore an appropriate cost centre accounting is necessary, where overheads are allocated to the different divisions or operations of the company in form of cost centres. Administration and sales overheads are allocated to the production cost and finally lead to the prime cost or cost of manufacture (Däumler & Grabe, 2008, pp. 266-267). Table 1 shows the difference between the two approaches.

Table 1. Examples of Single- and Multi-Level Overhead Costing

Single-level overhead costing		
Direct material		350
10 labour hours	50/h	500
Sum of direct costs		850
Overhead rate on labour	50%	250
Prime costs		1.100

Multi-level overhead costing		
Direct material		200
Material overheads	10%	20
4 Metalworking hours	40/h	160
Metalworking overheads	100%	160
8 Polishing hours	30/h	240
Polishing overheads	60%	144
3 Turning hours	40/h	120
Turning overheads	150%	180
12 Assembling hours	50/h	600
Assembling overheads	70%	420
Manufacturing costs		2.244
Administration overheads	10%	224,4
Sales overheads	10%	224,4
Prime costs		2.693

Source: K.-D. Däumler & J, Grabe. *Kostenrechnung 1*, 2008, pp. 266- 267.

In contrast, **process costing** relates to those situations where masses of identical units are produced and it is unnecessary to assign costs to individual units of output (Drury, 2008, p. 37). Therefore companies that produce a homogenous product on a continuous basis like oil refineries, breweries, paint and paper manufacturers, for example use this product costing system (Jackson & Sawyers, 2001, p. 63). Products are manufactured in exactly the same way and consume the same amount of direct costs and overheads. Therefore it is not necessary to assign costs to every individual product or service. Instead, the average cost per unit of output is calculated by dividing the total costs for a batch divided by the number of products produced (Drury, 2008, p. 37). This is similar to the so-called *Divisionskalkulation* (translated as output costing), which can be found in German literature (Däumler & Grabe, 2008, p. 259).

Operations costing is a hybrid of job and process costing and is used by companies like clothing or automobile manufacturers who make products in large batches, in other words large numbers of products that are standardized within a batch. Each batch is priced like a job in job-costing but each single unit in the batch is priced like a homogeneous product in process costing (Jackson & Sawyers, 2001, p. 63).

2.4.6 Assigning costs to cost objects - Cost tracing, Cost allocation

Costs are assigned to objects for many purposes such as pricing, profitability studies and control of spending. The process of assigning costs in reasonable and realistic proportion to the resource consumption, benefit provided or other equitable relationship to cost objects, is called cost allocation. This term includes both direct assignment of cost and the reassignment of a share from an indirect cost pool (Office of Management and Budget, 2004). However,

management accounting textbooks often use the term **cost tracing** when a cost can be directly assigned to a cost object and **cost allocation** for assigning indirect costs to cost objects.

A **cost object** can be anything, for which cost data is requested, such as products, product lines, job order but also organizational sub-units. In order to attribute costs to those cost objects, costs are divided in either direct or indirect costs (Seal, Garrison, & Noreen, 2009, p. 35) as described in detail in the following Chapter.

Simplistic as well as sophisticated systems accurately assign direct costs to cost objects. In the case of direct costs, cost assignment merely involves the implementation of suitable clerical procedures to identify and record the resources consumed by cost objects. For example direct labour: time spent on manufacturing a specific product is recorded on source documents, such as **time sheets** or **job cards**. Details of the job account number are also entered on these documents. For direct material the source document is a **materials requisition**. Details of the materials issued for manufacturing a product are recorded on this materials requisition as well as the job number. The details on these source documents thus represent the source information for assigning the cost of direct materials and direct labour to the appropriate cost object. In many organizations the recording procedure for direct costs is computerized using bar coding and other forms of on-line information recording. The source documents then only exist in form of computer records (Drury, 2004, p. 61).

This is not the case in this company. In practice, *SMG* uses one source document, the so-called *Auftragskontrolle* (literally translated as order control or job control sheet), where the to-manufacture product or batch name, the job number as well as the direct material and direct labour hours required by the specific job are recorded.

Cost allocation is the process of assigning costs when a direct measure does not exist of the quantity of resources consumed by the different cost objects. It involves the use of surrogates rather than direct measures (Drury, 2008, p. 48). Therefore, cost allocation involves finding a logical method of assigning overhead costs to the products or services produced by a company. If a company only produces one product, the allocation would be simple. The total overhead cost would be divided by the total number of units produced. However, if the company produces more than one product, it does not make sense to allocate overhead based on the number of units produced, particularly not if the products are highly diverse. A more logical approach might be to allocate the overheads to different products based on the number of direct labour hours or labour costs consumed in the manufacture of each (Jackson & Sawyers, 2001, p. 67). This basis is called **allocation base**. Historically, many manufacturing firms used direct labour hours or direct labour cost as an allocation base for overheads. This occurred due to the fact that most production processes were very labour intensive prior to the profound technical innovations of the last quarter of the century. It simply made sense (and still does today) to use labour hours or direct labour cost to allocate overhead when large quantities of labour were used to create a product or service. However, as machines increasingly replaced labour and production processes became more automated, the use of

machine hours as an allocation base is gradually becoming more prevalent (Barsky & Catanach, 2005, p. 325).

A practical example of the *SMG* would be the cost centre laser-cutting. Since this is a highly mechanized activity, the laser-cutting hours of the specific machine, is a much better allocation base than for example labour hours, since the manual work of loading is just a minor part of the activity. Whereas in the manufacturing, powder-coating or polishing cost centres the labour hours or the labour costs may be a more appropriate allocation base, since labour plays a major role in the manufacture cost centres.

However, the selection of the allocation base is a precarious issue. If, for example, labour hours are used as the overhead allocation base, managers might try to cut labour to reduce overhead surcharges to the jobs for which they are responsible. But if labour time is reduced it does not necessarily mean that overhead costs are also reduced, since at least in the short run, many of the overhead costs may be fixed. Thus, the apparent cost savings may not be realized. In other words, the costing system can make it appear that costs are decreasing, when in fact they are not (Jiambalvo, 2001, p. 49). Such issues need to be taken into consideration when applying overhead allocation rates.

Understanding what causes overhead costs is key to allocating overheads. The choice of a logical base on which to allocate overheads depends on finding a cause-and-effect relationship between the base and the overhead. A good allocation base is one that drives the incurrence of the overhead cost. Therefore allocation bases are often referred to as **cost drivers** (Jackson & Sawyers, 2001, p. 67).

Based on this finding, cost drivers are not necessarily limited to the most common ones, such as labour or machine hours. For example the costs of (raw) material handling: It is assumed that, more material respectively the higher priced materials need more handling. The basis that is used to allocate costs to cost object is therefore the direct material cost (Drury, 2008, p. 48).

In traditional manufacturing companies, direct labour hours, respectively direct labour cost have often served as cost drivers. However, as companies make more diverse products and become more heavily automated, one single cost driver might not provide accurate cost information. Therefore companies form separate cost pools (Jackson & Sawyers, 2001, pp. 68-69). A **cost pool**, also referred to as **cost centre** is a defined area to whom direct and indirect costs are allocated. In regards to responsibility, it is a distinctly identifiable department, division or unit of an organization whose managers are responsible for all its associated costs and for ensuring adherence to its budgets (BusinessDictionary.com) but have no control over revenue or capital investment decisions (Jackson & Sawyers, 2001, p. 344).

Since overheads are assigned to products using predetermined overhead rates based on estimates, it is likely that actual overhead costs (when they become known) differ from the applied rates. If the applied overheads are higher than the actual overheads, the company

under-applied overheads or in the case of lower actual overheads, it over-applied overheads (Jackson & Sawyers, 2001, p. 72). The former, leads to higher prices of the end product, which might lead to higher revenues. However, this might very likely lead to the fact that products cannot be sold or the company does not receive enough orders. The latter leads to too low pricing, resulting in loosing profit or even generating a loss due to insufficiently covering costs.

However, even with the most sophisticated costing methods, there is inevitably some amount of discretion in determining the distribution of overhead costs (Taylor, 2000, p. 4).

2.4.7 Direct versus Indirect costs

In general, **direct costs** are the costs that can be identified specifically with a specific project, an instructional activity, or any other institutional activity, or can be directly assigned to such activities relatively easily with a high degree of accuracy (Office of Management and Budget, 2004). More specifically, direct costs can be physically or conveniently traced to the particular cost object. To be traced to a cost object such as a particular product, the cost must be caused by the cost object (Seal, Garrison, & Noreen, 2009, p. 35).

Primary direct costs are direct material and direct labour. **Direct material** that goes into the final product is called raw material. This term is somewhat misleading since it seems to imply unprocessed natural resources like wood pulp or iron ore. Actually, raw materials refer to any materials that are used in the final product and the finished product of one company can become raw material for another company. It is important to note that direct materials are those materials that become an integral part of the finished product (Seal, Garrison, & Noreen, 2009, p. 23). Examples of raw materials are wood, iron but also purchased parts that go into the final product. **Direct labour** comprises of employees or workers that are directly involved in the production of goods and services (Bogensberger, Messner, G. Zihr, & M. Zihr, 2008, p. 53). It is the portion of the total cost of production that is associated with salaries, benefits, taxes and other expenses related to the personnel needed for the process. Though, it does not include indirect labour costs such as accounting, human resources or other administrative functions that support the process or personnel (InvestorWords.com). However, especially in small and middle-sized enterprises labour costs are mostly fixed, since employees cannot be adapted at any time. Nevertheless, primary labour costs are usually considered as variable (Greimel-Fuhrmann, et al., 2010, p. 182/4).

In comparison, **indirect costs** or **overheads** cannot be physically traced to the particular cost object (Seal, Garrison, & Noreen, 2009, p. 36). In general, indirect costs mean any cost not directly identified with a final cost object, but identified with two or more final cost objects or with at least one intermediate cost object (Office of Management and Budget, 2004). In other words, indirect costs arise when a resource is shared by several users and are therefore sometimes referred to as common costs (Zimmermann, 2006, p. 343). A common cost is common to a number of costing objects but cannot be traced to them individually. It is a particular type of indirect cost (Seal, Garrison, & Noreen, 2009, p. 36). However, following

the practice of common literature the terms indirect costs, overheads and common costs are used interchangeably.

Overheads can be further classified into manufacturing overheads and non-manufacturing overheads. **Manufacturing overheads** include all costs of manufacturing except direct materials and direct labour. These are for example materials (that cannot be physically or conveniently traced to the cost object), indirect labour, maintenance and repair on production equipment, heat and light, depreciation of equipment, et cetera. In contrast, all of the costs that are not connected with the manufacturing part of the company and are associated with its selling and administrative functions are referred to as **non-manufacturing costs**, which can be sub-classified into administrative costs and marketing or selling costs. While **administrative costs** include all executive, organizational and clerical costs associated with the general management of an organization, **marketing** or **selling costs** include all costs that are necessary to secure customer orders and get the finished product or service into the hands of the customer (Seal, Garrison, & Noreen, 2009, pp. 23-24).

This cost classification is fundamental for further cost allocation. Direct costs can be directly charged to cost objects, whereas overheads need further costing methods to allocate them to the specific cost objects.

2.4.8 Variable versus Fixed costs

Another way of classifying costs is in accordance to their cost behaviour. Cost behaviour means the reaction of costs in response to changes in the level of business activity. As the production level rises and falls, a particular cost may rise and fall as well, or it may remain constant. **Variable costs** are costs that vary in proportion to changes in the level of activity respectively production. An activity can be expressed in many ways, such as units produced, units sold, miles driven, beds occupied, lines of print, hours worked and so forth (Seal, Garrison, & Noreen, 2009, p. 33).

The distinction between variable and fixed costs is important for managers to understand how costs behave in order for strategic and operating decision-making. Cost behaviour can be recognized through cost functions. A cost function is a mathematical description of how a cost changes with changes in the level of an activity relating to a particular cost. It can be plotted on a graph by drawing the level of an activity, such as number of batches produced or number of labour, respectively machine hours on the horizontal axis (x-axis) and the amount of total costs corresponding to – or preferably, dependent on – the levels of that activity on the vertical axis (y-axis) (Horngren, Datar, & Foster, 2006, pp. 332-333). In practice it is much more complicated since costs rarely depend on only one factor. However, in order to reduce complexity, management accountants take two assumptions as a basis. First it is assumed that variations in total cost can be explained by variations in the level of one single activity. Furthermore, cost behaviour is approximated by a linear cost function within the **relevant range**. A relevant range is the range of the activity in which there is a relationship between total cost and the level of activity. For a linear cost function, represented graphically, total

cost versus the level of a single activity related to that cost is a straight line within the relevant range (Horngren, Datar, & Foster, 2006, p. 333).

In practice, there are three criteria (Horngren, Datar, & Foster, 2006, p. 335) for classifying a cost into its variable and fixed components: First of all, there is the **choice of the cost object**. A particular cost item could be variable with respect to one cost object but fixed with respect to another cost object. In the example of *SMG* a specific tool that must be purchased for a specific order (batch of products) might be a variable one with respect to the number of orders/batches. But if a particular product is the cost object, then the cost is a fixed cost. Whether a cost is variable or fixed with respect to a particular activity also depends on the **time horizon** being considered in the decision- making situation. The longer the time horizon, ceteris paribus, the more costs are variable. Typically labour costs are fixed in the short run but can be adapted (in form of redundancies) in the long run. Finally, it needs to be considered that variable and fixed cost-behaviour patterns are valid for linear cost functions only within the given **relevant range**. Outside this range, the variable and fixed cost-behaviour pattern changes, causing costs to become nonlinear, respectively jumping up or down. One example would be the higher number of machine hours requiring a new machine to be purchased causing a doubling in depreciation costs. Another reason could be due to labour and other inefficiencies, such as the learning time at the beginning (Horngren, Datar, & Foster, 2006, p. 335).

2.4.9 Cost splitting

Breaking down the costs into its variable and fixed components is the main issue of marginal costing or *Grenzkostenrechnung* (which will be described in detail in Chapter 2.6). It should answer the question which costs are independent from accepting an order or not and which costs change when accepting an order. The former are referred to as fixed costs, the latter are called variable costs. However, in practice, this question is not as easily answered as it may sound. Raw material is nearly always variable since no material is needed if there is no production. With labour costs the determination is not that simple. As mentioned above labour costs are mostly fixed but primary labour costs (direct labour) are usually considered as variable (Greimel-Fuhrmann, et al., 2010, p. 182/4).

Mixed costs have both variable and fixed shares. The theory provides several methods of separating mixed costs into their fixed and variable components. These are the high-low method, the scatterplot method and the method of least squares. The **high-low method** considers the total cost at the highest level of activity compared with the total cost at the lowest level of activity. The **scatterplot method** determines the equation of a line by plotting the data on a graph. The third method heads in the same direction and determines the best fitting line of a given set of data (costs in response to different levels of activities) with the difference of being calculated instead of plotted. The best fitting line is the line with the smallest (least) sum of squared deviations and represents the best predictor of total cost for some activity. Therefore it is referred to as the **method of least squares**. Since computing the

regression formula manually is tedious, spreadsheet packages such as Microsoft Excel have regression routines that perform the computations (Hansen & Mowen, 2007, pp. 82-83).

However, each of these methods assumes simplistically a linear cost relationship. A non-linear view may display real cost behaviour much more accurately but every activity could have a different cost function and so this approach would be very time consuming (if at all possible). Therefore, it is much simpler and feasible to assume a linear relationship (Hansen & Mowen, 2007, p. 83). Though, even if linearity is assumed that is just valid within a relevant range of output.

Sometimes, one activity driver is not enough to accurately display the cost function. In that case more than one single independent variable influences the costs. If so it might be necessary to search for additional explanatory variables. In the case of two or more independent variables, the high-low and scatterplot methods cannot be used and only an extension of the method of least squares is applicable. Whenever the least squares method is used to fit an equation involving two or more explanatory variables, this is called multiple regression (Hansen & Mowen, 2007, p. 95).

Finally, the distinction of costs into variable and fixed costs is often based on assumptions and estimations. At the end of the day someone must have the rights to determine how much of the actual overhead is fixed and how much is variable (Zimmermann, 2006, p. 541). See Chapter 4.5.3 that deals with cost splitting in practice.

2.4.10 Cost conversion

The typical design of German cost accounting systems deals with the difference of expenses used for financial accounting and costs used for management accounting and includes as first step the so-called *Betriebsüberleitungsbogen* (which could be translated as cost conversion sheet) that reconciles expenses from the financial accounting system and costs. The typical chart of accounts also includes groups of accounts for neutral expenses and for additional costs. However, it depends on the company if all distinctions are done in practice, which are suggested in theory (Ewert & Wagenhofer, 2007, p. 1039).

Expenses are led over into costs, which could be referred to as transition from expense to costs or cost conversion. With an existing ERP tool and already defined clear demarcations of expenses and costs already considered when they were recorded, the cost conversion might be done at the push of a button (Bogensberger, Messner, G. Zihr, & M. Zihr, 2008, p. 18). Besides that more and more large-scale enterprises are moving towards international accounting standards. Valuation and accounting regulations of these standards are more close to reality than accounting standards in German-speaking countries. A transition from expenses to costs is therefore not necessarily required (Kreuzer, 2010, p. 331).

However, in small businesses without the use of cost accounting software, the transition of expenses can be carried out manually, respectively with the help of a spreadsheet (such as Microsoft Excel) and with hindsight. This generally looks as is displayed in Figure 2.

2.5 Costing in general

Figure 2. Overhead Costing Sheet

Expenses	Demarcations		Costs
	-	+	

Source: S. Bogensberger, S. Messner, G. Zihr, & M. Zihr, *Kostenrechnung – Eine praxis- und beispielorientierte Einführung*, 2008, p. 340.

Traditional cost accounting (TCA) first calculates the total cost of raw materials and direct labour and only then applies overhead costs using an arbitrary allocation factor such as labour hour costs. In contrast activity based costing (ABC) attributes variable, fixed, and overhead costs directly to each product or service by using the activities required to produce the product or service by means of allocation (Rezaie, Ostadi, & Torabi, 2008, p. 1050). ABC is explained in detail in Chapter 2.7.

One of the ubiquitous difficulties is the allocation of indirect costs to various objects such as products, departments, divisions et cetera. Cost accounting traditionally used predetermined overhead rates in order to apply the indirect cost of manufacturing to the different products by means of some base such as direct labour cost or direct labour hours (Taylor, 2000, p. 4). The main characteristic of traditional overhead allocation is that overheads are allocated to products or services based on some trait, that products and/or services have in common. This common trait is the allocation base, as already explained above (see Chapter 2.4.6) (Barsky & Catanach, 2005, p. 325).

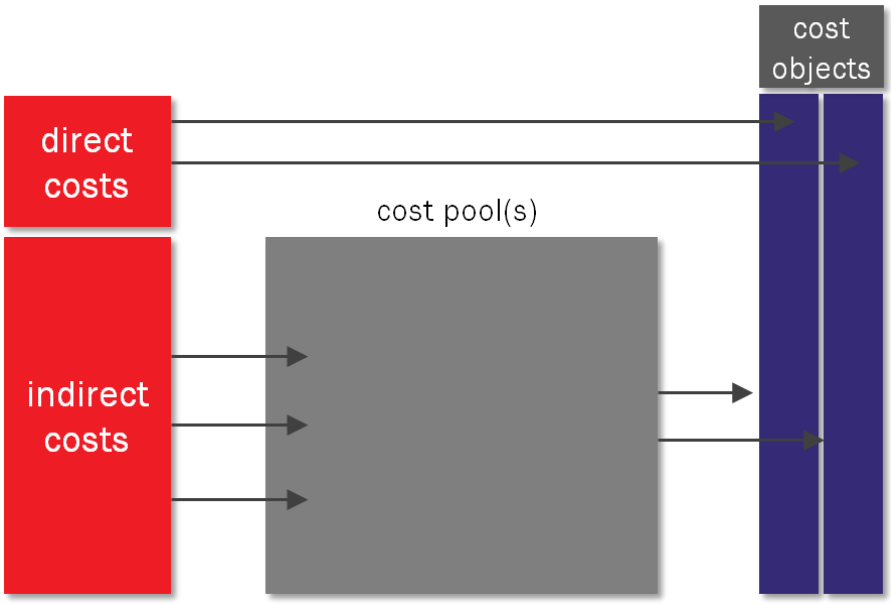
Sometimes the term traditional costing is used to state that only one single allocation base or cost driver, such as labour hours, is used for the whole company or plant (see for example Horngren, Harrison Jr., & Oliver, 2009, p. 905 or Barsky & Catanach, 2005, p. 326). This would lead to the fact, that *Grenzplankostenrechnung* (which will be explained in detail in Chapter 2.6) should not be considered as a traditional costing tool.

Actually, using a single overhead rate for the organization as a whole represents the most simplistic traditional costing system. This single overhead rate is called blanket overhead rate or plant-wide rate (Drury, 2004, pp. 61-62). However, a single overhead rate for the whole department will result in the inaccurate assignment of overheads when a department consist of a number of different production centres with products passing through the departments consuming overheads of each production centre (or at least some of them) in different proportions. Therefore, it makes sense to establish separate overhead rates for each production centre within the company. If a single rate for the whole company is applied, all of the

overheads within the department would be averaged out and the product would be indirectly allocated with some of the overheads of production centres, which might not even be involved in the specific production process. It is therefore concluded that if a company or department consists of a number of different production centres, each with significant overhead costs that can be precisely (to a certain extent) assigned to them, separate overhead rates should be established for each production centre within the department. The term **cost centre** or **cost pool** is used to describe a location to which overhead costs are initially assigned. The total costs accumulated in each cost centre are further assigned to the specific cost object (Drury, 2004, p. 63).

Particularly, literature of English-speaking countries often refers to traditional cost accounting system as system with only one overhead rate throughout the firm, which is displayed in Figure 3 below. Thus, it is claimed that a traditional cost accounting system is incapable of providing managerially relevant product costs because it tries to do the impossible, to measure the true relationship between common costs and output (Boyd & Cox, 2002, p. 1880).

Figure 3. Traditional Cost Accounting in Anglophone Countries



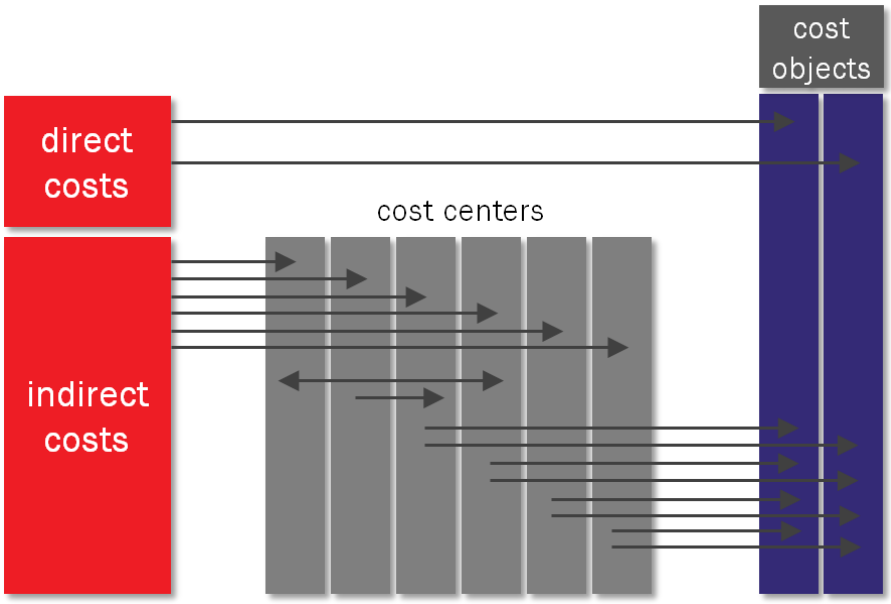
Source: L. Nadig, *Prozesskostenrechnung in Theorie und Praxis*, 2000, p. 11.

However, in this work the term traditional cost accounting is referred to the instance that business's overheads or indirect costs are calculated as a proportion of an activity's direct costs, for example labour or materials (Coulter, McGrath, & Wall, 2011, p. 12) and that cost centres are built in respect to the different entities within the company not necessarily due to their processes. Even though this could be overlapping as is the case at the laser-cutting division of *SMG*. Laser-cutting represents an own cost centre because costs are and can be conveniently assigned to this entity of the company but it is actually also a process including activities such as programming, set-up and laser-cutting itself.

Overhead rates in traditional costing, sometimes also called the volume-based overhead rate, is called a **single overhead rate** if there is only one for the entire organization (plant wide rate) or **departmental rates**, if a set of overhead rates exist with various rates for different departments or divisions (Blocher, Chen, Cokins, & Lin, 2005, p. 132). The former were and are traditionally more common in English-speaking countries, were the latter are more common in Europe (Nadig, 2000, p. 10).

These overhead rates use an output-volume-based activity or activities to assign (or spread) overhead costs to products and/or services. An output-volume-based costing system spreads costs evenly so that each cost object (product or service) receives the same amount (Blocher, Chen, Cokins, & Lin, 2005, p. 132). Overhead rates, however, can also be expressed as percentages of direct costs, which causes the costs to be assigned to the cost objects according to the amount of their direct costs. Figure 4 shows the example of a traditional costing system using a set of overhead rates based on different cost centres, which is fairly common in German-speaking countries and Europe in general.

Figure 4. Traditional Cost Accounting using a Set of Cost Centres



Source: L. Nadig, *Prozesskostenrechnung in Theorie und Praxis*, 2000, p. 11.

2.6 Costing in German-speaking countries

Management accounting and in particular cost accounting in German-speaking countries have developed from a common and long-standing history. German-speaking countries comprise Germany, Austria and (part of) Switzerland. In the following, cost accounting in these countries will be referred to as German cost accounting.

Management accounting has long been more important to companies in German-speaking countries than, to - for example - companies in the United States. This might be attributed to the fact that external accounting rules in these countries puts the interests of creditors before

those of shareholders (Friedl, Küpper, & Pedell, 2005, p. 56). Financial accounting in German-speaking countries is highly defined by governmental reporting requirements but not sufficient in supplying information needed to manage the business (Sharman, 2003, p. 31), providing little guidance for management decision-making and pricing. Thus, there is a need for a sophisticated cost accounting system, explicitly for management decision-making (Friedl, Küpper, & Pedell, 2005, p. 56).

For that reason German cost accounting systems have been among the most elaborate cost accounting systems worldwide (Ewert & Wagenhofer, 2007, p. 1035). German cost accounting was designed with the explicit objective of supporting management decision-making about which products, respectively services to offer, how to price them and how to plan and control operations (Sharman, 2003, pp. 30-31). However, it is mainly large firms in German-speaking countries, which implemented sophisticated cost accounting systems, while smaller firms use much simpler systems (Ewert & Wagenhofer, 2007, p. 1047).

A widely used German costing methodology that is designed to provide a consistent and accurate application of how managerial costs are calculated and assigned to a product or service is called ***Grenzplankostenrechnung (GPK)*** (Friedl, Küpper, & Pedell, 2005, p. 56).

GPK was developed shortly after the Second World War by H.G. Plaut with Prof. Dr. Wolfgang Kilger, who was very influential in developing the theory. Plaut and his consulting company deployed *GPK* to many manufacturing companies, as well as to a number of significant service organizations including banks and the postal system in Germany. As a competing model Prof. Dr. Paul Riebel also created a highly sophisticated contribution margin accounting method called *Einzelkosten-* und *Deckungsbeitrags-rechnung*. Both models are integrated in modern German cost accounting systems, whereas the resulting *GPK* methodology has become the standard for cost accounting in German speaking countries. This might be due to the fact that the primary German cost accounting textbook *Flexible Plankostenrechnung und Deckungsbeitragsrechnung* was originally written by Wolfgang Kilger and therefore features *GPK* (Sharman, 2003, p. 31).

The German approach to cost accounting roughly translates as flexible margin costing but is simply referred to as *GPK* in the United States (C.E. Davis & E. Davis, 2011, p. 204). It is comparable to direct costing, which is widely present in international literature. Similar to direct costing, the idea behind *GPK* is that fixed costs are not charged to products. Within *GPK* variable (proportional) and fixed costs are strictly separated. In practice *GPK* can be combined with a multilevel allocation of fixed costs (Friedl, Küpper, & Pedell, 2005, p. 57). In one of their International Good Practice Guidance the Professional Accountants in Business (PAIB) Committee of the International Federation of Accountants (IFAC) states that *GPK* is used as both a variable costing but also full costing system (PAIB, 2009, p. 37).

The aim of *GPK* is to provide a consistent structure that provides relevant costs for decision–making by tracking factors of the production process through a system of *Bezugsgrößen* (*BGs*), a form of allocation bases, which are similar to cost drivers in activity-based costing.

The core of *GPK* is the premise of linearity and the use of a system of cost centres. The firm's activities are structured into direct and indirect cost centres, which collect costs for the centres' activities and trace them to specific *BGs*. In the simplest case, resource usage only depends on the output quantity the centre produces (output is defined centre-specific, it may be an intermediary or final product or some service provided for other centres), which would be the case at purely homogenous production (Ewert & Wagenhofer, 2007, pp. 1047-1048).

In practice, *GPK* application varies in complexity depending on the history, culture and requirements of an organization, which is in turn determined by the complexity of its products and processes. It focuses on how resources are consumed and on the modelling of causal relationships. However, it does not have the ability to support activity analysis and assigns resource costs using direct tracing of resource outputs. The disadvantage of *GPK* is that administration and selling cost are generally not conducive to such direct charging or are only achievable at significant measurement costs (PAIB, 2009, p. 37).

2.7 Activity based costing (ABC)

Just knowing the product costs is not enough anymore. The last decades have shown that companies are subject to consistently reducing costs in order to remain competitive. Therefore it is necessary to know the workflows and processes within the company explicitly and in particular their cost relationships (Nadig, 2000, p. 6).

An important factor for the loss of information value of existing cost accounting concepts lies in the changing structures of costs. Production environments have experienced a significant increase in overhead costs and subsequent decline in direct labour costs (Bilici & Dalci, 2008, p. 62).

Chapter 2.4.7 has shown that direct costs, such as materials and labour, are comparatively easy to assign to products. However with indirect costs, for instance costs for utilities, planning engineer and plant depreciation, the situation differs. It is the indirect costs, the overheads – which are actually significant - that must be allocated somehow (Horngren, Harrison Jr., & Oliver, 2009, p. 902). Assigning overhead to products and services using traditional allocation methods and volume-based cost drivers may not provide adequate information to managers for the decision-making process (Jackson & Sawyers, 2001, p. 85).

There is a danger that only those incremental costs that are uniquely attributable to individual products (direct costs) will be classified as relevant and those that are not attributable to products are considered as irrelevant for decision-making. Direct costs are fairly transparent and how they will be affected by decisions is clearly observable. There has been a tendency to assume that these costs are fixed and irrelevant for decision-making. However, in many organizations indirect costs have escalated over the years. Therefore and with the emphasis on long-term decisions, indirect costs cannot be assumed to be irrelevant for decision-making in general. The costs of many joint resources fluctuate in the long term according to the demand for them. For example support functions, such as materials procurement, materials handling,

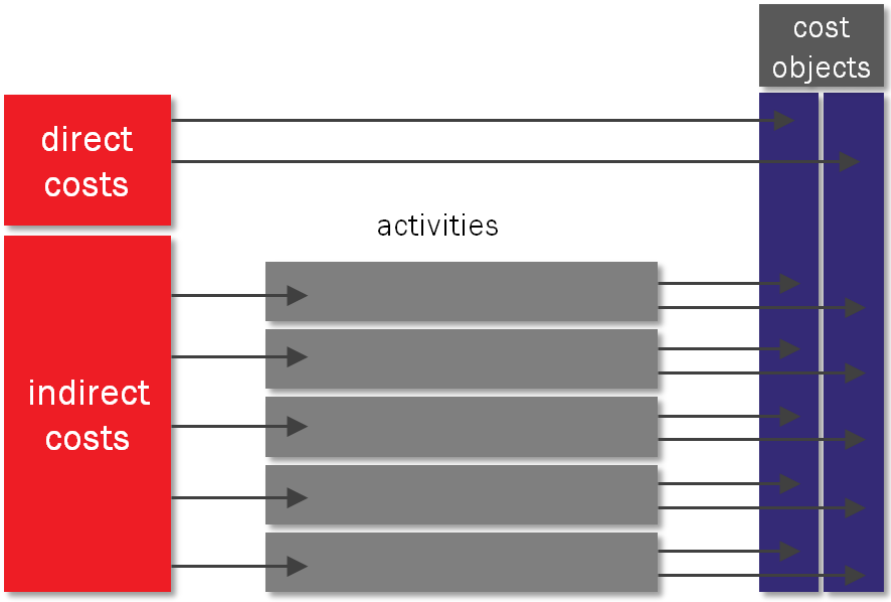
production scheduling and warehousing. The costs of these activities are either not directly traceable at all, or would involve such detailed tracing that the costs would exceed their benefits. The demand for these support functions is determined by product introduction, re-design, mix-conditions and discontinuation. Thus, to estimate the impact that decisions will have on support activities, a cost accumulation system is required that assigns those indirect costs, using cause-and-effect allocations, to products (Drury, 2004, pp. 371-372).

Activity-based costing (ABC) was developed by Cooper and Kaplan in the mid-1980s, based on their experiences with a number of production companies in the USA. The activity based approach to overhead costs is the extension of the traditional volume-based costing that treats manufacturing overhead as a complex set of costs with multiple cost drivers (Bilici & Dalci, 2008, p. 63). As the name already indicates, ABC focuses on activities, which represents small groups of homogeneous tasks in all departments within an enterprise. Activities represent mediators for cost allocation on final products and must be demarcated, so that the consumption of resources caused by one activity can be determined through a single cost driver (Marjanovic, Gavrilovic, & Stanic, 2011, p. 2). Although some overhead costs may relate to a single allocation base, it is quite likely that many do not. In fact, overhead costs generally result from many activities, and the activity that drives one overhead cost (for instance indirect labour) may be completely different from the activity that affects another cost (for example indirect material) (Barsky & Catanach, 2005, p. 326).

One of the most important developments in the theory of ABC was the hierarchical classification of the activities performed at different levels such as unit, batch, product and facility (Bilici & Dalci, 2008, p. 63). The costs of the activities become the building blocks for allocating the costs to products and services (Jackson & Sawyers, 2001, p. 85). In detail, ABC allocates overhead to products or services based on the activities that cause the overhead cost. It assigns the overhead costs of major production or service activities to multiple cost pools. Next, multiple overhead allocation rates are computed by dividing the amount in each cost pool by measuring the activity that drives the overhead cost in each pool, the so-called **cost driver**. Each activity has its own (usually unique) cost driver (Barsky & Catanach, 2005, p. 326). These measures are in fact the process oriented form of the *Bezugsgrößen* used in *Grenzplankostenrechnung* (see Chapter 2.6). Therefore, cost driver analyses is not a new approach developed with activity based costing but an already well-established element of cost accounting. (Baltzer & Zirkler, 2012, p. 31). The next step consists of assigning overheads to the product or service based on how much of each activity it caused (Barsky & Catanach, 2005, p. 326).

The major difference between Activity-based costing and traditional cost accounting is that TCA assumes that cost objects consume resources, whereas ABC acknowledges that cost objects consume activities (Hall & McPeak, 2011, p. 11), which is displayed in Figure 5.

Figure 5. Activity-Based Costing



Source: L. Nadig, *Prozesskostenrechnung in Theorie und Praxis*, 2000, p. 12.

Activity based costing is a costing approach that assigns resource costs to cost objects such as products, services or customers, based on activities performed for the cost objects. The condition of this costing approach is that a firm's products or services are the results of activities and activities use resources, which incur costs. Costs of resources are assigned to activities based on the activities that use or consume resources. These costs of activities are again assigned to cost objects. ABC therefore recognizes the causal or direct relationships between resource costs, cost drivers, activities and cost objects in assigning costs to activities and then to cost objects (Blocher, Chen, Cokins, & Lin, 2005, p. 136).

An important issue is that resources consumed by batch-level and product-level activities do not change at unit level. In traditional costing systems, batch-level and product-level costs such as set-up costs at the laser-cutting division, are accepted as fixed costs, whereas in activity-based costing systems they are considered as direct and therefore variable costs. In general the traditional approach to the calculation of operating leverage factor treats set-up, inspection, material handling, engineering and similar batch-level and product-level activity costs as fixed with respect to the number of units produced. Since traditional systems only take volume-based cost drivers into account, the operating leverage factor is assumed not to change at different levels of volume within the relevant range of fixed costs. However, changes in batch and product-level cost-driver activity levels result in changes in the batch and product-level costs. Therefore, modifying the traditional model to take into account multiple cost drivers such as activity-based costing can be a better way to allocate cost to a product (Bilici & Dalci, 2008, p. 62). This issue is well described by the concrete example of the laser-cutting division (see Chapter 4.6.2).

Activity-based costing can be applied as operative but also as a strategic instrument. An operative utilization deals with the particular procedures and activities, whereas the strategic

approach tries to recognize, investigate and analyse the core processes of the entire company (Nadig, 2000, p. 309). According to Jackson & Sawyers (2001, p. 85) ABC is, strictly speaking, an alternative product costing system. Traditionally, activity based costing is a full costing approach, meaning that all costs are applied to the product or cost object, which enables effective pricing strategies (Balanchandran, Li, & Radhakrishnan, 2007, p. 21). According to Hummel (in Baltzer & Zirkler, 2012, pp. 4-5) however, the German-approach of activity based costing, referred to as *Prozesskostenrechnung* (see the following Chapter 2.8), can be either formed as full cost or direct cost accounting.

In summary, ABC works on the principle that activities cause costs and therefore it matches these activities to the appropriate products and services in order to provide more accurate information about how much they actually cost (Coulter, McGrath, & Wall, 2011, p. 12).

2.8 Activity based costing (ABC) in German-speaking countries – *Prozesskostenrechnung*

All cost accounting systems which are based on activities and processes have one significant common feature: the overhead cost allocation is carried out with the help of certain cost drivers, which represents the repetition coefficient of chosen activities that cause overhead costs (Marjanovic, Gavrilovic, & Stanic, 2011, p. 2). In German, ABC is most commonly referred to as *Prozesskostenrechnung*, which can be translated as process cost accounting. However, in management accounting literature activity oriented cost accounting systems have been given various titles, such as activity accounting, transaction costing, cost-driver accounting system, *Vorgangskostenrechnung* or *prozessorientierte Kostenrechnung* (which both can be translated as process oriented cost accounting) (Däumler & Grabe, 2004, p. 252).

While ABC has attracted considerable attention in Anglo-Saxon countries, ABC is less commonly applied in Germany. Compared to the application in Anglophone countries it is evident that there are also different approaches to ABC (Hoffjan, Nevries, & Stienemann, 2007, p. 22).

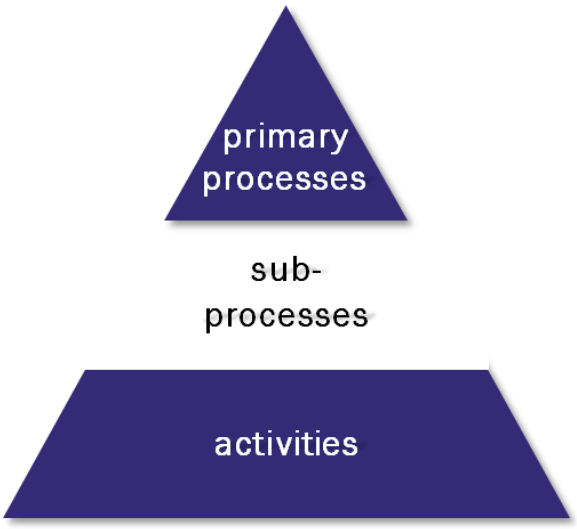
Although, many companies in Germany and German-speaking countries have used *GPK* for as long as 30 years, they have also considered some changes. German specialists, foremost Dr. Peter Horvath considers ABC as complementary to *GPK*, resulting in the application of ABC to analyse indirect costs, including fixed costs in operations and support departments, in order to improve product and service cost-profitability analysis. This has become known as *Prozesskostenrechnung*. Applying *Prozesskostenrechnung* in the context of *GPK* is a different approach then elsewhere (Sharman, 2003, pp. 31-38).

One of the main differences between ABC and *Prozesskostenrechnung* is the scope of application. While ABC covers the whole company, meaning the production area as well as indirect divisions, *Prozesskostenrechnung* only focuses on these indirect parts. This is due to the fact that traditional cost accounting in German-speaking countries is more developed (see Chapter 2.6). Therefore the introduction of ABC in Anglo-Saxon countries was a significant

improvement. Not only was process orientation introduced but also methodological shortcomings were made up with entering more cost drivers (Baltzer & Zirkler, 2012, p. 12).

The second difference deals with the process level. While in ABC the only process level is the one of activities, *Prozesskostenrechnung* deals with primary processes and sub-process, composed of individual activities (see Figure 6). The primary processes consist of several sub-processes from different cost centres (Kemmetmüller & Bogensberger, 2004, p. 311).

Figure 6. Process Levels of *Prozesskostenrechnung*



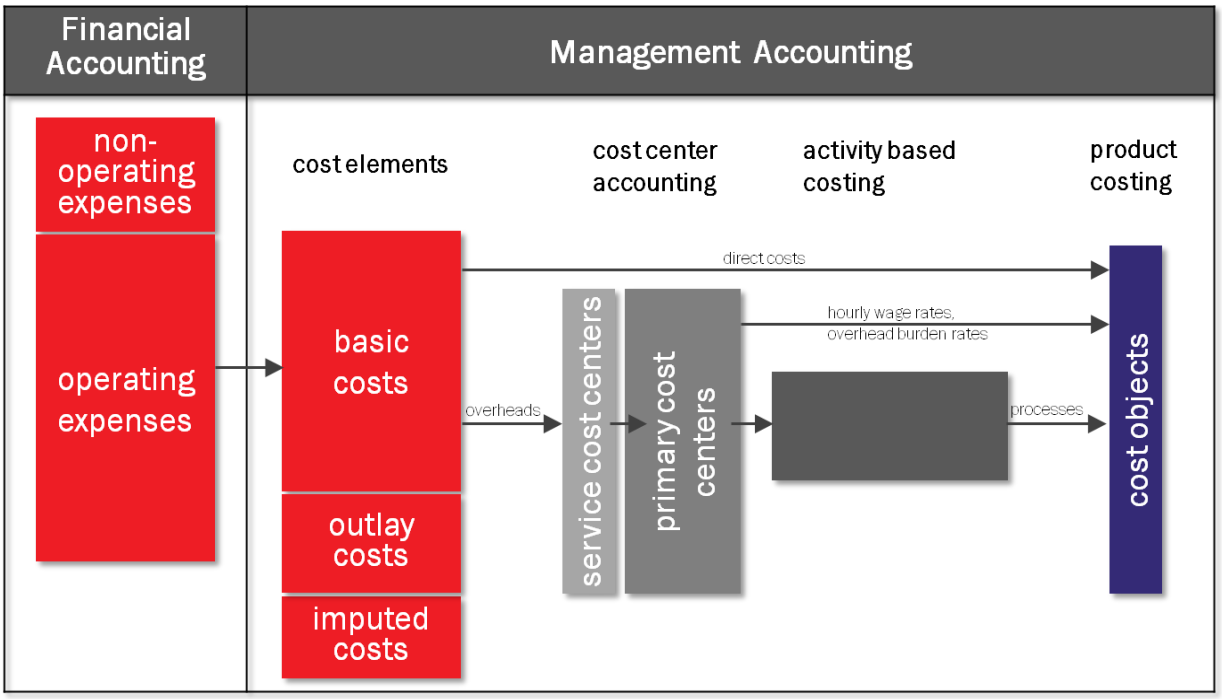
Source: B. Baltzer & B. Zirkler, *Time-driven Activity-based Costing - Entwicklung, Methodik Anwendungsfelder*, 2012, p. 13; W. Kemmetmüller & S. Bogensberger, *Handbuch der Kostenrechnung*, 2004, p. 311.

The main difference might be that German ABC differs, according to the repetition frequency of the cost centre performance, between **activity quantity induced** and **activity quantity neutral processes.** Marjanovic, Gavrilovic, & Stanic (2011, p. 2) translate these distinction with value-added and non-value-added processes. The difference resides in the fact that for the former a useful measure (referred to as cost driver) can be determined which is not possible for the latter. Cost drivers will be determined just for the value-added or quantity induced processes because their output is dependent on the cost centres performance. This cost driver's function is twofold: First it is the main factor (driver) of resource consumption and second it measures the quantity of transaction within the sub-process (Baltzer & Zirkler, 2012, pp. 31-32). The costs of non-value-added or quantity neutral processes can either be proportionally attributed to quantity induced process costs or treated as a compound block (Coenenberg, Fischer, & Günther, 2007, pp. 141-142), which is similar to variable or direct costing described in Chapter 2.4.2.

In practice, however, the difference between the German approach *Prozesskostenrechnung* and Activity-based Costing in Anglophone countries is smaller than theory seem to imply. According to Coners & van der Hardt (2004, p. 109) different costing designs can be found in practice that cannot be explicitly classified as *Prozesskostenrechnung* or ABC.

The practice of German-speaking countries has shown that Activity-based costing in German-speaking countries is more commonly used as an amendment rather than as a replacement for the traditional approach. Therefore Männel (in Baltzer & Zirkler, 2012, p. 5) sees *Prozesskostenrechnung* as a link between cost centre accounting and cost object accounting. Figure 7 shows the position of *Prozesskostenrechnung* in a typical accounting system using ABC Costing as amendment to its traditional costing approach.

Figure 7. Position of Activity-Based Costing within a Managerial Costing System



Source: B. Baltzer & B. Zirkler, *Time-driven Activity-based Costing – Entwicklung, Methodik, Anwendungsfelder*, 2012, p. 6.

In general, it can be stated that activity-based costing as well as the German approach *Prozesskostenrechnung* is particularly suitable for repetitive activities (Nadig, 2000, p. 308).

2.9 Time-driven activity based costing (TDABC)

Even Kaplan and Anderson (2004, p. 131) themselves have acknowledged that the traditional model of ABC had been difficult for many organizations to implement. Although ABC appears logical, it is not simple to introduce as all business activities must be broken down into their discrete components (Coulter, McGrath, & Wall, 2011, p. 12). It therefore requires a considerable commitment in terms of resources. Beyond that, traditional ABC models often fail to capture the complexity of actual operations. Kaplan and Anderson (2004, p. 132) use the example of the activity ship order to customer: Rather than assuming a constant cost per order shipped, a company may wish to recognize the cost differences when an order is shipped in a full truck, in a less-than-truckload shipment, using overnight express or by a commercial carrier. In addition the order may be entered into the system either manually or electronically and it may be either a standard or an expedited transaction. All these different variations cannot be considered with the traditional model unless new activities are added to the model, which of course expands its complexity considerably.

Datar & Gupta (1994, pp. 567-568) found that the intuitive argument that multiple cost pools and multiple activity drivers better reflect the cause and effect relation between overhead resource consumption and products does not hold. In the end they concluded that a firm cannot assume that refining its cost system will always lead to more accurate product costs. The logical consequence would be to reduce the number of processes within the system and to combine as many activities as possible to a homogenous process. However the more activities are combined to one homogenous process, the more heterogeneous resource consumption is. Which means that only one cost driver rate for such a process cannot accurately allocate costs to the consuming cost object (Baltzer & Zirkler, 2012, p. 16). Therefore a trade-off between aggregation and measurement error exists. The **aggregation error** occurs when costs are aggregated over heterogeneous activities to derive a single cost allocation rate, whereas the **measurement error** is caused by the problems of identifying costs and resources consumed by different activities and volumes of drivers consumed by different cost objects. In addition, a **specification error** occurs when the wrong activity driver is used (Datar & Gupta, 1994, pp. 567-568). New costing systems such as ABC are often devised to increase accuracy by reducing aggregation and specification error. More cost pools (meaning less aggregation) are defined to increase homogeneity within a cost centre. Cost drivers of each centre can be chosen to better reflect cause and effect-relationships. This is done to increase the accuracy of the reported product costs. However, similar to Datar & Gupta (1994, pp. 567-568), Cardinaels & Labro (2009, p. 3) showed that disaggregating a costing system by defining more activities might lead to more measurement error.

Time-driven activity based costing (TDABC) overcomes that issue by incorporating **time equations**, a new feature that enables the model to reflect how order and activity characteristics cause processing times to vary. Time equations– according to Kaplan & Anderson (2004, p. 135) greatly simplify the estimating process and produce a far more accurate cost model than would be possible using traditional ABC techniques. In one of their articles they give an example of the process of packaging. Standard packaging requires a specific amount of time (expressed in minutes), special packaging, if required, adds another amount of minutes and additional minutes are added if the item is to be shipped by air. The duration of a process is typically not only dependant on a single cost driver but also on a variety of process parameter. TDABC tries to implement all of these process parameter into the above mentioned time equation. This time equation can be either depicted through an if-clause or in algebraic equation. Equation (1) shows the algebraic equation in a generic form, symbolism is shown in Table 2.

$$Y_i = \alpha + \beta_0 \times X_0 + \beta_1 \times X_1 + \beta_2 \times X_2 + \beta_3 \times X_3 + \ldots + \beta_n \times X_n \qquad (1)$$

Table 2. Symbolism of Time-Equation (1)

Symbol	Type	Meaning
$\boldsymbol{Y_i}$	dependent variable	time to perform an activity
$\boldsymbol{\alpha}$	constant element	standard time to perform the basic activity
$\boldsymbol{X_0 - X_n}$	independent variable	incremental activity i-n
$\boldsymbol{\beta_0 - \beta_n}$	coefficient	estimated time for incremental activities
$\boldsymbol{n}$	continuous index	number or the incremental activities
$\boldsymbol{i}$	continuous index	process or sub-process

Source: B. Baltzer & B. Zirkler, *Time-driven Activity-based Costing – Entwicklung, Methodik, Anwendungsfehler,* 2012, p. 38; J.-O. Hall & C. J. McPeak, *Are SMEs ready for ABC,* 2011, p.13.

The variables $\boldsymbol{X_0 - X_n}$ can be either metric or binary. The constant $\boldsymbol{\alpha}$ represents the standard time to perform the basic activity independent from incremental activities (Baltzer & Zirkler, 2012, p. 38).

As an example, the time equation for a purchase order process (2) may appear as follows:

$$Y_i = \alpha \times X_1 + \beta_1 \times X_2 - \beta_2 \times X_3 \qquad (2)$$

The dependent variable Y_i, stands for the yet to be determined process duration. Each order item needs a specific amount of time, meaning that variable X_1 stands for the amount of order items and α for a specific (determined) amount of minutes needed for each item. In the case of a foreign supplier, the binary variable X_2 is set 1 (X_2 = 1) and a specific amount of time β_1 is added. In the opposite case of a domestic supplier no additional time is needed, so X_2 is set 0 (X_2 = 0). Electronic orders (X_3 = 1) are faster than fax orders (X_3 = 0) so that a specific amount of time β_2 can be deducted (Baltzer, 2013; Baltzer & Zirkler, 2012, p. 38). The result is a time equation that enables the consideration of different parameter to adequately deal with more complex workflows without the need of adding more activities and cost drivers.

In addition, a subtle but serious problem arises from the interview and survey process itself (Kaplan & Anderson, 2004, p. 132). With the traditional ABC method, companies were forced to survey employees on how they spent their time, which took up a significant amount of time and resources and tended to be flawed (McGowan, 2009, p. 60). When people estimate how much time they actually spend on a list of activities handed to them, they invariably report percentages that add up to 100. Few individuals report that a significant percentage of their time is idle or unused. Therefore, cost-driver rates are calculated assuming that resources are working at full capacity, which of course do not hold true in reality. This leads to the fact that the estimated cost-driver rates are usually much too high (Kaplan & Anderson, 2004, p. 132). This is not the case with TDABC since it uses the average staff availability to complete operational activities instead of surveying employees. That means that the practical capacity of resources available is computed as a percentage of the theoretical

capacity (McGowan, 2009, pp. 60-61). It therefore enables managers to compare the value of **used capacity** to the value of **available capacity** and thereby determine a cost of under-activity (Kaplan & Anderson, 2004, p. 134), also called idle capacity (Gervais, Levant, & Ducrocq, 2010, p. 3). This is one of the key aspects of TDABC, it provides an insight into the cost of unused capacity and managers can contemplate actions to determine whether and how to reduce the costs of supplying unused resources in subsequent periods (Kaplan & Anderson, 2004, p. 134).

However for pricing purpose, the fact that it solely contains the cost of the capacity used needs to be taken into consideration. Process cost rates of TDABC do not contain costs of unused capacity. This is on the one hand an advantage, since a customer would not accept a higher price for the same service due to a lower rate of activity of the company. TDABC therefore overcomes the issue of the death spiral mentioned later on in Chapter 3. However, on the other hand, it must be ensured that all costs of a period, the ones for used and unused capacity, needs to be covered (Baltzer & Zirkler, 2012, pp. 56-57) to avoid losses.

The main characteristic of TDABC is that the approach is based solely on time rates. A **time rate** is a fixed time for each activity, meaning each sub-activity in a workflow. Time rates for all sub-activities needs to be determined through estimations or measurements (Fladkjaer & Jensen, 2011, p. 7). Managers directly estimate the resource demands imposed by each transaction, product or customer rather than assign resource costs first to activities and then products or customers. For each group of resources, estimates of only two parameters are required: **the cost per time unit of supplying resource capacity** and the **unit times of consumption of resource capacity** by products, services, customers and/or orders (Kaplan & Anderson, 2004, p. 133).

Activities are repetitive operations. Due to feasibility and cost effectiveness reasons, ABC is particularly suitable for well-structured, repetitive activities with notable frequency but comparably low leeway in decision-making. Less suited are management-, research and development- as well as marketing functions (Coenenberg, Fischer, & Günther, 2007, p. 133) but also highly flexible non-repetitive activities. However, according to Kaplan & Anderson's response (2009, p. 145) to an editor's letter, TDABC is not limited to repetitive, predictable activities. In fact, the time-equation innovation in time-driven ABC specifically allows for unit-time estimates to vary based on the complexity of the performed task. Nevertheless, even Kaplan & Norton cannot deny that the implementation and maintenance of ABC or TDABC in divisions with highly flexible production is connected with high effort in terms of time and money, which might not exceed the added benefit.

Summing up, TDABC aims to be in contrast to traditional ABC a more simplified solution to the complexity of the traditional model. It differs from conventional ABC in that it takes the analysis down from the high-level activity volume picture to a forensic understanding of costs and process efficiency (McGowan, 2009, p. 60). TDABC enables dealing with the complexity of business transaction (such as variations of operational transactions) by using time equations, which may accurately reflect the time involved in a particular process, thereby

removing the need to track multiple activities to account for the different costs associated with a single activity. It only relies on time estimates that, for example, can be established based on direct observation of process. This eliminates the need for a time-consuming, subjective, interview and survey process. TDABC enables a more accurate representation of under capacity. According to Stout & Propri (2011, pp. 3-4) TDABC simplifies many steps in comparison to a traditional ABC system, yet an effective ERP system is reasonable to implement it successfully.

2.10 Resource consumption accounting (RCA)

RCA is a costing approach that combines the best of *GPK* and US ABC practices. It claims to provide decision makers with optimization information by combining learning, proven application and sound decision support principles. It uses three core elements in operational modelling that allow it to lay a very different foundation for its cost model compared to traditional costing approaches. First element is the **view of resources**: Resources and their costs are considered as foundational to proper cost modelling and decision support. An organization's cost is a function of the resources that produce them. The second element is referred to as **quantity-based modelling**. The entire model is constructed using operational quantities. Operational data is the foundation of value creation and the leading indicator of economic outcomes. The latter element deals with **cost behaviour**, which is determined by the behaviour of the underlying resource quantities as they are applied to value-creating operations within an organization (PAIB, 2009, p. 39).

3 MANAGERIAL COSTING IN PRACTICE

In general, a firm's costing system should mirror the production process. A cost management system modelled after the production process allows managers to better monitor the economic performance of the firm.

The use of special cost accounting software, preferably with a connection to the financial accounting software might be reasonable especially for larger corporations or standardized businesses. Standardized cost accounting software, however, is usually connected with high costs and standardization that might not meet the specific requirement of the particular company. In the case of *SMG* the implementation of cost accounting software is not planned. It is of course also possible to set-up a cost accounting tool on the basis of Microsoft Excel.

As defined in Chapter 2.4.6 overhead rates can be developed by dividing actual overhead by the actual level of the allocation base. Most companies cannot follow this practice, because total actual overhead cost and the total actual level of the allocation base are simply not known until the end of the accounting period, thus making it impossible to determine the actual overhead rate until that time. Therefore overhead rates are typically based on estimates of overhead cost and estimates of the level of the allocation base rather than on actual cost and quantities. Overhead rates calculated in that way are referred to as **predetermined overhead**

rates or **budgeted overhead rates** (Jiambalvo, 2001, p. 49). In practice at SMG, costs were budgeted based on a standardization of the quantity based on the three last years adapted to expected price changes in the following period. Labour hours are based on the projected capacity of employees adapted to the specific criteria of the accounting period, such as public holidays. As the company is not expected to grow the approach is easier and more comprehensible.

Budgeted volume can be determined in two ways: It can be estimated as either the volume expected for the coming year (expected volume) or the long-run average volume. Long-run average volume is called normal volume or the average volume that is predicted over upturns and downturns in the economy (Zimmermann, 2006, p. 474).

Basing overhead rates on the capacity volume or even long-run average volume prevents reported unit costs from falling when volume increases and from rising when volume falls. Instead when the actual volume exceeds normal volume, overhead is usually over-absorbed, leading to an increased income. However, under-absorbed overheads lead to a reduction of income or even a loss in the worst case, since not all overhead costs can be covered (Zimmermann, 2006, p. 477).

When significant amounts of fixed costs are allocated, this is referred to as **death spiral.** The death spiral results, when utilization of a common resource falls, which leads to excess capacity. The average (full) cost transfer pricing charges the users for the common resource. If fewer customers use the common resource, the fixed costs need to be carried by a smaller amount of users, leading to higher cost for each of them (Zimmermann, 2006, p. 398). Such an example is the cost centre laser-cutting. The laser-cutting division of the company provides cutting of several metal material using the laser-cutting machine, which is inevitably comprised by a high amount of fixed costs. The original estimation of machine hours, which represents the allocation base of the cost centre, was estimated to 800 hours per year (accounting period). However, the experience of the last two years has shown that this assumption was estimated too highly, and 600 hours would be more appropriate. If the estimated machine hours are now reduced to the more reasonable 600 hours, this would cause even higher costs for a machine hour which inevitable leads to even less hours that can be sold (due to the even higher price that would need to be charged).

Fladkjaer & Jensen (2001, p. 1) found several articles, that conclude that ABC has failed to succeed in practical use. It is argued that ABC was hyped in numerous articles in journals and books, it is included in all major management accounting textbooks and in curriculum at most business schools. However, in fact ABC is not used very much by companies. Many large companies, which tried to implement ABC, seem to have abandoned the approach. Empirical data is uncertain but in developed countries according to Fladkjaer & Jensen (2001, p. 1) perhaps only approximately 20% of large companies use ABC to some extent. There are probably even less among small and medium sized enterprises, in fact there might be only very few SME companies using ABC (Fladkjaer & Jensen, 2011, p. 1).

3.1 Managerial costing and the metal-working industry

Managerial costing systems were primarily developed for industrial enterprises. Most of the commonly accepted economic literature focuses on industry establishments in general, and therefore provides costing methods devised for industrial manufacturing. However, as it makes no sense to apply these methods unadjusted to other sectors (Götze, 2010, p. 250), it is useful to adapt and modify the costing system to the specific demands of the underlying business.

The metalworking industry, in particular, is split into a consolidated commodity-producing, energy-intensive group with high volumes and low margins and a diffuse, diverse group of companies serving specialty niche markets with value-added products, into which *SMG* can be classified. This so-called **applied metal production** encompasses many companies, which tend to be smaller and focused on narrow or specialized segments. These manufacturers and service providers take basic metal products as inputs and manufacture metal products for specific industrial, commercial or residential purposes (KEMA Inc., 2012, p. 1 and 21). In fact *SMG* can be classified as a **Sheet Metal Work Manufacturing** (NAICS code 332322) company, of the NAICS category of fabricated metal product manufacturing. In addition, *SMG* also provides powder-coating, polishing as well as other allied services to manufacturers (see NAICS Association, 2012). There is considerable diversity across businesses and the competitive landscape is characterized by heavy fragmentation, meaning little dominance when it comes to market share. Almost all of these firms produce specialized products and many serve regional markets rather than national or global ones, which also applies to *SMG*. Success generally depends on knowing customers well and producing quality workmanship (KEMA Inc., 2012, pp. 1, 21). Due to the rather small size of the entity and producing quality workmanship *SMG* might be more appropriately categorized as a **handicraft enterprise** despite the increased use of machinery.

There is no concrete definition to differentiate a handicraft business from the industrial sector according to the number of employees or turnover. Job-shop production in comparison to series production does not represent a valuable distinguishing mark, since handicrafts as well as industrial businesses perform both forms. However according to Posluschny (2004, pp. 5-6) and his experience from practicing consultancy, handicraft businesses typically have three characteristics in common. These are a **dominant position of the owner(s)** as CEO(s), a comparatively **small size** and **independent** (in terms of ownership and management) of other enterprises. These characteristics customarily lead to the implication that there are no resources available for the development of managerial costing. All of this applies to *SMG* and the reason for the present project is the lack of internal resources.

Designing a managerial costing system leads to a variety of design options based on alternative methods and techniques. Within the chosen system there multiple compositional alternatives exist such as the number and kind of cost categories, cost centres (optionally processes), cost objects as well as cost drivers, which are, at best, adjusted specifically to the

concrete business. Moreover it needs to be economically efficient, meaning that benefits should exceed the costs (Götze, 2010, p. 251).

3.2 Managerial costing in SME's

Small-to-medium sized enterprises (SME) are under increased pressure to stay competitive in today's global economy. More than ever it is important to know where and how costs arise throughout the company for adequate pricing, decision-making and general management.

Typically SME's are too large for the owner or other individuals to be able to oversee the entire company and ensure efficiency and profitability in all processes. In contrast, the companies are too small to be able to devote large resources to implement advanced cost management or business intelligence solutions (Fladkjaer & Jensen, 2011, p. 1).

ABC is rarely implemented in small and medium enterprises. This is due to the fact that it is, firstly, too difficult to implement and, secondly, data foundation for the model is not available in the required quality from the ERP systems used by the firms. In relation to corporate organisations it is so complex that it may be difficult to implement. It is a challenge to limit the activities of complex organizations and to determine the appropriate driver. Extensive work is required to collect and record the time spent and other data to drivers, which makes the implementation of ABC very costly. The implementation and recurring updates of the ABC model involve significant challenges for the organizations (Fladkjaer & Jensen, 2011, pp. 1-22). However, in all fairness this also applies to traditional costing systems. Nonetheless, a managerial costing system that is entirely based on ABC in an industrial enterprise might be hardly feasible, due to the fact that not all divisions meet the requirements of ABC-Costing (Baltzer & Zirkler, 2012, p. 56).

4 DESIGNING A SPECIFIC MANAGERIAL COSTING SYSTEM FOR *STAUDINGER METALLBAU GMBH*

The following Chapter of the thesis describes the process of designing a managerial costing system specifically adapted to the underlying company, ***Staudinger Metallbau GmbH***. First it describes the business and structure of the organization, as well as the specific requirements that resulted from the objective of the costing system. It further depicts the main difficulties that have arisen during the development and implementation process. Examples of job-order (overhead costing) calculations demonstrate the difference between the existing calculation scheme with the previously used wage rates and the newly developed traditional costing system with and without the further improvement of ABC-usage.

4.1 *Staudinger Metallbau GmbH (SMG)* – Company Presentation

Staudinger Metallbau GmbH is a small metal processing, family owned corporation, which was established in 1976. The company under the legal form of a *Gesellschaft mit beschränkter Haftung (GmbH),* - which can be translated as private (closed) limited liability

company - has three shareholders who are at the same time managing directors. While one shareholder owns 48% of the company, the other two share 26% each. Even though the former is sole trade-law representative, the memorandum of association requires a 75% majority for crucial managerial decisions.

SMG has developed from a tinsmith workshop to a manufacturer of high-quality sheet metal products during the 1990s. Around five corporate customers generate approximately 70% of the overall turnover, while the remaining 30% results from smaller occasional and walk-in customers.

According to Austrian law, as a *Gesellschaft mit beschränkter Haftung (GmbH) SMG* is obliged to keep accounting records subject to the *Unternehmensgesetzbuch (UGB)*, the Austrian commercial code (§ 189 (1) *UGB*). However, there is no legal obligation for managerial costing. Actually, *SMG* does not have an existing cost accounting system in place.

The company provides an extensive range of processing capabilities, including diverse welding techniques, turning, drilling, bending, powder-coating, polishing and laser-cutting. Primarily specializing on single unit to small batches of highly heterogeneous products based on customer request, their manufacturing process is based on a make-to-order or job-order production model. *SMG* is in fact kind of a handicraft enterprise despite the increasing number of machines coming into operation. Traditionally, the factory is organized so that similar machines are grouped together. This is the basis for the cost centres as a fundament of the whole managerial costing concept.

As a manufacturing company *SMG* transform purchased raw materials within their production process into finished products. The transformation typically requires labour and the incurring of other costs such as supplies, utilities and the depreciation of plant and equipment. The three managing directors are in charge of the areas sales, pricing and administrations itself as well as production and design engineering. Another white-collar worker represents the intermediate between the management and the workforce. This so-called planning engineer is responsible for production engineering, which includes all preparative activities for the commercial manufacturing of orders. In addition, the company employs eight blue-collar workers and one apprentice in the production site, summing up to a staff size of 13.

Manufacturing companies that produce on stock are mostly price takers (as described in Chapter 1.1) and have therefore often little influence on market prices. Bigger companies that can afford using marketing mechanics might have an impact on the price at that they are able to sell to their customers. Nevertheless, usually the market determines the selling price and therefore marketing executives deal with the importance of pricing. However, in the case of *SMG* it is a little different. *SMG* just produce on customer demand mostly by giving price quotes beforehand and sometimes without quoting. In any case, the costs of the production set the prices, and not the market. This is due to the fact that products are overall unique and not standardized at all. Therefore the customer is willing to pay more since in the majority of cases there is no standardized product available on the market. However, this does not mean

they have a monopoly of the service, since there are other companies of the same business in the region. Though, the business of *SMG* can be considered as a **niche market**.

As already mentioned in the first Chapter, the common approach to set the price of the goods or service of a company is called **cost-plus pricing**. It deals with establishing a cost base and adds this base a mark-up to establish the target-selling price (Weygandt, Kimmel, & Kieso, 2010, p. 341).

4.2 Present situation

Currently, *SMG* uses adapted yearly hourly wage rates based on the calculation of the chamber of commerce years ago. This wage rate was adjusted according to higher costs in the powder-coating and polishing divisions. However, in the end these rates are nothing more than standard rates showing at what price the average company in the metal working industry can sell an hour of labour. They are not based on the actual costs of the particular company. The case of the laser-cutting division is a bit different. The price calculation of laser-cutting consists of price rates for different operations involved in laser-cutting (similar to activities used in activity based costing). However, these price rates are based on those of competitors and do not represent the actual costs involved.

Not knowing the actual costs of the corporation leads to the risk of not charging enough to cover the costs. Yet, it could also lead to the risk of losing potential customers due to too high quotes (loss of competitiveness).

Therefore the main goal of the project for the company is to calculate **hourly wage rates** as well as **overhead burden rates** thoroughly, based on the different divisions within the company. First it was necessary to develop a **managerial costing concept** including different cost centres that displays the corporation as accurate but also as simple as possible. The system had to be easily adaptable and maintainable in the future, taking its cost benefit into consideration.

The ultimate aim of this work is to provide the *SMG* with adequate hourly wage rates and overhead burden rates for submitting offers. As already stated, it cannot overcome the issue of difficulties in estimations. If an order requires the submission of an offer, calculations have to be made in advance. Material and time need to be estimated for calculating the binding price. Making proper estimations plays an important role at *SMG*. Not even the most sophisticated cost accounting tools can overcome the problem of such estimations. The accuracy of these estimations depends on the diligence and experience of the executer.

4.3 Specific requirements and characteristics

In general, *SMG* produces single unit to small batches of highly heterogeneous products just in time in response to a specific demand. Meaning that, their manufacturing process is based on a make-to-order or job-production model. Thus, manufacturing starts after receiving a customer’s order in contrast to the build-to-stock approach where it is produced to a fixed

schedule. This leads to the fact that *SMG* does not need to carry large amounts of inventory of finished or semi-finished (work-in-process) products. The existing stock they maintain includes merely raw-, auxiliary- and operating materials.

However, job production also means that the price calculations for the quotes require an exact estimation about the material and working team needed for the specific order. Furthermore it can be stated that for small businesses, such as *SMG*, it is harder to estimate the degree of capacity utilization accurately.

As already stated in Chapter 2.9 the traditional ABC model surveys employees to find how their work was allocated on a day-to-day basis (McGowan, 2009, p. 61). Also traditional costing needs appropriate time recording to allocate labour costs to cost causing objects. This is considered as negative since this requires a lot of time and effort. This is, in fact, not the problem of *SMG* (at least not within the productive part of the company), since they have – for a company of such a small size – quite a sophisticated time recording.

4.4 Target/Expected additional benefit of the new system

The general target of the managerial costing system is to develop an **appropriate costing system adapted to the specific requirement of the company**. The aim is to obtain an adequate system for enhanced decision-making, in particular for adequate pricing.

Therefore the objective is to calculate the **hourly wage rates** as well as the **overhead burden rates** thoroughly, based on the different divisions within the company. For that reason, it was necessary to develop a **sophisticated cost accounting concept** including different cost centres that display the company structure as accurately but also as simply as possible. The system must have to be easily adaptable and maintainable in the future (cost-benefit consideration). Hence, a direct collaboration with the management of *SMG* throughout the whole creation process was essential. The benefit must outweigh the resources that will have to be engaged in future maintenance activities.

Since the result of this work should support both the short-term and long-term decision-making, both **variable overhead burden rates** as well as **full ones** for each cost centre were calculated.

Beyond that, the project work - as expected - discovered potential for implementing activity based costing or even the more recent approach of time-driven activity based costing in (at least) part of the corporation.

4.5 Traditional managerial costing system of *SMG* in practice

The managerial costing system should be based on (future) standard or planned costs. The problem with this forecast planning is that though last year's financial accounting figures are available, the future development needs to be estimated. This difficulty is slightly reduced due

to the fact that the company is not set out to grow. Nevertheless, hardly any (marketing) measures have been taken to influence sales.

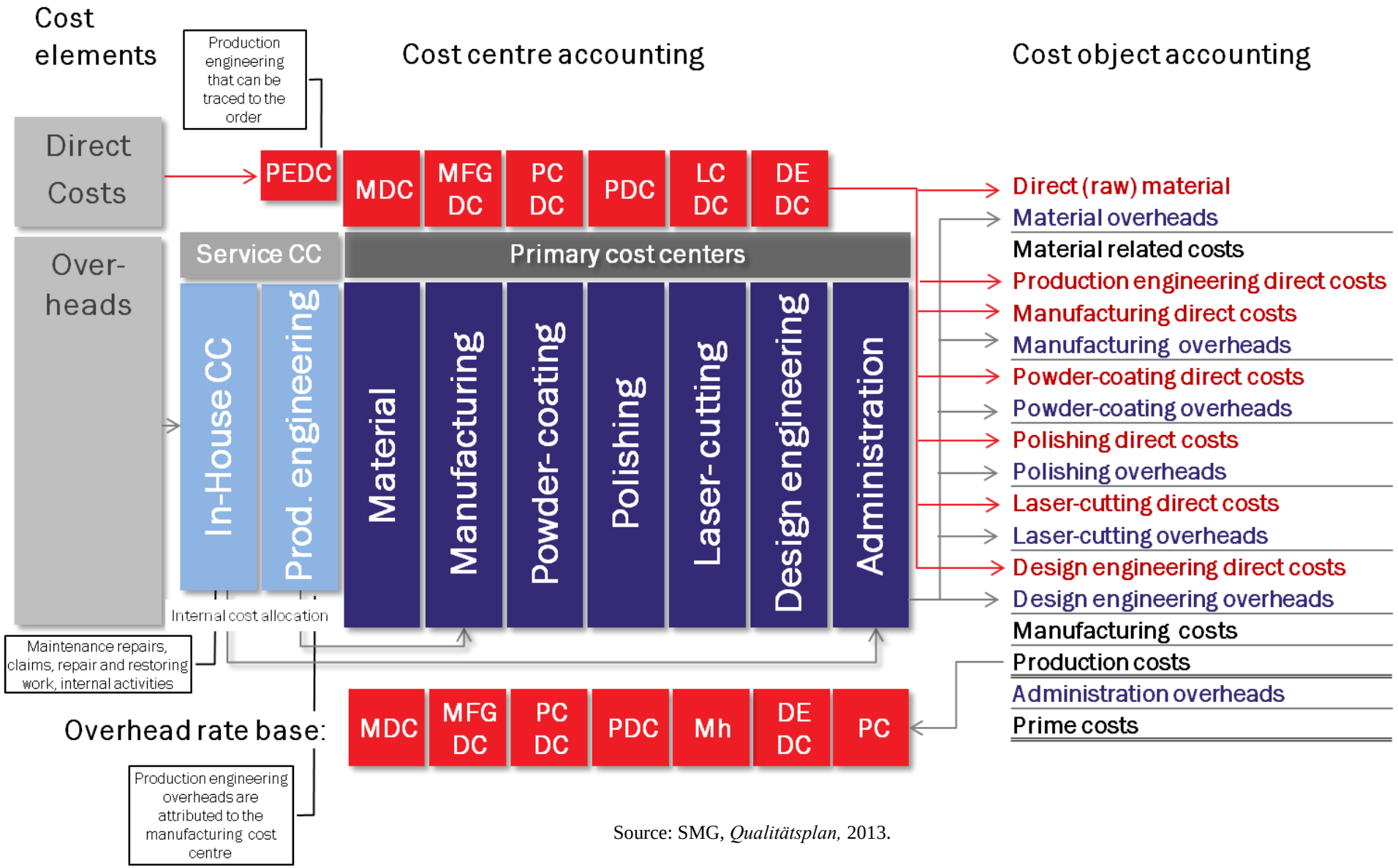
4.5.1 Analysis of the operational sequences – Development of cost centres

The creation of cost centres is a particularly important and demanding process. The parts of the company that are summarized in a cost centre depend on the company structure but also on the amount of costs incurring in the different divisions of the company. To define cost centres for a specific company, it is necessary to have detailed knowledge about processes and workflows but also about the cost structures of the business. A typical manufacturing firm usually has separate cost centres for administration and sales, a material cost centre, and several cost centres for the production area, which frequently represent the individual production stages of the company (Bogensberger, Messner, G. Zihr, & M. Zihr, 2008, p. 104).

The analysis of the operational sequences of *SMG* led to separating cost centres for the production stages powder-coating, polishing, laser-cutting and design engineering, whereas the production practices welding, turning, milling, drilling and bending were combined to an accumulated cost centre named manufacturing. This is due to the fact that it is near impossible to distinguish the practices and their costs. This could be done, however it would require considerable time and effort, which would inevitably succeed the benefit.

These six manufacturing cost pools represent the **primary cost centres** of the costing system, which serves to provide saleable output. In comparison, **service cost centres** provide internal services for the primary cost centres (Bogensberger, Messner, G. Zihr, & M. Zihr, 2008, p. 104). These are the **in-house cost centre** and the centre **production engineering**. While the service centre production engineering exclusively provide internal service for the manufacturing department, such as engineering drawings, the in-house centre supports the whole company with maintenance repairs, claims, internal activities such as workshop clearance but also dealing with customer claims as well as repair and restoring. Therefore the costs of the former are passed on, but only to the manufacturing department, whereas the cost of the in-house services are allocated to the administrative cost centre, which represents the last primary cost centre. The Cost driver of the administrative cost centre is the prime costs. The cost centres, their internal relationships as well as their cost driver, are graphically represented in Figure 8 with explanations followed in Table 3.

Figure 8. Specific (Traditional) Managerial Costing System of *SMG*



Source: SMG, *Qualitätsplan,* 2013.

Table 3. Legend of the Graphical Representation of *SMG* Costing System

Abbreviation	Meaning
CC	Cost centre
PEDC	Production engineering direct costs
MDC	Material direct costs
MFG DC	Manufacturing direct costs
PC DC	Powder-coating direct costs
PDC	Polishing direct costs
LC DC	Laser-cutting direct costs
Mh	Machine hours
DE DC	Design engineering direct costs
PC	Prime costs

4.5.2 Cost conversion, Cost type accounting and Cost planning in practice

The first step of the practical work within cost accounting was the transition from expenditure to costs as described in Chapter 2.4.10. Within the project cost conversion, cost type accounting as well as turning actual costs to standard (planned) costs (see Chapter 2.4.1) was executed in one step, respectively one Excel worksheet.

Cost conversion includes the consideration of imputed costs, which in practice is a more difficult issue than theory may suggest. The analysis of the company's cost structure led to a recognition of three types of imputed costs. Concretely, these are **imputed interests** (for equity as well as debt capital), **imputed risks** (in fact accounts receivables risk), and **imputed depreciation** (also referred to as calculatory depreciation).

Economics literature usually also suggests an imputed entrepreneurial salary as well as imputed rent. Imputed risks could also comprise many more risks, such as risk of damaging premises, equipment and inventory or warranty risks.

As private limited company managerial salaries are accepted as expenses and therefore represent costs so that the additional imputed entrepreneurial salary (as it is common practice for sole proprietorship and partnership businesses) does not need to be implemented. In addition, imputed rent does not need to be considered, since the company building and premises are rented so that the expenses from financial accounting can be taken directly as costs for cost accounting purpose. The same goes for insurance fees, since insurance covers potential damages of company property. Beyond that there is no need for additional imputed risks.

Interest on debt was calculated on the basis of the actual debt obligations of the 2013 period. Interest rates that are subject to the Euribor, were estimated based on forecasts but rather conservative. Imputed interest on equity calculations were based on calculatory equity instead

of financial equity. In order to calculate calculatory equity all the necessary operating assets were re-valued according to their replacement values. This revaluation of necessary operating assets is also necessary to calculate imputed depreciation. Necessary operating assets are re-valued with respect to their replacement and scrap value as well as the expected useful life. Many *SMG* machines are already written off in financial accounting but are still used, so that imputed depreciation differs significantly from depreciation in financial accounting.

The cost types were based on the expense categories of financial accounting. In some cases it was necessary to itemize the cost to better estimate of future costs for cost planning purpose. For example this was the case with cleaning expense that contains the cleaning of the premises as well as cleaning of working garment. The same applied to consultancy fees, waste collection and disposal fees as well as equipment rent. The latter cost type showed how cost planning was executed in detail. Actually, the rent of tools only partially derived from the expenses of the last year. In fact the number and type of required tools were estimated and list prices of the coming year were solicited or price rises were estimated. Further, the labour costs were not based on previous periods at all. The gross pay per employee was adapted to legally obligated pay increases as well as increases in legally obligated ancillary labour costs. In fact, personnel cost calculations were the most sophisticated and elaborate calculations of the whole system, due to quite complex Austrian legal requirements regarding ancillary labour costs. An extract of the calculations can be found in Appendix C. Since the cost rates naturally represent sensitive data for the company, confidential values were multiplied by a certain factor to change the interpretational character.

However, naturally not all costs were planned in such detail. Costs that are considered stable or marginal costs, such as expendable materials were normalised, meaning that an average of at least three years was taken to estimate a forecast.

4.5.3 Cost splitting in practice

The above-mentioned methods (Chapter 2.4.9) of cost splitting imply that mixed costs can be (more or less) easily separated into fixed and variable portions and that the variable stake behaves linearly and are only affected by changes in level of activities. In practice, however, cost behaviour is much more complex than these suggested methods. Electricity costs at *SMG,* for example, have developed inversely to the activity level, meaning that in a period of lower level of activity costs were higher than in a period of higher level of activity. This is due to the fact that there are no accurate measures of electricity use. Therefore, electricity costs include the costs of electric lightning, operating machines (apart from the laser cutter), heating et cetera. All of them might have different cost drivers, such as for example a cold or warm winter for heating, which is of course independent of the level of activity. However, the share of electrical heating only pertains the administrative part of the company and is negligible low. There are estimations to allocate the different shares of the cost to their causative cost centre but these are also ju*st* estimations, since a more accurate cost recording is not only complex but also expensive. The separate electricity measurement of the laser-cutting machine for example costs almost 300 Euros per year. Implementing separate electricity

measurements for each cost centre might lead to the costs as well as time and effort to inevitably exceed the benefit.

Therefore, Tanne (2007, pp. 36-37) suggests cost splitting by percentage rate. In this method a percentage is quoted that shows the portion of fixed and variable costs. These percentage rates are then only valid for this specific level of activity. Based on these percentages for different cost classifications the absolute values can be determined. The fixed elements remain stable and the variable cost elements vary according to changes in the level of activity. This method is a very pragmatic one and more an approximation approach than a standardised procedure. Due to the lack of a scientific basis this method can hardly be found in economic literature. However this procedure has undisputed advantages, especially in small companies such as *SMG*. First of all it is easily managed and demands comparably low time and effort. It is necessary to analyse the costs precisely so that mistakes that might occur using a rigid mathematical technique could be avoided. Moreover, the cost analysis turns out to be the first step towards the planning of future (standard) costs for budgeting purposes.

In the case of *SMG* the latter method was chosen due to the following reasons: First of all to keep time and effort involved to a minimum but also to reach an understanding of the part of the management that needs to continue cost accounting in the future. Furthermore, it was necessary to analyse the costs precisely, to allocate costs as accurately as possible to the several cost centres but also to avoid overgeneralisations due to cost classes that are pooled together (already from financial accounting data) which would lead to mistakes, if only the mathematical procedures would be used.

For example the account for costs disposals showed to contain the disposal of domestic waste (plastic, paper and organic) and special waste such as varnish, powder (waste of powder-coating) and bulky waste as well as annual rent for the container and the chimney sweep costs. With the help of this thorough breakdown of costs it was fairly easy to detect the fixed components of the costs. In addition, it was also necessary to estimate a fixed portion of domestic waste costs for the administration of the company, which also represents fixed costs.

Generally, each cost category was analysed through trying to answer one simple question: How much would it cost the company if no production takes place. Of course this only holds on a short-term basis since in the long-run the company would close down without any production.

4.5.4 Cost centre accounting

The term cost centre accounting refers to the allocation of overheads to cost centres. Cost centre accounting represents the core of *Grenzplankostenrechnung* and might be its most important element. To allocate costs to their inducing cost centre, it is necessary to evaluate the different divisions within the company, which enables the cost accounting system to better allocate costs in accordance with the cause of costs. Costs should be assigned as explicitly as possible to the particular cost centre. Cost centres were already developed to enable a distinct allocation of cost to the causing cost centre. Therefore processes where costs cannot be

distinguished (or only with too much effort and time) were pooled together to one single cost centre (manufacturing).

The allocation of costs to the specific cost centres in practice depends on the cost type. For example, labour costs were assigned to the cost centres based on time recordings, whereas rent, insurance and maintenance was attributed according to their square meters. For some of the costs such an allocation key does not exist, therefore allocation was based on educated guesses of the management. However, for other costs in contrast the cost assignment was rather clear. That particularly concerns the laser-cutting division, since it was only set-up two years ago and it was emphasized at the beginning that costs, such as electricity, maintenance, leasing and further training need to be separated. Depreciation and interest on tied-up capital could also be allocated rather accurately through the detailed breakdown of machines and equipment which was necessary anyway for the calculation of depreciation based on actual values (see Chapter 4.5.2).

The table where costs are allocated to the different cost centres is called a **cost allocation sheet** (*Betriebsabrechnungsbogen – BAB)* and it usually contains the overhead burden rates calculated through dividing overheads by allocation base. In practice, however these two steps were accomplished in two steps, respectively two Excel sheets. The first step is the allocation of costs to the cost centres with the use of percentages, followed by the calculation of overhead burden rates. These procedures increase clarity, since two overhead burden rates (variable and full cost) for each cost centre have been calculated. An extract of the cost allocation sheet that has been created for *SMG* and its connection with the subsequent cost object accounting is shown in Appendix D.

4.5.5 Overhead burden rates

When choosing among alternative allocation bases (such as direct labour hours, direct labour cost, machine hours or direct material cost) it needs to be taken into consideration that orders (respectively products) with greater quantities of an allocation base will be charged with larger amounts of overheads. This is appropriate if greater activity, as measured by the particular allocation base, generally requires the firm to incur more overhead cost. Therefore it is essential that the allocation base, which is used, is strongly associated with the overhead costs, meaning that increases in overhead costs should coincide with the increases in the allocation base (e.g. labour costs) (Jiambalvo, 2001, p. 48).

Within *SMG*'s traditional managerial costing system mostly direct labour costs came into consideration to indicate the cause of overheads. However, the cost centre material uses direct material as an allocation base, since it is assumed that respectively higher priced materials need more handling, whereas the division laser-cutting uses machine hours. Though, as described in Chapter 4.6.3 overheads are allocated to machine hours and direct labour hour costs are separately allocated within the cost object scheme.

4.5.6 Cost object accounting

Cost object accounting shows how costs can be assigned to the individual cost objects according to how they are incurred. Table 4 therefore demonstrates a traditional cost object scheme based on overhead costing as described in Chapter 2.4.5.

Table 4. Cost Object Scheme based on Traditional Costing (Overhead Costing)

	Direct (raw) material
+	Material overheads
=	**Material related costs**
+	Production engineering direct costs
+	Manufacturing direct costs
+	Manufacturing overheads
+	Powder-coating direct costs
+	Powder-coating overheads
+	Polishing direct costs
+	Polishing overheads
+	Laser-cutting direct costs (labour hours)
+	Laser-cutting direct costs (machine hours) incl. overheads
+	Design engineering direct costs
+	Design engineering overheads
=	**Manufacturing costs**
=	**Production costs**
+	Administrative overheads
=	**Prime costs**

Source: SMG, *Qualitätsplan*, 2013.

According to the time of execution it is important to distinguish between preliminary, interim and following-up or post calculations. **Preliminary calculations** take place before the actual execution and serve the submission of quotes. **Interim calculations** during the production process enable contemporary project controlling especially for long-duration manufacturing projects. **Following-up** or **post calculations** identify the actual costs after the production process (Coenenberg, Fischer, & Günther, 2007, p. 105).

4.5.7 Critical findings of the results

To compare the hourly wage rates to the previously used price rates, it was necessary to add administrative overheads, which was calculated as a percentage rate of prime costs, to the individual wage rates of each cost centre.

The results have shown that in general hourly wage rates used before, where actually higher than the outcome of the project. Therefore the project has shown that *SMG* is able to cover its costs at the planned degree of capacity utilizations. However as a for-profit-organization *SMG*

aims to leave a margin, which lies between the calculated wage rates and the actual charged wage rates.

It can be concluded that the used wage rates are appropriate to cover costs if the planned degree of capacity utilization can be achieved, but could be even more competitive when lowering price when it is suitable for follow-up orders. With the calculation of the variable hourly wage rates, *SMG* has a short-term bottom price for economically weak times, when capacity is not utilized a hundred percent.

However, the rates for the laser-division were not useful. The generated machine hour rates as well as wage rates would only be expedient if machine hours and labour hours could be estimated sufficiently in advance for an adequate submission of quotes. Unfortunately this is not the case. Moreover the traditional approach does not take into account the programming and set-up costs that occur independently of the size of the specific order.

Finally it needs to be emphasized that both, costs as well as allocation bases (direct material costs, labour hours or machine hours in the laser-cutting department) are estimations. The depiction of hourly wage rates and overhead burden rates with two decimal places may indicate an accurateness that does not exist in reality. In practice more problems arise with estimating the costs then within calculating the results.

4.6 Potential for optimization

This traditional cost accounting system assigns overheads to the cost objects using an allocation model, where costs are allocated following a quantitative scale such as working or machine hours. This model is adequate as long as the cost objects are relatively uniform in how they affect indirect costs. But if there is a significant variation in how the various cost objects cause the indirect costs, this model might result in a distorted image of objects' cost consumption (Fladkjaer & Jensen, 2011, p. 2) and thus be unsuitable for pricing and/or decision-making. In the case of the laser-cutting department, for instance, the number of setting-ups as well as programming times affects indirect costs. Of course these activities could also be determined in labour and machine hours but these are hard to estimate beforehand. Therefore, other cost drivers, which are easily obtainable from the enquiry need to be determined. As a result it is necessary to analyse the process of laser-cutting, broken down to the individual (repetitive) activities.

4.6.1 Characteristics of laser-cutting

The term laser is an acronym of the description of the laser process: Light Amplification by Stimulated Emission of Radiation. In other words, a beam of light is amplified by supplying a laser-active medium with energy, exciting it and then using already existing radiation to stimulate it to emit radiation itself (Berkmanns & Faerber, p. 2).

Laser-cutting is a very fast and precise process that cuts out parts from sheet metal for precision flat patterns, virtually any shape with amazing precision (Mattson, 2009, p. 17). The

cutting process uses the strength of a laser to cut materials of varying strength. The technology is used to speed up the cutting process but also to enhance precision, which is very important in industrial applications. Many lasers can be used for laser-cutting, provided their beam can be focused on a small spot with sufficient intensity to melt the material and their specific wavelength is absorbed in the material. carbon dioxide (CO_2) gas lasers, neodymium-doped yttrium aluminium garnet (Nd: YAG) solid-state lasers and excimer gas laser are the most commonly used in the field of materials processing (Berkmanns & Faerber, 2003, p. 5).

SMG uses a CO_2 laser-cutting machine of the brand Amada, a large Japanese manufacturer of metal processing equipment and machinery. As the name implies, carbon dioxide is the laser-active component in the CO_2 laser's gas mixture, which also contains nitrogen for stainless steel and aluminium cutting or oxygen for steel cutting (Berkmanns & Faerber).

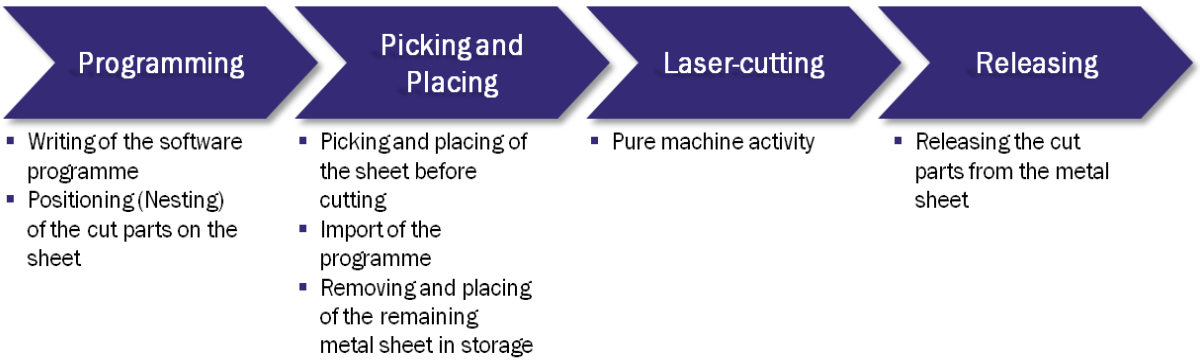
The laser-cutting machine was purchased in the last quarter of 2010 and therefore it is the most recent division of *SMG*. Fortunately, since its implementation this division has since always been strictly separated from the other parts of the company such as the manufacturing, powder-coating and polishing division. There was even a new electric meter reader installed, which enables electricity cost to be strictly determined from the other cost centres without the need of discreet estimates.

4.6.2 Activity of laser-cutting – Process description

The analysis of the laser-cutting process has shown that the workflow starts with programming, which contains a detailed writing of the software programme followed by the positioning of the cut parts on the sheet. The next stage represents picking and placing the metal sheet on the machine before cutting, the import of the (previously generated) programme directly on the machine and the removing, measuring and placing the remaining metal sheet in the storage. Laser-cutting itself is purely conducted by the laser-cutting machine. Releasing the cut parts from the metal sheet is the last step of the process, which is again carried out by an employee.

These operations can be combined into the main activities, which are graphically displayed in Figure 9.

Figure 9. Process of Laser-Cutting



Source: SMG, *VA Laser*, 2013.

Summing up the activities to these four main activities is necessary to keep the overhead calculation in the end manageable and not too complex. These activities are based on the executive routine of the process and different executors of the activities. Programming is executed by the CTO or production engineer, picking and placing as well as the other activities involved are carried out by the operating employee. Laser-cutting is performed by the laser-cutting machine itself but releasing the part involves the final treatment of the cut parts and is once again executed by an operating employee. It is also based on the charging positions that are common in the practice of laser-cutting.

In the laser-cutting division the number of parts to be cut, play a secondary role for determining how costs behave. The number of production runs and programming units as well as the labour hours of releasing the cut parts from the metal sheets determine the costs and not the number of pieces that are cut. The following table shows the above mentioned activities with their specific cost drivers:

Table 5. Laser-Cutting Activities and their Cost Drivers

Activities	Cost Driver
Programming	Programming unit
Picking and placing (set-up)	Number of set-ups
Laser-cutting	Laser-cutting machine hours
Releasing	Releasing labour hours

Source: SMG, *VA Laser*, 2013.

Therefore a job-order costing based on activity-based costing that only involves laser-cutting looks as follows:

Table 6. Job-Order Costing Scheme on the Basis of ABC

	Direct (raw) material
+	Material overheads
	Material related costs
+	Programming units
+	Set-up costs (picking and placing)
+	Laser-cutting (machine hours)
+	Releasing labour hours
	Manufacturing costs
=	**Production costs**
+	Administrative overheads
	Prime costs

Source: SMG, *VA Laser*, 2013.

It needs to be emphasized that only the cost centre laser-cutting is broken down into its activities. This is not the case for the administrative part of the company. Since the laser-cutting department needs to carry part of these administration costs, the traditional procedure

of allocation is followed so that administrative overheads are allocated with the percentage surcharge derived from the traditional costing system.

The traditional approach of cost allocation is based on the assumption that only volume-based cost drivers determine how costs behave. That means that **facility-level**, **product-level** and **batch-level costs** are assumed not to change at a specific level of activity within the relevant range, they are considered as fixed costs. Under the activity based costing theory, however, batch-level and product-level costs, which are accepted as fixed under the traditional approach may vary at different levels of activity with respect to factors such as number of production runs and number of design specifications, rather than the number of units of products produced within the relevant range. Therefore predicting total costs requires multiple cost drivers such as the number of set-ups, number of output units and or for example the number of design specifications. **Unit-level costs** are treated the same under both models because under both traditional and activity-based assumptions, these costs are assumed to change in direct proportion to a change in volume (Bilici & Dalci, 2008, pp. 63-64).

For a better understanding of the concept, a (over-)simplified example of an order might be helpful to explain the differences between the three terms **unit**, **product** and **batch**. Let's assume a customer requires laser-cutting for ten squares, fifteen circles and twenty triangles all out of one material and the same material thickness. Each unit produced such as one single square or circle is considered as one unit, whereas the specific product square or triangle, (no matter how many of them there are) is referred to as product (or product family). Since the same material and material thickness is required and all of the units of products fit on one metal sheet, the whole order can be treated as one batch. If the customer for example requires the squares and circles to be of a different material as the triangle, the order would consist of two batches. Facility-level costs within the laser-cutting division would be the depreciation of equipment and reconstruction necessary for the installation of the laser as well as part of the rent and maintenance of the machine. These are the costs that support the division as a whole and are considered as fixed costs in both the traditional and activity-based-costing approach.

4.6.3 Specific advantage of ABC within that process

Within a traditional costing approach one single cost driver for the whole department would be used, preferably machine hours that would be considered as an allocation base that determines cost behaviour of a machine based division better than for example labour hours. However, since labour hours (picking and placing as well as releasing the cut parts from the metal sheet) do not necessarily develop in direct proportion to a change in machine hours, the traditional costing approach that was developed for *SMG* previously, used machine hours as a cost driver for overheads but labour hours for picking, placing and releasing of the parts are as well allocated directly to the cost object. In fact this can be considered as using two cost drivers. This might be better than the traditional approach of using just one single cost driver but it still disregards the variable characteristics of the product and batch-level costs. The aforementioned variable behaviour is not in terms of a change in machine hours or labour

hours but in respect to cost drivers other than that, such as the number of set-ups or the number of programming units.

In this regard product costs are programming costs and batch costs are set-up costs in the form of picking and placing and everything that is involved with it. The costs for the laser-cutting are charged with the effective machine hours and costs of releasing with the actual amount of labour hours involved. In the traditional ABC model costs would be assigned to the different activities (programming, picking and placing, laser-cutting and releasing). This would be done by surveying employees to estimate the percentage of time they spend (or expect to spend) on the four activities and then assign the department's resource expenses according to the average percentage gathered through the survey (Kaplan & Anderson, 2004, p. 131). However, as already stated *SMG* conduct a quite sophisticated time recording. The year 2012 serves as a reference period with around 600 machine hours of laser-cutting, which is also the aim for the following year. On this bases the percentages of time spent for the laser-cutting division of the employees involved was estimated. Since different employees are in charge of different activities the assignment of costs to the specific activity is self-evident. Releasing time (labour hours) was as an exception captured separately.

In general it is said that a model, which takes multiple cost-drivers into consideration will result in more rational pricing than the traditional model in automated production environments where non-volume related costs such as batch and product costs incur (Bilici & Dalci, 2008, p. 73).

4.6.4 Is TDABC applicable in this specific case?

TDABC is promoted with the instance that instead of surveying employees on how they spend their time, managers first directly estimate the practical capacity of the resources supplied as a percentage of the theoretical capacity. There are various ways to do this. As a rule of thumb, it can be simply assumed that practical full capacity is 80% to 85% of theoretical full capacity. According to Kaplan & Anderson (2004, p. 133) managers should allot a lower rate, around 80% to people, allowing 20% of their time for breaks, arrival and departure, communication and training. For machines, managers might allot a 15% differential between theoretical and practical capacity to allow for downtime due to maintenance, repair and scheduling fluctuations. A more systematic approach, however, is to review past activity levels and identify the month with the largest number of orders handled without excessive delays, poor quality, overtime, or stressed employees.

As already mentioned *SMG* has the advantage of a sophisticated time record, which explicitly records working hours spent, divided into productive (direct), non-productive (indirect) and paid non-attendance time, such as sick time or training time (indirect) labour hours. A forenoon break and the lunch break are therefore not considered as effective time (these are not paid). Of course small breaks during the working day apart from the two larger breaks are not considered. However, even Kaplan & Anderson (2004, p. 133) suggest not being overly

sensitive to small errors. The objective is to be approximately right, within 5-10% of the actual number, rather than precise.

The next step is to determine the time it takes to carry out one unit of each kind of activity. These numbers can be obtained through interviews with employees or by direct observation. It is important to emphasize that here the question is not about the percentage of time an employee spends doing an activity but how long it takes to complete one unit of that activity (the time required to process one order). Here the same holds as for estimating capacity: precision is not so critical. According to Kaplan & Anderson (2004, p. 133) rough accuracy is sufficient. Based on these two input variables the cost driver rates can now be calculated by multiplying the two estimated input variables.

However, as already stated in Chapter 2.9, not only the cost driver influences the duration of a process. The amount of time required for the programming process, for example, differs due to several factors, such as the quality of the data file provided by customers, the number of cut-outs as well as the number of units to cut which influence the time needed for positioning (nesting) of the cut part on the sheet.

Based on this a **time-equation for the activity programming** (3) as part of the whole laser-cutting process has been developed:

$$Y_P = 5 \times \#\ of\ products + \begin{matrix} Quality\ good \rightarrow +0 \\ Quality\ ok \rightarrow +5 \\ Quality\ bad \rightarrow +10 \end{matrix} + 0{,}5/100\ cut-outs + \begin{matrix} < 10\ units \rightarrow +0{,}5/unit \\ > 10\ units \rightarrow +10 \end{matrix} \quad (3)$$

The basis time per product is presumed to be 5 minutes per product. The second component relates to the quality of the provided data file. In case of a good quality no additional time needs to be considered whereas an average data file needs additional 5 minutes, whereas a bad quality requires additional 10 minutes of programming time. As the number of cut-outs influences the process time, 0,5 minutes are considered per 100 cut-outs. The last procedural step forms the positioning of cut parts on the sheet, which is also referred to as nesting. Nesting can be either conducted manually which is the most efficient for a smaller number (below ten parts). Above 10 pieces the automatic function of the laser-cutting programme becomes more efficient.

Every activity of which duration time is dependent on more than the cost driver needs to have such a time equation. In the present case of the laser-cutting division this is in particular the activity of picking and placing, which is determined by the number of sheets necessary as well as the size of the sheet (small, medium and large scale format). The process of laser-cutting itself by the machine, in contrast, can only be expressed by the duration of time. However, this effective laser-cutting time can easily be calculated with the associated software. The activity of releasing is charged on a time basis at a certain hourly wage rate and therefore needs to be estimated in advance in case an advanced offer is required. This is of

course subject to errors of estimations but in comparison to the traditional approach it is reduced to a minimum.

4.7 Critical findings of the different approaches

The difference between the existing calculation scheme and the newly developed job-order (overhead costing) calculation schemes with and without the improvement of ABC-usage are shown in Appendix E. Again, all the data were multiplied by a certain factor.

The first example (Appendix E, Table 1) shows a job-order that demands the cost centres production engineering, manufacturing and polishing. It shows that the actual costs of this specific order are lower than the quotation price. In fact, all but one of the calculated actual wage rates added with the particular overhead burden rates were below the actual rates used for the current year. This indicates that the company is and will be able to cover their costs. The only exception represents the division design engineering, showing that this division is partly supported by the other divisions of the company. The example also showed that this order could have been sold at a lower price, which could have improved the company's competitiveness. Here it needs to be emphasized that an additional profit margin is added to the prime costs and is not represented between the two calculation approaches. However, this example does not deal with the specific requirements of the laser-cutting division, which are covered in the second example (Appendix E, Table 2).

When laser-cutting comes into operation the traditional costing approach does not provide appropriate data, in fact it arrives at much higher prime costs, which may lead to even greater underutilization of the laser as it is already the case (see Chapter 3 about the issue of death spiral). This issue indicated that traditional costing is not sufficient in a more automated production environment. So the ABC-usage represented a considerable improvement, which is shown in the third part of the second example (Appendix E, Table 2). However, the case of an order with laser-cutting usage of low value shows that ABC is in this division clearly superior to traditional costing, since it does not consider batch and product costs (see Appendix E, Table 3).

Summing up, the laser-cutting division has shown that traditional cost accounting - even with the extension of the two cost drivers (machine hours for laser-cutting and labour hours for picking, placing and releasing) instead of one – does not suffice in an automated production environment, where non-volume related costs such as batch and product costs incur. It actually would suffice if the machine hours and labour hours could be estimated sufficiently, in advance for adequate submissions of the proposals, which is not the case. Therefore ABC offers the possibility to deal with batch and product costs and enables overhead costing similar to the existing calculation procedure.

The comparison between the actual cost rates and traditional ABC cost rates revealed that rates for programming and laser-cutting itself were too low, whereas set-up rates and labour hours for releasing were actually sold at much higher rates than their prime costs.

However, traditional ABC leads to substantial averaging (aggregation) of costs for the individual activities. Programming time for one product, for example, differs in practice. Applying traditional ABC leads to substantial averaging, also referred to as aggregation error (see Chapter 2.9), so that in some cases the actual time lies under the average time and sometimes vice versa. Certainly, more activities could be implemented, for example picking and placing itself, import of the program and removing in the case of the sub-process picking and placing. However, this would lead to higher measurement errors (as described in Chapter 2.9). Here TDABC with the implementation of time-equation for activities, which are depended on more than a single cost driver, enables a more precise calculation without adding more activities, which would inevitably make the calculation more complex and less concise. However, the implementation might keep complexity lower than adding more activities, but it also contains an aggregation error, since even the sophisticated time-equation does not hold in every case. The question is if the effort of generating the time equation with the necessary measurements and/or estimations succeeds the benefit of lowering the aggregation error. Also the higher amount of time needed with every job-order calculation should not be underrated. In addition, the effort needed for future system maintenance also needs to be taken into consideration. Above all, gross errors may occur, when estimates of unit times are not frequently reviewed.

Usually it is considered a disadvantage that ABC requires substantial resources and that once it is implemented it is costly to maintain. As time recording is already sophisticated at *SMG*, the traditional ABC approach does not demand substantial resources but some additional time to assess the existing data. However, this is not so in the case of TDABC where creation and maintenance of time-equations require considerable time and effort.

One of the key aspects of TDABC is that it solely uses the capacity used and the costs for idle capacity are not included in the calculated cost rates. That overcomes the issue of the death spiral (see Chapter 3), since in times of lower capacity utilization the prices would have to be increased, which might cause an even lower order volume. Therefore a reasonable activity level (expressed in machine hours) was defined - which is in fact lower than the theoretically possible activity level but it is reasonable for the present workforce. The difference between this practical capacity level and the actual capacity level is considered as idle capacity and shall not flow into the cost rates that are allocated to the cost objects. However, since the present costing system is based on planned (standard) costs the standard and therefore reasonable activity level is taken to calculate the cost rates. In this specific case this is therefore no advantage over the traditional ABC approach.

In practice actually, the adoption of a specific approach also depends on the understanding and approval of the management. Traditional ABC might not perfectly display the workflow with its complexity leading to a certain extent of aggregation error. However, the traditional ABC approach of the laser-cutting division is a rather simple and pragmatic solution, which still represents a notable improvement to traditional costing. The solution is also in line with the requirements of *SMG*, as it is close to the existing cost calculation scheme that is already used in the laser-cutting division, so that the administrational workflow does not have to be

highly adapted. The use of planned (standard) costs instead of competition based price rates, demonstrates the actual costs of the individual activities that needs to be covered.

CONCLUSION

Anglophone literature determines traditional costing with relying on single allocation base to assign all overhead costs (that means it uses a single cost pool). When comparing this simple costing approach to activity based costing, ABC seems to be more than superior. It is suggested as a possible solution to the single-allocation-base dilemma (Barsky & Catanach, 2005, p. 326). However, a more diverse cost classification in the context of cost pools could also solve this dilemma. The assignment of overhead costs to multiple cost centres can also be implemented in traditional costing without the necessarily consideration of processes and/or activities. Though, as practice shows, the assignment of cost centres according to its reasonable and viable assignment of costs, often correlates with the processes of the company. This is the case with powder-coating, polishing, laser-cutting and the design engineering cost centres at *SMG*.

Chapter 2.4.6 deals with the issue of choosing the appropriate allocation bases. It is emphasized that the allocation base must be strongly associated with the overhead costs, meaning that increases of overhead costs, should coincide with increases of the particular allocation base. Jobs with greater quantities of an allocation base receive larger allocations of overhead (Jiambalvo, 2001, p. 48). In practice it is often the case that larger jobs are able to carry higher amounts of overhead costs because a bigger order can handle higher amounts of overheads, since it can be sold at higher prices. The underlying principle is called cost viability principle (see Chapter 2.4.4), meaning that overheads are allocated according to the ability to carry the costs. A practical example of *SMG* is small orders. The handling for a small piece of metal might be the same as for a whole meter. However, a customer will not be willing to pay the same amount of overhead for it. This is called product-cost cross subsidization, which means that under-costing of products, inevitably leads to over-costing for other products, which distorts cost reality. Nevertheless, small jobs like these are necessary for the company and their reputation and often lead to bigger jobs.

Designing such a specifically adjusted cost accounting system requires comprehensive knowledge of the company to develop and apply the model, which might have been one of the greatest challenges of this work. Furthermore, a project like this may often provoke resistance to new ideas and changes, which requires management's ability and willingness to complete the process. In this particular case it was the adoption of ABC at one cost centre (laser-cutting division) that has enabled to overcome this issue, amongst others due to the fact that the ABC approach was more close to the existing cost calculation used in the specific division.

Whereas traditional costing allocates overhead costs based on direct expenses without compensating for a product's greater or lesser use of overhead costs, ABC allocates overhead to a product based on the actual amount of overhead used by that product (Hall & McPeak,

2011, p. 12). The laser-cutting division as a division with fairly structured and repetitive activities has in particular shown that ABC is a powerful tool, which effectively deals with batch and product costs. However, while the implementation of ABC or even TDABC might be possible for the whole enterprise, the time and effort used for implementing and maintenance would almost certainly exceed the benefits. ABC is therefore employed in the division where it most efficiently applies its strengths.

Analysing the laser-cutting department has shown that in the particular case TDABC provides a practical solution to increase precision without adding more activities, through the implementation of time-equations. However, this is not due to the fact that TDABC in comparison to ABC, features reduced complexity. In fact, it increased complexity due to the needed time equations. The reason for that is that the developed ABC system was rather simple and may not accurately display the workflow with its complexity and therefore leading to a certain extent of aggregation error. However, in practice the traditional ABC approach actually represents a simple and pragmatic solution, in-line with the specific requirements of *SMG*. Therefore the cost benefit evaluation indicates that traditional ABC might be more suitable in this specific case.

Finally, it needs to be emphasized that no single system can satisfy all the requirements of each function, so trade-offs have to be made. Costing systems need to be revised and updated constantly as technology and the organizational structures and workflows change. Examining the known problems in costing systems provides a greater appreciation of how to implement them and how to become a more intelligent user of the data. At last, it is essential to be careful not to reject a particular type of cost system (e.g. traditional absorption costing) solely because a particular firm or industry implemented it badly (Zimmermann, 2006, p. 533).

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APPENDIXES

TABLE OF APPENDIXES

APPENDIX A: LIST OF ABBREVIATIONS

ABC	Activity-based costing
BAB	*Betriebsabrechnungsbogen* (Cost allocation sheet)
BG	*Bezugsgröße* (Cost driver or allocation base at *GPK*)
CEO	Chief Executive Officer
CTO	Chief Technical Officer
e.g	for example (exempli gratia)
ERP	Enterprise resource planning
EStG	*Einkommensteuergesetz* (Income Tax Act)
GPK	*Grenzplankostenrechnung* (Variable or marginal costing)
h	Hours
IFAC	International Federation of Accountants
IFRS	International Financial Accounting Standards
IGC	International Group of Controlling
IMA	Institute of Management Accountants – The Association of Accountants and Financial Professionals in Business
KStG	*Körperschaftsteuergesetz* (Corporate Income Tax Act)
NAICS	North American Industry Classification System
PAIB	Professional Accountants in Business
RCA	Resource consumption accounting
SME	Small-to-medium sized enterprises
SMG	*Staudinger Metallbau GmbH*
TCA	Traditional cost accounting
TDABC	Time-driven activity based costing
UGB	*Unternehmensgesetzbuch* (Austrian Commercial Code)
USA	United States of America
US-GAAP	United States Generally Accepted Accounting Principles

APPENDIX B: ABSTRACT

The thesis starts by outlining what management accounting and the German controlling approach are about and gives essential terminology to provide the foundations. It goes on to examine the components of costs, cost behaviour and distinguishes between absorption costing and variable (marginal) costing as well as traditional cost accounting, the German approach *Grenzplankostenrechnung (GPK)* and activity based costing including the more recent approach of time-driven activity based costing. These topics are not only defined in theory parts but also with examples of the underlying company, a small metal-processing corporation, in particular *Staudinger Metallbau GmbH* (hereafter: *SMG*).

Before turning to the practical part of the thesis and the conceptual design of a cost accounting respectively managerial costing system for *SMG*, it deals with the issue of managerial costing in practice in the metal-working industry as well as for small and medium sized enterprises in general.

The practical part of the thesis deals with the specific requirements and characteristics of the *SMG* as well as the organizational structure and main processes of the company. It examines the present situation and the expected additional benefit of the managerial costing system. The aim was to develop a sophisticated cost accounting concept including different cost centres that displays the company structure as accurate but at the same time also as simple as possible. The basis for that built an analysis of the concrete processes, activities and workflows within the corporation to develop appropriate cost centres to accurately depict the whole firm. The so-developed managerial costing system is based on the German traditional cost accounting approach *Grenzplankostenrechnung* but only using practices that are appropriate for the specific situation and requirements of *SMG*. On the basis of this costing concept, potential for activity based costing in one part of the company was revealed, to better plan and allocate overheads to a particular job-order.

The practical part of the thesis does not only represent the procedure of developing a layout of a managerial costing system that is adapted to the specific requirements of the underlying company. In fact, it also contains the direct realization and execution of managerial costing in practice for the next planning period. Not all of the results are presented in detail but the procedural method, calculations and what was followed from the results is shown on the basis of three practical examples of job-orders. To comply with the sensitive nature of such cost information the data was multiplied with a specific factor to modify the data shown in the thesis.

In conclusion, the thesis sets out the main difficulties that occurred during the conception stage of developing the managerial costing system. Specifically it explains how the issues were dealt with and it provides reasons for particular proceedings to solve them.

APPENDIX C: PERSONNEL PLANNING (EXTRACT)

Ancillary labour costs

	Blue-collar	White Collar	Apprentice
KommSt.*	3,00%	3,00%	...
DB FLAF*	4,50%	4,50%	...
DZ*	0,39%	0,39%	...
MVK-Beitrag*	1,53%	1,53%	...
DG-Beitrag SV lfd.*	21,70%	21,83%	...
DG-Beitrag SV SZ*	21,20%	21,33%	...
Höchstbeitragsgrundlage*	4.400	4.400	...

*municipal tax, employer contribution to family burden equalisation fund, additional fee to the employer contribution, employee provision fund (severence payments), employer contribution to social insurance (ongoing, supplementary), limit of employer contribution of social insurance

Personnel expense

Blue-collar worker

			Allocation to cost centers							
			Direct costs							Overheads
			In-House CC	Prod. Engineering	Material	Manu-facturing	Powder coating	Polishing	Laser-cutting	
	gross pay	per year**								
Employee 1	1.812	33.251				95%				5%
Employee 2	1.836	33.688				94%				6%
Employee 3	1.442	26.449					85%	5%		10%
...	...	...	...	...	...	...	...	...	...	...
			Σ	Σ	Σ	Σ	Σ	Σ	Σ	

			Overheads							
			In-House CC	Prod. Engineering	Material	Manu-facturing	Powder coating	Polishing	Laser-cutting	Admini-stration
		overheads								
Employee 1		1.663	88%		2%	8%				2%
Employee 2		2.021	35%		57%	8%				
Employee 3		2.645	25%		9%		61%	4%		1%
...		...	...	...	...	...	...	...	...	...
			Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ

→ cost allocation sheet

**=IF(gross pay<Höchstbeitragsgrundlage;gross pay*14+gross pay*14*sum(KommSt.:MVK-Beitrag)+gross pay*12*DG-Beitrag SV lfd.+gross pay*2*DB-Beitrag SV SZ;gross pay*14+gross pay*14*sum(KommSt.:MVK-Beitrag)+Höchstbeitragsgrundlage*12*DG-Beitrag SV lfd.+Höchstbeitragsgrundlage*2*DB-Beitrag SV SZ)

Working days

	Employee 1	Employee 2	Employee 3
Days/year	365	365	365
- Saturdays, Sundays	-104	-104	-104
- Public holidays	-10	-10	-10
- Holidays	-25	-25	-30
- Sickness absence***	-10	-10	-10
- Education and training			
Productive days	**216**	**216**	**211**
Hours per day	7,7	7,7	7,7
Hours per year	**1.663,20**	**1.663,20**	**1.624,70**

*** Average sick absence according to the chamber of commerce

Direct costs per cost centre (division) per hour

Cost centre	Sum	hours/year	chargeable	chargeable hours	hourly wage rate
Manufacturing	Σ	12.042	100%	12.042	20,65
Powder coating	Σ	1.440	100%	1.440	23,29
Polishing	Σ	695	100%	695	20,39
Laser-cutting	Σ	480	100%	480	21,85
...	...	...	...	...	...

→ cost object accounting

Source: SMG, *Modified managerial costing data*, 2013.

APPENDIX D: EXTRACT OF THE COST ALLOCATION SHEET CREATED FOR SMG

	Cost category	Standard Costs	var. portion	var. direct costs	var. over-heads	fixed overheads	Allocation key		Service cost center				Primary cost center													
									In-House CC		Prod. engineering		Material		Manufacturing		Powder coating		Polishing		Laser-cutting		Design engineering		Administration	
									var.	fixed	var.	fixed	var.	fixed	var.	fixed	var.	fixed	var.	fixed	var.	fixed	var.	fixed	var.	fixed
Personell																										
	White-collar employee	176.281	16%	28.205		148.076				448		35.867										14.441		3602,1		93.719
	Blue-collar employee	316.273	94%	297.297		18.976				9.515				5.129		1.600		2.380		176		11				165
	...	...	...	...	...	...			...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Raw materials and supplies																										
	Raw material (Manufacturing)	129.375	100%	129.375																						
	Powder (Powder coating)	3.750	100%	3.750																						
	Operating materials	16.875	100%		16.875		according to estimation								12.994		1.688		1.688		506					
	Auxiliary materials	9.255	100%		9.255										1.155						8.100					
	...	...	...	...	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other operating expenses																										
	Office supplies	1.200	0%			1.200																				1.200
	Insurance	11.250	0%			11.250	902,42	m²				180		3.457		4.488		748		823		1.025		70		460
	Electricity	16.568	68%		11.266	5.302	according to estimation								5.070	2.386	3.380	1.590	1.408	663					1.408	663
	Advertising expenses	7.380	0%			7.380	functional attribution																			7.380
	Maintenance (Machinery)	7.125	30%		2.138	4.988							21	50	1.945	4.539	86	200	86	200						
	Rent	30.900	0%			30.900	902,42	m²				493		9.495		12.328		2.054		2.260		2.815		192		1.264
	...	...	...	...	...	...			...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Imputed costs																										
	Imputed depreciation on fixed assets	34.115	0%			34.115	index to appendices					1.365		4.094		14.328		1.706		1.365		3.070		1.365		6.823
	Imputed depreciation on (tooling) equipment	3.675	70%		2.573	1.103	according to estimation								1.801	772	386	165	386	165						
	Imputed (calculatory) interest	17.445	0%			17.445								523		6.629		349		349		2.093		174		7.327
	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	...	...	...		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sum of costs	Σ							Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ
	Internal cost allocation																									
	Total sum of costs												Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ	Σ
													MDC*		MFG DC*		PC DC*		PDC*		Mh*		DE DC*		Prime costs	
													var.	full	var.	full	var.	full	var.	full	var.	full	var.	full	var.	full
													1,3%	13,0%	8,9%	51,9%	15,0%	52,6%	25,7%	86,5%	20,4/h	105,3/h	0,0%	141,8%	0,3%	22,5%

Cost object accounting at full costs
Direct (raw) material
+ Material overheads
= Material related costs
+ Production engineering direct costs
+ Manufacturing direct costs
+ Manufacturing overheads
+ Powder coating direct costs
+ Powder coating overheads
+ Polishing direct costs
+ Polishing overheads
+ Laser-cutting direct costs (labour hours)
+ Laser-cutting direct costs (machine hours) incl. overheads
+ Design engineering direct costs
+ Design engineering overheads
= Manufacturing costs
= Production costs
+ Administrative overheads
= Prime costs

Source: SMG, *Modified managerial costing data*, 2013.

*For explanation of abbreviations see Table 3, p. 45.

APPENDIX E: JOB-ORDER EXAMPLES

Table 1. Job-Order Calculation without Laser-Cutting

Existing calculation scheme			
Raw material			306,00
Surcharge		30%	91,80
Material related costs			**397,80**
Production engineering	1,00 h	39,00/h	39
Manufacturing	15,50 h	39,00/h	604,5
Polishing	12,00 h	52,50/h	630
Prime costs			**1.671,30**
Job-order (overhead costing) calculation based on traditional costing			
Direct (raw) material			306,00
Material overheads		13,01%	39,82
Material related costs			**345,82**
Production engineering direct costs	1,00 h	31,21/h	31,21
Manufacturing direct costs	15,50 h	20,65/h	320,00
Manufacturing overheads		51,90%	166,09
Powder-coating direct costs		23,29/h	0,00
Powder-coating overheads		52,63%	0,00
Polishing direct costs	12,00 h	20,39/h	244,73
Polishing overheads		86,48%	211,63
Laser-cutting labour hours (direct costs)		21,85/h	0,00
Laser-cutting machine hours (incl. overheads)		105,28/h	0,00
Design engineering direct costs		22,11/h	0,00
Design engineering overheads		141,82%	0,00
Manufacturing costs			**1.319,48**
Administration overheads		22,45%	296,23
Prime costs			**1.615,71**

Source: SMG, *Modified managerial costing data*, 2013.

Table 2. Job-Order Calculation with Laser-Cutting

Existing calculation scheme			
Raw material			4.470,00
Surcharge		30%	1.341,00
Material Transport			66,00
Surcharge		10%	6,60
Material related costs			**5.883,60**
Manufacturing	85,70 h	39,00/h	3.342,30
Design engineering	2,50 h	52,50/h	131,25

(table continues)

(continued)

Programming unit Laser	3,00 PU	3,75/PU	11,25
Set-up Laser	1,00 Set-up	15,00/Set-up	15,00
Laser-cutting machine hours	61,22 Mh	86,25/Mh	5.280,23
Releasing labour hours Laser	11,78 Lh	37,50/Lh	441,75
Additional surcharge		30%	1.724,47
Prime costs			**16.829,84**
Job-order (overhead costing) calculation based on traditional costing			
Direct (raw) material			4.470,00
Material overheads		13,01%	581,70
Material related costs			**5.051,70**
Production engineering direct costs	2,00 h	31,21/h	62,43
Manufacturing direct costs	83,70 h	20,65/h	1.728,00
Manufacturing overheads		51,90%	896,88
Laser-cutting labour hours (direct costs)	62,00 h	21,85/h	1.354,58
Laser-cutting machine hours (incl. overheads)	61,22 h	105,28/h	6.445,07
Design engineering direct costs	2,50 h	22,11/h	55,29
Design engineering overheads		141,82%	78,41
Manufacturing costs			**15.672,35**
Administration overheads		22,45%	3.518,47
Prime costs			**19.190,83**
Job-order (overhead costing) calculation based on traditional costing with ABC-usage			
Direct (raw) material	5.960,00		4.470,00
Material overheads		13,01%	581,70
Material related costs			**5.051,70**
Production engineering direct costs	2,00 h	31,21/h	62,43
Manufacturing direct costs	83,70 h	20,65/h	1.728,00
Manufacturing overheads		51,90%	896,88
Laser programming units	3,00 PU	4,89/PU	14,67
Laser set-up (Picking and Placing)	1,00 Set-up	7,73/Set-up	7,73
Laser-cutting machine hours	61,22 Mh	76,61/Mh	4.689,76
Laser releasing labour hours	11,78 Lh	21,85/Lh	257,36
Design engineering direct costs	2,50 h	22,11/h	55,29
Design engineering overheads		141,82%	78,41
Manufacturing costs			**12.842,22**
Administration overheads		22,45%	2.883,10
Prime costs			**15.725,32**

Source: SMG, *Modified managerial costing data*, 2013.

Table 3. Job-Order Calculation with Laser-Cutting of Low Value

Existing calculation scheme			
Raw material			117,15
Surcharge		30%	35,15
Material related costs			**152,30**
Production engineering	0,50 h	39,00/h	19,50
Manufacturing	10,25 h	39,00/h	399,75
Polishing	2,50 h	48,75/h	121,88
Programming unit Laser	2,00 PU	3,75/PU	7,50
Set-up Laser	1,00 Set-up	15,00/Set-up	15,00
Laser-cutting machine hours	0,10 Mh	86,25/Mh	8,63
Releasing labour hours Laser	0,08 Lh	37,50/Lh	3,13
Additional surcharge		30%	10,28
Prime costs			**737,95**
Job-order (overhead costing) calculation based on traditional costing			
Direct (raw) material			117,15
Material overheads		13,01%	15,25
Material related costs			**132,40**
Production engineering direct costs	0,50 h	31,21/h	15,61
Manufacturing direct costs	10,25 h	20,65/h	211,61
Manufacturing overheads		51,90%	109,83
Polishing direct costs	2,50 h	20,39/h	50,98
Polishing overheads		86,48%	44,09
Laser-cutting direct costs	0,11 h	21,85/h	2,40
Laser-cutting overheads	0,10 h	105,28/h	10,53
Manufacturing costs			**577,45**
Administration overheads		22,45%	129,64
Prime costs			**707,09**
Job-order (overhead costing) calculation based on traditional costing with ABC-usage			
Direct (raw) material			117,15
Material overheads		13,01%	15,25
Material related costs			**132,40**
Production engineering direct costs	0,50 h	31,21/h	15,61
Manufacturing direct costs	10,25 h	20,65/h	211,61
Manufacturing overheads		51,90%	109,83
Powder-coating direct costs		23,29/h	0,00
Powder-coating overheads		52,63%	0,00
Polishing direct costs	2,50 h	20,39/h	50,98
Polishing overheads		86,48%	44,09

(table continues)

(continued)

Laser programming units	2,00 h	4,89/PU	9,78
Laser set-up (Picking and Placing)	1,00 h	7,73/Set-up	7,73
Laser-cutting machine hours	0,10 h	76,61/Mh	7,66
Laser releasing labour hours	0,08 h	21,85/Lh	1,82
Design engineering direct costs		22,11/h	0,00
Design engineering overheads		141,82%	0,00
Manufacturing costs			**591,51**
Administration overheads		22,45%	132,79
Prime costs			**724,30**

Source: SMG, *Modified managerial costing data*, 2013.