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Capital Flow Design – Management Accounting's Role in a Lean Enterprise

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Abstract

Lean Production Systems are the accepted benchmark for an efficient and effective production. Despite the rising prevalence of Lean in manufacturing and service companies, traditional management accounting systems are widely used unmodified in companies. This often creates distinct conflicts for the management during a Lean transformation. Traditional management accounting is a model based on assumptions that are not valid any more in today's Lean companies. As an approach to solving this problem the paper shows the ten guiding design principles of an Accounting for Lean system. The principles were developed by an intensive literature research as well as a three-year case study in a manufacturing company. The consideration of these principles in the design of the company's internal management accounting system creates financial information, that actively support the Lean strategy. The resulting management accounting system for Lean companies is called Capital Flow Design.

Keywords: Accounting for Lean, Lean Accounting, cash flow, management accounting.

Traditional management accounting as barrier for Lean

> "Standard-cost accounting systems are incompatible with Lean. They are antithetical to Lean practice because they encourage and reward precisely the behaviours that you want to eliminate. In fact, I think of standard-cost accounting as "the anti-Lean". (Byrne, 2013)

Despite distinct developments in production systems towards Lean, traditional management accounting systems are widely used unmodified in companies (Rao & Bargerstock, 2011). The basic structure and principles of traditional accounting were developed to support tayloristic mass production systems in sellers' markets about 100 years ago (Darlington, 2012).

Most companies do not adapt or question their management accounting systems during the Lean transformation, which results in conflicts between accounting and Lean. In literature, there exist many examples of top management stopping Lean turnarounds, because their organization's accounting system is unable to show any or even negative financial results (e.g. DeLuzio, 2006; Sobczyk & Koch, 2008). Especially in early Lean implementation phases, blind faith in the Lean success is rarely enough for CEOs and CFOs.

For a sustainable and resounding success it is not enough to implement Lean exclusively in production and logistics. A company is a living system (Johnson, 2006), that interacts permanently with all direct and indirect functions. Figure 1 shows the necessary elements of a successful Lean transformation environment and the mutual relationship of the single aspects (c.f. Gerberich, Teuber, & Schäfer, 2006; Grasso, 2006; Grasso, Tyson, Skousen, & Fullerton, 2015)

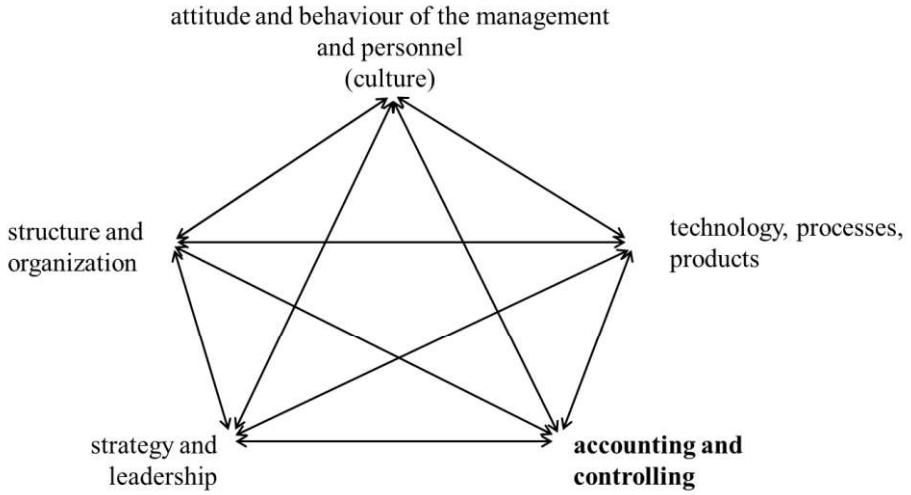

Figure 1 – Elements and their relationship for a successful Lean transformation

Every element of a successful Lean environment in figure 1 influences all other elements and is influenced by all others. The research and business practice show current developments in the following elements:

- Culture, in terms of kaizen or Toyota Kata (Rother, 2013)
- Structure and organization, like management principles and value stream orientation (Rother, Shook & Wiegand, 2004; Schneider, 2016)
- Strategy and leadership, like Hoshin Kanri (Kudernatsch, 2013)
- Customer focused design of products and processes with methods like target costing (Cunningham 2003).

In contrast to these elements, accounting and controlling are a quite unexplored field in the Lean movement (Chiarini, 2012; Huntzinger, 2007). Due to the high importance of the accounting system for internal communication, budgeting and controlling aspects it needs to be changed for supporting the Lean strategy (Ahlstroem & Karlsson, 1996). Therefore, the core research question of the paper is "What are the guiding design principles of management accounting system for Lean?".

To answer this question section 2 will give a short summary of the assumptions of traditional accounting and its deficits in a Lean company. Section 3 shows the results of an empirical analysis of requirements on management accounting system for Lean. This is the foundation for the development of ten guiding design principles of the Capital Flow Design System in section 4. Section 5 gives a short summary.

Assumptions of traditional management accounting systems

Management accounting systems are a model of the company's financial reality. The validity of a model is always dependent on its underlying premises and assumptions. These assumptions must be considered during the interpretation of its results and information. The correctness of financial statements about the profitability of a production system is therefore dependent on the assumptions of the applied accounting system (c.f. Ansari, Bell, Klammer, & Lawrence, 1997).

To understand the roots of the conflicts between traditional management accounting and the Lean philosophy (c.f. Michalicki, 2016; Smith, 2000) you need to identify the assumptions of traditional accounting systems and analyse, if these assumptions are still valid in a Lean environment. The following groups of assumptions of traditional accounting systems have been detected:

- Assumptions about the production system and factory type

- Assumptions about the cost structure and main influencing factors of costs
- Assumptions about the production and market environment.

Assumptions about the production system and factory type

Traditional cost accounting systems reflect the time of emerging mass production systems (Darlington, Found, & Francis, 2016). The core of most modern management accounting systems was developed in the 1920s (Cunningham, Fiume, & Adams, 2003) without any significant improvements or adjustments (Solomon & Fullerton, 2007). Therefore, traditional accounting supports the production system and factory type of the early period of industrialization including their premises about achieving highest profitability. Most companies were anonymous single-step mass producers with a low level of automation (Brauckmann, 2015), which is the opposite of highly integrated and partly automated Lean enterprises.

Traditional accounting systems have been developed for tayloristic mass production systems with a high division of labour and big batches for generating economies of scale (Cunningham et al., 2003). The assumption is, that concentrating similar resources like machines or employees improves the efficiency. In contrast, this functional organization and local optimization is seen as the central driver of waste in Lean Thinking (Kennedy & Brewer, 2006).

Assumptions about the cost structure and main influencing factors of costs

Traditional accounting systems assume the cost structure of a mass producer of the early 20th century, which differs fundamentally from modern industrial companies. The typical cost structure till the 1950s was characterised by high direct labour costs and low overhead costs of typically below 10 % of the total costs. The continuously rising effort for planning, controlling and managing tasks causes a much higher portion of overhead in modern companies. Direct labour costs are constantly decreasing due to automation, rationalization and outsourcing. Figure 2 summarizes the development of cost structures in the last decades (c.f. Solomon & Fullerton, 2007).

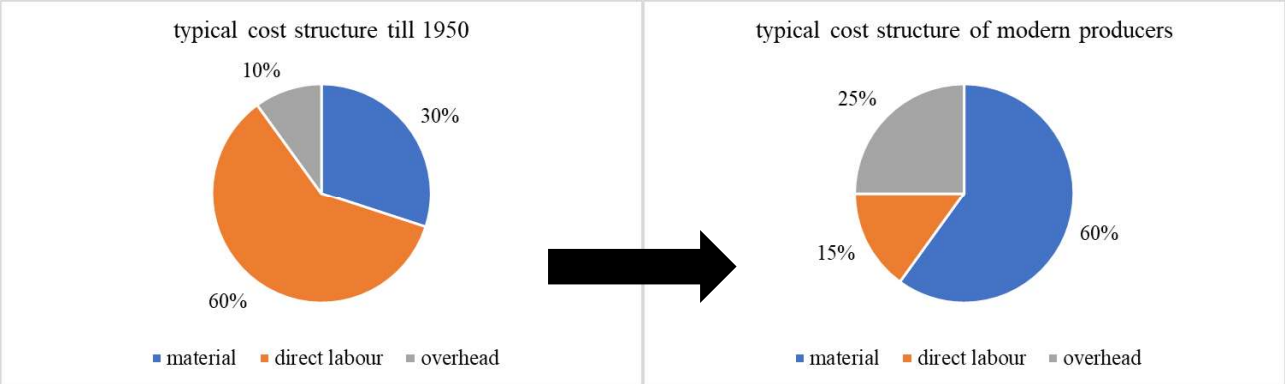

Figure 2 – changes of cost structures

The changing cost structures limit the usability of traditional management accounting systems considerably. Traditional costing systems were not developed for handling high overhead cost as well as high fixed costs that are dominant in modern production systems (Coenenberg, Fischer, & Günther, 2016)

The main influencing factor of costs in traditional accounting systems is the capacity utilization of resources. But modern production systems are characterised by a fixed cost portion of 70 – 90 % of total costs without material or other external costs. Therefore, the utilization of resources does not have a great impact on total costs (without material). The calculative reduction of unit costs through high capacity utilization does usually not affect the spending, the total costs or even improve the cash flow (Darlington et al., 2016).

Assumptions about the production and market environment

The economies of scale describe the fact, that unit costs decrease with rising production volume. This tayloristic view bases on the assumption of a sellers' market, where the sales volume is constantly increasing and the whole production volume can be sold with constant prices. These assumptions are not valid for modern buyers' markets, where product life cycles get shorter, customers define the value and the market is highly competitive. The singular focus on economies of scale in a buyer's market can cause overproduction, the worst of all kind of wastes in Lean Thinking (Ohno, 2013). So, the economies of scale are true in general but only valid for companies in a sellers' market.

The view of unsaturated demand manifests in the traditional calculation of cost of goods sold. The fixed costs of a period are traditionally spread over the whole production volume of the period. So unit costs and total costs of goods sold get less the more it is produced. By adding a portion of fixed costs to the overproduced volume, rising inventories of work in progress or finished goods get motivated (c.f. Silvi, Bartolini, & Visani, 2012). In Lean Thinking overproduction has no value at all from the customers point of view.

All these assumptions lead to the fact, that traditional accounting systems work actively against a Lean Production System. Despite some singular developments on the field of Accounting for Lean (e.g. value stream costing (Maskell, Baggaley, & Grasso, 2012)) a systematic approach for the identification of requirements on a holistic management accounting system for Lean companies is missing.

Empirical analysis of requirements on management accounting systems for Lean

To identify requirements on an accounting system for Lean companies, interviews with experienced Lean practitioners were performed. Guided qualitative interviews with experts are a recommended way of empirical information collection in complex situations (Buber & Klein, 2007). For the traceability of the research process the following framework conditions of the interviews are defined:

- **Research object**: The focus is on determining requirements of profit and loss responsible managers in Lean Production systems on a management accounting system.

- **Target group**: The target group consists of company-internal customers of management accounting information. An expert in case of the study is a manager with profit and loss responsibility in a Lean Production system. The expert needs to have a profound knowledge and practical experience in Lean Production. The target group consist of managers from the middle and upper management level, ranging from industrial foremen up to CEOs. Two Lean consultants are included. The size and respective industries of the expert's companies varied widely.

- **Random sample**: The random sample is N=23 interviews. Qualitative interviews cause high effort for preparation and execution. The sample size of 23 ensures an economically justifiable effort-benefit relation and is accepted for hermeneutic interpretation of the statements (Helfferich, 2009). The 23 interviewees are out of twelve different companies.

A detailed description of the interview methodology and the analysis procedure can be found in (Michalicki & Schneider, 2017). The following list shows the top three extracted requirements from the expert interviews (with reference to the number of deductions on statements of the experts):

- Value stream as a holistic profit center and calculation object

- Value-added and non-value-added cost categories
- Direct costing on the value stream level to avoid cost allocation

Value stream as a holistic profit center and calculation object

Many experts stated, that their traditional accounting approach focuses on local/single objects like product costs or cost centers. But the calculated effects of isolated cost objects are sometimes not relevant in a more holistic value stream view. The widely-used hourly rate calculation shows cost changes only, if the direct

minutes (of persons or machines) change. This fact undermines todays growing importance of overhead costs. The standard accounting tools are not able to cost the changes by the Lean transformation on indirect functions like logistics or production planning. A more holistic and process-oriented cost view for planning and controlling purposes is needed. The highly differentiated cost center structures in most companies need to be replaced by a more simple and holistic value stream view. Lean Production systems focus on improving value streams. Therefore, value streams should become the calculation objects in Lean companies.

Value-added and non-value-added cost categories

Lean focuses the reduction of waste (non-value-adding work in the customers view). Traditional accounting does not consider this view of resource consumption. It is neither able to quantify the amount of non-value-adding work nor to locate the greatest monetary potential for Lean improvement projects. This creates two main problems:

Lean managers get challenged in determining the results and benefits of Lean. While soft facts like reduced lead times or less transportation effort can be quantified easily, the costs, especially unit-costs, stay mostly constant. Some experts stated that some traditionally calculated unit-costs even increased after some kaizen events. Justifying a Lean improvement project in front of upper management gets difficult when (calculated) costs rise.

Most experts were concerned about the profitability of their Lean efforts. Although their aim is to realize the greatest financial impact of Lean projects, the lacking knowledge about the monetary amount and location of non-value-adding activities creates problems. For this reason, Lean managers are not able to maximize the financial benefit of their limited resources (capital and money) for kaizen (optimization) projects. Planning and controlling the costs of value-added activities and waste can be a solution by the opinion of the experts.

Direct costing on the value stream level to avoid cost allocation

In the opinion of many experts, the traditional cost allocation process is just a mathematical solution for handling overhead, but it creates a lack of transparency. Overhead allocation hides waste and motivates local improvement. Traditional cost accounting was not invented for the allocation of increased overhead costs.

During the interviews, there was no clear consensus in the solution of the overhead problem. Some expressed a more detailed allocation process (like done by activity based costing) as a solution. This mind set of “improving the system by detailing every aspect and improving every detail” can be traced back to the tayloristic management view and be declared as unsuitable for the complexity of modern production (Schneider, 2016). The other mentioned solution was to avoid allocations as much as possible. This implicates a more suitable direct costing method.

Further findings of this empirical research is described in (Michalicki & Schneider, 2017). These requirements are the basis for the development of the guiding principles of an Accounting for Lean system.

Guiding principles of Capital Flow Design

The transfer of knowledge in the form of principles is deeply rooted in the Lean philosophy (Schneider, 2016). On this occasion, a principle can be defined as a tenet, that gives direction (in contrast to a strict rule). Considering the results of the empirical research as well as a literature research and personal experience as Lean consultants ten principles of an Accounting for Lean system are identified. Table 1 lists the principles and connects them with the explained requirements and the five Lean Thinking principles according to Womack and Jones (Womack & Jones, 2013).

Table 1 – Guiding principles of Capital Flow Design

Empirical requirement or Lean Thinking principle	**Guiding principle of the management accounting system for Lean**	**Short description**

Value stream as a profit center / Identification of the value stream	**Value stream orientation**	A hierarchy of reference objects (e.g. company → value stream → process) ensures that all costs can be assigned, while the value stream level is a must. Periodical financial statements and one-time profitability analysis should focus on value streams.
Value-added and non-value-added cost categories / Flow of the value	**Total cost focus (spending)**	Unit costs /product costs lose their relevance in buyers' markets and often motivate overproduction through economies of scale thinking. It is more important to plan and control the total costs / spending of the value streams and the total company.
Specification of value from the end customer standpoint	**Value adding orientation**	The cash flow must be differed in value adding and non-value adding parts. This ensures the end customer orientation in the accounting system and aligns the language of production and accounting.
Value-added and non-value-added cost categories	**Shop floor orientation**	Actual costing must consider shop floor data about capacity usage (e.g. stoppings, defects, waiting).
-	**Behavioural orientation**	Behavioural orientation towards Lean thinking must be embedded in periodical and one-time calculations.
Flow of the value	**Cash flow orientation**	Predominating usage of spending instead of costs; production and information flow improvement is accompanied with cash flow changes.
Direct costing on the value stream level	**Direct costing principle**	Allocation of overhead costs hides waste and reduces the controllability of costs.
-	**Cost relevance principle**	Every decision needs individual monetary information. A basic monetary record of costs and capacity usage is the fundament for individual decision accounting in the Capital Flow Design system.
-	**Contribution principle**	Complex production systems create the need for several financial perceptions by contribution accounting
Specification of value from the end customer standpoint.	**Capacity usage orientation**	Cost of value added and non-value-added resource consumption can only be determined by analysing the capacity usage of all resources.

The full realisation of the principles in table 1 creates a management accounting system for Lean that we call "Capital Flow Design". Figure 3 shows the framework of the Capital Flow Design System.

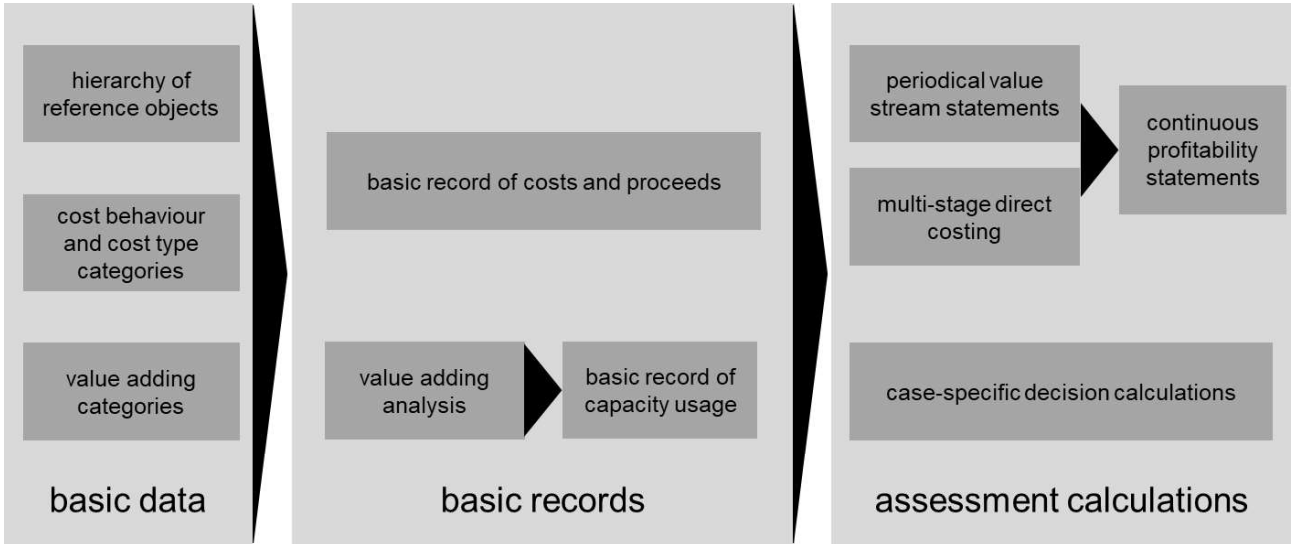

Figure 3 – Framework of Capital Flow Design

The Capital Flow Design System consists of three basic elements:

- the basic data
- two basic records and
- the assessment calculations.

Basic Data

The hierarchy of reference objects forms the basis for the realization of the direct costing principle. Their purpose is to avoid relevant cost allocations by providing hierarchically ordered and multi-level reference objects. All costs in the company are clearly assigned to a reference object, without any allocation. Typical levels are company, value stream, process, workplace.

In addition to the reference objects, the cost types significantly characterize the following basic records. A cost type is used to describe and cover the costs (spending) for a type of production factor used (personnel, material, etc.). As far as the cost types are concerned, it is important to define as clear as possible the cost behaviour categories. The central cost behaviour categories are performance costs (total variable costs) and fixed costs. The purpose of this categorization is to classify the recorded cost elements regarding the main determining factors in order to be able to assess short- and long-term decisions with relevant costs.

The last element of the basic data is the value adding categories. These serve to integrate the value understanding of the customer regarding the internal use of resources in cost accounting. Controlling and production thus create a uniform language. The following basic records of the capacities as well as all assessment calculations use the defined value-added categories.

Basic records

After defining the basic data, the period-related basic calculations can be carried out. The basic record of costs (spending) and proceeds is mentioned first. This represents a period-related and allocation-free acquisition of all costs and proceeds for the respective reference object. The reference object hierarchy, the cost types, and the cost-behaviour categories are used as input. The purpose of the basic record of costs lies above all in the provision of all information modules for the subsequent period-related income statements as well as the case-specific decision calculations. It is usually carried out in a table format with the reference objects in the columns and the cost types in the rows.

The basic record of the capacity usage is founded on the results of the value-added analysis. It is used for the period-related quantification of the total resource input in original determination variables and their pro rata attribution to the value-added categories. In addition to the value-adding analysis, capacity data (e.g. the number of available worker hours), shop floor data from different systems (e.g. actual downtimes) and standard times are used as input. In contrast to the basic record of costs and proceeds, the basic records of the capacity

usage thus represent the non-monetary view of the production system and calculates with original quantities of the production factor input.

Assessment calculations

If both basic records have been carried out, the data base exists for different assessment calculations. In the assessment calculations, a distinction is made between regular period-related income statements (standard calculation) and problem-specific decision calculations (special calculation). Both are typical performed in a multi-stage direct costing way.

The main purposes of the standard calculations are the ongoing planning, performance control as well as the behavioural control. For these income statements, a link between the basic records of cost and proceeds and the basic records of capacity usage is created.

Various decision calculations or case-specific evaluations are possible with both basic records. This includes the planning and control of investments or rationalization measures. The basic record of the capacity is primarily used to consider the origin of costs from the analysis of resource procurement and its use, while the basic record of costs provides decision-relevant cost data. Investment calculation and cost accounting are integrated here.

The Capital Flow Design system is a system of cost accounting and cost analysis for a variety of evaluation and decision purposes that meets the requirements of Lean production systems.

Summary and perspectives

Traditional management accounting systems are a typical barrier to a sustainable Lean transformation. Despite some singular developments on the field of Accounting for Lean a holistic approach is still missing. The Capital Flow Design system was developed as a management accounting system, that actively supports the Lean strategy. It is built upon ten guiding principles that emerged from empirical research with Lean practitioners. The Capital Flow Design system was successfully tested in a pilot value stream of a German electronics manufacturing company. The first practical use initiated a considerable paradigm shift towards Lean in the company. Further research will examine the overall transition of the traditional cost accounting system to the new system.

To further disseminate the system, it is important to point out the dangers of traditional accounting already in the (university) education and to show Capital Flow Design as an alternative for Lean companies. Therefore, Capital Flow Design is used to expand traditional Lean simulation games by an accounting module. It is necessary to show mangers and accountants in Lean companies the conflicts between traditional accounting and the Lean philosophy as well as the alternative “Capital Flow Design”. The basic concept of an Accounting for Lean simulation game is described in (Michalicki, 2016b).

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