

YAŞAR UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
BUSINESS ADMINISTRATION PROGRAMME

MASTER THESIS

LEAN ACCOUNTING:
Lean Accounting Practices in a non-Lean Production
Company

UĞUR İPEK

THESIS ADVISOR: ASST.PROF.DR. MUSTAFA GÜROL DURAK

2018 İZMİR

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MASTER THESIS JURY APPROVAL FORM

I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and in quality, as a thesis for the Master degree.

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ABSTRACT

LEAN ACCOUNTING:

Lean Accounting Practices in a non-Lean Production Company

Uğur İpek

Msc, Business Administration

Advisor: Asst.Prof.Dr. Mustafa Gürol DURAK

2018

Since lean accounting is regarded as a tool to see improvements in lean manufacturing systems, it seems to be applicable only if the organization has a lean manufacturing system. The idea behind this thesis is to show there are no preconditions, such as lean manufacturing, to apply lean accounting. Using lean accounting system, companies can improve its accounting processes and managers can evaluate organizations performance in a more value added way.

In this thesis, basic concepts of lean is introduced and lean accounting tools are applied to a non-lean company. As a result, lean accounting system tools increased efficiency and provided a better information for managers.

Keywords: lean, lean accounting, lean tools, waste.

ÖZ

YALIN MUHASEBE:

Yalın Olmayan Üretim Şirketindeki Yalın Muhasebe Uygulamaları

Uğur İpek

Yüksek Lisans Tezi, İşletme

Danışman: Dr. Öğrt. Üyesi Mustafa Gürol DURAK

2018

Yalın muhasebe, yalın üretim sistemlerinde yapılan iyileştirmelerin görülmesini sağlayan bir araç olarak kabul edildiği için, sadece yalın üretim sistemine sahip olan organizasyonlarda uygulanabilir gibi görülür. Bu tezin arkasındaki fikir, yalın muhasebenin uygulanması için herhangi bir önkoşulun olmadığını, örneğin yalın üretim sistemi gibi, ortaya koymaktır. Yalın muhasebe sistemi ile şirketler muhasebe süreçlerini geliştirebilir ve yöneticiler organizasyonun performansını daha katma değerli şekilde değerlendirebilirler.

Bu tezde, yalının genel kavramları tanıtıldı ve yalın olmayan bir şirkette yalın muhasebe araçları uygulandı. Sonuç olarak, yalın muhasebe sistemi araçları verimliliği arttırdı ve yöneticiler için daha iyi bilgi sağladı.

Anahtar sözcükler: yalın, yalın muhasebe, yalın araçları, israf.

ACKNOWLEDGEMENTS

I would like to thank my supervisor Asst.Prof.Dr. Mustafa Gürol DURAK for his guidance and patience during this study.

Uğur İpek
İzmir, 2018

TEXT OF OATH

I declare and honestly confirm that my study, titled “LEAN ACCOUNTING” and presented as a Master’s Thesis, has been written without applying to any assistance inconsistent with scientific ethics and traditions. I declare, to the best of my knowledge and belief, that all content and ideas drawn directly or indirectly from external sources are indicated in the text and listed in the list of references.

Uğur İpek



May 01, 2018

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LIST OF ABBREVIATIONS

%C&A	: %Complete and Accurate
ABC	: Activity Based Costing
AR	: Accounts receivable
C/O	: Changeover Time
C/T	: Cycle Time
EBIT	: Earnings Before Interest and Taxes
EBITDA	: Earnings Before Interest, Taxes, Depreciation, And Amortization
Ed.	: Editor
et. al.	: Multiple Authors
FTT	: First time through
HR	: Human Resources
IT	: Information Technology
KPI	: Key Process Indicator
LT	: Lead Time
min	: Minute
N	: Non-Value Added
NVA	: Non-Value Added
OEE	: Overall Equipment Effectiveness
OOE	: Overall Office Effectiveness
OPE	: Overall Professional Effectiveness
p	: Page
PDCA	: Plan, Do, Check and Act
pp	: Pages
ppm	: Parts Per Million
PCE	: Process Cycle Efficiency
PE	: Process Efficiency
PLT	: Process Lead Time
PT	: Process Time
ROS	: Return of Sales
SIPOC	: Suppliers-Inputs-Processes-Outputs-Customers
SMED	: Single Minute Exchange of Die
SOPF	: Sales, Operations, and Financial Planning

SOX : Sarbanes-Oxley
SWIP : Standard Work-In-Process
VA : Value Added
VSA : Value Stream Accounting
VSM : Value Stream Mapping
WIP : Work In Process

INTRODUCTION

Globalization forces organizations to focus on customers. To give customers what they want, become an obligatory to sustain their competitiveness in the market. As a result, organizations are being expected to offer quality goods with a lowest cost and at a time when customer wants.

In order to survive, organizations need to evaluate new methodologies. To maximize customer value and minimize waste, organizations should adopt lean philosophy to all of the other processes of the value stream. Lean accounting system is one of the other processes that lean philosophy needed to be adopted. If managers can't see the effects of lean practices and can't have a proper decision support system, all the activities related with lean manufacturing could be misinterpreted. Besides that, lean accounting serves as a platform where lean initiatives can be encouraged in all processes of the value stream.

This thesis aims to apply lean accounting tools in a non-lean organization to encourage the initiatives related to lean. Since every company lives with its own truth, the new designed system will be prepared according to the needs of the organization. Route to design and implement lean accounting tools is presented in this thesis. In the end of this thesis, a flexible, effective and easy to interpret analysis form and decision support system is explained in detail.

The data is collected through interviews, current reports and job studies. The analysis is made according to lean tools and decisions are taken through meetings. The final state is accomplished with the approval of top management.

This thesis is done in a non-lean organization to prove the positive effects of applying lean accounting tools even if the organization is not applying lean production. It is expected to be valuable in both academy and industry, since there isn't any case like this thesis is founded in the literature.

CHAPTER.1.LEAN METHODOLOGY

Toyota's philosophies were molded by the personalities, ethics, and capabilities of its creators in the Toyoda family (Bicheno and Holweg, 2009). Ohno (1988) indicates that since the Toyota Production System was developed into broad management system, it is beyond a simple production system.

Although lean was initially introduced by Japanese automobile industry, it is more recently spread into other industries. Lean methodology is now being applied in service processes such as human resources, administration, and accounting processes.

Academics (Cocolicchio, 2008; Haskin, 2010; Koenigsaecker, 2005) are all agree that the most important goal of lean is to obtain organizational profitability provided from pioneer performance. In order to achieve that; organizations should internalize the principles of lean, discover the wastes within organization and systematically eliminate them. The basic concepts of lean is mentioned in this section.

1.1.Lean Principles

The Lean principles are developed based on scientific methods (Bicheno and Holweg, 2009). Lean simply means minimizing waste and maximizing the value. In order to achieve that, Womack and Jones (1996) identify 5 principles of lean manufacturing, which can be applied later with all the activities related to lean, which are:

- Value
- Value stream
- Flow
- Pull
- Perfection

Value is what customer exactly claim, along with the price they are willing to pay. Value is the base for lean philosophy, and the customer can be external or internal, but eventually the value should be determined according to end customer. Value should be described in terms of a specific good or service. Lean organizations define and calculate customer value continually and set indicators according to these measures.

Value stream is the sequence of activities that consist all necessary steps to yield a good or service, from supplier to customer. Value stream is simply a grouping of similar products / services in order to manage them more effectively. Types of activities in the value stream can be separated into three - value added, type one muda (stands for waste in Japanese) and type two muda:

- *Value-Added*: Activities which create value.
- *Type One Muda*: Activities which don't create value and can't be eliminated since it is obligatory.
- *Type Two Muda*: Activities which don't create value and can be eliminated through improvements.

Rather than calculating standard costs for product or service by adding direct and allocated indirect costs, lean organizations focus on the total cost and profitability of the value stream which they track directly in the shop floor.

Flow is the continually accomplishment of activities in the value stream so that a good or service move from supplier to customer without stoppages, rework or scrap. In lean organizations, value streams are organized to yield continuous flow between processes.

Pull is a system of running organization from downstream to upstream. In pull system, downstream customer indicate a need, then upstream supplier start the process accordingly. This prevent excess inventory that utilizes resources and increases risk. Lean organizations redesign their processes according to pull systems like Kanban to prevent unwanted values by customer.

Perfection is the removal of waste in all activities to ensure that value stream create value at maximum level. This principle implies that, the lean is a continuous process, which should be never abandoned. Lean organizations continuously analyze and improve the processes in the value stream to yield maximum efficiency and effectiveness (Womack and Jones, 1996: 306-311).

Traditional accounting aims to meet predetermined standards. In lean organizations, since in every level of the value stream strive to continuously improve processes to reach customer value, the accounting process aims to providing timely, valid and understandable information to all levels of the value stream.

1.2.Types of Waste

One of the most important targets of lean in any organization is to eliminate waste (Lewis, 2008). Waste within organizational processes can be separated in various ways, but the most common are (Chiarini, 2013:17):

- 3 MU
- 4 M
- Seven wastes

1.2.1.The 3 MU

Lean aims to balance the capacity and workload. Attaining optimum amount of sources to obtain accurate amount of final goods or services as at a time requested by customers, is the basic target of lean. The 3 MU stands for the three Japanese word which are: (Chiarini, 2013:18):

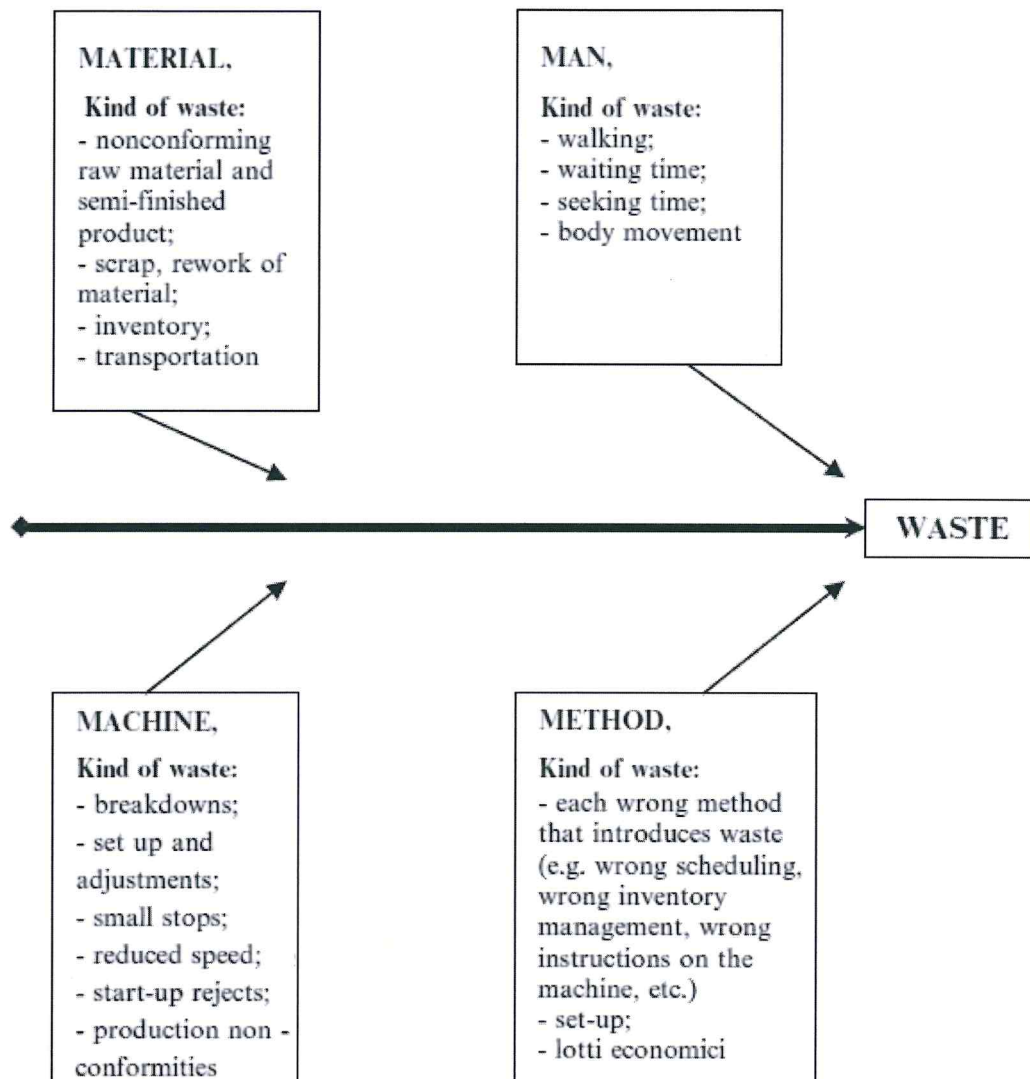
- Muda = workload is less than capacity.
- Mura = capacity is not steady, it swings around target.
- Muri = capacity is less than workload.

Since generally muda is the main waste in activities, it can be used to imply a waste in different situations.

1.2.2.The 4 M

In 4M, waste is separated according to root cause: Man, Material, Machine and Method of work. The 4M diagram can sometimes be diversified, it can be called 5M which “Mother nature” (weather conditions, earthquake etc.) is added as the fifth component. Figure 1 may be useful to understand the separation of waste in 4 M.

Figure 1. Lean Wastes and 4M



Source: Chiarini, A. (2013). *Lean Organization: from the Tools of the Toyota Production System to Lean Office*. New York: Springer. p.19

Scrap, rework of material, inventory and transportation are some examples of the material type waste. Walking, waiting and body movements of individuals are some of the possible root causes of the man type waste. The breakdowns of machines, set up and exchange of tools, slowed machine speed and scraps related with machine error are the common wastes under machine type waste. Wrong methods related with any process like wrong inventory management and wrong scheduling, should be evaluated in the methods type waste (Chiarini, 2013:18).

1.2.3. Seven Wastes

This separation help organizations to explore the root causes of waste by analyzing process. Camp (2013), Marksbury (2012), Singh et al. (2010), Samuel (2010), Hines et al. (2008) and Liker (2004) suggested seven types of waste which are related with lean thinking (Bhasin, 2015:3-5):

- a. Over-production
- b. Inventory
- c. Defects
- d. Waiting
- e. Transportation
- f. Motion
- g. Over processing

In addition to seven waste, some authorities add 8th waste to the seven wastes which is (Wincel and Kull, 2013):

- h. Not properly usage of abilities of team members

If an organization is providing goods or services more than customer order, it is called over-production. In that case, organization could be providing goods or services which will never be ordered. This waste is very risky since it can influence other wastes dramatically. It may increase inventory, defects, waiting, transportation, motion and in some cases over processing.

Inventory is the amount of parts needed to hold in stock to realize the goods or services to accomplish a customer order. When not being utilized by value stream, they occupy a worthy floor area and they may become defected while waiting in stock. Lean organizations improve their data management systems to take inventory under control so that the sources are not wasted on defected goods or services.

Defects are the parts being found to be under quality level of customers. In that case, the part should be reworked to assure quality conditions. If it can't be reworked, it will became scrap and should be disposed. Improperly designed manufacturing or service process may result in defects. Rework means to take extra processes to correct the defected part, which eventually increase the cost of a process, since it uses additional sources. On the other hand, scrap is worse, since the defect can't be corrected and only option is to dispose the part, hence all cost of disposed part will

increase the cost of a process. Both disposal and reworked of parts are costly processes which eventually has a great effect on organizational profitability.

Waiting in downstream process can be occurred according to waste in upstream process, and similarly, other processes in the downstream, since all activities are linked with each other in a value stream. If any of the resources delay the process (information, staff, materials, tools etc.), the waiting will occur and process cost will increase as related resources will be wasted.

Transportation of resources (information, staff, materials, parts etc.) result in wasted time and unnecessary usage of resources, if not requested by the customer. Wasted transportation increases the risk of defects, which may lead to loss of goods or services. In addition, to take movements under control, organizations should invest in data management system improvements, or attain more resources, which will increase the cost of the process.

Motion covers the movement of personnel in the working area and, if it is not requested by the customer, all movements are regarded as a waste in any process. Process and layout redesign and job analysis activities should be implemented to reduce unnecessary motion in any process.

Over processing is providing a good or service which is overqualified according to customer expectations. Mainly this happens if an organization is not properly analyze the customer value or some inefficiencies in providing goods or services.

Not efficiently benefit from the skills and abilities of staff, non-use of their ideas can lead to missed improvement and learning opportunities. Staff needs to be integrated to the value stream. Since the owners of each operation has the most knowledge of that process, they can find ideas to eliminate wastes in that process. This integration will contribute to develop processes and personnel consistently (Bhasin, 2015:3-5).

Traditionally seven wastes can be used in service processes; however, different set of division, suitable for the service processes can be more efficient. The ten types of waste for the service processes are as follows (Chiarini, 2013:143-145):

- a. *Processes not comply with the schedule*: Information is processed too fast or too slow and do not adjust with the program. Since the activities are not balanced, this waste can lead to increase in process length.
- b. *Waiting of personnel*: Waiting of personnel because of the wastes in the upstream process.
- c. *Slow processes*: Processes that performance level is below the pre-defined target.
- d. *Accumulation of information that requires processing*: WIP (Work in Process) which occurs when processes are not well sync in a value stream or the flow has decelerate or interrupt for some reason.
- e. *Defects*: Repeating of the process is needed when mistakes are made in the service process.
- f. *Customer complaints*: If any mistake reaches to the end user, it will be very costly since organizational image will be damaged.
- g. *Service exceeds the customer's requirements*: In lean, organizations must provide service to customers exactly what they want. If service is overqualified, generally it may not have benefits to organizations and in some cases, it may lead to troubles.
- h. *Duplications within process*: This is very common in the processes, where many activities are implemented more than one, or information is processed in more than one medium of information such as computer and paper.
- i. *Unnecessary personnel movements*: Members of value stream that move unnecessarily to complete customer order.
- j. *Unnecessary transport*: Movement of documents or customers to be able to implement a service.

1.3. Lean Tools for Service Processes to Eliminate Waste

Lean Methodology has a lot of tools that can be implemented. It is important to point out the tools that can be used in service processes. Kaizen, Kanban, 5S, Standardized Work, Balancing Process, Value Stream Mapping and Makigami are the common techniques for the implementation of service processes.

1.3.1.Kaizen

The Japanese word Kaizen is formed by the words Kai and Zen. The meaning of Kai is “making something apart from and analyzing critically”, and the meaning of Zen is “doing something good”. When they come up together and built the word Kaizen it gets the meaning "taking something apart from each other, analyzing them and making it brand new by putting it back together in a different way which will make it better. If we carry this meaning to organizations it becomes "analyzing every activity in a continuous way in order to get rid of the barriers that are preventing any improvement". "Lean Organization" gets its roots from "continuous improvement" implemented in all activities in the organization, with the intention of higher performance and better financial results. If the organizations need to see the road that must be taken, Kaizen will help them by showing it immediately (Chiarini, 2013:51). The actions are called as ‘Kaizen events’ if they are taken under Kaizen philosophy.

There are three main steps in a typical Kaizen Event. Everything starts with planning. A good plan will determine the rest, at all times. Consequently, listing and defining of processes is done in this very first step called planning. This listing and defining of processes are the things that must be improved in the organization. For that, assigning people that best suits for this improvement activity, is a must. These people must be determined to achieve the best results. Second step is coming together. This can be done by a seminar for Kaizen and brainstorming together to make improvements. Reporting is the final step of Kaizen. Work that has been done together so far, must be reported to the management of the organization and that must be continued since it was started from the Kaizen event (Tapping & Daan, 2006).

1.3.2.5S

"5S" is a good method to guarantee and sustain the order in the workplace and through the whole organization. These S's are the initials of the Japanese words: Seiri, Seiton, Seiso, Seiketsui and Shitsuke. These five words are: Sort, Set, Shine, Standardize, and Sustain, in English version. With the help of this strong tool, companies could improve the quality in their processes or production with a better security and higher safety and increased productivity. Moreover, the main principles of visual management and control will be introduced. Today, many companies have a good knowledge of possible sources of defects, WIP, spaces organized in a bad way

etc. while they are implementing 5S Method or after having done that. The indicators below, can be used to measure the benefits gained:

- Defects
- Amount of space gained
- Accidents and injuries
- Lead time / WIP
- Productivity

The meaning of "Seiri" is "to sort". Here, sorting is picking the activities that are useful in a process and taking apart them from the others which are not useful. This separating work is done subsequently. Eliminating those useless activities in the process naturally reduces waste related with the process.

The meaning of "Seiton" is "to set". Set means here, tidy up everything that is used in process comprehending unfinished goods, equipment and tools. By this way, staff will be able to find the necessary things for them to use, easier and quicker.

The meaning of "Seiso" is "to shine", which stands for keeping the area clean. The methods should be designed and tested to maintain the order in this stage.

The meaning of "Seiketsu" is "to standardize" which stands for preparing easily applicable standards for staff. Workplace must be preserved tidy and clean, in regard to the former steps those have to be repeated to sustain order.

The meaning of "Shitsuke" is "to sustain", which stands for sustaining first four S forever. During the implementation of these steps, a strong discipline is a must. 5S is a very convenient method while dealing with the deployment of continuous improvement, as it standardizes daily workplace management. Regular inspections should be carried out and results should be published in related area to encourage staff (Chiarini, 2013:82-88).

1.3.3. Standardized Work

Standardized work is more than a tool, it can be regarded as a working method. It consists of the description of all parameters related to process needed to accomplish the work properly.

The aim of standardized work is forming a guideline to accomplish a specific process with the light of best practices. The benefits of standardized work are decreased variability, prevented mistakes and easily trained staff. Since standardized work serve as a base for improvements, as improvements are made, documentation should regularly updated (Tapping & Dunn, 2006:120-210).

1.3.4.Kanban

Kanban is a tool to manage and evaluate the flow in the value stream visually. It can be piece of paper, electronic signal or anything to indicate processes' need in extra material or stoppage visually. It is a very useful tool to visualize workplace for the service processes. Visualization leads to increase the control of the process and prevent any wastes, such as waiting, before happening (Tapping & Dunn, 2006:120-210).

Kanban is a good tool to use to prevent from overproducing, while syncing to the takt-time (to satisfy customer order, the maximum amount of time that goods or services needs to be accomplished). Kanban indicates the type and amount of parts or information need to be used in each activity. Besides avoiding overproduction, properly application of Kanban system increases agility in responding variations of customer demand, increase ability in producing smaller lots, simplify information system and increase connection between all processes from supplier to customer (Chiarini, 2013:88-90).

1.3.5.Balancing the Process

To sync with takt-time, processes within value stream should be balanced. In unbalanced process, wastes such as waiting and overburden can be seen. This wastes should be avoided at all costs. The following steps can be used while balancing any process:

- a. The current state mapping can be formed by measuring the basic indicators and parameters. Simple flowcharts which shows the steps and basic information is enough.
- b. Graph can be formed to visualize the takt-time and cycle time comparison.
- c. The resources needed can be calculated.
- d. Future state mapping can be formed and the process can be redesigned by using lean improvement tools.

While balancing the process, to response variations in takt-time, staff should be capable of working in more than one activity. Job diversification may help to move staff between processes to response variations quickly. Staff must be trained in order to fulfill the needs of the redesigned process (Chiarini, 2013:97-99).

1.3.6.Value Stream Mapping

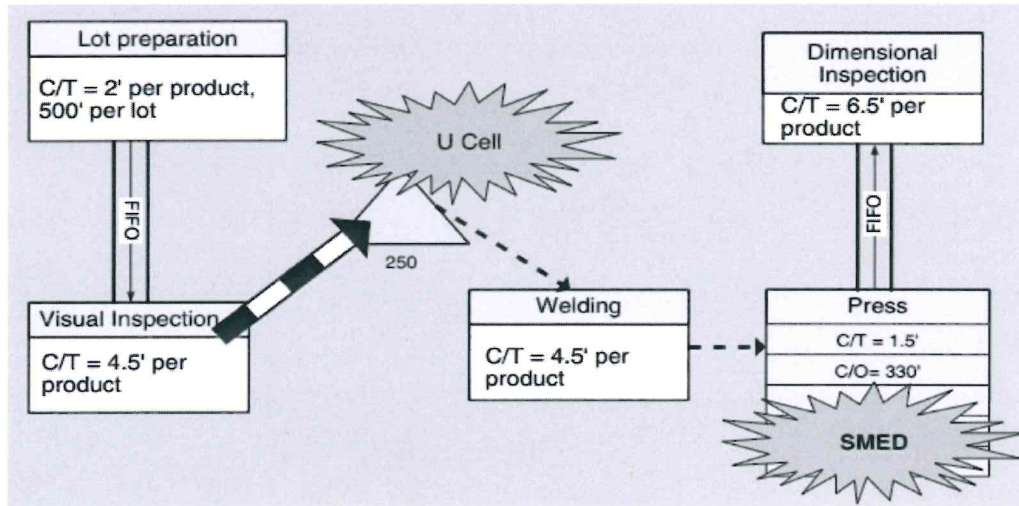
As people understand the wastes that may present in the organizations, they need a process visualization tool such as Value Stream Mapping (VSM) to make wastes visible. VSM may help to explore opportunities to waste elimination, decrease non value added activities, and smoothen flow. As people set their priorities according to strategic objectives, they make kaizen to eliminate wastes.

Lean generally applies the PDCA cycle to all its improvement processes. PDCA refers to Plan, Do, Check and Act. It is an infinite cycle which encourages the idea of continues improvement. The PDCA cycle of VSM is as follows (Chiarini, 2013:31-34).

- a. Plan
 - a.1. Define KPIs (Key Process Indicator) for VSM.
 - a.2. Explain the significance of lean to every personnel in Value Stream.
- b. Do
 - b.1. Assign a manager for value stream.
 - b.2. Form current state VSM.
 - b.3. Form future sate VSM.
- c. Check
 - c.1. Measure the KPI's after improvements are made.
 - c.2. Evaluate financial results.
- d. Act
 - d.1. Inform every staff about results.
 - d.2. Set new targets.
 - d.3. Form new value stream.

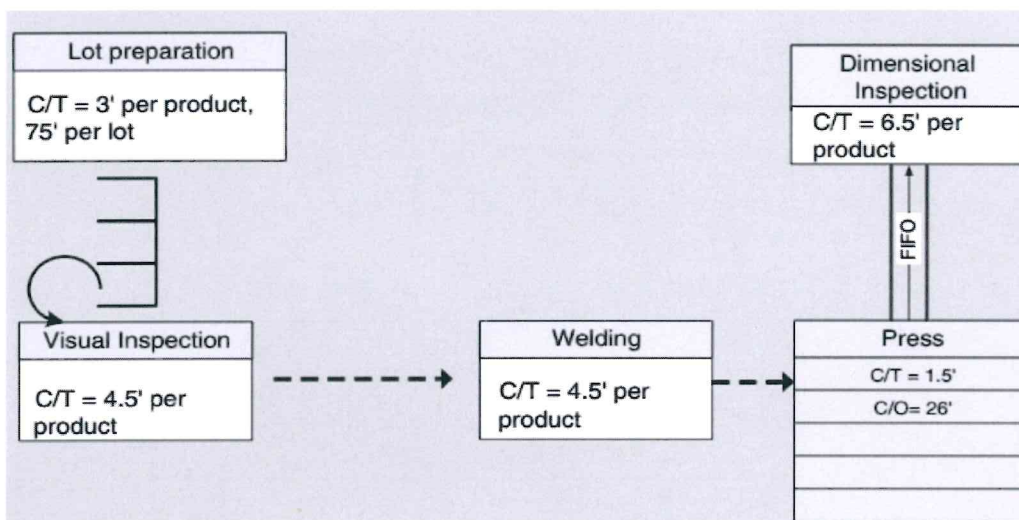
In Figure 2 and 3, examples of current state VSM and future state VSM is presented.

Figure 2. Current State VSM



Source: Chiarini, A. (2013). Lean Organization: from the Tools of the Toyota Production System to Lean Office. New York: Springer. p.132

Figure 3. Future State VSM



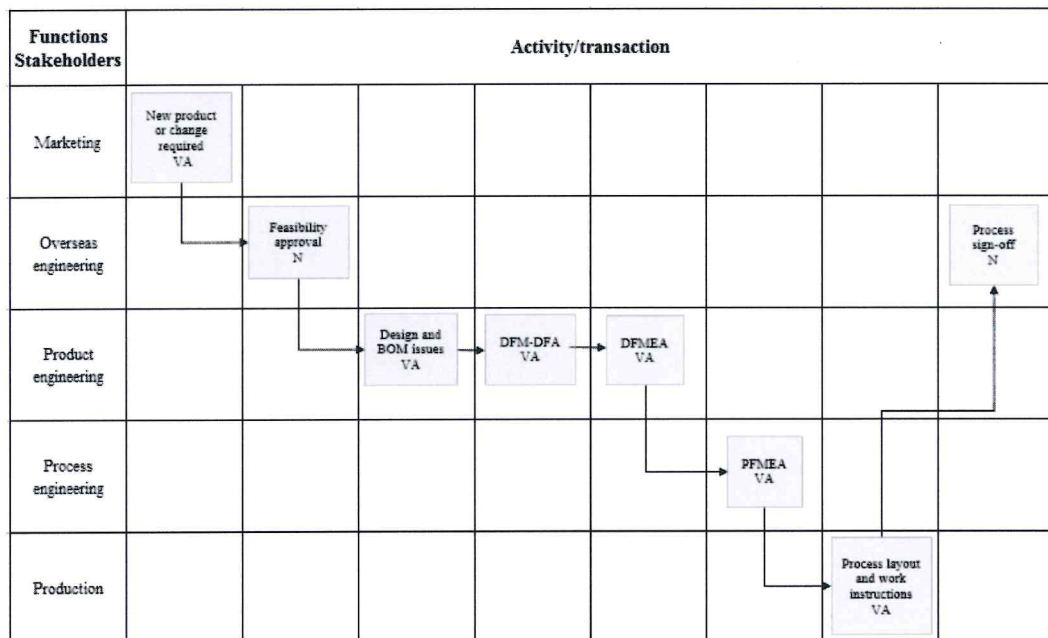
Source: Chiarini, A. (2013). Lean Organization: from the Tools of the Toyota Production System to Lean Office. New York: Springer. p.132

The processes in this example are lot preparation, visual inspection, welding, press and dimensional inspection. In current state VSM, the Changeover Time (C/O), Cycle Time (C/T), and lot amounts in each process are measured and the flow is visualized. Then in future state VSM, it is redesigned according to possible improvement opportunities like U cell and SMED (Single Minute Exchange of Die).

1.3.7.Makigami

Makigami is a useful tool that can define and eliminate waste in the service process. Makigami can be considered as another version of VSM which is designed for service processes. To start identification wastes, the first step is to visualize the process flow. Services must be mapped separately, because one single service can be extremely complicated. To describe suppliers, customers and customers' requests before process analysis, SIPOC (Suppliers-Inputs-Processes-Outputs-Customers) scheme can be used. SIPOC is a tool, can be beneficial with mapping the current state to reveal the output and input of any process. In Makigami, activities are mapped and labeled the as value added of not. Then future state is prepared, and improvements can be started to reach the future state. Same PDCA cycle as VSM can be useful. An example of Makigami is as follows (Chiarini, 2013:143-150):

Figure 4. Makigami



Source: Chiarini, A. (2013). Lean Organization: from the Tools of the Toyota Production System to Lean Office. New York: Springer. p.149

**The Figure is arranged to be appropriate for the purpose of the thesis*

The departments are in the first column, activities/ transactions are in other columns. The makigami diagram shows the activity movements between departments and indicate if it is non value added (N – or NVA) or value added (VA). This diagram should be redesigned according to process which is evaluated.

1.4.Accounting and Costing Systems in Lean

Traditional cost accounting has lots of critics in the cost management literature (Suri, 1998; Henderson and Larco, 1999; Algeo and Barkmayer, 2001; Cokins, 2001; Levinson and Rerick, 2002; Hyer and Wemmerlöv, 2002; Maskell and Baggaley, 2004; Maskell and Katko, 2007). Activity based costing is developed and has a high reputation in both in academy and industry, to come over the difficulties of traditional cost accounting (Kaplan and Cooper, 1988; Gosselin, 2007).

Lea and Min (2003), Compare the traditional accounting, target costing and activity based costing and find out that, activity based costing is better among three. In other words, they find out that resource based systems perform better than others. Cokins (1996) and Kaplan and Anderson (2007) show the problems of activity based costing and Kaplan and Anderson (2007) offered time driven activity based costing method.

Ahlström and Karlsson (1996) examine role of cost accounting in the lean transformation and find out that cost accounting directly affect the lean transformation of a company. Cunningham and Fuime (2003) and Maskell and Baggaley (2004) describe the lean accounting concept and principles.

Grasso (2007) examines the potential failure reasons of lean accounting applications. Kennedy and Widener (2008), examine the contribution of lean accounting practices to management in a lean production. Katko (2014) explains how lean companies should design a lean accounting system instead of traditional cost accounting system. He emphasizes the importance of the role of financial managers.

Basic concepts relevant to lean accounting and costing systems is mentioned in this section.

1.4.1.Lean Accounting

Lean accounting apply lean principles to accounting process and produce a required data to support lean initiatives. Maskell and Baggely (2006), determine the vision of lean accounting as follows:

- a. Increase customer value, profitability and growth, by providing understandable, correct and on time information to lean efforts.
- b. Eliminate waste from accounting processes by using lean tools.
- c. Comply with accounting principles and reporting requirements.

- d. Support lean culture and continuous improvement by motivating development of staff and ensuring information which is in related.

Maskell and Baggely (2006), identify 5 principles and describe the practices and tools under these principles. The 5 principles are:

- a. Lean and simple business accounting.
- b. Accounting processes that support the lean transformation.
- c. Clear and timely communication of information.
- d. Planning and budgeting from a lean perspective.
- e. Strengthen internal accounting controls.

Summarization of the principles, practices and tools of lean accounting can be seen in Table 1.

Table 1. The Principles, Practices and Tools of Lean Accounting

PRINCIPLES	PRACTICES	TOOLS OF LEAN ACCOUNTING
A. Lean & simple business accounting	1. Continuously eliminate waste from the transactions processes, reports, and other accounting methods	a. Value stream mapping; current & future state
		b. Kaizen (lean continuous improvement)
		c. PDCA problem solving
B. Accounting processes that support lean transformation	1. Management control & continuous improvement	a. Performance Measurement Linkage Chart; linking metrics for cell/process, value streams, plant & corporate reporting to the business strategy, target costs, and lean improvement
		b. Value stream performance boards containing break-through and continuous improvement projects
		c. Box scores showing value stream performance
	2. Cost management	a. Value stream costing
		b. Value stream income statements
	3. Customer & supplier value and cost management	a. Target costing

C. Clear & timely communication of information	1. Financial reporting	a. "Plain English" financial statements b. Simple, largely cash-based accounting
	2. Visual reporting of financial & non-financial performance measurements	a. Primary reporting using visual performance boards; division, plant, value stream, cell/process in production, product design, sales/marketing, administration, etc.
	3. Decision-making	a. Incremental costs & profitability analysis using value stream costing and box scores
D. Planning from a lean perspective	1. Planning & budgeting	a. Hoshin policy deployment b. Sales, operations, & financial planning (SOFP)
	2. Impact of lean improvement	a. Value stream cost and capacity analysis b. Current state & future state value stream maps
		c. Box scores showing operational, financial, and capacity changes from lean improvement. Plan for financial benefit from the lean changes
	3. Capital planning	a. Incremental impact of capital expenditure on value stream box-score. Often used with 3P approaches
4. Invest in people	a. Performance measurements tracking continuous improvement participation, employee satisfaction, & cross-training b. Profit sharing	
E. Strengthen internal accounting control	1. Internal control based on lean operational controls	a. Transaction elimination matrix b. Process maps showing controls and SOX risks
	2. Inventory valuation	a. Simple methods to value inventory without the requirement for perpetual inventory records and product costs can be used when the inventory is low and under visual control.

Source: Maskell, B. and B. Baggaley (2006). Lean accounting: What's it all about? Target Magazine, 22(1), 35-43. p.37

First principle can be seen as applying lean methods to accounting process. Many of the accounting activities have a type two muda, so they can be identified and removed. Kaizen, value stream mapping and PDCA (Plan-Do-Check-Act) are the common tools to identify and eliminate waste. As wastes are eliminated in accounting process, the accounting personnel can have more time to work on other lean accounting

improvements. When the waste elimination done continuously, accounting personnel will be more available for the big changes in the accounting process.

Second Principle is about aligning accounting with the lean transformation. According to this principle, lean accounting, driven by continuous improvement, concentrates on understanding and measuring the customer value and reflects performance of the overall value stream flow to mature and lean improvement.

Third principle is to provide easy-to-understand knowledge for everybody. According to this principle, the reports should be very simple and even the shop floor personnel should readily understand the content.

Fourth principle describe on the planning process of a lean organization. In lean organizations, planning process starts with the business strategy, which covers from 3 to 5 years. Then Hoshin Policy deployment is prepared to plan the activities of the coming year and finally SOFP (Sales, Operations, and Financial Planning) is prepared on monthly bases. The performance levels are evaluated on monthly based SOFP meeting which is sync with hoshin policy deployment and business strategy.

Fifth principle emphasizes that, accounting controls have always been important, and lean accounting enhances these controls. In lean accounting the improvements are applicable, which are not weaken financial or operational control.

1.4.2. Value Stream Accounting

Lean Accounting is a concept developed from ABC (Activity Based Costing) accounting practices in the 1990s. In Value Stream Accounting (VSA) since there are no overhead costs, all costs considered to be direct in a value stream. There aren't standard and indirect costs in lean accounting, since maximum efficiency in processes can be achieved by continuously improvement process time, customer order speed and order to cash rate. Standard costing is not useful, since it prevents the wastes to be identified.

In ABC accounting, the costs are not separated as direct and indirect, all costs are recognized as direct in the process. However, all processes are separated into activities and in all activities, a driver is identified and all costs related with all activities are added up to find the cost of a process. The correction of drivers is the main suspect in ABC accounting, which effect the cost of all activities.

In lean accounting, all direct costs in the value stream is added together and sum of them gives the cost of the value stream. All costs which are not in the value stream are not the subject of value stream costing. This simple calculation is the main difference between ABC and VSA. In order to implement VSA, the organization should transformed into a lean organization and more the organization became lean, VSA practices will be easier and more accurate as a result.

In order to prevent complex calculations similar to ABC, all cost elements (staff, machinery, supportive activities etc.) should be attained in only one value stream. Otherwise the cost elements should be separated into more than one value streams, with drivers, which increases the complications. To prevent inventory calculations, the stock should remain minimum and steady.

If an organizations stabilize its processes with lean applications, VSA becomes a clear and easily applied method. VSA is only appropriate for organizations which focus on value stream management. Otherwise cost allocations according to cost drivers should be used to divide the costs that can't be assigned directly to Value Stream (Chiarini, 2013:137-140).

1.4.3.Lean Performance Indicators

It is vital to have targets in each level of the organization that are related with strategic objectives. Setting lean performance indicators in all levels of organization will lead to not only a better evaluation of performance, but it will also motivate the philosophy and pattern of behavior, that an organization needs to earn at all levels. The followings are some of the most important benefits of implementing lean performance indicators (Chiarini, 2013:118):

- More aware of lean, especially about targets.
- Visually controlled management.
- Simply collection of data.
- Development of personnel in terms of data reading and analysis.
- More focus on continuous improvement.

In lean, key indicators should be available at any time, without having to wait reports for weeks. It should be updated daily or even better, hourly, to recognize and resolve problems related with process. While specifying the lean metrics, it is important to bear that in mind.

1.4.3.1. Commonly Used Lean Indicators

Lean indicators can be divided into three categories as strategic, value stream and cell indicators. Value stream can be defined as a set of activities from supplier to customer to complete goods or services, which includes flow of sources (materials, information etc.). This activities can be regarded as cells. If an organization has a more than one type of good or service, this means it has a more than one value stream. So each value stream can have different indicators since they have different cells inside them. Similarly each cell can have different indicators in the same value stream since each cell can be different than each other.

The important point is one cell can have different indicators than other cells but they all should be aligned with value stream indicators which they belong to. Similarly, the value stream can have different indicators than other value streams but they all should be aligned with organizations strategic indicators which they belong to. Strategic indicators are important for entire organization. So strategic indicators should considered to be important for every value stream and every cell for that organization. Some of these indicators are given as follows:

Strategic indicators:

- Turnover
- EBIT (Earnings Before Interest and Taxes)
- Average lead time
- Cost of poor quality/Turnover
- Safety
- Customer satisfaction
- Cash Flow
- Warehouse rotation
- Sales per person
- On-time delivery
- Sales growth

- EBITDA (Earnings Before Interest, Taxes, Depreciation, And Amortization)
- % people engaged in improvements

Value Stream indicators:

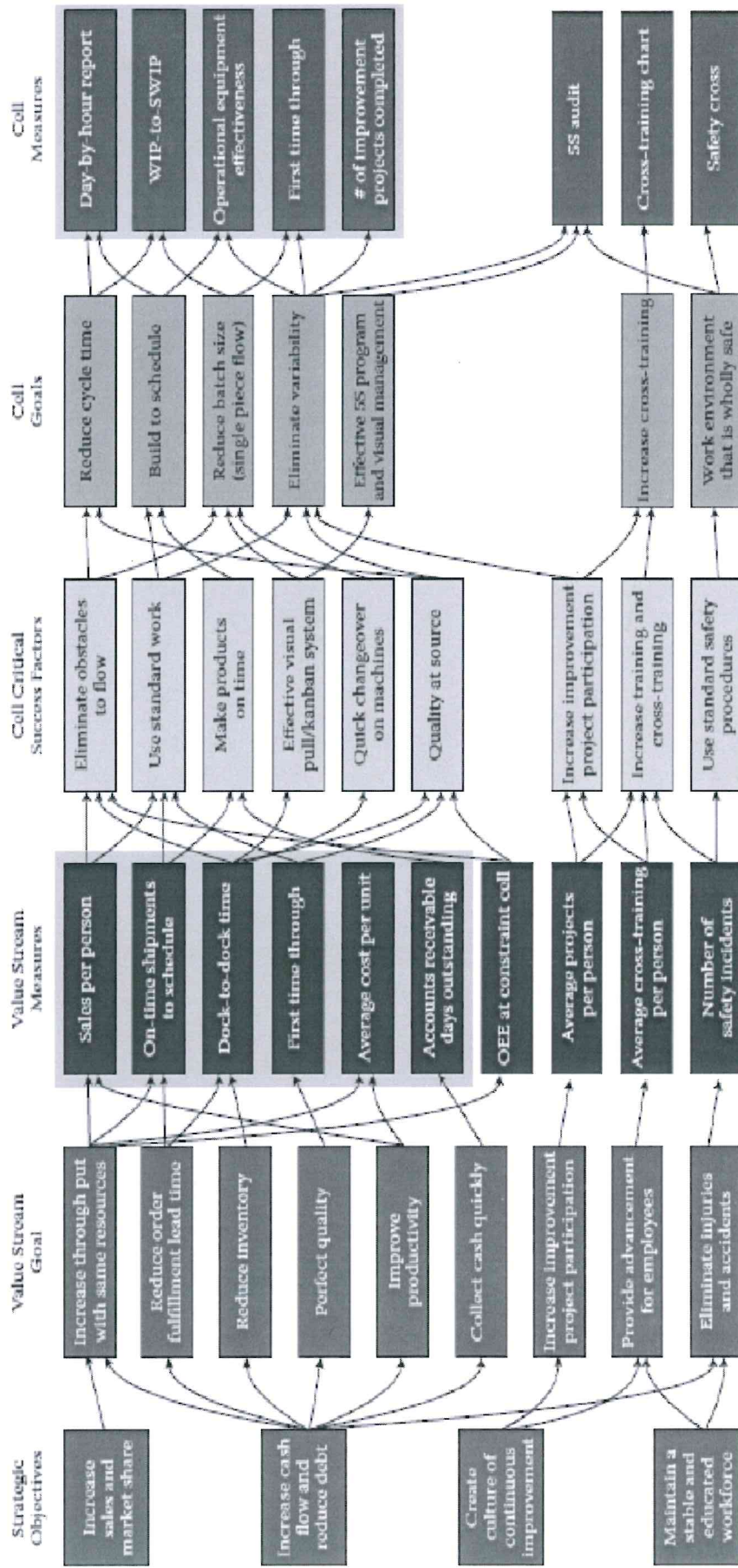
- Lead time/WIP
- Sales per person
- Reprocessing hours/Processing hours
- Waste ppm (parts per million)
- Supplier cost of poor quality/Supplier turnover
- Average cost per unit
- Process cycle efficiency
- OEE (Overall Equipment Effectiveness)
- Cost of warranty work
- On-time delivery
- On-time delivery supply code
- First time through (FTT)
- On-time delivery supply code
- Dock-to-dock time

Cell indicators:

- First time through
- Day-by-the hour production
- OEE
- WIP to SWIP (Standard Work-In-Process)
- Waste ppm

Figure 5 shows the linkage of the framework elements from strategic objectives to cell measures.

Figure 5. Linking the Elements from Strategic Objectives to Cell Measures



Source: Maskell, B., Baggaley, B. and L. Grasso (2011). Practical Lean Accounting: A Proven System for Measuring and Managing the Lean Enterprise (2nd Edition). New York: CRC Press. p.369

The important point is selecting indicators which can be track easily and linked with each other. Cell measurements should be linked with cell goals, cell goals to cell success factors, cell factors to value stream measurements and this link should be continue till our strategic objectives.

1.4.3.2. Lean Indicators for Service Processes

The indicators listed above are not the only indicators used by Lean organizations; in service processes, different indicators can be defined according to needs of the processes such as accounting, human resources etc.

When considering service processes' metrics, the most important indicators are PT (Process Time) and LT (Lead Time), which are shown below Makigami. PT is similar to CT (Cycle Time) in manufacturing processes, which measures the time a process is taken up. When we sum other time spent in the process with PT, we can calculate LT. Both PT and LT start at a time when information is available and finish when it is processed. To measure the rate of complete and accurate information, %C&A (%Complete and Accurate) can be used as another indicator. %C&A measures the ratio of mistakes within a process. Reduction of number of steps indicator is another useful metric designed for service processes, which simply measures the improvements related with job simplifications (Chiarini, 2013:150-153).

Similar to OEE, OOE (Overall Office Effectiveness) or OPE (Overall Professional Effectiveness) can be used in service processes. Since OEE is composed of three indicators, which are quality, availability and efficiency, it can be modified for service processes. %C&A can stand for quality, efficiency can be measured with PT and LT and availability can be measured by process stoppages or disruptions such as problems related with computers or unexpected meetings.

1.4.4. Box Score

The box score provides a structure to evaluate the operating and financial effects of Lean. The box score has two important purposes. The first is as a planning tool to judge the effectiveness of Lean from a business perspective. The second is to monitor how to progress toward achieving the plans. Table 2 presents the box score report without any data. Three categories of data listed down the left-hand margin. Operational, Resource Capacity, and Financial. Besides that, there are four columns to the right of the items measured (Maskell, Baggely and Grasso, 2011:63-70):

- a. Current State indicates the realized values of measured items up to date. This provides the base to compare improvements to be planned.
- b. Future State indicates the expected values of measured items if the planned initiatives are realized. The time horizon is usually six months or less.
- c. Change from the Current State shows the difference between the Current and Future States.
- d. Long-Term Future State indicates expected values of measured items of lean initiatives over the long term. Generally several scenarios are developed to evaluate and choose the most beneficial ones from a business perspective.

Table 2. Box Score Report

Lean Value Stream Box Score						
Value Stream:						
		Current State	Future State	Change	Long Term Future State	Change From Current Stage
Operational	Dock-to-dock days					
	First Time Through					
	On-time shipment					
	Floor space					
	Sales per person					
	Average cost per unit					
Resource Capacity	Productive					
	Nonproductive					
	Available					
	Inventory value					
Financial	Revenue					
	Material costs					
	Conversion costs					
	Value stream profit					

Source: Maskell, B., Baggaley, B. and L. Grasso (2011). Practical Lean Accounting: A Proven System for Measuring and Managing the Lean Enterprise (2nd Edition). New York: CRC Press. p.64

**The table is arranged to be appropriate for the purpose of the thesis.*

The aim is to maximize the benefits to the business from Lean. The Box score format can be changed according to needs of the value stream. The idea is to visualize the performance indicators of the value stream. In the following sections, the indicators of each category of box score is presented.

1.4.4.1. Operational Information in the Box Score

Operational indicators are the predefined measures to assure process under control. In table 3, starter set measurements of operational category is explained.

Table 3. Starter Set Measurements for Operational Information

Value Stream Performance Measurement	What Does It Measure?	Lean Principle
Sales per person	Productivity of the value stream expressed in terms of sales amount achieved per person Sales amount divided by the number of people in the value stream	Increase value created with the same, or fewer, resources
On-time shipment	The ability of the value stream to ship products to customers on the day (or time) required by the customer Percentage of sales order lines shipped on the right day	Bring all the processes within the value stream under control
Dock-to-dock time	The amount of inventory throughout the value stream expressed in days or hours of requirement The amount of inventory within the value stream divided by the rate of shipment of products	Increase the rate of material flow through the value stream
First Time Through (FTT)	The ability of the value stream to make the product and perform the service perfectly every time The product of the FTTs calculated at each step in the value stream process	Make to standardized work every time throughout the value stream processes
Average product cost	Total value stream cost divided by the number of products shipped to customers	Continuously reduce the amount of resources required to make and sell the products
Accounts receivable days outstanding	The amount of money owed by customers expressed in days of shipments Total amount of money owed by customers for products shipped from the value stream divided by the average shipment sales value	Increase the rate of cash flow through the value stream

Source: Maskell, B., Baggaley, B. and L. Grasso (2011). Practical Lean Accounting: A Proven System for Measuring and Managing the Lean Enterprise (2nd Edition). New York: CRC Press. p.171

Dock-to-Dock Days is the amount of time from material receipt to shipment of the product to the customer. It can be found by dividing the sum of inventories by the average rate at which the finished goods are manufactured in that value stream in products per day.

First Time Through measures the quality level. It is measured by the ratio of goods or services that proceed within the value stream without being defected. It is often called First Pass Yield. Because it is measured for all value stream, it is the output of the measure at each evaluation point in the entire value stream.

On-Time Shipment is measured by the rate of the right goods have been transported on the right date and in the right order. It is calculated as the percentage of the scheduled customer order quantity actually shipped on schedule.

Floor Space is the space the value stream takes up, including the production field and the field dedicated to inventories.

Sales per Person is a measure of both the productivity and value created. It can be found by dividing the revenue, by the average number of personnel, in the value stream during the period.

Average Cost per Unit can be found by dividing the total value stream costs, by the amount of finished goods transported during the period. Costs included are all production labor, production support, operations support, energy, facilities and maintenance, production materials, and other costs consumed by the value stream.

It is significant to know that the costs included are not only those incurred by the “touch” manufacturing departments, but also the employee costs incurred in supporting production, which would normally call indirect costs.

Accounts Receivable Days Outstanding can be used as an alternative measurement. This measures the speed in which cash is received from the customers. It divides the Accounts Receivable balance by the average daily sales amount.

1.4.4.2.Resource Information in the Box Score

Three indicators related with capacity usage is used in measuring the resources in terms of available people and machines, to realize value stream targets (Maskell, Baggely and Grasso, 2011:79).

- a. **Productive:** Labor or machine time spent on manufacturing the product.
- b. **Nonproductive:** All other uses of time, for example, nonvalue adding time spent on changeovers, rework, movement, inspection, maintenance, waiting, etc. Lean companies conduct improvements projects to reduce nonproductive rate.
- c. **Available:** Machine and labor time left over after subtraction of productive and nonproductive time. This gives simply the empty capacity of the value stream. Organizations may receive new orders to utilize this available time.

1.4.4.3.Financial Information in the Box Score

Five indicators form the financial data to be included in the box score. These are the indicators that are most often the concern of both financial affairs and the top level management of the company.

Inventory value is the end-of-period cost of inventory in the value stream, using the amounts in the books of the company.

Revenue is the invoiced amounts for shipment of goods from the value stream during the period, as recorded in the company's books.

Material cost is the amount the company spent for production materials during the period. In lean company in which inventories are level and low, this amount is equal to the material cost included in cost of sales for the period. This is because materials are purchased and deplete in production for products sold during the same period.

Conversion costs contain expenses incurred in the value stream during the period. To calculate conversion cost for the box score, the use of the total costs for the period will eliminate the effects of changing inventory levels on the conversion costs for the period.

Value stream profits are the difference between revenues and costs of sales (Maskell, Baggely and Grasso, 2011:67-69). It is the bottom line indicator in managerial reports, which is the resulting success factor for lean initiatives.

1.4.5. Value Stream Income Statement

Value Stream income statement yields value stream members to understand the operations in value stream in a better way. There is no complicated calculations in value stream income statement and every important knowledge is grouped as managers may need. In Table 4 and Table 5, the typical format of standard costing-based income statement and value stream income statement can be found. Costs and revenues can be grouped for intend of use.

Table 4. Standard Costing-Based Income Statement

Standard Costing - Based Income Statement			
	Total Revenue		
	Standard Cost Of Goods Sold		
	Standard Margin		
	<u>Adjustments (Favorable) Unfavorable</u>		
	Purchase Price Variance		
	Materials Usage Variance		
	Labor Variance		
	Overhead Absorption		
	Total Adjustments		
	Selling, General and Administrative Expenses		
	Income Before Taxes		

Source: Katko, N. (2014). The Lean CFO: Architect of the Lean Management System. New York: CRC Press. p.70

**The table is arranged to be appropriate for the purpose of the thesis.*

The standard costing based income statement shows Cost of Goods Sold at standard based on the products shipped in the period. The standard costing based income statement is very useful for financial reporting but insufficient for operating analysis.

Table 5. Value Stream Income Statement

Value Stream Income Statement	A Value Stream	B Value Stream	C Value Stream	D Value Stream	E Value Stream	TOTAL
REVENUE						

Materials						
Direct Labor						
Support Labor						
Machines						
Outside Process						
Facilities						
Other Costs						
TOTAL COST						

VALUE STREAM PROFIT						
Return on Sales						

Opening Inventory	
Closing Inventory	
Inventory Adjustment	

NET PROFIT	
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Source: Katko, N. (2014). *The Lean CFO: Architect of the Lean Management System*. New York: CRC Press. p.70

**The table is arranged to be appropriate for the purpose of the thesis.*

In lean income statement, the top and bottom line is the same as traditional model. The difference can be seen in the middle lines. Presentation of costs is different than traditional model. In lean, the costs assigned directly to value stream as much as possible, rather than allocating to cost objects. The value stream income statement provides clearer and more understandable information to make business decisions since it separates value stream profit from financial adjustments.

Root causes of spending decisions can be identified and the necessary decisions can be taken to reduce spending over time, since the Value Stream Income Statement is based on actual spending (Katko, 2014:68-70).

CHAPTER.2.IMPLEMENTATION

In this section, the lean practices applied in a non-lean company accounting department is described. The company name and the numbers are changed due to insuring anonymity. The company is named as “ABC Company”.

In the first part of this section, the analysis tool of lean for service processes (Makigami) is revised and adopted according to the needs. The processes are analyzed and improvements are made according to PDCA cycle method.

In the second part of this section, value stream income statement and the box score are revised and adopted according to the needs and proper decision support system is formed.

2.1.Lean for Accounting Operations

Lean has many useful tools for any kind of a process to make improvements. When taking accounting operations as a process, first step should be separating them to map one by one, since there are lots of sub-processes under accounting. The best way to start is to form SIPOC scheme to evaluate input and output of a complex process. After understanding the relations from supplier to customer, it is easier to separate sub processes regarding to their flow. After creating SIPOC scheme, gathering customer requirements and setting goals regarding customer expectations is done.

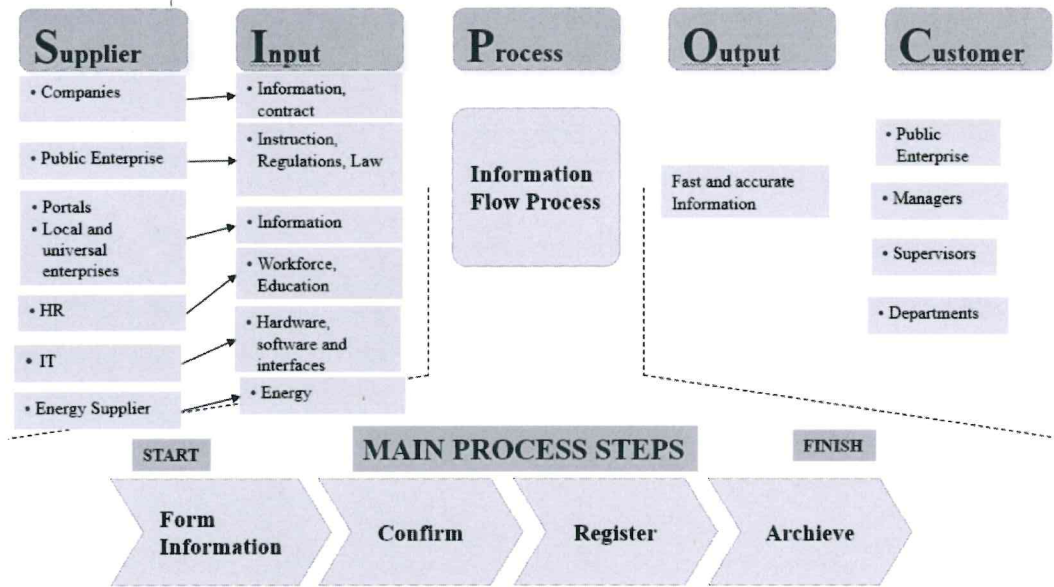
As a second step, each sub process is mapped in a simple flow diagram to show the general flow of all operations. It is vital to bear in mind that, if the flow is a bit different, it has to be examined separately as a sub group.

As a third step, each sub process can be mapped in detail. For service processes, makigami diagram can be used. In this stage process definition and analysis can be done and improvements to reach predefined indicator can be started.

2.1.1.Setting Indicators

In this section, information flow process in accounting process is examined. From supplier to customer, SIPOC scheme is formed in Figure 6. To form SIPOC scheme, brainstorming method is used with accounting employees to determine the supplier, input, customer and main process steps of the process and interviews are made with customers to determine the output, which is the customer value.

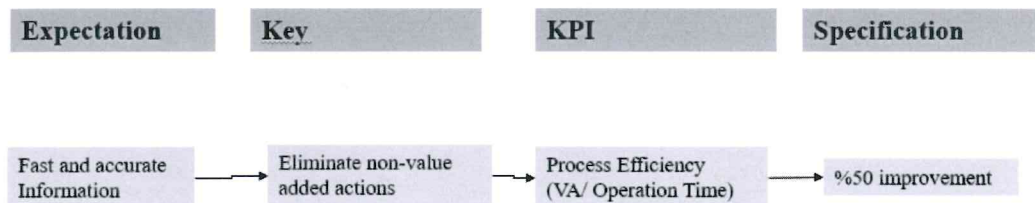
Figure 6. SIPOC Scheme of Information Flow Process in Accounting



The information flow process take information and contract as input from companies supplier, instruction, regulations and law as input from public enterprise supplier, information as input from portals, local and universal enterprises supplier, workforce and education as input from human resources (HR) supplier, hardware, software and interfaces as input from information technology (IT) supplier and energy as input from energy supplier.

The customers of information flow process are determined as public enterprise, managers, supervisors and departments. Customer value is defined as fast and accurate information, which is the output of the process. Main process steps are defined as form information, confirm, register and archive. Finally expectation of the customer is transformed to specification as can be seen in Figure 7.

Figure 7. Transforming Customer Expectation into KPI



To reach the fast and accurate information, elimination of non-value added actions is determined as a key. To measure the performance of elimination of non-value added actions, Process Efficiency (Value Added Time / Operation Time) is determined as KPI .The specification has been declared as improvement of process efficiency by 50%.

2.1.2. Forming Flow of Accounting Information Flow Process

After main process steps in SIPOC scheme is determined, detailed version of main processes, to see how many different value streams available under this process, started to be formed. Data is gathered from the employees who are the members of process and simple flow diagram to show the general flow of all operations is formed as can be seen in Figure 8 and Figure 9.

Figure 8. Information Flow of Purchased Goods and Services

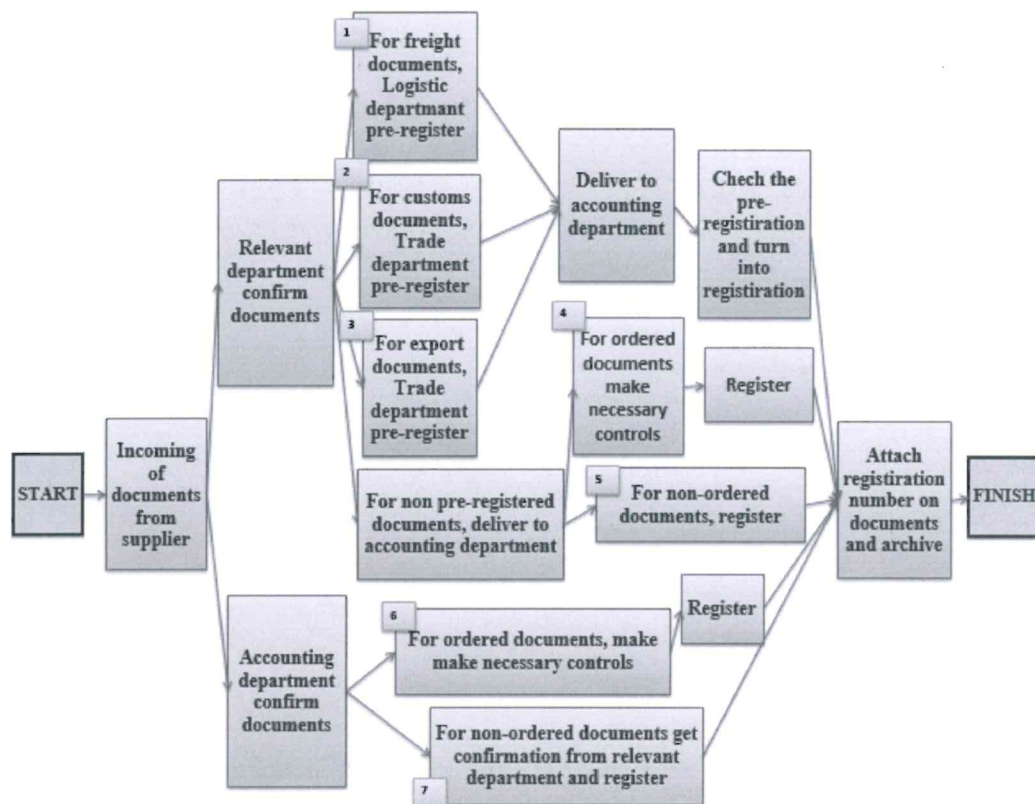
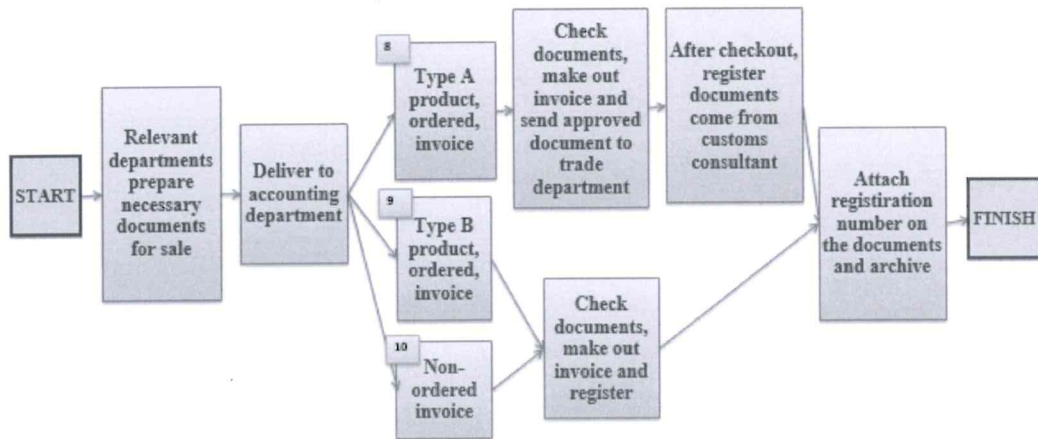


Figure 9. Information Flow of Sold Product



Two main groups are created as purchase of good & services information flow and sale of product information flow as they are very different from each other. In the end, 10 different value streams are determined which means 10 different makigami diagram should be made to analyze these 10 sub value streams.

2.1.3.Detailed Analysis of Processes by Revised Makigami

2.1.3.1.Forming Revised Makigami Form

Since every company lives with its own truth, the tools should be designed regarded their characteristic style of work. In this section, original makigami diagram is revised due to needs of the process. The empty revised makigami form after revisions can be seen in Table 6.

Table 6. Empty Revised Makigami Form

Division A	Division B		Division C	Division D	Medium of Information	Activity Time	Time Unit	VA Time	NVA Time	Stock	Waiting Time	Total Time	Explanation / Waste / Opportunity	Earnings
	Person A	Person B												

In this form, the flow is designed to be top-down. “Person” sub column is added to be able to analyze the workload of persons. “Medium of Information” is very important to define how each operation is made. “Activity Time” is separated into value added (VA) and non-value added (NVA) time to define each operations efficiency. Stock is also very important to see the inventory between steps. At the end “Total Time” which is calculated simply by summing activity time and waiting time. In the “Explanation / Waste / Opportunity” column, notes are taken and potential earnings are calculated in “Earnings” column. The operations are defined in boxes and there are 3 different colors regarding the value of that operation. If the operation is value added it is green, if the operation is non value added but obligatory, it is yellow, if it is non value added but obligatory, then it is red.

2.1.3.2.Filling Revised Makigami Form

This revised form is filled for 10 sub value streams but only one is explained in this thesis. In Figure 10, the filled form of hurdle sales process can be seen.

Figure 10. Hurdle Sales Process Revised Makigami Form

Environment	Ware - house	Accounting		Foreign Trade	Customs Consultant	Medium of Information	Activity Time	Time Unit	VA Time	NVA Time	Stock	Waiting Time	Total Time	Explanation / Waste / Opportunity	Earnings
		Person A	Person B	Person C			19,25		7,75	11,5		45	64,25		
Create sales order scan and send weighbridge receipt						*Document *Scanner *E-Mail *ERP									
	Form & send letter of carriage					*Document									
	Print weighbridge receipt and letter of carriage					*E-mail *Printer *Document	3,5	min/ invoice		3,5	3		3,5	Instead of printing, what if we keep it on server?	3000 copies per year + 25 manhour earnings
	Form and print out the invoice					*ERP *Printer *Document	4,75	min/ invoice	4,75		3	1	5,75		
						*E-mail *Document	1,5	min/ invoice		1,5	3	23	24,5	How we prevent control?	
						*Document	0,5	min/ invoice	0,5		3	15	15,5	Must be signed	

Environment	Ware - house	Accounting		Foreign Trade	Customs Consultant	Medium of Information	Activity Time	Time Unit	VA Time	NVA Time	Stock	Waiting Time	Total Time	Explanation / Waste / Opportunity	Earnings
		Person A	Person B	Person C											
		Print out the copy of signed invoice				*Printer *Document	1,5	min/ invoice	7,75	11,5		45	64,25		
		Scan the invoice and send e-mail. Send the invoice with wet signature to Foreign Trade				*Document *Scanner *E-mail	1,75	min/ invoice		1,75	3	3	4,75		
		Attach the copy of signed invoice, weighbridge receipt and letter of carriage and deliver to person C					1,25	min/ invoice		1,25	3	1	2,25	What if we remove this operation?	25 manhour
						*Document									
						Send invoice to customs consultant									

Environment	Ware-house	Accounting			Foreign Trade	Customs Consultant	Medium of Information	Activity Time	Time Unit	VA Time	NVA Time	Stock	Waiting Time	Total Time	Explanation / Waste / Opportunity	Earnings
		Person A	Person B	Person C												
					Send the customs documents and invoice copy to accounting. Keep the original documents	*Document	19.25		7.75	11.5		45	64.25	Is wet signature obligatory?		
				Match the documents and destroy the excess invoice copy		*Document	2	min/ invoies		2		6.5	2			
				Create a record of invoice		*Document *ERP	1.5	min/ invoies		1.5		6.5	1.5			
				Archive customs documents, invoice copy, weighforlit-ge receipt and latter of carriage		*Document	1	min/ invoies		1		6.5	1	What if only customs documents and invoice copy is archived?	25 min/hour	

The form is filled with persons who are the owner of each operation. Since it is a discrete process, it is hard to make observations to take measurements. To be able to collect time and stock data, measurement form is designed (Table 7).

Table 7. Empty Measurement Form

Responsible	Activity	Stock	Activity Time	VA	Waiting	Notes

The measurement form is attached to each document and flowed with relevant document. In each operation, data is measured and written down to form by the owner of each operation. The empty measurement form of hurdle sales process can be seen in Table 8.

Table 8. Hurdle Sales Process Empty Measurement Form

Responsible	Activity	Stock	Activity Time	VA	Waiting	Notes
Environment	Create sales order scan and send weighbridge receipt					
Warehouse	Form & send latter of carriage					
Person A	Print weighbridge receipt and latter of carriage					
Person A	Form and print out the invoice					
Person C	Check unit price					
Person B	Sign the invoice					
Person A	Print out the copy of signed invoice					
Person A	Scan the invoice and send an e-mail. Send the invoice with wet signature to Foreign Trade					
Person A	Attach the copy of signed invoice, weightbridge receipt and latter of carriage and deliver to person C					
Foreign Trade	Send the invoice to customs consultant					
Customs Consultant	Send the customs documents and invoice copy to accounting. Keep the original documents					
Person C	Match the documents and destroy the excess invoice copy					
Person C	Create a record of invoice					
Person C	Archive customs documents, invoice copy, weightbridge receipt and latter of carriage					

End of the process, the measurement forms are collected and by taking average of all measurement forms, the time and stock information are calculated. The fulfilled version of measurement form of hurdle sales process can be seen in Table 9.

Table 9. Hurdle Sales Process Measurement Form - Before

Responsible	Activity	Stock	Before Act Time	VA	Waiting	Notes
Environment	Create sales order scan and send weighbridge					
Warehouse	Form & send latter of carriage					
Person A	Print weighbridge receipt and latter of carriage	3	00:03:30			Keep document as pdf at server
Person A	Form and print out the invoice	3	00:04:45	X	00:01	
Person C	Check unit price	3	00:01:26		00:23	
Person B	Sign the invoice	3	00:00:30	X	00:15	
Person A	Print out the copy of signed invoice	3	00:01:30		00:02	Keep document as pdf at server
Person A	Scan the invoice and send an e-mail. Send the invoice with wet signature to Foreign Trade	3	00:01:45		00:03	
Person A	Attach the copy of signed invoice, weighbridge receipt and latter of carriage and deliver to person c	3	00:01:15		00:01	Remove the operation
Foreign Trade	Send the invoice to customs consultant					
Customs Consultant	Send the customs documents and invoice copy to accounting. Keep the original documents					
Person C	Match the documents and destroy the excess invoice copy	6,5	00:02:00		07:10	Match easily, there is no excess document
Person C	Create a record of invoice	6,5	00:01:30	X	00:24	
Person C	Archive customs documents, invoice copy, weighbridge receipt and latter of carriage	6,5	00:01:00	X	00:03	Archive only customs documents and invoice copy

As the form is fulfilled, the stock, act time and waiting time is measured. In the notes column, observations related to each activity is written. These notes from responsible are main source for improvements. The main improvements opportunities are noted as keeping documents as pdf at server of company, removing operations and archiving less documents. The process indicators are calculated related to this information can be seen in Table 10.

Table 10. Hurdle Sales Process Indicators - Before

Activity Time	19,25	min
VA Time	7,75	min
Waiting	2259	min
PLT	38	hour
PCE	0,34%	
PE	40%	

Activity Time is calculated as 19,25 min and VA (Value Added Time) is 7,75 min. Since it is a discrete process, Waiting is 2259 min. Process Lead Time is calculated as 38 hour (Activity Time + Waiting). PCE (Process Cycle Efficiency) is calculated as 0,34% (VA/ PCE). Finally our main KPI – PE (Process Efficiency) is calculated as 40% (Value Added Time / Activity Time).

2.1.4. Implementing Improvements

After mapping process flow by revised makigami diagram, the form itself tell about the potential improvement points. During analyzing the process, most of the non-value added action determined to be occurred in printing and scanning documents. To avoid that, managing documents on server of ABC Company seem a better method to take into consideration. Managing documents on server leads to reduce scanning and printing work as well as removing unnecessary activities related to documents like matching and achieving. The suggestion is analyzed and seem reasonable. After improvement is made, to measure earnings, the measurement form is flowed between operations again. The measurement form can be seen in Table 11.

Table 11. Hurdle Sales Process Measurement Form - After

Responsible	Activity	Stock	After Act Time	VA	Wait- ing	Notes	Paper Earning	Time Earning	Manhour Earning
Environment	Create sales order scan and send weighbridge receipt								
Warehouse	Form & send latter of carriage								
Person A	Print weighbridge receipt and latter of carriage	3	00:00:30			Keep document as pdf at server	3000	00:03:00	75
Person A	Form and print out the invoice	3	00:04:45	X	00:01				
Person C	Check unit price	3	00:01:26		00:23				
Person B	Sign the invoice	3	00:00:30	X	00:15				
Person A	Print out the copy of signed invoice	3			00:02	Keep document as pdf at server	1500	00:01:30	37,5
Person A	Scan the invoice and send an e-mail. Send the invoice with wet signature to Foreign Trade	3	00:01:45		00:03				
Person A	Attach the copy of signed invoice, weighbridge receipt and latter of carriage and deliver to person c	3				Remove the operation		00:01:15	31,25
Foreign Trade	Send the invoice to customs consultant								
Customs Consultant	Send the customs documents and invoice copy to accounting. Keep the original documents								
Person C	Match the documents and destroy the excess invoice copy	6,5	00:01:00		07:10	Match easily, there is no excess		00:01:00	25
Person C	Create a record of invoice	6,5	00:01:30	X	00:24				
Person C	Archive customs documents, invoice copy, weighbridge receipt and latter of carriage	6,5	00:00:30	X	00:03	Archive only customs documents and invoice copy		00:00:30	12,5

As a result, just by managing documents from server, more than 180 man-hour is saved per year. Besides that, 4.500 copy of paper is earned due to reduced printing activity. The process indicators after improvements can be seen in Table 12.

Table 12. Hurdle Sales Process Indicators – After

Activity Time	12	min
VA Time	7,25	min
Waiting	2259	min
PLT	38	hour
PCE	0,32%	
PE	60%	

As some non-value added activities are eliminated, the activity time is reduced to 12 minutes. The comparison of before and after situation can be seen in Table 13.

Table 13. Hurdle Sales Process – Before & After

Responsible	Activity	Before		After		Earnings		
		Before Act Time	After Act Time	Notes	Paper Earning	Time Earning	Manhour Earning	
Environment	Create sales order scan and send weighbridge receipt							
Warehouse	Form & send latter of carriage							
Person A	Print weighbridge receipt and latter of carriage	00:03:30	00:00:30	Keep document as pdf at server	3000	00:03:00	75	
Person A	Form and print out the invoice	00:04:45	00:04:45					
Person C	Check unit price	00:01:26	00:01:26					
Person B	Sign the invoice	00:00:30	00:00:30					
Person A	Print out the copy of signed invoice	00:01:30		Keep document as pdf at server	1500	00:01:30	37,5	
Person A	Scan the invoice and send an e-mail. Send the invoice with wet signature to Foreign Trade	00:01:45	00:01:45					
Person A	Attach the copy of signed invoice, weighbridge receipt and latter of carriage and deliver to person c	00:01:15		Remove the operation		00:01:15	31,25	
Foreign Trade	Send the invoice to customs consultant							
Customs Consultant	Send the customs documents and invoice copy to accounting. Keep the original documents							
Person C	Match the documents and destroy the excess invoice copy	00:02:00	00:01:00	Match easily, there is no excess document		00:01:00	25	
Person C	Create a record of invoice	00:01:30	00:01:30					
Person C	Archive customs documents, invoice copy, weighbridge receipt and latter of carriage	00:01:00	00:00:30	Archive only customs documents and invoice copy		00:00:30	12,5	
	Activity Time	19,25	12					
	VA Time	7,75	7,25	Total Earning	4500		181,25	
	VA/Opr	40%	60%					

As a result the target is reached and the process efficiency is improved from 40% to 60%. 4.500 copy of paper and 181,25 man-hour is earned.

2.1.5.Results

Similar method is used to all 10 sub value streams. As a result 50% improvement is reached in all processes and in total 2.200 man-hour / year earning is achieved. More importantly the motivation and qualification of operation owners are increased. They gained 20% of their time and since they realize the big picture from supplier to customer of their operations, they gained a competence of a new way to see their operations in the road of perfection.

2.2. Lean for Managerial Accounting

The top-managers are eager to attain effective information. In traditional managerial reports, especially in production companies, managers can't see the production effect on performance properly. Since lean is a production based approach, its indicators and method to serve data are more informative for managers. In this section, the traditional reports are transformed and managerial accounting tools of lean are used to provide appropriate managerial report. Value stream income statement is prepared in order to track managers to see the effect of different cost groups and the defined indicators are provided in the box scores to oversee general performance of the organization.

Since the company is a non-lean manufacturing company, it is impossible to prepare income statement of box score for each different value stream. To be able to do that, both the income and cost information must be directly assigned to each value stream. In this work the company is accepted as a one value stream and reports are redesigned according to that.

2.2.1. Value Stream Income Statement

ABC Company has a traditional income statement which basically gives an information of revenue, cost of goods sold, financial costs and profit. The report is prepared monthly, however, managers can't interpret the report effectively since they can't see the detailed information they need. In lean, since the customer satisfaction is the most vital figure, first the project group collect expectations of managers with interviews. Then the lean value stream income statement is formed according to expectations.

2.2.1.1. Forming Value Stream Income Statement

As a first stage, the customer value is defined with interviews. Expectation of managers is to have an income statement, in which they can see the cost elements they follow and to understand them easily. Then project group listed out the cost elements they need. Then cost elements are separated according to their behavior of being fixed or variable and together they are assigned into cost groups. In that case, managers can see both the groups and under that, cost elements with fixed or variable detail when they need. In Table 14 and Table 15 lean income statement and expanded lean income statement can be found. The numbers are changed due to secrecy policy.

Table 14. Lean Income Statement

Lean Income Statement						
Value Stream Income Statement	Last Year		Budget		Present	
	Unit	%	Unit	%	Unit	%
Sales	100.000	119,0%	110.000	119,7%	112.000	119,4%
Sales Return & Allowance	1.000	1,2%	1.100	1,2%	1.200	1,3%
Variable Transportation Costs	15.000	17,9%	17.000	18,5%	17.000	18,1%
Net Sales	84.000	100,0%	91.900	100,0%	93.800	100,0%
Material Related Costs	23.300	27,7%	24.271	26,4%	25.519	27,2%
Employee Related Costs	35.450	42,2%	36.927	40,2%	38.826	41,4%
Equipment Related Costs	14.992	17,8%	15.617	17,0%	16.420	17,5%
Outside Process	1.585	1,9%	1.651	1,8%	1.736	1,9%
Other Costs	1.899	2,3%	1.978	2,2%	2.080	2,2%
Inventory Change	33	0,0%	34	0,0%	36	0,0%
Value Stream Profit	6.741	8,0%	11.422	12,4%	9.183	9,8%
Financial & Other Income and Costs	256	0,3%	267	0,3%	280	0,3%
Profit	6.485	7,7%	11.155	12,1%	8.903	9,5%

The lean income statement is used to evaluate performance by comparing present with last year and this year's budget. The main cost groups are variable transportation costs, material related costs, employee related costs, equipment related costs, outside process, other costs and inventory change. To analyze these cost groups, expanded version of lean income statement can be used.

Table 15. Lean Income Statement – Expanded

Lean Income Statement						
Value Stream Income Statement	Last Year		Budget		Present	
	Unit	%	Unit	%	Unit	%
Sales	100.000	119,0%	110.000	119,7%	112.000	119,4%
Sales Return & Allowance	1.000	1,2%	1.100	1,2%	1.200	1,3%
Variable Transportation Costs	15.000	17,9%	17.000	18,5%	17.000	18,1%
V - Shipping Costs	12.000	14,3%	13.000	14,1%	12.500	13,3%
V - Foreign Storage Cost	3.000	3,6%	4.000	4,4%	4.500	4,8%
Net Sales	84.000	100,0%	91.900	100,0%	93.800	100,0%
Total Variable Costs	56.274	67,0%	58.619	63,8%	61.633	65,7%
Total Fixed Costs	20.985	25,0%	21.860	23,8%	22.983	24,5%
Material Related Costs	23.300	27,7%	24.271	26,4%	25.519	27,2%
V - Direct Material Costs	20.000	23,8%	20.833	22,7%	21.905	23,4%
V - Other Material Costs	1.500	1,8%	1.563	1,7%	1.643	1,8%
F - Other Material Costs	1.800	2,1%	1.875	2,0%	1.971	2,1%
Employee Related Costs	35.450	42,2%	36.927	40,2%	38.826	41,4%
V - Labor Cost	18.000	21,4%	18.750	20,4%	19.714	21,0%
F - Labor Cost	9.000	10,7%	9.375	10,2%	9.857	10,5%
V - Officer Cost	4.500	5,4%	4.688	5,1%	4.929	5,3%
F - Officer Cost	3.500	4,2%	3.646	4,0%	3.833	4,1%
F - Training & Motivation Costs	450	0,5%	469	0,5%	493	0,5%
Equipment Related Costs	14.992	17,8%	15.617	17,0%	16.420	17,5%
V - Energy, Water and Fuel Costs	12.000	14,3%	12.500	13,6%	13.143	14,0%

F - Energy, Water and Fuel Costs	1.100	1,3%	1.146	1,2%	1.205	1,3%
F - Maintenance & Repair Costs	1.892	2,3%	1.971	2,1%	2.072	2,2%
Outside Process	1.585	1,9%	1.651	1,8%	1.736	1,9%
V - External Processes	154	0,2%	160	0,2%	169	0,2%
F - External Processes	536	0,6%	558	0,6%	587	0,6%
F - Externally Provided Services	895	1,1%	932	1,0%	980	1,0%
Other Costs	1.899	2,3%	1.978	2,2%	2.080	2,2%
F - Shipping Costs	259	0,3%	270	0,3%	284	0,3%
F - Product Development Test Costs	235	0,3%	245	0,3%	257	0,3%
F - Communication Cost	12	0,0%	13	0,0%	13	0,0%
F - Insurance Costs	12	0,0%	13	0,0%	13	0,0%
F - Rent Costs	500	0,6%	521	0,6%	548	0,6%
F - Travelling Cost	65	0,1%	68	0,1%	71	0,1%
F - Lawsuit, Execution and Notary Cost	13	0,0%	14	0,0%	14	0,0%
F - Due, Donation and Aids	1	0,0%	1	0,0%	1	0,0%
F - Representation and Hospitality Costs	16	0,0%	17	0,0%	18	0,0%
V - Marketing Costs	85	0,1%	89	0,1%	93	0,1%
F - Marketing Costs	96	0,1%	100	0,1%	105	0,1%
F - License, Consultation and Auditor Costs	14	0,0%	15	0,0%	15	0,0%
F - Stationery and Printed Matter Costs	34	0,0%	35	0,0%	37	0,0%
V - Severance Pay	14	0,0%	15	0,0%	15	0,0%
F - Severance Pay	12	0,0%	13	0,0%	13	0,0%
F - Tax, Levies and Charges	19	0,0%	20	0,0%	21	0,0%
F - Depreciation	512	0,6%	533	0,6%	561	0,6%
Inventory Change	33	0,0%	35	0,0%	36	0,0%
V - Inventory Change	21	0,0%	22	0,0%	23	0,0%
F - Inventory Change	12	0,0%	13	0,0%	13	0,0%
Value Stream Profit	6.741	8,0%	11.421	12,4%	9.183	9,8%
Financial & Other Income and Costs	256	0,3%	267	0,3%	280	0,3%
Profit	6.485	7,7%	11.155	12,1%	8.903	9,5%

In expanded lean income statement, all cost elements are visible. Managers can easily track performance of cost elements and determine which cost element should be improved.

2.2.1.2.Results

In the former income statement, the managers can only concern about do they have a profit or not. In order to follow objectives, they had to prepare reports to make analyses of their processes. In lean income statement, it is easy to understand how the cost elements are changed and they can interpret in which cost element they need to take attention. So In lean income statement, it also shows the alerts of possible improvement points. As a result, managers are provided with clearer and more precise information to make business decisions wiser.

2.2.2.Box Score

The box score establish a basic conceptual structure to examine operational, capacity and financial benefits of lean efforts. However it is also very effective tool for non-lean companies to evaluate the performance of its operations. In this study, the performance parameter in there categories (Operational, Capacity and Financial) are determined with managers through interviews and box score is preparing accordingly. Different than traditional box score, the parameters are followed in three dimensions, which are last year, this year's budget and present.

2.2.2.1.Forming Box Score

The box score parameters are determined through interviews with managers. In selection of parameters, beside the standard parameters of traditional box score, the parameters company currently used are listed together. The final selection of parameters are made by board of managers. The final box score parameters can be find in Table 16. The numbers are changed due to secrecy policy.

Table 16. Box Score

BOX SCORE		Last Year	Budget	Present
		Unit	Unit	Unit
Operational	Sales Unit	1.500	1.788	1.759
	Sales Weight (kg)	2.400	2.861	2.814
	Sales per Person (ton/person)	1,69	1,74	1,76
	On Time Shipment	0,95	0,98	0,96
	Dock-to-Dock Days	68,75	64,59	71,86
	First Time Through	0,60	0,66	0,74
	Average Cost	32,19	28,13	30,07
Capacity	Productive	0,65	0,70	0,69
	Non-Productive	0,20	0,16	0,17
	Available	0,15	0,14	0,14
Financial	Inventory Value	1.000	950	980
	Revenue	100.000	110.000	112.000
	Variable Transportation Cost	16.000	18.100	18.200
	Net Revenue	84.000	91.900	93.800
	Variable Material Cost	21.500	22.396	23.548
	Other Variable Costs	34.774	36.223	38.086
	Contribution Margin	27.726	33.281	32.167
	Fixed Costs	20.985	21.860	22.983
	EBIT	6.741	11.421	9.183
	EBITDA	7.253	11.955	9.744
	Profit	6.741	11.421	9.183
	ROS	6,74%	10,38%	8,20%

In operational and capacity dimensions, the traditional box score parameters are used and calculated as mentioned before. In financial dimension, some parameters which are vital for company and not appear in traditional box score are added.

Fixed costs is defined as a parameter and all fixed behaving cost elements are collected in this parameter. It is important to see fixed costs separately for the company. Since it is an important indicator, it should be under control to reach company's objectives.

Material cost is separated as variable material cost and fixed material cost and variable material cost is defined as a parameter, since it covers a big portion of costs. The fixed material cost is added to fixed costs.

Other variable costs are determined as a parameter, which consist of variable costs other than material.

Contribution margin is determined as other parameter, which is calculated by revenue minus variable costs.

EBIT (Earnings Before Interest and Taxes) and EBITDA (Earnings Before Interest, Taxes, Depreciation, And Amortization) are determined as another parameter. EBIT is calculated as Net Profit minus Variable Material Cost minus Fixed Costs minus Other Variable Costs. EBITDA is calculated as EBIT plus Depreciation.

As a final parameter ROS (Return of Sales) is added to measure firms operating profit margin. It is calculated as revenue divided by EBIT.

2.2.2.2.Results

The box score study enable ABC Company to compare the KPI's which lean organizations monitor and set better KPI's to remain competitive. The new Lean KPI's lead to measure company performance more effectively. Besides monitoring performance, the company gain a tool for evaluating scenarios. For instance, in investment feasibility stage, company can measure how the investment will affect the box score parameters, hence the company profitability.

CONCLUSION

Lean accounting seems only applicable in lean or at least in companies which are attending be in lean transformation process. The overall purpose for this thesis is to explore the effects of lean tools and principles in a non-lean organization.

Basic lean concepts are identified in this thesis. Processes in accounting department are examined and analysis are made according to lean methodology. Makigami form is redesigned and application of analysis in one process is described. Improvements are applied and benefits are explained in detail. As a result, general process efficiency in accounting process is increased by %50.

Lean income statement and box score report is redesigned according to company needs to encourage company for lean initiatives. With lean income statement and box score, the performance of the company become more visible and analyzable. The managerial reports become user friendly. Managerial decisions are expected to be more accurate with lean income statement and box score report. As a consequence, the lean accounting principles and tools are proven to be useful in a non-lean company in this thesis.

This thesis could be expanded for other departments of a company. Concepts like Lean Human Resources, Lean Sales etc. are getting popular in literature and application of these concepts in non-lean companies can have very interesting results for potential researches.

Finally, this thesis may motivate researchers to conduct study on non-lean companies in other industries. Effect of lean applications on non-lean organizations in different industries can be inspirational.

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