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Lean Management and Management Accounting System: An Actor-Network Conceptualisation

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Abstract

Lean management is a philosophy that seeks the continuous improvement and meeting customer demands, through the elimination of any and all types of wastes. Initially rooted in Toyota corporation's production system, lean management has rapidly spread to various manufacturing and non-manufacturing sectors. Yet, even with such spread of lean management implementation, our understanding of the developments in organisations' management accounting system (MAS) in the context of lean is still ambiguous. The available literature either from the academic or the consultancy domain problematises the traditional accounting system to work with lean management and suggest either shedding traditional accounting practices at all or using *'lean accounting'* as a 'lean-tailored' accounting system. However, neither the academic nor the consultancy literature succeed in developing an overall theoretical conceptualisation of how an organisation's MAS works with lean. Nor do they provide an in-depth investigation of the role played by the main lean accounting practice; Value Stream Costing (VSC) and the factors affecting its acceptance or rejection. Additionally, management accounting literature has not contributed much to our academic knowledge on the MAS associated with lean management as a form of horizontal organisation and process innovation. Hence, this research aims at developing a theoretical conceptualisation of the developments in organisations' management accounting system (MAS) in the context of lean management. Additionally, the research seeks to investigate the performative role of the lean accounting VSC practice and explore the factors affecting managers' willingness to accept or reject its implementation.

A longitudinal case study informed by the use Actor Network Theory (ANT) and Michel Callon's (2007, 2010) performativity thesis, is conducted on one of the factories of a multinational manufacturing organisation, adopting a lean management system. ANT's elements of the 'sociology of translation' (Callon, 1986; Latour, 1986; Latour, 2005) are used first to develop a literature driven conceptualisation of the current discourse in both consultancy and academic literatures on the MAS associated with lean. Empirically, various human and non-human actors are identified at both the organisation's local and global levels. Callon's (1986) and Latour's (1986, 1996) four moments of translation are used to interpret actors' interactions making up the

developments in organisation's MAS. Callon's (1998a) concepts of framing and overflow and performativity thesis (Callon, 2007, 2010) are then used to develop an empirical driven theoretical conceptualisation of the developments in organisation's MAS in the context of lean. The research tested the performativity of VSC by tracing its effects on product cost and analysed if, or to what extent, the organisation is willing to implement it. The research contributes to both academics and practitioners through providing new nuances on the operation and developments in organisation's MAS and practices in the context of lean. It also, responds to calls from both management accounting and lean management literatures to the develop more context related management accounting research and provide in depth empirical analysis on the management accounting practices relevant to lean management.

The use of ANT unpacked new insights on the social and technical aspects of the developments in an organisation's MAS in the context of lean. Such aspects include; the influential role of management accountants and consultants in lean organisations, the performative role of operating structures in lean settings and the association between the performativity of accounting calculations and management accounting relational ontology. The literature driven theoretical conceptualisation shows that, more research is needed on actors' interactions forming the fabrics of organisations' MAS and how its calculations interact with other actors in a process innovation such as lean. In terms of VSC, the practice performed in an opposite direction to the predictions made for it. In the case study conducted, VSC was mobilised by the factory layout and intentions of the organisation actors; both locally and globally, which may have distorted the expectations from its implementation. Additionally, it was found that committing to a lean accounting tool as VSC can be difficult in the context of headquarters' pressures and political unrest. Successful VSC implementation, requires organisations to review their needs for product unit costs along with, the construction pattern of their value streams. It is suggested that more case study research is required at the intersection between both MAS and lean management research areas, to help expand academics' and practitioners' understanding of the operation and development in the MAS's of companies implementing a lean management system. Additionally, it would be helpful to provide more empirical evidence on the conditions needed for VSC implementation and continue to explore the role played by other management accounting or lean

accounting practices in lean organisations. This strand of literature is still evolving and lacks codification.

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List of Abbreviations

Abbreviation	Meaning
4Q	Four Quadrants (approach)
5S	Sort, Straighten, Shine, Standardize, Sustain
ABC	Activity-based costing
ABM	Activity-based management
ANT	Actor-Network Theory
BSC	Balanced Scorecard
CI	Continuous Improvement
C/O	Changeover time
COPQ	Cost of Poor Quality
C/T	Cycle Time
DPO	Days of Purchases Outstanding
DSO	Days of Sales Outstanding
EGP	Egyptian Pound
F&Acc	Finance and Accounting
FCC	Features and Characteristics Costing
FPY	First Pass Yield
GMT	Global Managing Team
HV	High Voltage
JIT	Just-in-Time
KPI	Key Performance Indicator
KVA	Kilo-Volt-Ampere
LBU	Local Business Unit
LMDT	Large Distribution Transformer/s
LOC	Levers of Control
LV	Low Voltage
MA	Management Accounting
MAS	Management Accounting System
MC	Management Controls
MCS	Management Control System
MDT	Medium Distribution Transformer/s
MPC	Manufacturing Process Cost
OP	Operating team
OPEX	Operation Excellence
OTD	On-Time Delivery
PGTR	Product Group Transformers
PMS	Performance Measurement System
ROTD	Requested On-Time Delivery
RQ	Research Question
SAS	Shared Accounting Services
SDT	Small Distribution Transformer/s
SPC	Statistical Process Control
TPS	Toyota Production System
TQM	Total quality Management
VSC	Value Stream Costing
VSM	Value Stream Mapping

Chapter 1: Introduction

This research aims at developing a theoretical conceptualisation of the developments in organisations' management accounting system (MAS) in the context of lean management, as an example of process innovation. This aim is motivated by work from management accounting literature highlighting the lack of attention to the development of an overall conceptualisation of management accounting and control systems (van der Stede, 2015), and the need to develop more context related management accounting research (Otley, 2016). This research also, responds to calls from lean management literature to provide in depth empirical analysis on the management accounting practices relevant to lean management (Fullerton et al., 2013; Tillema and van der Steen, 2015), such as Value Stream Costing (VSC); the most recommended management accounting practice to support a lean management environment (Maskell and Kennedy, 2007; Debusk and Debusk, 2012; Fullerton et al., 2013). Finally, the research seeks to contribute to work calling for developing theoretical conceptualisations that succeeds to treat the social as a construction, and hence, establishes a middle ground between the 'implicit' predictability embedded in using contingency theory and the freedom associated with some grounded theory research (Otley, 2016). In doing so, Actor-Network Theory (ANT) is chosen as the theoretical lens for this research, together with Michel Callon's (2007, 2010) performativity thesis. As will be explained later in this chapter, ANT is chosen for this research, to help present such conceptualisation as the pure interaction between different actors associated with both lean management environment and MAS as they naturally occur, viewing reality as a construction of different human and non-human actors (Latour, 1998; Latour, 2005). Hence, the main objectives of this research are to:

- Develop a theoretical conceptualisation of the developments in MAS in the context of lean management.
- Investigate the role played by management accounting practices recommended for lean, namely the Value Stream Costing (VSC) practice.

This chapter in divided into six sections. Section 1.1 provides a brief overview of lean management. Section 1.2 overviews the literature on MAS in lean organisations

and discusses the contribution of innovation literature to this body of work. Both sections 1.1 and 1.2 highlight the reasons for the need to meet the two research objectives mentioned above. Section 1.3 outlines the research questions of this study. A brief discussion of the research method used in this study is presented in section 1.4. Section 1.5 presents an overview of actor-network theory as the theoretical lens chosen for this research. The chapter ends up with a description of the structure of this thesis, outlined in section 1.6

1.1 Lean Management – An Overview

As initially introduced by Toyota motors corporation, the term 'lean management' was first known as the Toyota Production System (TPS) (Womack et al., 1990; Womack and Jones, 1996; Shimokawa and Fujimoto, 2009). In general terms, TPS was used to denote a production approach aiming at waste elimination and meeting customer demands (Hines et al, 2004). To Toyota, lean represented the compilation of innovations – [including just-in-time (JIT), the use of Kanbans to promote pull production and high levels of employee empowerment] – done in the corporation's shop floor (Hines et al., 2004), in response to the severe competition in Japanese automobile market in 1940s and to expel the corporation's wasteful mass production system (Maskell and Kennedy, 2007; Shimokawa and Fujimoto, 2009).

The success of TPS lead to the spread of the system outside Toyota and its emulation by other organisations, even those working outside the manufacturing sector (Hines et al., 2004; Holweg, 2007; Alves et al., 2012; Malmbrandt and Ahlstrom, 2013; Bateman et al., 2014). With the release of Womack and Jones's (1996) book, the approaches used by Toyota were highlighted under the five principles of what the authors called the 'lean enterprise'. These principles are; define customer value, identify value streams, keep the production flow, the pull principle and the perfection/ continuous improvement principle. The TPS was then known as lean production (Liker, 2004; Alves et al. (2012), lean manufacturing (Bicheno, 2004) and lean management (Ward and Graves, 2004; Grasso, 2005; Kennedy and Widener, 2008). Yet, even with the success of manufacturing and service industries to apply lean management, our understanding of the developments in an organisation's MAS in the context of lean, is still ambiguous (Fullerton et al., 2013). The available literature either from the academic or the

consultancy domain problematises the traditional accounting system to work with lean management (Ahlstrom and Karlsson, 1996; Maskell and Baggaley, 2004; Johnson, 2006; Kennedy and Widener, 2008; Fullerton et al. 2013; Fullerton et al., 2014; van der Steen and Tillema, 2018). This literature suggests either shedding traditional accounting practices at all (Johnson, 2006), or using a simplified accounting system (Fullerton et al., 2013; Fullerton et al., 2014) known as *'lean accounting'* (Maskell and Baggaley, 2004; Grasso 2005; Maskell and Kenney, 2007; Kennedy and Widener, 2008). However, neither the academic nor the consultancy literature succeed in developing an overall theoretical conceptualisation of the construction and developments in an organisation's MAS in the context of lean. Additionally, both literatures lack an in-depth empirical investigation of the role played by the main lean accounting/ management accounting practice; Value Stream Costing (VSC). Albeit the most recommended 'lean-tailored'/ lean accounting practice, VSC is still receiving very low implementation rates (Rao and Bargerstock, 2011, Ruiz-de-Arbulo-Lopez et al., 2013). Empirical research focusing on the use of VSC and factors affecting its success is heavily needed (Ruiz-de-Arbulo-Lopez et al., 2013, Fullerton et al., 2013).

The next section overviews the literature on MAS in lean organisations and discusses the contribution of innovation literature to this body of work

1.2 MAS, Lean Accounting and the Contribution of Innovation Literature – An Overview

The term management accounting system (MAS) and management control system (MCS) are usually used interchangeably (Malmi and Brown, 2008; Chenhall and Moers, 2015). This research uses the term MAS defined as the systematic use of management accounting with its various practices to achieve some organisation goal (Chenhall 2003, p. 129; Malmi and Brown, 2008). The various definitions of MCS, diversity in control categorisations, together with the variety of frameworks associated with the term 'MCS' has over the time caused a lack of precision and inconsistencies in MCS research (Chenhall, 2003; Bisbe et al., 2007; Malmi and Brown, 2008; Tessier and Otley, 2012a) and eventually resulted in frameworks acting more as guidelines for each organisation, based on its needs and circumstances (Willert and Otley, 2016). Hence, focusing on a simple definition of MAS suits the nature of this research linking lean management,

MAS and lean accounting literatures, which represents a literature integration on which our academic and consultancy knowledge is still evolving (Chopra, 2013).

A discussion of the contribution of MAS literature to lean management, invites an understanding of the form of organisation arrangement which lean management represents, and the type of innovation to which lean management relates. In doing so, the researcher has the objective of grasping an understanding of whether MAS literature has contributed to the form of organisation arrangement which lean represents or to the type of innovation to which lean belongs, searching for some guidance which can be brought about to facilitate the conceptualisation of MAS in the context of lean. Hence, looking at the bigger picture, the characteristics of a lean management system is that of a horizontal organization arrangement (Chenhall, 2008). Additionally, lean management is an example of process innovations defined as: the innovations associated with the modification of organisations' operating system or processes (Meeus and Edquist, 2006) used in producing goods or services for the organisation's customers (Damanpour and Gopalakrishnan, 2001), with the objectives of reducing delivery times, decreasing production costs and increasing operational flexibility (Boer and During, 2001).

Looking at lean as a horizontal organisation arrangement; one cannot develop a rigorous understanding, nor find a comprehensive empirical analysis of the MAS associated with lean management. According to Chenhall; *'there are no studies that have addressed, directly, how management accounting practices have been employed to help configure horizontal organisations to achieve lateral coordination focused on customers'* (2008, p. 539). At the same time, looking at lean as an example of process innovations, one cannot find a theoretical conceptualisation of the developments in MAS in the context of lean that accounts for the interactions of both human and non-human actors and for the various roles played by the MAS's practices. The analysis of the literature on MAS and innovation shows that, this literature has not contributed much to the study of lean management. This strand of literature first started by viewing MAS as a mere reflection of the innovation adopted (Kaplan, 1984). Later work moved to discussing the effect of innovation adopted on changing organisations' MAS and practices (Ahlstrom and Karlsson, 1996, Kennedy and Widener, 2008). Finally, recent work views MAS's practices and calculations as influencing the innovation implemented (Briers and Chua, 2001; Mouritsen et al., 2009; Revellino and Mouritsen,

2015; Themsen and Skærbæk, 2018), they mediate between different organisations actors and the innovation adopted (Vosselman, 2014) and lure people into making different decisions (Revellino and Mouritsen, 2015). This later stream of literature is the one relevant for this research, given its focus on the role played by VSC practice and on conceptualising the developments in MAS in the context of lean, where management accounting calculations are one of the actors in such conceptualisation. However, most of this recent literature is not contextually lean driven.

As mentioned earlier, from a lean specific view point, the available work on lean and MAS fall into two streams; academic (Ahlstrom and Karlson, 1996; Johnson, 2006; Kennedy and Widener, 2008; Chiarini, 2012; Fullerton et al.; 2013, Ruiz-de-Arbulo-Lopez et al., 2013; Fullerton et al., 2014; Tillema and van der Steen, 2015) and consultancy literature (Baggaley and Maskell 2003a; Baggaley and Maskell 2003b; Maskell and Baggaley, 2004; Grasso, 2005; Baggaley, 2006), where both promote the use of a 'lean-tailored' accounting system, i.e. 'Lean accounting' (Maskell and Baggaley, 2006; Kennedy and Widener, 2008; Fullerton et al., 2013). However, both streams of literature present a discourse that problematises the use of traditional accounting practices with lean management (Johnson, 2006; Maskell and Kennedy, 2007; Kennedy and widener, 2008; van der steen and Tillema, 2018). Yet, none of the two streams provides an overall theoretical conceptualisation of organisation's MAS in the context of lean, nor can we find a detailed empirical investigation of how alternative management accounting or lean accounting practices, such as VSC, would perform in a lean environment.

1.3 Research Questions

As briefly discussed in the previous sections, when looking at the lean and management accounting specific literature i.e. lean accounting literature or at the bigger umbrella in which lean belongs in relation with MAS i.e. lean as a horizontal organisation arrangement and process innovation, one cannot find a rigor understanding nor a theoretical conceptualisation of the developments and operation of MAS in the context of lean. Nor can one find an in-depth empirical analysis or explanation of the role played by the lean accounting practice suggested to work with lean; VSC. Hence, as mentioned earlier in this chapter, this research aims at:

- Developing a theoretical conceptualisation of the developments in MAS in the context of lean management.
- Investigating the role played by management accounting practices recommended for lean, namely the Value Stream Costing (VSC) practice.

Driven by these research objectives, the research seeks to develop an answer to the following first research question (RQ1) associated with the first research objective:

> **RQ 1:** How can we conceptualise the developments in organisations' management accounting system (MAS) in the context of lean management?

In association with the second research objective, this research seeks to develop an answer to the following second and third research questions (RQ2 and RQ3):

> **RQ 2:** In a specific lean management setting, what is the performative role, if any, of VSC calculations?
> **RQ 3**: In a specific lean management setting, what factors might affect the acceptance/rejection of VSC?

The next sections present an overview of the research method used and the theoretical lens chosen to help achieve the research objectives and develop answers to study research questions.

1.4 Overview of Research Method Used

This section presents an overview of the research method chosen for this research in order to meet the research objectives and develop answers for its three research questions. The research uses a longitudinal case study covering twelve years of lean implementation in one of the factories of a leading multinational organisation for automation and supply of electrical power components, operating in Egypt. The organisation's headquarters is in Zurich, Switzerland and it has subsidiaries in more than 90 countries across the world. The longitudinal case study covers the period from the start of lean implementation – year 2004 till end of year 2016. A longitudinal case study is best suited for this research as it enables *'...the researcher to examine change*

processes within social, economic and political context' (Collis and Hussey 2009, p. 78). This specially fits with the first research objective and question of this research on the conceptualisation of the MAS developments in the context of lean. The way a longitudinal case study allows researchers to *'investigate the dynamics of a research problem'* over a long-time period (Collis and Hussey 2009: p. 78) is not only useful in meeting the first research objective, but is also beneficial in meeting the second research objective and its associated research questions. As will be elaborated in chapters six and seven, studying the case organisation over a long period of time, brought about dynamic and rich set of data on the role played by VSC in different organisation circumstances. Analysing these data in different circumstances and over a long period of time has proved to be helpful in examining different factors affecting the adoption of VSC as intended by the third research question.

The case study organisation is chosen on basis of its suitability to develop rich data which help achieve the research objectives and answer the research questions. As will be discussed in detail in chapter five, the case study organisation has gone through different progressive stages of lean implementation since its adoption in 2004. In most of the twelve years of the study period – more specifically from 2009 to 2016 – the organisation has been trying to grasp an understanding of how its MAS with its practices can operate with lean. This presented an excellent chance for the researcher to study the developments in MAS in context of lean, as sought by the first research objective and its associated research question (i.e. RQ1). Also, being of a multinational nature, the data for the case organisation are thought to present different views from local organisational actors in Egypt and global actors in Zurich. As will be seen in chapters 6 and 7, the data for the case organisation has revealed different views of both local and global organisation actors on the organisation's MAS and role played by VSC. Additionally, the researcher has been previously involved with the case organisation in developing possible frameworks of management accounting practices including VSC, as will be detailed in chapter six. This has established some understanding of the term 'lean accounting' and VSC among a sizable group of organisation's actors; something that is rarely found in most lean firms[1] (Chopra, 2013; Rao and Bargerstock, 2013). Yet,

[1] In this research, the term 'lean firms' is used to mean companies/ organisations implementing a lean management system.

facilitates the analysis of the role played by VSC practice and the factors affecting its acceptance or rejection. The understanding of VSC by a group of organisation actors together with the different views of global and local organisation actors on VSC, has presented rich and dynamic data set that immensely facilitated the investigation of the role played by VSC as targeted by the second research objective and its associated research questions (RQ2 and RQ3).

1.5 Overview of Actor-Network Theory

This section presents a brief overview of actor-network theory (ANT) (Callon, 1986; Latour, 1986, 1987, 2005) and of the rational for choosing it as the theoretical lens for this research. The main claim of ANT is that *"it is utterly impossible to understand what holds society together without reinjecting in its fabric the facts manufactured by natural and social sciences and the artefacts designed by engineers"* (Latour 1996, p. 370). ANT is used as the theoretical lens of this research in order to be able to trace the associations between both human and non-human actors (Latour, 1998; Latour, 2005) related to the case organisation's MAS and its operating system using lean. ANT's flat ontology (Modell et al., 2017, p. 68) places objects at the centre of the research (Justesen and Mouritsen, 2011, p. 161). Hence, using ANT, non-human actors are as important in their study and analysis as human ones. This forms one of the main reasons for choosing ANT, since given the research objectives and questions focusing on the developments in MAS involving interactions of people and various management accounting practices – such as VSC –, there is a need to use a theoretical lens which facilitates the understanding of non-human interactions, as much as, it does with human ones

Additionally, ANT's relational ontology (Callon 1987, p. 93) involves a constructivism aspect where, reality is not only seen as relational, but also as being "continuously constructed" (Law, 1992, Modell et al., 2017). Such continual constructivism aspect of ANT allows for exploring developments experienced in MAS and the role played by VSC as actors' interactions change over time. This is quite helpful given the longitudinal nature of the case study conducted in this research. Using ANT, the developments in the organisation's MAS are treated as an indeterminate and ongoing process (Modell et al., 2017), which can only be understood by delving into the

dynamics of the stories of organisation's actors as they tell them, "*without imposing on them a priori definition of their world-building capacities"* (Latour 1999, p. 20).

In addition to ANT, as the main theoretical lens chosen for this research, the research uses Callon's (2007, 2010) performativity thesis. The use of Callon's (2007, 2010) performativity thesis seeks to provide a rich understanding of data related to the second and third research questions on the performative role of VSC practice and factors affecting its acceptance or rejection. Combining ANT and performativity thesis allows the researcher to move beyond the idea of how MAS's reality is constructed, to analysing the trails and fabrics making up this construction. In doing so, the research applies Latour's (2005, p. 165) approach to 'slowciology' i.e. 'going slow'/ 'don't jump' (Latour, 2005, p. 190), to better understand the trail of events and interactions forming a construction. This is thought to help bring about rich interpretations of the organisation's MAS and practices, especially given the ambiguity of our knowledge of the developments and operation of MAS and lean accounting practices as VSC, in a lean context (Fullerton et al., 2013).

In this research, ANT is used on two levels. On the literature analysis level, the research first uses ANT's four moments of translation (Callon, 1986; Latour, 1986; Latour, 2005) to develop a conceptualisation of the current discourse in both consultancy and academic literature on the MAS associated with lean. This literature driven theoretical conceptualisation aims at putting such discourse in context to demonstrate the messages which the current literature on lean management, MAS and lean accounting seem to suggest to its users. On the empirical level, Callon's (1986) and Latour's (1986, 1996) four moments of translation are used to interpret data collected from the case study conducted in this research. The research then uses Callon's (1998a) concepts of framing and overflow, together with performativity thesis (Callon, 2007, 2010) to develop an empirical driven theoretical conceptualisation of the organisation's MAS in the context of lean. Implications driven from these conceptualisations are then used to develop answers for this study's research questions.

Having overviewed the main research aims, research questions, research method and the theoretical lens chosen for this research, the last section of this chapter presents the structure of this thesis.

1.6 Thesis Structure

This section outlines the structure of the remaining chapters of the thesis. This thesis is composed of eight chapters which are organised as follows:

Chapter two presents a review of the literature on both lean management, management accounting system and lean accounting with its associated value stream costing practice. The chapter details the various definitions of lean management, its history in the Toyota corporation and the difficulties it faces with the traditional accounting practices. Chapter two also discusses the reasons for focusing on MAS rather than MCS, it also details how the literature on MAS and innovation literature is relevant to this research, as briefly outlined in this introduction chapter.

Chapter three introduces ANT as the theoretical lens of this research. In doing so, the chapter starts with a brief background of ANT. The chapter then discusses the ontology of ANT and the reasons why it is chosen for this research, in comparison to alternative theories. Chapter three defines ANT theoretical concepts used in this research, including; actors, network and translations, in addition to discussing Callon's (1998a) concepts of framing and overflow and Callon's (2007, 2010) performativity thesis. The chapter also discusses key misconceptions about and critique to ANT and performativity thesis. Callon's (1986) and Latour's (1986, 1996) four moments of translation are then used in chapter three, to develop a literature driven theoretical conceptualisation of the current discourse in both consultancy and academic literature on the MAS associated with lean.

Chapter four discusses the research methodology. The chapter lays out the ontological and epistemological stands of the research and details the research approach and design. Chapter four also explains the reasons for choosing case study as method for this research and discusses the approaches used for data collection and data analysis and the role of researcher. The chapter concludes with a chapter summary that includes an overall illustration of the research design adopted and discussed throughout the chapter.

Chapter five presents the background of the case study organisation chosen for this research. The chapter presents the organisation chart and discusses the responsibilities

of key actors involved in this research. Chapter five also, discusses the primary key findings from the case study in terms of; how the organisation manages its management accounting information and the accounting information systems used for this, the organisation's progress with lean management implementation and the changes witnessed in its management accounting system throughout the twelve years of the longitudinal study period.

Chapter six uses the findings explained in chapter five and ANT's moments of translation (Callon, 1986; Latour, 1986; Latour; 1996), to discuss and analyse the events and interactions making up MAS in the case study organisation. In this discussion more findings driven from case study data are also elaborated. Interactions constructing the organisation's MAS involve many human and non-human actors. These interactions are presented in the form of three major story plots. Story plots revolve around the drivers of change in organisation's performance measures, negotiations on its costing practices throughout the study period and tension events experienced between organisation's accounting representatives and engineers. Chapter six discusses these three plots and analyses them. The stories are then used to tailor the discussion in chapter seven.

Chapter seven presents a discussion of the research findings presented in chapters 5 and 6 and how they are used to develop answers for the study research questions. Chapter seven uses Callon's (1998a, 2007) concepts of framing and overflow and the performativity thesis (Callon, 2007, 2010), to develop an empirical driven theoretical conceptualisation of the developments in the case organisation's MAS. Various implications are driven from this conceptualisation which are used in this chapter to develop answers for the study research questions.

Chapter eight concludes the thesis with a summary of the main objectives of the research and how they have been met together with how the research questions have been answered. The chapter discusses the main contributions of this research, presents the research limitations and provides a discussion of directions for future research.

Chapter 2

Lean Management and Management Accounting System: A Review of Literature

2.1 Introduction

Driven by the severe competition in the Japanese automobile market in 1940s and to expel the myths behind a mass production system (Maskell and Kennedy, 2007; Shimokawa and Fujimoto, 2009), the Toyota motors corporation came to ideas of the Toyota Production System (TPS) (Womack et al., 1990; Womack and Jones, 1996; Shimokawa and Fujimoto, 2009), which has been emulated by both manufacturing and service institutions (Hines et al., 2004) and is currently known as 'lean management' (Ward and Graves, 2004; Grasso, 2005; Kennedy and Widener, 2008). In general terms, lean management represents a philosophy (Ohno 1988, Liker, 2004) that seeks the continuous improvement (Emiliani and Stec, 2005) and meeting customer demands (Liker, 1996; Pettersen, 2009; Alves et al., 2012) through the elimination of any/ all types of wastes (Womack et al., 1990; Liker, 1996; Shah and Ward, 2003). Even with the wide spread of lean management in both manufacturing and services organisations, our understanding of the developments in the MAS in the context of lean is still ambiguous. The available literature either from the academic or the consultancy domain problematises the traditional accounting system to work with lean management (Ahlstrom and Karlsson, 1996; Maskell and Baggaley, 2004; Johnson, 2006; Kennedy and Widener, 2008; Fullerton et al. 2013, Fullerton et al., 2014) and suggest either shedding traditional accounting practices at all (Johnson, 2006) or using lean accounting (Maskell and Baggaley, 2004; Grasso 2005; Maskell and Kenney, 2007; Kennedy and Widener, 2008) as a 'lean tailored' accounting system (Fullerton et al., 2013; Fullerton et al., 2014). However, neither the academic nor the consultancy literature succeed in developing an overall theoretical conceptualisation of how a firm's MAS works with lean. Nor do they provide an in-depth investigation of the role played by the main lean accounting practice; Value Stream Costing (VSC) and the factors affecting its acceptance or rejection. Additionally, the management accounting (MA) literature has not contributed much to our academic knowledge of the management accounting system (MAS) associated with lean.

This chapter discusses these literature gaps by presenting a detailed review of the literature on lean management, management accounting system (MAS) and lean accounting. The chapter is divided into sixteen sections, sections 2.2 to 2.6 are devoted to the review of lean management literature. Section 2.2 identifies the two perspectives of defining lean. Section 2.3 explains the five main principles of lean. Section 2.4 discusses the history of lean, the role of Toyota and how lean has gradually moved to non-manufacturing institutions. Section 2.5 focuses on the benefits and briers associated with lean implementation. Finally, section 2.6 analyses the form of organisation arrangement that lean management represent and the types of innovation to which it belongs.

Sections 2.7 to 2.11 focus on the review of the MAS literature. Section 2.7 explores the various definitions of a management accounting and management control system. Section 2.8 reviews management control frameworks that are most commonly discussed in the literature and explain the pattern in which these frameworks will be used in this research. Section 2.9 discuss the various categorisations of the term 'control'. A comparison between the term MAS and MCS is presented in section 2.10 which also explains the reason why this research choses the term MAS rather MCS. Finally, section 2.11 presents an analysis of the MAS and innovation literature to explore how this body of literature can contribute to the study of lean as on type of innovations.

A review of the lean accounting literature is discussed in sections 2.12 through to 2.15. Section 2.12 first starts by discussing the lessons learnt from organisations move from a mass production system to lean, emphasizing the need for the new 'lean tailored' system; lean accountings. Section 2.13 discusses the definition of lean accountings. Section 2.14 details the reasons behind the need for lean accounting and section 2.15 introduces the lean accounting value stream costing tool and discusses its operation. The chapter then concludes with a final section: 2.16 which summaries the chapter and identifies its key take points.

2.2 Lean Management Definition

The available literature on lean comprises divergent ways to define it (Pettersen, 2009; Bhamu and Sangwan, 2014). Lean was presented in a variety of names starting from the Toyota Production System (TPS) (Womack et al., 1990; Womack and Jones, 1996; Shimokawa and Fujimoto, 2009), to lean production (Holweg, 2007), lean manufacturing (Shah and Ward, 2003) and finally lean management (Grasso, 2005; Fullerton et al., 2014). In simple terms, some authors would view lean as an approach to organisation improvement via waste elimination, for example; Moore and Scheinkopf (1998, p. 2) defined lean manufacturing as; *"an approach that guides practitioners to improve their organizations by focusing on the elimination of any and all waste"*. In more detailed terms, Hines et al. (2004, p. 994) described lean as;

> This lean operations management design approach focused on the elimination of waste and excess from the tactical product flows at Toyota (the Toyota "seven wastes") and represented an alternative model to that of capital-intense mass production (with its large batch sizes dedicated assets and "hidden wastes").

The Toyota seven wastes were then identified by a broad number of authors to include: overproduction, inappropriate processing, defects, inventory, waiting, transportation and unnecessary motion (Liker, 1996; Oliver et al., 1996; Standard and Davis, 2000; Grasso, 2005; Bhasin and Burcher, 2006; Pepper and Spedding, 2010). Other authors would view lean as a practice (Simpson and Power, 2005), a framework (Hopp and Spearman, 2004) or more of a manufacturing paradigm (Seth and Gupta, 2005). From a broader perspective lean is generally defined according to two main perspectives, one that views lean as a way of "thinking" or more of a philosophy and another that views lean as a "toolbox" (Shah and Ward, 2007; Pettersen, 2009). The philosophical view defines what lean in concept, goals and principles is (Womack and Jones, 1996; Spear and Bowen, 1999), while the "tool box" view is concerned with defining the tools and management practices associated with lean management implementation (Shah and Ward, 2003; Li et at., 2005).

2.2.1 Lean Defined as a Philosophy/ a Way of Thinking

Various authors view lean as a whole philosophy, one of the earliest attempts can be traced to Womack et al. (1990). Even though to them lean was still known as lean production yet, they had the perception that it constitutes a dynamic process of change that is backed up with a systematic set of principles and practices targeting continuous improvement. To them, *"the lean producer…combines the advantages of craft and mass production, while avoiding the high cost of the former and rigidity of the latter"* (Womack et al. 1990, p. 13). Later, there have been different views on lean which can fit within the philosophical perspective. These views include how lean was defined as a model, a system and a whole philosophy.

Viewed as a model, Womack and Jones (1994, p. 1-2) introduced a new deployment of the lean production system which they called the "Lean enterprise". According to them;

> Applying lean techniques to discrete activities is not the end of the road. ……value-creating activities can be joined, but this effort will require a new organizational model: the lean enterprise.
> ……the lean enterprise is a group of individuals, functions, and legally separate but operationally synchronized companies. The notion of the value stream defines the lean enterprise. The group's mission is collectively to analyse and focus a value stream so that it does everything involved in supplying a good or service (from development and production to sales and maintenance) in a way that provides maximum value to the customer.

More recently Alves et al. (2012) defined lean from the viewpoint of workers engagement, in other words how the role of the workers contributes to the whole lean model of individuals, functions and practices. According to Alves et al. (2012, p. 219-220), lean production represents;

> A work organization model where the worker assumes a position of thinker, continuously looking for improvement and continuously looking for wastes, by reducing wastes, the company will be prepared to accommodate changes and will attain agility; the ability to quickly react to technical or environmental unpredictable problems or difficulties.

Simultaneously there were authors who found defining lean as a system better serves their holistic view about lean. For example, Cooper (1996, p. 28-29) define lean as;

> Lean production is a system designed to compete on the assumption that sustained product advantage is unlikely; rather than avoid competition, the lean producer faces it head-on. Just as mass producers compete differently from craft producers, lean producers compete differently from mass producers. Mass producers create stove pipes; lean competitors develop overlapping systems (for cost, for quality, for design, for production) that create intense pressure on all elements of cost.

Here Cooper's (1996) perception of lean being a system is mainly driven by the holistic way of how lean targets elements of cost, quality, design and production acting as an enabler for organizations to face competition. On the other hand, Emiliani and Stec (2005) would designate lean being a system owing to the holistic approach lean exhibits in adding value to all its stakeholders. In this sense lean is defined as:

> A management system designed to be responsive to the needs of humans in business and deliver better outcomes for key stakeholders such as associates, suppliers, customers, investors and communities. It is rooted in two key principles – continuous improvement and respect for people (Emiliani and Stec, 2005, p. 371)

From a system's viewpoint, Shah and Ward's (2007, p. 791) defined lean as; '*an integrated socio-technical system'* with the objective of eliminating wastes through the concurrent reduction or minimization of variability achieved at any of the internal, customer or suppliers' fronts. Such definition captures both premises i.e. a socio-system that targets all organization stakeholders and a technical-system that encompasses the tools enabling organization competition. Shah and Ward (2003, p. 130) comment that some literature promoting the idea of lean targeting waste elimination and the respect for all organization stakeholders would view lean as a whole philosophy defining it as *"a philosophy that focuses on avoiding seven cardinal wastes and on respecting customers, employees and suppliers".* On the other hand, there have been authors who defined lean as a whole philosophy almost about the time Womack and Jones (1996) published their book on the lean enterprise. For example, Liker (1996, p. 481) defines lean as a *'philosophy'* that succeed to reduce the time a firm needs from customer order

to delivery through the elimination of the sources of wastes achieved in a production flow.

Liker (1996) viewed lean as a philosophy from the perspective of how it eliminates waste in the whole value chain i.e. from customer order to delivery, albeit not being literally put in value chain terms. Comm and Mathaisel (2000, p. 122) then described lean within such context as; '*a philosophy intended to reduce cost and cycle time significantly throughout the entire value chain while continuing to improve product performance'.* Detty and Yingling (2000, p. 429) then offered a holistic definition of lean as a philosophy reporting that; *"Lean manufacturing is a comprehensive philosophy for structuring, operating, controlling, managing and continuously improving industrial production systems"*. Despite that, Detty and Yingling's definition tend to enclose lean application to industrial production systems at that time, their definition mirrors the broad view of how lean spams various organization aspects as a whole philosophy.

A common theme in all previously discussed lean definitions is that almost all of them stress on lean being a philosophy that targets waste elimination in all its kinds and achieving customer value to help improve the organizations wellbeing. Lean should be regarded as a whole philosophy since the cooperation of all business units and stakeholders including; workers, employees and suppliers committing to the change, is needed for such lean targets to be achieved. In all these definitions, waste or "Muda" in Japanese terms (Womack et al., 1990) represents; *"anything other than the minimum amount of equipment, materials, parts, space and time which are absolutely, essential to add value to the product"* (Russell and Taylor 2000, p. 737). In more general, nonautomotive terms; waste includes everything or any activity that is perceived by customers as non-value adding when compared to their needs and preferences (Emiliani and Stec, 2005; Alves et al., 2012).

2.2.2 Lean defined as a "Tool-Box"

According to Shah and Ward (2003, p. 129) lean is defined as *"a multi-dimensional approach that encompasses a wide variety of management practices, including just-in-time, quality systems, work teams, cellular manufacturing, supplier*

management, etc., in an integrated system. The core thrust of lean production is that these practices can work synergistically to create a streamlined, high quality system that produces finished products at the pace of customer demand with little or no waste." Pettersen (2009, p. 133) also comment that to most practitioners lean manufacturing tends to be defined as *"a set of waste reduction tools".*

The most prevailing attempts to define the frequently used lean practices relate to the work of Shah and Ward (2003) and Pettersen (2009). Shah and Ward (2003) concluded 22 practices among the frequently discussed lean practices used within a lean management system. They found that JIT/continuous flow production, pull system, Kanbans and quick changeover techniques come at the top of the most frequently used lean practices, while safety improvement methods came among the least frequently used ones. Later, Pettersen (2009) made a more detailed analysis of the common practices constituting lean. To Pettersen, JIT, continuous improvement, setup time reduction, pull system, failure prevention and production levelling represented the most frequently mentioned lean practices.

Accordingly, there are commonly shared practices that are used by most companies implementing lean management, like: JIT, pull system, the use of Kanbans and the pursuit of continuous improvement efforts. Most of these practices re related to the main five principles of the lean management system discussed later in this chapter. On the other hand, while there might be a conceptual definition for lean which makes it a separate concept identifiable from others like TQM for example, there are no agreed upon set of practices that shall accompany lean implementation in all organizations (Pettersen, 2009). This could be attributed to various reasons; first according to Hines et al. (2004) lean as a concept is evolving and will still evolve as more companies and different industries start applying it. Second, there should be a maturity path to lean in which enterprises move steadily from mass production to lean thinking and the approaches on how to move to lean and which practices to be adopted differ from one company to another (Maskell and Baggaley, 2004). Third is the fact that Toyota's executives their own selves had no designed plan in mind when they arrived at the idea of lean (Shimokawa and Fujimoto, 2009). They were just experimenting with ideas to face Toyota's financial crisis and achieve Toyota's goals at that time. To Taichii Ohno, one of the main founders of the TPS, the process of reaching the principles of the

system followed what he can describe as a procedure of trial and error (White and Prybutok, 2001).

Ohno's idea of viewing lean as a process of trial and error coincides with the view of looking at the lean management process as an 'iceberg' where there needs to be due care for the mix between processes below and those above the water (Hines et al., 2008). Figure 2.1 provides an illustration of lean management processes viewed as an iceberg. The figure shows that the majority enabling processes are the ones below the surface. The lean tools, practices and process management techniques are the ones visible on the surface. At the same time, a more 'whole' view of lean in terms of strategy alignment, employees' engagement and behaviours and organisations' leadership forms, the bigger is the mass keeping the strength of the iceberg. Yet, the iceberg components are interdependent (Hines et al., 2008), which implies a balance between the enabling components – below the water – and the visible components – beneath the water.

Figure 2. 1: **The Lean Iceberg Model**

Source: Hines et al. (2008, p. 54)

Indeed, there is a plethoric number of lean definitions in literature with different objectives and scopes and different practices and tools targeting waste elimination and a variety of other objectives (Bhamu and Sangwan, 2014). A considerable number of lean literature review papers tried to analyse these definitions (Hines et al. 2004; Shah and Ward, 2007; Pettersen, 2009; Bhamu and Sangwan, 2014) and they would mostly admit a real difficulty in capturing them all (Bhamu and Sangwan, 2014). Reaching a conclusion that; even with the vast number of lean definitions there is no consensus on one that fits all organization needs (Pettersen, 2009). Yet, most lean authors would recommend that academics and practitioners view lean from the philosophical angle (Ohno, 1988; Vasilash, 2000; Liker, 2004; Bhasin and Burcher, 2006) rather than the toolbox one. Bhasin and Burcher (2006) literally trace some failures to lean implementation to implementers default to treat lean as a philosophy not just another tactic, process or strategy that one can use occasionally to target a group of end results. Bhasin (2012, p. 454) demonstrates that; *"every organisation's Lean journey is unique and to simply recommend replicating another organisation's processes would be imprudent since the cultures, organisational pressures and supporting infra-structures vary. Evidently, by concentrating on the tangible outcomes, organisations lose sight of the intangible aspects of change and culture and in particular that companies comprise of people".* Liker (2004) also suggests that the way to a lean organisation should involve the right mixture of people, processes, a long-term philosophy and approaches to problem solving. This coincides with how Seddon et al. (2011, p. 42) describe the means leading to lean implementation as something that should be *"experimental, empirically-based and emergent (as change was for Taiichi Ohno) in contrast to 'project managed' or predetermined change".* Hence, this research follows Ohno's (1988;), Vasilash's (2000) and Liker's (2004) view of lean management as a 'philosophy' that has no simple rule guarded model (Maskell and Baggaley, 2004), but is mainly dependent of each organisation journey which will typically take into account the lessons learned from the Toyota corporation experience.

2.3 Lean Management Principles

In their Book, "Lean thinking" Womack and Jones (1996) identified five main principles of a lean which are: (1) specify the customer value, (2) identify the value stream, (3) keep the process flow, (4) the pull principle and (5) the perfection principles

(Womack and Jones, 1996; Haque and Moore, 2004, Alves et al., 2012). This section presents a brief discussion on each of these principles.

2.3.1 Specify the Customer Value

The first lean principle targets defining what constitutes a value adding activity from the perspective of the customers (Haque and Moore, 2004; Maskell and Baggaley, 2004). Traditionally this has always meant freeing the production process from any activities that are perceived as "muda" or waste, i.e. reducing costs through waste elimination (Hines et al., 2004; Bicheno, 2004). However, an evolution of lean did strengthen the customer focused mind set. That is; even if an activity seemed wasteful or costly from a shop-floor viewpoint, it is only the customer who shall define what constitutes a wasteful activity and what does not. Even in cases where the buyer is not the user of the product or service, a lean perspective defines value as perceived by both the buyer and the end user (Emiliani and Stec, 2005).

Ward and Graves (2004, p. 4) quotes Womack and Jones comment on how lean companies apply the first lean principle stating that lean companies;

> Precisely define value in terms of specific products with specific capabilities offered at specific prices through *a dialogue with specific customers*.

Hines et al. (2004) show that the lean value principle is not only about eliminating wasteful activities and reducing costs from the shop floor viewpoint. Fulfilling the value principle shall also include adding more activities and features that shall not be always costly, yet they do increase the customer's value proposition of the product or service provided. Examples of these activities include; offering shorter delivery cycle times or smaller delivery batches.

2.3.2 Identify the Value Stream

The second principle of lean focuses on aggregating all value adding activities needed to produce a product or provide a service in one value stream. Such process includes the removal of all wasteful and non-value adding activities included in offering products or services (Bicheno,2004; Haque and Moore, 2004; Bicheno and Holweg, 2016). Kennedy and Brewer (2006, p. 66) define a value stream as;

> A value stream represents all activities and resources consumed from the time a customer order is received until the product is delivered to the customer. This includes accounting, sales, purchasing, and receiving as well as all steps in production including support areas such as maintenance and distribution.

To Maskell and Baggaley (2004, p. 105) the ideal value stream is the one including *"... all the steps required to create value for the company's customer for a family of products. These products are a family because they all require similar steps through the value stream"*. Figure 2.2 represents an illustration of how a value stream should mostly look like. A typical format of a value stream shall start from sales or order entry till product shipment or service delivery and shall even include after sales/delivery support services. It is usually unadvisable to identify value streams revolving around operation processes solely.

Companies matured with lean even extend their value streams to include customers and suppliers (Maskell and Baggaley, 2004). Value Stream Mapping (VSM) represents the lean tool most related to this second principle. Rother and Shook (2003) define VSM as a tool used to help visualize the whole operating process including both material and information flow. It is aimed at improving process operation through a three steps approach of detecting sources of waste; 1) select a relevant product family for improvement, 2) use actual operating process to extract information useful for mapping the current product family value stream state and 3) construct a future potential map for the targeted family value stream.

Mcdonald et al. (2002) used a dedicated product family line in a small company to demonstrate how the use of some technological approaches like simulation can complement VSM and help envisage more dynamic features of the product family future state value stream. An idea also emphasized by Abdulmalek and Rajgopal (2007). VSM not only provides a way for pinpointing waste sources subject to future elimination, but also serves as an approach to improvement through the development of product families future state maps. An operating way that highly matches the Japanese concept of "Kaikaku", which entails the continuous inspection and questioning of production processes for purposes of discovering non-value adding activities and improving the system's value adding ones (Moore and Scheinkopf, 1998, Bicheno,

2004). However, Pepper and Spedding (2010) would view the idea of integrating complex software such as simulation modelling with VSM a bit of time consuming which can affect the validity of the mapped model to provide timely data for potential change.

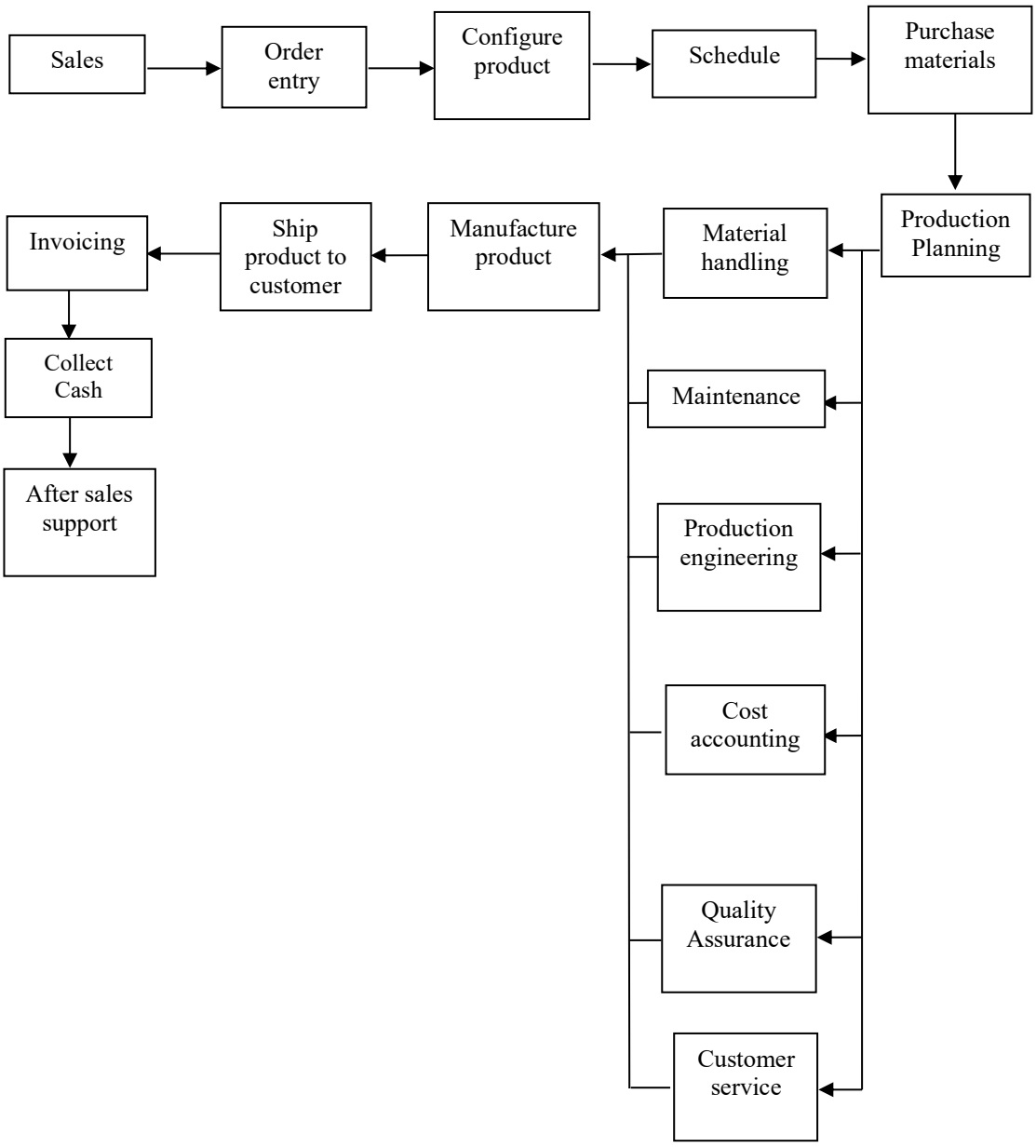

Figure 2. 2: Typical Format of a Value Stream
Source: adapted from (Maskell and Bagagely 2004, p. 95)

A next step following mapping of the value streams should be the division of machinery and equipment into cells included in each value stream so that people involved in each value stream i.e. value stream teams can be identified (Kennedy and Brewer, 2006). An ideal value stream shall include every person who aids in creating a customer value and it is quite common that there are shared personnel across value streams as it perceived that such condition will be eliminated through cross training programs whenever the organization is short of skilled people and the more it gets acquainted with lean implementation (Maskell and Baggaley, 2004).

At the same time, even with the benefits of VSM as a tool supporting the second lean principle, Pepper and Spedding (2010) will not still qualify having a powerful set of value stream maps as lean. A true implementation of lean for them is the one that has a holistic understanding of the lean philosophy.

2.3.3 Keep the Flow of Process

The third principle of lean aims at sustaining a rapid smooth flow of the production process. In other words; *"Make the remaining value creating steps flow"* (Haque and Moore 2004, p. 1387). This lean principle seeks to optimize the three types of flow within a value stream; the flow of information, the physical flow of materials and other inventory and the flow of cash so that the whole pace of the process of creating customer value is maintained effectively (Maskell and Baggaley, 2004). This is done through replacing clusters of functional departments with cellular teams, where a number of cells are responsible for the production of a certain product within the value stream which shall motivate a smooth "Single Piece Flow" of the product within the value stream (Bicheno, 2004). This means that whenever work is done over a product in a certain cell, the product is moved to another cell when this cell is vacant, i.e. having available space ready to complete working on the product. The idea of single piece flow minimizes the effect of inventory queues consequently decreasing production time and speeds up customer delivery time (Kennedy and Brewer, 2006).

A famous tool associated with the flow principle is the 5S practice. The 5S includes the five key aspects explained in Table 2.1, which collectively aim at alleviating the disorganization slack within lean firms. According to Eaton and Carpenter (2000) an

application the 5S practice helps operationalize the idea of change by practically integrating it to the shop-floor. To Kennedy and Brewer (2006, p. 67) the use of 5S creates a sense of ownership among workers who eventually feel more responsible of their production cells, which adds to their understating of the operating process so they can easily discover areas for wastes and prevent processing errors.

5S	**Methodology Objective**
Seiri/Sort	Separate the necessary things from the unnecessary and discard the unnecessary
Seiton/Straighten	Neatly arrange and identify things for ease of use (a place for everything and everything in its place)
Seiso/Shine	To always clean up; to maintain tidiness and cleanliness – to clear your workplace thoroughly
Seiketsu/Standardize	To constantly maintain the 3S mentioned above, Seri, Seiton and Seiso.
Shitsuke/Sustain	To have workers make a habit of always conforming to rules

Table 2. 1: The 5S Practice

Source: adapted from (Kennedy and Brewer 2006, p. 67)

Warwood and Knowles (2004) surveyed a sample of 100 manufacturing and service UK organisations, in an attempt to investigate the effect of using 5S in UK industry. Their survey results showed that 5S leads to the creation of an organised and clean workplace, improves the flow of work and allows for more available workplace. More importantly, Warwood and Knowles (2004) report that there is a great scope for the use of 5S outside the manufacturing environment. Yet, in the same way that Pepper and Spedding (2010) see VSM as powerful within the context of a whole philosophical implementation of lean, they also regard the use of 5S on its own or prior to major system approach to lean implementation as self-limiting, to them 5S shall be implemented as part of the whole lean initiative.

2.3.4 The Pull principle

The pull principle of a lean means that customer orders shall pull the production of products (Bicheno, 2004; Kennedy and Brewer, 2006, Alves et al., 2012; Bicheno and Holweg, 2016). In other words, products and services are processed not only in the way customers want them but also only when customers order them (Womack and jones, 1996; Haque and Moore, 2004). Some authors define a system as being lean or not on basis of the extent to which it succeeds in decreasing buffering costs associated with the production of more goods and services (Hopp and Spearman, 2004). De Treville and Antonakis (2006, p. 102) define lean as;

> Lean production is an integrated manufacturing system that is intended to maximize the capacity utilization and minimize the buffer inventories of a given operation through minimizing system variability (related to arrival rates, processing times, and process conformance to specifications).

Variability is regarded as the main cause of increasing buffering costs (Hopp and Spearman, 2004; De Treville and Antonakis, 2006). Hopp and Spearman (2004) report that variability can be present in anything that is not regular and predictable in the system which can be caused by either internal factors (setups, rework, scheduled and unscheduled downtime, production rates fluctuations caused by operators…etc.) or external ones (customer change orders, producing variable products in response to market needs…etc.). To them regardless of the sources of variability it shall be buffered in some sort of a way. That is why the fourth lean principle of pull works effectively after the flow principle. As Seddon (2003) reports; Ohno's solution to the variability problem in Toyota was to put variety in line with the process, a thing that cannot feasibly be sustained without the cooperation of both the flow and pull principles.

"*Takt time"* and the use of *"Kanban"* systems represent the lean practices usually associated with the pull principle. Takt time is computed using the available production time divided by the rate of customer demand per day (Moore and Scheinkopf, 1998). In other words, the takt time is the rate at which the customer demands a product, which helps companies identify the pace of production. Kanbans represent *"A signal from a downstream process in the production line that indicates to an upstream process that it*

needs to have parts replenished" (Maskell and Baggaley 2004, p. 100). Kanbans help control inventories through the use Kanban cards restricting the quantity of inventory moving and being processed on the shop floor.

At the same time, Hopp and Spearman (2004, p. 141-142) criticize the way organizations tend to view the pull principle as equivalent to just the idea of "make-to-order", which they perceive as one of the reasons why various organizations would see having a Kanban system as the exact operationalization of the lean pull principle. Holweg (2007, p. 432) regard the lean concept as *"the outcome of a dynamic learning process that adapted practices",* which shall explain why Hopp and Spearman (2004) tend to stick Ohno's view of the pull principle as strategic rather than tactic, through which Ohno meant that organizations shall generally "level" production and demand so as to meet variety of demands.

2.3.5 The Perfection Principle

The fifth principle of lean seeks the pursuit of perfection through the continuous removal of all forms of waste (Womack and Jones, 1996; Haque and Moore, 2004; Hines at al., 2004). Since the preceding four principles will eventually make more capacities available and potentially reduce effort, time, cost, space and processing errors then new improvement opportunities can be offered. So, the perfection principle urges lean adopters to always focus on continuous improvement activities in order to make the best use out of available capacities and still offer value adding products and services to their customers. Most lean firms seek continuous improvement *"Kaizen"* efforts to sustain the perfection principle of lean (Bicheno, 2004). Kaizen is the Japanese word for "continuous improvement" (Womack and Jones, 1996; Liker, 2004; Suarez-Barraza et al., 2009) which represents a philosophy that targets the improvement of all the business functions that support the conversion of inputs into final output products (Stevenson, 2005).

Lean firms use kaizen tools to continuously improve their operating processes, eliminate wastes and achieve high profitability levels (Emiliani and Stec, 2005) and thereby achieve better competitive positions. The lean perfection principle also seeks the use of continuous improvement/kaizen efforts to empower employees and front-line

workers through cross-training programs. Such improvement efforts develop opportunities for problem solving (Staats et al., 2011) and motivate employees to get involved in quality related decisions that help improve the operating process continuously (Baggaley, 2006). Continuous improvement and the development of multifunctional teams are very crucial aspects of lean thinking (Baggaley, 2006), even with regard to managing lean service institutions (Bowen and Youngdhal, 1998, Ahlstrom, 2004; Liker and Morgan, 2006). As reported by Malmbrandt and Ahlstrom (2013, p. 1150); *"the participation of employees in improvement teams where problems are brought up and systematically solved by the people that actually do the work is the basis of this lean principle"*.

2.4 Toyota Production System and the Spread of Lean Management

Reminiscing his experience with developing lean i.e. the then known as Toyota Production System (TPS), Taiichi Ohno, Toyota's executive and one of the main founders of the TPS reports that it all began since the year 1943. It was during wartime when Toyota gave more focus to its vehicles production and sought to catch up with the U.S. automobile production (Shimokawa and Fujimoto, 2009). Productivity levels in the U.S. automobile industry were almost ten times higher than that of the Japanese. That is why Taiichi Ohno reckoned that such large productivity gap cannot be solely attributed to equipment productivity factors. Consequently, Ohno focused on a whole modification process for Toyota's production system (Womack et al., 1990; Shimokawa and Fujimoto, 2009).

Together with other mentors of the TPS, Taiichi Ohno paid several visits to American automobile companies to learn more about the industry and through their journeys they concluded that mass production system is not be able to manifest with their Japanese market requiring a relatively high level of diversified products that come in low volumes (Alves et al., 2012). As Kennedy and Brewer (2006) suggest, Toyota was dispelling the myths behind a mass production system. From its financial crisis, during the 1940's (Shimokawa and Fujimoto, 2009), Toyota has learnt the essentiality of leveling purchasing and production to only the amount of goods demanded by customers and such goods should be produced at the time in which they are required to be sold. That is why the TPS was first acknowledged as Just-in-Time (JIT) (Fullerton

and Kennedy, 2009; Kennedy and Widener, 2008). JIT represents *"a manufacturing program with the primary goal of continuously reducing, and ultimately eliminating all forms of waste"* (Shah and Ward 2003, p. 137). Waste elimination here means the alleviation of those wastes accompanying the piling of unnecessary and un-demanded inventory in all its forms (Shah and Ward, 2007). Toyota started to use JIT practices to help level its production to the demands of customers. Then other practices including kanbans, flexible workforce and automation (Monden, 1998) began to spread across other western countries in what became known as the "Japanese system" (Womack et al., 1990).

Toyota's focus on implementing a JIT approach to manufacturing was coupled with the application of a whole quality control system that made sure products were produced just in the quantity, quality and time demanded by the customers. Consequently, production emphasis shifted from producing huge volumes of a limited interval of products to turning out small volumes of a multiple range of demanded products (Shimokawa and Fujimoto, 2009). Womack, Jones and Roos (1990) then introduced the TPS or as they called it: "lean production", in their book "*the Machine that Changed the World*", followed by Womack and Jones's (1996) "*Lean Thinking*" describing the main five lean principles and introducing the idea of the lean enterprise. Noteworthily, Taiichi Ohno was always reluctant to record some data explaining the tools Toyota used, in fear that writing the tools down may lead to "crystallizing" the concept (Ohno, 1988). This is what was referred to as 'codifying' lean as a method (Seddon and Caulkin, 2007; Seddon et al., 2011). To Ohno the TPS was more of a strategic journey not just a toolkit. In developing the TPS he also focused on establishing a system that secures the full respect of all employees through promoting their participation in running the operation process as well as continuously improving it (Sugimori, 1977). The TPS has evolved a lot since then. It integrated some of Henry Ford, Charles Sorenson and Fredrick Taylor's key practices and added its own experience to evolve into a whole management strategy that's not explicitly enclosed to manufacturing operations (Emiliani and Stec, 2005). It was obvious to manufacturers that with increasing global competition, a mass production system includes universal pitfalls that are being faced everywhere, consequently most western manufacturers started to adopt the lean thinking outside Japan and even outside the automotive industry (Hines et al., 2004).

Even though the roots of lean thinking lie within manufacturing it has eventually been adopted by various service institutions (Holweg, 2007; Alves et al., 2012; Malmbrandt and Ahlstrom, 2013; Bateman et al., 2014). To Barrosso et al. (2010, p. 4-5), the same lean production purposes of waste reduction and enhancing companies' competitiveness are easily be moved to services. Seddon and Caulkin (2007) also view the use of lean thinking as one of the most suitable ways to resolve problems related to the conventional way of managing services. Lean literature tackles several types of applications and service institutions including; new product development (Salgado and Dekkers, 2018), hospitals (Bowen and Youngdahl, 1998; Spear, 2005), Military services (Bateman et al., 2014), health care services (Kolberg et al., 2007; Grove at al. 2011; Robinson et al. 2012; Burgess and Radnor, 2013; Narayanamurthy and Gurumurthy, 2018), pharmaceutical industry (Rybski and Jochem, 2016), food industry (Bowen and Youngdahl, 1998; Ming-Te at al., 2013), airline services (Bowen and Youngdahl, 1998), banking (Bortolotti and Romano, 2012) and financial services (Delgado et al. 2010), telecommunication (Psychogios at al., 2012), software services (Staats et al., 2011) and higher education (Hines and Lethbridge, 2008; Cooper, 2009; Barrosso et al., 2010). Even with call centres, Piercy and Rich (2009) tested the applicability of lean thinking in a pure service environment through conducting a case study of call centres related to three UK financial service institutions. They concluded that, the use of lean in these call centres is able to resolve the cost-quality trade-off usually experienced in managing the majority of service institutions. Various authors would agree that, healthcare represents the major sector involved in lean service literature (Radnor and Walley, 2008; Malmbrandt and Ahlstrom, 2013). Be it in services or manufacturing organisations, most lean firms have reported similar benefits and major common barriers to its implementation. The next section explores these benefits and barriers to lean implementation.

2.5 Benefits versus Barriers of Applying Lean

The implementation of a lean management has contributed to a lot of benefits for its adopters. From a manufacturing viewpoint, such benefits include producing fewer defective products, reducing the probability of receiving defective parts from supplier firms (Oliver et al., 2002; Emiliani and Stec, 2005) and improving labour productivity (Shah and Ward, 2003; Oliver et al., 2002). As cited in Bhasin and Burcher (2006); to

Hanson and Voss (1998) the use of various practices of lean production can be directly related to improving firms' performance. More generally speaking, the use of lean has been reported to help in creating a better understanding of the business processes for labour workers, decreasing processes cycle time and better matching customers delivery dates (Shah and Ward, 2003). In addition to cost reduction, increasing profitability rates and developing new core competences for lean firms (Emiliani and Stec, 2005). The real contribution of lean is in its ability to strengthen the overall system in which it is being implemented, suggests Meier and Forrester (2002). To them, lean is able to pinpoint any system short comings if it is to be applied properly. Detty and Yingling (2000) also report that the use of lean contributes to employee empowerment, developing organizational learning opportunities and aids in revising the way management, roles and information systems are being structured. Various authors also report that using lean helps improve organisations competitiveness (Liker, 1996; Oliver et al., 1996; Standard and Davis, 2000; Vasilash, 2001; Liker, 2004).

On the other hand, there are still a lot of companies that have implemented lean and accomplished just modest improvements which do not go beyond operating activities. This has been attributed to a lack of lean implementation know-how and resistance to change problems association with the adoption of lean principles (Emiliani and Stec, 2005). Willingness to implement lean practices can be related to the organisation size, age and the industry it engages in, for example Shah and Ward (2003), found that older plants are less willing to implement lean practices compared to new plants, while large firms are more motivated to implement lean than small ones. Additionally, they found that discrete industries are more likely to implement key lean practices, such as JIT, compared to process industries, as the nature of small lots production in discrete industries makes JIT practices and Kanban implementation easier than with process-oriented industries. Hines et al. (2004) report that some organisations faced difficulties implementing lean as result of being unable to apply a production levelling and scheduling system such as Kanbans which to them a sort represented failure to adapt to customers demand variability (Hines et al., 2004).

On the other hand, a considerable body of lean and accounting literature trace lean implementation inefficiencies to failures to consider lean as a whole philosophy (Hines at al., 2004; Liker, 2004; Bhasin and Burcher; 2006; Radnor and Walley, 2008; Bhasin,

2012), i.e. a whole new culture that shall be extended to every aspect within the organisation in order to work effectively (Womack and Jones 1994; Warnecke and Hüser, 1995). Other authors trace the inefficiencies in lean implementation to the unsuitability of the traditional accounting system used to support lean behaviours (Baggaley and Maskell, 2003a; Baggaley and Maskell, 2003b; Maskell and Baggaley, 2004, Baggaley, 2006; Johnson, 2006; Chiarini, 2012; Ruiz-de-Arbulo-Lopez, 2013; Fullerton et al. 2013). The available literature either from the academic or the consultancy domain problematises the traditional accounting system to work with lean management (Ahlstrom and Karlsson, 1996; Maskell and Baggaley, 2004; Johnson, 2006; Kennedy and Widener, 2008; Fullerton et al. 2013, Fullerton et al., 2014) and suggest either shedding traditional accounting practices at all (Johnson, 2006) or using a simplified accounting system (Fullerton et al., 2013; Fullerton et al., 2014) which is referred to as *'lean accounting'* (Maskell and Baggaley, 2004; Grasso 2005; Maskell and Kenney, 2007; Kennedy and Widener, 2008). However, as will demonstrated in detail in the next chapter, our understanding of the MAS associated with lean is still ambiguous. This research focuses on this later barrier to lean management implementation given its two main aims of this research; 1) to develop a theoretical conceptualisation of the development of MAS in the context of lean and 2) to investigate the role played by management accounting practices suggested for lean firm namely the use of the lean accounting Value Stream Costing (VSC) tool. In doing so, the research first identifies the type of innovation to which lean management belongs and the form of organisation arrangement it represents as discussed in the next section.

2.6 Lean Management as a Process Innovation and a Horizontal Organization Arrangement

In general terms, innovation has been defined as the process of developing and/or using new ideas or new behaviours (Zaltman et al., 1973; Daft, 1978; Walker, 2006). Danampour and Gopalakrishann (2001), define innovation as the adoption of an idea or behaviours which relate to a new organisation product, service, system, policy or programme. Conceptually, the term innovation describes an idea or behaviour that can be new to any of; the whole organisational, an individual adopter, an organisational department/ sector, a whole industry or an organisational population (Damanpour and Evan, 1984; Bantel and Jackson, 1989; Walker, 2006; Danampour et al., 2009). To

Chenhall and Moers (2015, p. 2) innovation is defined as; '*the creation and implementation of new products, services and processes which result in significant improvement in outcomes.'* The term innovation has mostly been linked to the concept of creativity however, the adoption procedure is what differentiate between the two concepts (Chenhall and Moers, 2015). In other words; creativity is associated with the production of new ideas while, innovation is the 'successful implementation'/ 'adoption' of these new/creative ideas (Amabile et al., 1996, p. 1154-1155; Chenhall and Moers 2015, p. 2). In explaining the various reasons why organisations innovate, Damanpour et al. (2009) noted that this could be attributed to external environment pressures such as change in customer demands, lack of resources, competition, isomorphism or deregulation or an organisational choice made internally for purposes of achieving a remarkable competitive advantage or a higher level of aspiration. They conclude that in either cases; *'the adoption of innovation is intended to ensure adaptive behaviour, changing the organization to maintain or improve its performance'* (Damanpour et al., 2009, p. 653).

The innovation literature has been consistent in the way authors have defined the term. In other words, one can conclude that there is an overall agreement between innovation authors that the term is used to denote the process of adopting new ideas or behaviours. Authors only varied in the way they had defined the different typologies of innovations. Zaltman et al. (1973) identified 20 types innovations that they then categorised into the three groups of; innovations related to the organisation's status, group of innovation that differ according to main innovation focus and a third category that includes innovations that differ according to the outcome expected from the adoption of each innovation type. However, the two most widely discussed types of innovation are product and process innovations (Abernathy and Utterback, 1978; Kotabe and Murray, 1990; Light, 1998). Elaborating the distinction between those types of innovations Kotabe and Murray (1990, p.389) stated that;

> ----innovation may be defined as know how composed of product technology (the set of ideas embodied in the product) and process technology (the set of ideas involved in the manufacture of the product or the steps necessary to combine new materials to produce a finished product) [Abernathy and Utterback 1978; Capon and Glazer 1987; Acs and Audretsch 1988].

Innovation literature views both products and service innovations as a type of innovation that is characterised by an external focus, is market driven and leads to a differentiation in organisations output supplied to the market (Damanpour and Gopalakrishnan, 2001). Accordingly, the innovation literature makes no distinction between the conceptualisation of an innovation implemented in a service offered or in a product manufactured (Miles, 2001). If a difference is to be noticed between both innovations, it would only be the one associated with the external factor to which the product or service innovation is offered, i.e. the type of customer or client and his/her specific demands (Damanpour et al., 2009). According to Boer and During (2001), process innovations come in contrast to product or service innovations in terms of having a rather internal focus. Process innovations seek to enhance the efficiency and effectiveness of organisations' internal processes for purposes of facilitating the production and delivery of organisations' outputs (be it products or services) (Abernathy and Utterback, 1978; Boer and During, 2001, Damanpour et al., 2009).

Innovation research distinguished between two types of process innovations namely; technological/ technical process innovation and administrative process innovations (Damanpour and Evan, 1984; Edquist et al., 2001; Meeus and Edquist, 2006). Technological process innovations are those process innovations associated with the modification of organisations' operating system or processes (Meeus and Edquist, 2006). Technological process innovations are defined as; the new elements adopted by an organisation's production or operating system used in producing goods or services for the organisation's customers (Damanpour and Gopalakrishnan, 2001). The main objectives of this type of process innovation is to reduce delivery times, lower production costs and increase operational flexibility (Boer and During, 2001).

Administrative process innovations are those having a more social or managerial core (Meeus and Edquist, 2006; Damanpour et al., 2009). They are the new practices and approaches used in modifying the organisation's managerial processes, structuring functional units and tasks, devising strategy and establishing organisational reward system (Light, 1998; Birkinshaw et al., 2008). They are defined as;

> Administrative process innovations pertain to changes in the organization's structure and processes, administrative systems, knowledge used in performing

> the work of management, and managerial skills that enable an organization to function and succeed by using its resources effectively (Damanpour et al., 2009, p. 655).

For this research, lean management is viewed as one form of a process innovation. More specifically a technological process innovation that seeks to modify an organisation's operating system and processes to achieve various organisational objectives (Boer and During, 2001; Damanpour and Gopalakrishnan, 2001; Meeus and Edquist, 2006; Damanpour et al., 2009) including waste elimination, increasing customers value added, enhancing delivery times and various other organisation specific objective which can be association with lean management adoption.

Lean management is not only viewed as a technological process innovation but also with its lateral process view, lean is an example of a horizontal form of organisations arrangements (Chenhall, 2008). As Chenhall (2008, p. 538) put it;

> An important aspect of horizontal organisations is the application of advanced manufacturing practices in ways that integrate best practice operations with customer focused strategies and structures that are designed laterally with supporting HR and IT initiatives.

Elaborating his quote, Chenhall (2008) notes that aspects of such advanced manufacturing practices that are viewed as a form of horizontal organisation arrangement, can be found in practices as JIT and later in the application of what we now know as the lean manufacturing/ management system. According to him, the distinctive characteristics of a horizontal organisation related to two main categories; 1) the strategy to implement/ adopt this type of organisation arrangement and 2) the consequent orientation of organisation processes, structures and human resources. These characteristics can be easily traced in the lean management definition a philosophy and in its 5 principles. According to Schonberger (2001) horizontal forms of organisations are primarily centred around meeting customer demands. Chenhall (2008) identifies that such customer centric view entails that products, teams and performance objectives are focused on integrating customers preferences to the production process and develop an

overall organisational culture the promotes ‘customer value adding activities.’ More specifically, Ostroff (1999) explains that;

> --- the decision to develop a horizontal organisation (HO)---requires senior managers to identify the company’s ‘winning value proposition’ and then to assess whether a HO should be implemented and, if so, what type of HO should be developed. Value propositions indicate what the organization can do to create and deliver value to its customers and are often encapsulated by specific mission statements and credos.

The previous description of the strategic characteristic associated with the adoption of horizontal form of an organisation is almost the same description of how lean organisations shall identify their value preposition as defined by the first lean management principle (Haque and Moore, 2004; Maskell and Baggaley, 2004) discussed earlier in this chapter. The second characteristic of a horizontal organisation stresses that approaches to organising organisational production processes, organisational HR initiatives and over all structure should also be revolving around customers (Chenhall, 2008; Kastberg, 2014). These approaches include continuous improvement aspects, improving response and delivery time, removing wasteful activities, quality improvement, producing at the customer’s average demand and enhancing flexibility of production processes and between work teams (Schonberger, 2001). All of which are approaches included in the lean management’s 5 principles and its definition as a whole philosophy targeting almost all organisational aspects (Emiliani and Stec, 2005).

At the same time, the available management accounting and lean management literatures do not provide a rigor understanding, nor a comprehensive empirical analysis of the MAS associated with lean as one form of a horizontal organisational arrangement. As Hansen and Mouritsen (2007) reports, when it comes to management accounting and control practices needed in a lateral form of an organisation such as the one seen in lean companies, operations management and management accounting researchers confront and the argument in mainly on which field of research should be responsible of developing controls. As mentioned earlier, there is a considerable body of accounting literature that points to the need for a simplified accounting system with

horizontal organisation arrangements such as lean (Fullerton and Mcwatters, 2002; Anderson, 2007; Fullerton et al., 2010) for example increasing the dependency on non-financial performance measures (Ittner and Larker, 1995; Chenhall, 1997; Fullerton and Mcwatters, 2002). There is another stream of literature that would suggest shedding most of traditional accounting practices (Johnson, 2006) and another explaining how the use of operating controls can eventually substitute the need of accounting in horizontal organisation arrangements such as lean (Hoque and James, 2000; Davila and Wouters, 2006). However, it has been reported that insights into the management accounting practices - especially those related to costing - needed in a horizontal organisation were more frequently found in operation management, finance, strategy and even information technology literature rather than in accounting (Anderson, 2007). Chenhall reports that;

> There are no studies that have addressed, directly, how management accounting practices have been employed to help configure HO to achieve lateral coordination focused on customers, or how they are implicated in decisions within HO (2008, p. 539).

Following from Chenhall's comment on the connection between lean as a form of horizontal organisation and management accounting literature, the coming sections present a detailed discussion of the various definitions of the management accounting and control system, the control frameworks commonly discussed in MA literature, the different categorisations of the term 'control' together and provide an explanation of why this research choses to focus on the term MAS rather than MCS. The review of literature presented in this chapter then explores the literature on MAS and innovations to analyse how this literature can contribute to the study of MAS in the context of lean as one type of innovations. The literature review then concludes by exploring the new management accounting system suggested for lean 'lean accounting' to identify its different definitions, the lean accounting principles and present an explanation of the operation of its value stream costing tool.

2.7 Management Accounting and Management Control Systems: A discussion of the Various Definitions

The literature on management accounting (MA) and management controls (MC) have presented different approaches in which a management control system (MCS) can be defined. Over time this literature has also offered various ways of categorizing and developing frameworks for such management controls (Otley, 1999; Tessier and Otley, 2012). At the same time, various authors (Chenhall, 2003; Bisbe et al., 2007; Malmi and Brown, 2008; Tessier and Otley, 2012) point out to how the research on MCS lacks consistency and precision on which control practices are to be included in defining a MCS and this was attributed to the various approaches used to define the system. This section presents a discussion of the various ways used to define it.

According to Chenhall and Moers (2015), old literature on MC started by the simple term management accounting (MA) that was then expanded to include more management accounting practices and was then referred to as the management accounting system (MAS). A global market with a variety of uncertainties lead researchers to think of MA as more than just the calculative practices of budgeting and standard costing that are used to implement organisation's strategies (Anthony,1965). Managing in uncertain conditions together with the advancements achieved with innovations meant expanding the notion of control. Hence, expanding on what constitutes MA and better refer to it as MC which constitutes different groupings of controls. For example, Anthony (1965) divided management actions into planning and control actions and accordingly there would be planning controls and other performance measures controls in place. Controls were also then grouped according to their purposes, for example beliefs, boundary, diagnostic and interactive systems (Simon, 1995b). Chenhall (2003) grouped management controls into organic and bureaucratic controls.

The term MA has also evolved to include the classic practices as well as the newer ones such as activity-based costing and the BSC (Chenhall and Moers, 2015). Overtime, even the term MC and the technologies used in defining its groups of controls, have developed to include further complexities in organisation's business models (Nixon and Burns, 2005). Accordingly, the notion of controls has expanded and brought various

aspects of controls; operational controls, management controls and strategic planning controls, closer (Otley, 1994) in an integrated term which we now refer to as the management control system (MCS). MCS has been referred to as a 'package', a 'system' or a 'collection of control mechanisms' (Grabner and Moers, 2013).

As mentioned earlier the definition of what constitutes an MCS has developed overtime to become broader and more inclusive. Tables 2.2 and 2.3 provides a presentation of the most commonly used definitions of an MCS in academic literature (Willert and Otley, 2016, p. 18). From the definitions presented in table 2.2, Anthony (1965) presents a narrow definition of MCS that related to the old view of MA as a 'process' used by managers to make sure resources are used in an efficient and effective way. Fisher (1995) definition does not depart much from Anthony's (1965) view of MCS as a process but it strictly restricts the definition to the control managers exerts over each other.

Author	**MCS Definition**
Anthony (1965, p. 17)	"Management control is the process by which managers assure that resources are obtained and used efficiently and effectively in the accomplishment of the organisation's objectives."
Fisher (1995, p. 25)	"Management control is defined as the control managers excise over other managers. It is the process by which corporate-level managers ensure that midlevel managers carry out organizational objectives and strategies."
Simon (1995b, p. 5)	"Management control systems are the formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities."
Otley (1999, p. 364)	"Management control systems provide information that is intended to be useful to managers in performing their jobs and to assist organizations in developing and maintaining viable patterns of behaviour. Any assessment of the role of such information therefore requires consideration of how managers make use of the information being provided to them."

Table 2. 2: Most common definitions for MCS – (from 1960's to 2000)

Author	MCS Definition
Bisbe and Otley (2004, p. 709)	"The term Management Control Systems (MCS) refers to the set of procedures and processes that managers and other organizational participants use in order to help ensure the achievement of their goals and the goals of their organizations (Otley & Berry, 1994), and it encompasses formal control systems as well as informal personal and social controls"
Merchant and Otley (2007, p. 785)	"In broad terms, a management control system is designed to help an organization adapt to the environment in which it is set and to deliver the key results desired by stakeholder groups, most frequently concentrating upon shareholders in commercial enterprises. Managers implement controls, or sets of controls, to help attain these results and to protect against the threats to the achievement of good performance."
Malmi and Brown (2008, p. 290)	"Our suggestion to clarify these issues is to start with the managerial problem of directing employee behaviour. Those systems, rules, practices, values and other activities management put in place in order to direct employee behaviour should be called management controls. ---management controls include all the devices and systems managers use to ensure that the behaviours and decisions of their employees are consistent with the organisation's objectives and strategies but exclude pure decision-support systems."
Ferriera and Otley (2009, p. 264)	"---we prefer to use the more general descriptor of performance management systems (PMSs) to capture a holistic approach to the management and control of organizational performance. We see this term as including all aspects of organizational control, including those included under the heading of management control systems. ----we view PMSs as the evolving formal and informal mechanisms, processes, systems, and networks used by organizations for conveying the key objectives and goals elicited by management, for assisting the strategic process and ongoing management through analysis, planning, measurement, control, rewarding, and broadly managing performance, and for supporting and facilitating organizational learning and change."
Merchant and Van der Stede (2012, p. 6)	"The term management control--separates the management functions along a process involving objective setting, strategy formulation, and management. Control, then is the back end of the management process."

Table 2. 3: Most common definitions for MCS – (from 2001 onwards)

Even though Simon (1995b) seems broader that the previous two definitions in the sense that the definition expand to include; 'formal, information-based routines and procedures' used by managers, the definition failed to include informal controls discussed later in other definitions. Otley's (1999) also does not depart much from Anthony's (1965) other than providing more elaboration on the MCS role 'to assist organisations in developing and maintaining viable patterns of behaviour. Otely (1999) then expanded on Anthony's (1965) definition to include strategy planning and informal controls. Albeit it being regarded as a broad definition of MCS which unpacks the pillars of MCS as a process of, 'objective setting, strategy formulation and management', Merchant and Van der Stede definition in 2012 can still be regarded as one of the definitions stemming from Anthony's (1965) view of MCS as a process.

As displayed in table 2.3, A relatively new way of looking at what constitutes an MCS is the one offered by Merchant and Otely (2007), where the definition the definition links MCS to the environment in which an organisation is set and to the objectives required by stakeholder groups. The definition also goes on to elaborate of the idea of what does it for an organisation to be 'in control'. Another way of looking at the MCS definition was the one proposed by Malimi and Brown (2008), where the definition refers MCS to the 'systems, rules, practices, values…put in place in order to direct employee behaviour' and also to 'support decision making'. Unlike the rest of the definitions extending from the old MCS set by Anthony (1965), Ferriera and Otley (2009) view such definition as being of a 'restrictive' nature. They prefer to use the term Performance Management Systems (PMS) in an attempt to capture a 'holistic approach' that encompasses both 'management and control of organisational performance'. Ferriera and Otley's (2009) definition integrates a second level to readers perceptions about MCS to include 'systems, networks, information flows and facilitating organisation learning and change'.

As it can be seen from the previous discussion on various ways of defining MCS, as time goes, MCS become broader and more inclusive to cope with today's complex, uncertain and dynamic environment and help best serve organisations future development (Bisbe and Otley, 2004; Merchant and Otley, 2007). However, a common trend in the more recent definitions is that they are usually tailored to 'reflect authors research questions…and are consequently difficult to compare across studies' (Willert

and Otley, 2016, p. 4). For example, a recent study by Chenhall and Moers (2015) on the integration of innovation into management control, uses a definition the serves the purpose of their paper by stating that;

> We define MCS as a set of many formal and informal input, process and output controls that are used by management to achieve organisational goals; the controls are connected by many complementary relationships. MCS become more complex when they have many controls that are connected by many relationships that depend on their environmental and organisational context. (2015, p. 1).

In their definition of an MCS, Chenhall and Moers coincide with many earlier authors in viewing management controls as formal and informal controls (Simon 1995b; Otley, 1999). Yet, they keep on emphasizing the 'connection' between controls and how this is crucially related to 'environmental and organisational context'. The emphasis on environmental and organisational context here served the authors research question on the role of innovation in the evolution of MCSs. They then explain that they have chosen this definition given the nature of their study integrating innovation into management control context were they *'see MCS acting as a calculative practice focused on innovation'* (Chenhall and Moers 2015, p. 2). For this research, a detailed discussion of the various ways of defining an MCS, its frameworks and the different control categorisations is presented in this section and the next two sections. A discussion of the definition chosen for this research is presented in section 2.11 following an analysis of the multiple control aspects available in management accounting literature.

2.8 MCS Frameworks

The literature on MCS has developed various frameworks that seek to assist in categorising and analysing organizational used management controls. Table 2.4 displays the most commonly used frameworks in the literature on MCS (Willert and Otley 2016, p. 18) with an explanation of the purpose of each framework.

Authors	Purpose of the framework
Simon (1995)	The levers of control (LOC) framework was proposed as a method to control and implement business strategies. "A new theory of control that recognizes the need to balance competing demands is required. Inherent tensions must be controlled, tensions between freedom and constraint, between empowerment and accountability, between top-down direction and bottom-up creativity, between experimentation and efficiency. These tensions are not managed by choosing, for example, empowerment over accountability – increasingly, managers must have both in their organizations."
Otley (1999)	"This paper proposes a framework for analysing the operation of management control systems structured around five central issues. These issues relate to objectives, strategies and plans for their attainment, target-setting, incentive and reward structures and information feedback loops." "The intention of this paper is to provide a perspective more focused on the operation of overall control systems, and to do so by looking beyond the measurement of performance to the management of performance."
Malmi and Brown (2008)	"This analytical conception of MCS as a package provides a sufficiently broad, yet parsimonious, approach for studying the phenomenon empirically. Its aim is to facilitate and simulate discussion and research in this area, rather than suggesting a final solution to all related conceptual problems." "The purpose of this editorial is to enlighten the above-mentioned issues and lay a foundation to enable researchers to continue developing research on MCS."
Ferreira and Otley (2009)	"this paper puts forward the performance management systems framework as a research tool for describing the structure and operation of performance management systems (PMSs) in a more holistic manner." "Anecdotal evidence suggests that the extended framework provides a useful research tool for those wishing to study the design and operation of performance management systems by providing a template to help describe the key aspects of such systems. It allows a holistic overview to be taken while making this a feasible task."

Table 2. 4: Four of the most commonly Cited and Used Frameworks in MCS Literature

An initial step to discussing MCS frameworks is to mentions Anthony (1965) framework defining an MCS. Anthony's paper is almost the most cited paper when discussing MCS since his definition is one of the first definitions to specify what is an MCS and most frameworks followed on after referring to his definition. Anthony developed the term MCS and defined it and by this he made a distinction between operational control, controls for strategic planning and controls for management. Of the four listed frameworks in table 2.4, Simon (1995b) levers of control (LOC) framework is the one which has been used by most authors (Bisbes and Otley, 2004; Widener, 2007; Mundy, 2010; Tessier and Otley, 2012) in management accounting literature.

In his book, 'Levers of Control', Simon (1995b) aimed at developing an analytical tool that managers can use for controlling and implementing their organisational strategies. In this context, Simon identified controls into four groups based on control purposes: beliefs, boundary, interactive control and diagnostic control systems. However, Simon (1995b) received some criticism from other academic researcher including Bisbe et al. (2007). According to Bisbe et al. (2007) the framework failed to relate the four LOC to specific theory. Ahrens and Chapman (2004) also criticized the framework for its operationalisation difficulty.

With the aim of developing a simple framework that is intended to be used in analysing the operation of management controls, Otley (1999) develop his 5 dimensions framework which related analysed controls in terms of objectives, strategies and plans, target, reward and feedback loops. At that time, Otley's (1999) framework was distinguished in being simple, holistic and dynamic in the sense that the dimension-based analysis of management controls would change with the change in organisation settings in order to ensure the effectiveness of the controls used over different periods of time. Malmi and Brown (2008) presented a management control framework that treats management controls as a package. They divided controls into the 5 types of: cultural controls, planning controls, cybernetic controls, controls for reward and compensations and administrative controls. In their framework, Malmi and Brown (2008) were trying to strengthen readers understanding of the parameters of controls. For example; they built on Flamhotz (1983) definition of organisation's culture to explain three types of cultural controls; value-based controls, symbol-based controls and clan controls.

In 2009, Ferreira and Otley extended Otley's (1999) simple framework to a more comprehensive management control framework that added the elements of: vision and mission, organisation structure, key performance measures, information flow, changes in performance measurement systems, performance evaluation and strength and coherence, to the previous five control dimensions propose by Otley in 1999. Both Malmi and Brown (2008) and Ferriera and Otley (2009) frameworks are similar in terms of seeking to expand and enhance users understanding of the different parameters of an MCS, in being a broad and holistic MCS frameworks and in including the idea of interdependency between controls for their effective implementation.

The MCS frameworks discussed in section are the four most commonly cited control frameworks in management accounting literature. The frameworks represent different patterns of designing and analysing management controls or management control system. However, the effectiveness of these frameworks depends on how managers practically use them (Simon 1995a, p. 5).

2.9 Different Categorisations of Controls

The literature on MCS have categorised controls into various categories depending on the controls' objectives. According to Hopwood (1976) controls are categorised into administrative controls which involve the standard rules governing operating procedures and social controls which include personal controls affecting people's behaviour such as employees shared values and norms together with organisations' formal agreements and hierarchal structures. Merchant (1985) categorised controls into action, result and personnel controls, where action controls are those used to manage employees' behaviour and make sure they act in accordance with the organisation's guidelines. Result controls are those controls related to organisation target results, they are used to keep employees accountable for their work outcomes and are sometimes tied with organisational rewards. Finally, personnel controls are controls used to trigger employees' self-development and control through the creation of a common organisation culture of employees shared norms and values. Personal controls are also referred to as clan or cultural controls and they can include employee trainings, job design and employee recruitment and promotion controls (Merchant 1985, 1998). Anthony et al. (1989) categorised controls into the two broad categorisations currently

used in most of the management control literature; formal and informal controls. According to Anthony et al. (1989), formal controls constitute the visible and objective types of controls, they include the organisational set regulations together with the established standards for operation and accounting systems procedures. They consist of the explicit sets of procedures, processes, routines and structures which are purposefully designed to assist managers in making sure organisation's strategies are being implemented (Maciarello and Kirby, 1994; Simon, 1995a; Merchant, 1998). Langfield-Smith (2006) notes that formal controls consist of the typically top-down organisational controls that form its written reports such as organisations budget reports and its performance and rewards systems. Whereas informal controls include the unwritten and unconsciously designed organisational controls, these can include organisation culture, employees' norms and values and their leadership styles (Anthony et al., 1989). They are the more social controls (Ouchi, 1977; Otley, 1980) driven from the organisation culture and might sometimes be developed in a bottom-up pattern (Das and Teng, 1998).

The terms formal and informal controls were used extensively in management control literature following Anthony et al.'s (1989) identification of those control categories. The different categorisations included in each type of controls together form the 'package' of what constitutes an MCS (Malmi and Brown, 2008; Ferreira and Otley, 2009; Grabner and Moers, 2013; Strauss et al., 2013). As much as these different categorisations and the different control frameworks have contributed to our understanding of the variety of organisational controls, such diversity of controls and control frameworks have been reported to cause a lack of precision and inconsistencies in MCS research (Chenhall, 2003; Bisbe et al., 2007; Malmi and Brown, 2008; Tessier and Otley, 2012).

2.10 MAS and MCS: From a progressive evolutionary story to an 'incommensurate' set of definitions

The management accounting literature has generally used the terms management accounting system (MAS) and management control system (MCS) – and sometimes performance measurement system (PMS) as well - interchangeably to signify the various practices, routines, procedures and controls used to make sure an organisation

achieves its goals (Chenhall, 2003; Malmi and Brown, 2008; Ferriera and Otley, 2009; Chenhall and Moers, 2015). Old literature started by the simple term management accounting (MA) (Chenhall and Moers, 2015). The term was mainly used to indicate a focus on the budgeting processes (Hopwood, 1976) and on operations efficiency which was reasonably predictable given the clear hierarchical operating setting then used (Chenhall and Moers, 2015). This was also associated with the use of the term 'cost accounting' to signify the costing practices needed for product valuation following the industrial revolution (Horngren et al., 2015). Overtime the move from operating settings with hierarchical structure to more flat and horizontal organizational settings (Kastberg, 2014) - for e.g. the use of JIT and lean production (Chenhall, 2008) - meant more complexities driven by the need to direct employees efforts to value-added activities in order to achieve organisations' goals and create new organisations' opportunities (Malmi and Brown, 2008). A global market with a variety of uncertainties lead researchers to think of MA as more than just the budgeting and costing practices used to implement organisation's strategies (Anthony,1965). Overtime, this meant expanding what constitutes MA and better refer to it as a management accounting system. According to Chenhall (2003, p. 129), *'MA refers to a collection of practices such as budgeting or product costing'*. The term MAS refers to the 'systematic' use of management accounting with its various practices to achieve some organisation goal (Chenhall 2003, p. 129; Malmi and Brown, 2008). Researchers then expanded the notion of 'control' to go beyond the management accounting practices and include almost all types of controls; formal, environmental and personal controls. According to Anthony et al. (1989);

> Control is the process of guiding a set of variables to attain a preconceived goal or objective. It is a broad concept applicable to people, things, situations and organizations. In organizations, it includes various planning and controlling processes.

In his definition of the term 'control' Anthony tried to hint to how the concept can almost include every organisation aspect i.e. people, things and situations and this what was then established by the latter literature that referred to the control. Puxty and Chua (1989) then identified three meanings of the control concept, the first one is a tool to regulate based on cybernetic meaning. Second; a mean of dominating people through

sociologic and political power and finally as of controlling management procedures. Merchant and Otley (2007) then emphasized that, the concept of control for purposes of achieving an organisational goal or objective is a comprehensive and complex function. Accordingly, various management accounting literature started to use the term MCS (Simon, 1995; Otley, 1999; Chenhall, 2003, Malmi and Brown, 2008; Ferriera and Otley, 2009; Chenhall and Moers, 2015) to signify *"..a broader term that encompasses MAS and also includes other controls such as personal or clan controls"* Chenhall (2003, p. 129).

MCS has been defined in multiple ways, almost a plethora of frameworks have been developed to identify the different types of organisational controls. However, as much as the various definitions have massively contributed to academics' and practitioners' understanding of the complex and different categorisations of controls and their operation, the multiple definitions with the variety of frameworks result in a status of incommensurate sets of definitions. Eventually recent management control literature had confirmed that the multiple frameworks with the various definitions act as a guidance for each organisation based on its needs and circumstances (Willert and Otley, 2016). This research uses Chenhall's definition of MAS as *'the systematic use of management accounting with its various practices to achieve some organisation goal'* (2003, p. 129). The research chooses to focus on the MAS rather than MCS since this matches the first research objective of: *Developing a theoretical conceptualisation of the development of MAS in the context of lean management.* The focus on a simple definition of a MAS is also helpful in avoiding the complexity embedded in the different definitions and frameworks of MCS together with the different categorisations of the term 'control'. This suits the nature of this research linking lean management, MAS and lean accounting which represents a literature integration in which our academic and consultancy knowledge is still evolving (Chopra, 2013).

A choice of a simple definition of MAS also matches the ontology of actor-network theory (ANT) as the theoretical lens for this research with its focus on human and non-human actors (Latour 1998; 1999; 2005) and helps in avoiding the drawbacks associated with previous MCS contingency based research. According to Emmanuel et al. (2004) no set of controls is able to achieve the same outcome nor the same objectives in all settings in which these controls were used. Unfortunately, the use of contingency

theory in management accounting and management control research has a lot to do with Emmanuel et al. (2004) conclusion. As much as the use of contingency theory has contributed to our understanding of controls, it has also locked in this understanding to certain contextual fit factors that in many ways have ignored the interaction between human and non-human actors in the operation and development of management accounting systems used. In 2004, Gerdin and Greve analysed the use of contingency theory in strategy-MAS research area. According to them, the excessive and different uses of the concept of fit associated with contingency theory initiate the need for reinterpreting research results whether they are contradictory or supportive. Other studies report that while the use of contingency theory directs research and practice to certain expectations about the control results, the other left out contingent variables can be the real reason for these results (Fisher, 1998; Chenhall, 2003). Previous literature has also reported that the variability in the definitions of chosen variables in this stream of research have affected theory building, testing and developed fragmented theoretical conceptualisations (Otley, 1980; Fisher, 1995; Langfield-Smith, 1997). In a recent review of the use of contingency theory in the development of MCS frameworks, Otley (2016) argues that the *'mechanistic'* approach of using contingency theory supported by the regular use of applicable questionnaires have developed a misguided approach of what has been sought to become a *'predictive mechanism'* for MCS design (p. 45). Otley reports that additions or amendments to management accounting practices or MCS currently occur at a very fast rate compared to the results that the coordination efforts done on the various MCS frameworks can develop. According to him, this is in addition to the rapidly changing organisations' environments has eventually precluded the full coordination of the variety of control system elements especially given the unpredictable nature of how new control elements can be developed by different actors at different organisation's times. Otley recommends that such narrow view of the concept of contingency has to be substituted by *'a more tailored approach that takes into account the context of specific organisations'* (2016, p. 45), which is what this research tries to do by focusing on lean management and adopting an ANT theoretical approach.

2.11 Analysing the Literature on MAS and Innovation

The literature on MAS and innovation first started by viewing management accounting practices as the mere reflection of the strategy or innovation implemented (Kaplan, 1984, 1988, 1989). Management accounting practices are mainly designed for cybernetic purposes (McSweeny, 1997). Eventually, working in more and more uncertain environments initiated the need for more interactive controls, i.e. enabling controls that are supportive of innovative effort (Chenhall and Moers, 2015, p. 10), Hence, later work viewed the innovation adopted as having an effect on the organisation's management accounting and control system (Ahlstrom and Karlsson, 1996). According to Chenhall and Moers (2015, p.10);

> It is the evolution of openness, flexibility and comprehensiveness in the design and implementation of MCS that has provided a basis upon which efforts for innovation can be motivated and sustained.

This literature shows that new innovations and working in an environment of uncertainty have led to more complex concepts about management accounting practices and controls used (Langfield-Smith, 1997; Lillis and Mundy, 2005; Henri, 2006) and accordingly has led to the development of the term MAS and then the broader term of MCS. Chenhall and Moers (2015) view innovation as a key factor affecting the evolution of management accounting system and the reason for including more complex control practices leading to the creation of what we now know as the MCS. For example, they report that developments in management accounting system including the introduction of Activity-based costing (ABC) and Activity-based management (ABM) and the inclusion of performance measurements such as the Balanced Scorecard (BSC), have been the management accounting research response to advance in technological innovations in order to be able to *'capture costs and value along the value chain'* (Chenhall and Moers, 2015, p. 8).

More recent work on MAS and innovation focuses on the role played by management accounting practices and calculations. This work can be divided into two research strands; one that focuses on the diffusion of management accounting practices (Otley, 1999; Alcouffe et al., 2008) and a second strand - which is the one associated with this

research - focusing on the role of calculative practices in relation to the strategy or innovation adopted. This strand of research regards calculative practices as calculations that 'do things' (MacKenzie, 2006; Mouritsen et al., 2009; Revellino and Mouritsen, 2015; Themsen and Skærbæk, 2018) and mediate between actors' interactions and the innovation adopted (Vosselman, 2014). In a longitudinal case study, Briers and Chua (2001) traced the consecutive procedures leading to the adoption of ABC. Albeit, not deliberately focusing on the role of ABC calculations in organisation environment or strategy used, their empirical data shows that, the use of ABC calculations stimulated an identification of organisational boundaries. As will be discussed in further details in the next chapter, Mouristen et al. (2009) report that accounting calculations affect the innovation adopted in short and long translations processes.

Revellino and Mouritsen (2015) view management accounting calculations as engines that lure people into taking certain actions. In their study on the interaction between management accounting practices and innovation, they conclude that calculations affect innovation adopted leaving other calculative traces. These traces create a trajectory which continues to influence the innovation in place and can initiate the need for new calculations. Hence, innovation drifts with changes in management accounting practices. Grottke and Obermaier (2016) analysed the role of calculative practices in two process tracing studies of two German firms using industry 4.0 innovations. They conclude that the interaction between calculative practices and different actors in the two firms developed new layers of meanings to the calculative practices leading them to have an *'iridescent'* role in the context of complex innovations (Grottke and Obermaier, 2016, p. 1). Grotek and Obermaier (2016) show that MAS practices can have interchanging roles between cameras, brakes and engines. This strand of literature is the one relevant to this research, given its focus on the role played by VSC practice and on conceptualising the developments in MAS in the context of lean, where management accounting calculations can have an influential role in such conceptualisation. Yet, most of this recent literature is not contextually lean driven. There is still no agreement nor a theoretical conceptualisation that discusses the developments in organisation's MAS associated with a process innovation or a horizontal organisation arrangement as lean. What we have now is a compilation of consultants and academic literature that give guidelines on a so called 'lean accounting system' as shall be discussed in the following sections.

2.12 Lessons from a Production-line Approach, Services and Current Manufacturing Industries

The earlier sections of this chapter discussed the development of lean thinking and the history of how it became an operational necessity to manufacturing sectors and have sequentially moved to services as well. Historically, the need to compete on fulfilling customer demands and the necessity to exhibit an operating culture of employee empowerment formed the main reasons behind the failure of mass production in the production-line approach and in services and consequently the need to move to lean. What can be driven from this previous historical discussion is that the main mass production practices are almost the opposite to the five principles of lean management. Kennedy and Brewer (2006, p. 66) shows this in a comparison between the mass production and the lean management, in terms of the goal of each system, the way resources are organized, the flow of production, what triggers production and the definition of the human element. Figure 2.3 presents an adaptation of Kennedy and Brewer's (2006) illustration with an integration of the lean principles to show how each comes in contrast to the five lean management principles.

Figure 2.3 shows that the main objective of a mass production system is to achieve the lowest possible cost through maximizing the productivity of people and machinery. While lean focuses on adding more customer value and eliminating wastes from companies' processes. Maskell and Baggely (2004, p. 11) comment that:

> We recognize that an important part of the cultural shift to a lean enterprise is the transition from thinking cost to thinking value. Mass production companies have focused on cost reduction for years. An essential tenet of mass production is to "pile it high and make it cheap". The essential tenet of lean thinking is to maximize customer value and eliminate waste.

	Mass Production	*Lean Management*	*Supported Lean Principle*
The goal	Achieve the lowest possible cost per unit and the highest possible employee and equipment productivity	- Meeting customer demand	- Customer value principle
Organizing resources	Align resources functionally to achieve the goal of high-volume repetitive production	- Align resources to mirror the value stream	- Value stream principle
Defining the flow	Batch-and-queue, larger batches are preferable	- Cellular-based, one-piece flow	- Flow principle
Defining the trigger	Forecasts act as the trigger to a "push" production system	- Customer orders trigger a "pull" system	- Pull principle
Defining the human element	Intense supervision and adversarial supplier relationships	- Empowered workers and long-term supplier relationships	- Perfection principle/ continuous improvement

Figure 2. 3: Comparison between the Mass Production and Lean Management

Source: adapted from Kennedy and Brewer (2006, p. 66)

As shown in Figure 2.3, a focus on cost reduction by the mass production system implies a functional organisation of resources to promote repetitive production, large batch production, adopting a push production system and maintaining short term supplier relationships with supervisors held responsible for handling quality issues and changes in production processes. Such behaviours support overproduction and aim at obtaining lower purchasing prices from suppliers to minimize product costs. While a focus on meeting the customer demands by the lean management entails defining the activities that add customer value through the establishment of value streams, optimizing flow of production, using a pull production system empowering employees and sustaining a long-term supplier relationship to enhance the quality of supplied parts and improve suppliers' delivery time.

A system focusing on achieving the lowest possible cost as the mass production is reported encourage overproduction and trigger various non-lean behaviours (Johnson, 2006; Maskell and Kennedy, 2007; Fullerton et al.; 2013). As a result, a traditional

accounting system is thought to act against lean principles and a new accounting system is called for to better reflect a lean environment and support lean behaviours (Kennedy and Widener, 2008; Kroll, 2004). Such new accounting system is what is now known as the "Lean Accounting System". The coming section discusses the definition of a lean accounting system, why it is needed and how it operates.

2.13 Lean Accounting Definition

A lean accounting system is defined as *"A new method of managing a business that is built upon lean principles and lean methods"* (Kennedy and Widener, 2008, p. 302, Maskell and Baggaley, 2004, p. ix). Lean accounting definition has two perspectives; (1) accounting for lean and (2) lean accounting (Grasso, 2005). The accounting for lean perspective focuses on how the reported financial information shall support a lean management system (Grasso, 2005). This perspective relates to providing relevant lean information for decision making, how financial reporting can serve lean needs and can be easily understood by everyone. Also, how internal costing information and reports shall be developed in a lean management system and how the accounting information provided shall represent a strategy that focuses on adding customer value, using a pull system, empowering labour and exerting continuous improvement efforts (Crandall and Main, 2007), i.e. how the accounting information represents the current condition in lean firms.

The lean accounting perspective deals with integrating the lean concepts to the accounting process. In other words; how the lean thinking in terms of focusing on the customer's value adding activities and eliminating wastes can be applied to the accounting system of a lean firm (Crandall and Main, 2007). This entails the changes that shall be applied to the accounting system and tools in order to obtain simplified lean tailored information and reports (Grasso, 2005). This includes efforts to simplify the accounting process, eliminate non-value adding transaction records as well as developing a good costing system for lean firms.

2.14 Reasons for the Need for a Lean Accounting System

Lean accounting is needed for lean firms owing to two main reasons, first; to help avoid the drawbacks of the traditional costing system and second; to provide relevant lean tailored accounting information. These two main reasons are explained in this section.

2.14.1 To Avoid the Traditional Costing Drawbacks

The traditional costing system uses variance analysis to evaluate the company's performance. The problem with traditional costing performance measurement tools like variance analysis is that they mostly represent financial measures and are too complicated, which makes them understandable only by finance people (Kennedy and Brewer, 2006; Kroll, 2004). Also, the dependency on variance analysis as an indicator of work progress creates the notion of considering the time during which workers are not producing as an inefficient use of time (Kennedy and Brewer, 2006). In such a condition, a typical decision to resolve the problem and decrease product unit cost will be to increase production even if no customer orders are requested. Another solution may even include holding more inventories or accepting poor quality output units in order to absorb overhead costs. All of which represent non-lean behaviours that excessively use workers and create an atmosphere of de-motivation for continuous improvement efforts (Ward and Graves, 2004).

Additionally, the way a traditional costing system allocates overhead on basis of output level, direct labour hours or direct labour dollars, always links lower costs with high volume production associated with mass production (Johnson, 2006). Lean management system seeks to optimise the flow of production so to accelerate the pace of production and produce exactly what the customer demands. Consequently, applying traditional overhead allocation methods is reported to produce higher costs at a condition were batch production is reduced (Maskell and Baggaley, 2004). Moreover, overhead costs are not always linked to such commonly used allocation basis (Kroll, 2004; Ward and Graves, 2004). Consequently, allocating overhead this way distorts product costs and eventually leads most companies to lose their competitive positions.

2.14.2 To Provide Lean Tailored Information

Lean management implementation seeks to streamline the operating process and eliminate any/all wasteful activities (Shah and Ward, 2003). Consequently, in a lean firm, tracking of financial transactions related to such activities shall also be eliminated. This will free accounting and finance people to engage in continuous improvement efforts and work as agents for prospective developments in their companies (Crandall and Main, 2007).

The application of lean pull principle is associated with lower inventory levels (Kennedy and Brewer, 2006). Such decrease in inventory balances at the beginning of lean implementation is expected to show negative impact on the organisation's income (Kroll, 2004). Hence, lean firms will report lower profits even though they are achieving progress with decreasing inventory balances (Debusk and Debusk, 2012). Hence, the traditional accounting system especially with its absorption income statement is reported to give results that contradict the improvements achieved through lean implementation (Brosnohan, 2008; Crandall and Main, 2007).

Finally, costing in a lean firm is expected to differ from a mass production system since in the focus because the whole value stream rather than the individual product units (Maskell and Baggaley, 2003a; 2003b). Accountants shall focus on the whole costs incurred in a value stream, which can include quality costs, design costs, maintenance and even administrative costs (Maynard, 2008). Lean accounting proponents report that this can be achieved using the lean accounting "Value Stream Costing" (VSC) tool in which provides costing information tailored to the whole value stream activities (Maskell and Kennedy, 2007). The next section provides an explanation of the operation of VSC.

2.15 Value Stream Costing Operation

Maskell and Baggaley (2004, p.17) describe VSC as;

> VSC is used to eliminate most of the wasteful transactions associated with production control, materials, and product costing. VSC eliminates the need for

standard costing and overhead allocations and creates a simple and effective cost accounting method.

As shown in Figure 2.4, using value stream costing all costs incurred to operate one value stream shall be included in computing the total value stream costs. Such costs include production labour costs, materials costs, machinery and equipment costs, production and operating support costs, facilities and maintenance costs as well as any other costs paid to help the value stream deliver a customer value. Therefore, upon using VSC, there is no difference between direct or indirect costs as common overhead costs are traced directly to the value stream. As a result, computing costs using VSC requires little or approximately no overhead allocation practices and the total value stream costs are to be calculated weekly including all costs incurred to deliver a customer value (Maskell and Baggaley, 2006).

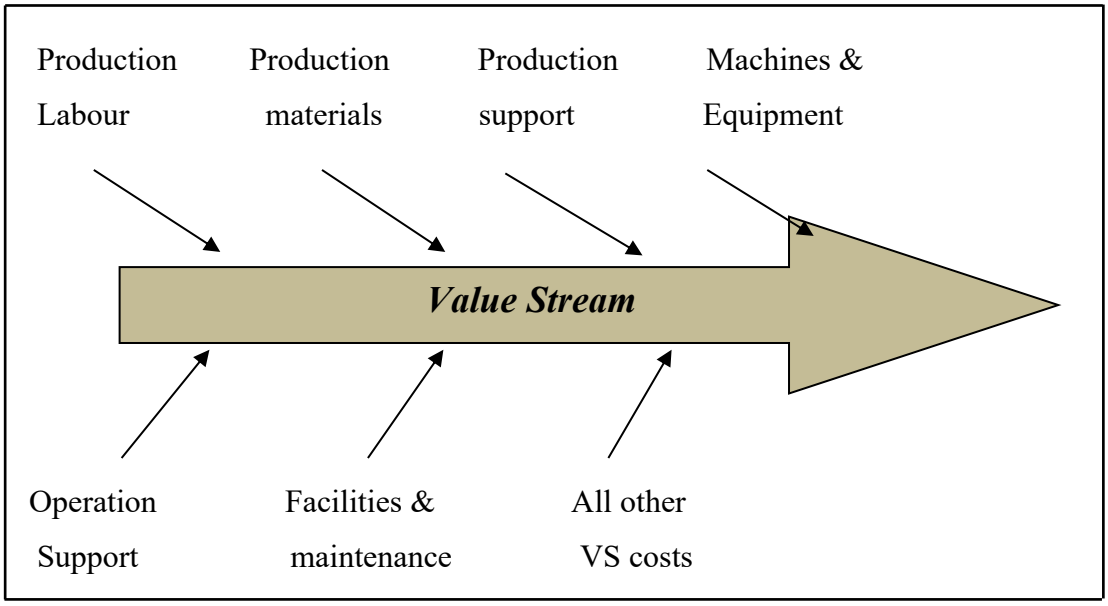

Figure 2. 4: Costs included in the Value Stream Costing Calculations

Source: adapted from Maskell and Baggaley (2004, p. 136)

A minor allocation process occurs that involves the allocation of facility costs to the value streams. VSC allocates facility costs including plant security costs, plant rent, depreciation of the building, utility costs and plant maintenance on basis of the square footage occupied by each value stream (Kennedy and Brewer, 2006; Maskell and Baggaley, 2004). However, the problem remains with how companies define what

constitutes utility costs, since if utility costs include costs for electricity then, allocating electricity on bases of square footage may distort the total value stream costs, especially in capital and energy intensive organizations. In such organizations, value streams occupying small space but producing products that need more power energy will be allocated less utility costs than those value streams occupying more space and producing less power intensive product families. Maskell and Baggaley (2004) coincide with this idea commenting that, utility cost is significant and is considered a cost that makes much variability among value streams.

2.15.1 Product Unit Cost using VSC

Using VSC, when all costs incurred to operate a certain value stream are assigned to its value stream in the manner explained in the previous section. An average cost per unit for all products made by the value stream, is then determined by dividing the total value stream costs with the total number of products shipped (Kennedy and Brewer, 2006).

At the same time, lean accounting advocates view the idea of computing an individual product unit cost for each product within the product family as unnecessary for lean firms (Fullerton and Kennedy, 2009; Debusk, 2008). This is because, using value stream costing, product prices are market driven (Brosnahan, 2008). Additionally, the standard product cost has always been needed for pricing decisions, make or buy decisions, new product introduction, product and customer rationalization decisions, measuring profitability, inventory valuation and performance measurement using variance analysis. Whereas in lean firms the focus is on adding customer value, consequently the concern is on the whole process, then profitability for example; is judged on basis of the total value stream profitability not the individual product profit margin (Maskell and Baggaley, 2004). Also, decisions like make or buy, removing a certain targeted customer or a certain product from the product family or introducing a new product can be made on basis of the whole value stream available capacity and profitability under this decision (Brosnahan, 2008). Also developing lean tailored performance measures that everyone can understand and react to makes variance analysis based on single product unit cost unnecessary (Maskell and Baggaley, 2004).

In the same sense, lean accounting adopters see that maintaining an effective control over inventory minimizes the need for computing product unit cost to be used in inventory valuation (Kroll, 2004). This constitutes a debatable part in the value stream costing postulations about the need for individual product unit costs for pricing decisions. This is because lean accounting advocates also admit that product unit cost is still needed for transfer pricing decisions and for exporting purposes. Also, if customer orders cover a long production execution period that might exceed three months for example, then individual product unit cost will be needed for inventory valuation purposes (Maskell and Kennedy, 2007). Such idea necessitates a more detailed information technique than the average product cost per unit developed by VSC, in such cases Maskell and Baggaley (2004, p. 156) comment that:

"We need an understanding of what causes cost in a value stream"

2.15.2 Value Stream Costing with Features and Characteristics Costing

In conditions where individual product unit costs are needed, lean accounting proposes the use of *"Features and Characteristics Costing"*, a method used to resolve costing distortions that may occur due to the dependency on the average value stream cost per unit, that is computed for all products produced in one value stream. Costing distortions may occur as a result of having products that take different time to be processed within the same value stream. Consequently, features and characteristics costing is used to normalize the average cost per unit computed using VSC (Maskell and Baggaley, 2004).

Features and characteristics costing postulates that in lean firms, "flow" is the main driver for product cost. As a result, having bottlenecks slows down the operation's rate of flow, which leads to turning out a lower number of shipped products which results in computing higher average unit cost (Maskell and Baggaley, 2004). According to Maynard (2008), controlling the flow helps control the cost. Accordingly, using features and characteristics costing, the cell which constitutes a bottleneck to the value stream operations shall be identified. A lean firm shall then define the products features and characteristics that make products use different processing time in this cell. Then a per unit conversion cost for each product is adapted based on the different cycle time taken

by products having different features and characteristics. Finally, the cost of direct materials paid over each product is added to its conversion unit cost to compute the new product's unit cost (Maskell and Baggaley, 2004).

The lean accounting suggestion to use features and characteristics costing represents a way to eliminate the need for establishing any cost allocation method and at the same time compute accurate product costs through the average unit cost computed using VSC. On the other hand, the use of features and characteristics costing still does not guarantee zero distorted product costs. This is because, features and characteristics costing considers the costing distortions initiated due to using different processing time in the bottleneck operation only. In fact, there may be cases in which the value stream products use different processing time in other value stream operating cells, which imply that products shipped do not use the production resources equally. Consequently, costing distortions may still be present due to having products that take different processing time in other operating cells which do not represent bottlenecks to the value stream operations. This may explain why Maskell and Kennedy (2007) comment that even though features and characteristics costing represents a simple and more accurate allocation method compared to traditional costing, it does suffer some similar problems regarding its accuracy and validity concerns. Maskell and Baggaley (2004) also recommend that lean firms shall better avoid such normalization of average product unit cost because it includes some complexity and subjectively in computing product costs.

The previous discussion of the VSC tool aimed to explain how the tool should operate with lean. However, VSC as a 'lean tailored' accounting practice is receiving very low implementation rates (Ruiz-de-Arbulo-Lopez et al., 2013). It is not known as to whether the tool does support lean or not or what role does it have in a lean organisation. Rao and Bargerstock (2011) report that, majority of lean firms are still depending on standard costs. There are no in-depth empirical investigations offered by the lean accounting literature on the role played by VSC nor the factors affecting its acceptance or rejection by lean firms. For example, Chiarini (2012) discusses the problems of using a traditional accounting practices in a lean SME and then attempts to compare this to the use of VSC and ABC. Yet, given how short his study was in addition to the early stage of lean implementation at which the SME was, Chiarini (2012) concludes that the study cannot be classified as one that fully demonstrates the process of VSC implementation.

Similar conclusion was reached by Ruiz-de-Arbulo-Lopez et al. (2013) for a different reason. Ruiz-de-Arbulo-Lopez et al. (2013) discussed the application of VSC in a case study organisation yet they only utilized VSC as a reflective calculation to visualize the improvements achieved from lean operations. Accordingly, the full implementation and success of a lean accounting and VSC as its main practice is still questionable (Tillema and van der Steen, 2015). The available literature only problematise the traditional accounting system to work with lean and fails to provide alternative conceptualisations of MAS or to investigate other suggestions from the lean accounting literature such as VSC.

2.16 Chapter Summary

This chapter presented a review of the literature associated with the three research strands associated with this research; lean management, MAS and lean accounting. The objective was to show how the lean thinking represented an innovation to the operating process at the Toyota manufacturing corporation that aimed at meeting customer demands and expelling the mass production system. The literature review then followed to demonstrate why lean management should be viewed as a philosophy and how the traditional accounting system presents a barrier to lean implementation. From the review of the lean management literature it was noted that lean represents a horizontal form of organisation arrangement and is an example of a technological process innovation. An exploration of the management accounting literature tackling horizontal form of organisation arrangements showed that here are no studies addressing how MA practices are used to support or affect the lateral view of a horizontal organisation arrangement focusing customers' needs (Chenhall, 2008) such as lean management. Additionally, a review of the literature on MAS and innovation showed that the its mostly not lean driven and fails to provide an overall conceptualisation of the MAS development in the context of lean. It is only the recent body of this literature viewing accounting calculations as actors that do things/ affect the innovation adopted, that is relevant to this research given its research aims. Finally, the chapter explored lean accounting literature in terms of the its definition, the reasons for its initiation and the operation of its main practice; value stream costings (VSC). The objective of this review was to provide an elaboration of why this literature proposes new and simpler accounting practices and to demonstrate how its main VSC operates. The key take point

from the review of lean accounting literature is to show that the use of lean accounting and VSC is still questionable and that VSC is receiving very low implementation rates, albeit perceived as the main lean 'tailored' accounting practice. The next chapter introduces the theoretical lens chosen for this research; Actor-Network Theory (ANT) and uses it to develop a literature driven theoretical conceptualisation, which presents the current discourse in the management accounting literature on the operation of MAS in the context of lean.

Chapter 3: Theoretical Underpinning

3.1 Introduction

Following the research questions identified in chapter one, Actor-network theory (ANT) is chosen as the theoretical underpinning for this research. ANT together with Callon's (2007, 2010) performativity thesis are used in this research, first to develop a literature driven theoretical conceptualisation on lean and MAS. Second, an empirical driven theoretical conceptualisation is then developed on basis of the case study data discussed in chapter 5 and 6. This chapter explains ANT as the theoretical lens chosen for this research. The chapter is divided into seven sections. Section 3.2 introduces ANT with a brief discussion on its background. Section 3.3 discusses the ontology of ANT and reasons why it has been chosen as the theoretical lens for this research. The core concepts of ANT which are used in this thesis, are illustrated in section 3.4. Section 3.5 explains Callon's (1998a) concepts of framing and overflow and section 3.6 discusses 'socio-technical agencements' and Callon's (2007, 2010) performativity thesis. These concepts are used later in the thesis to develop the empirical driven theoretical conceptualisation. Finally, section 3.7 utilises the literature introduced in chapter 2 on lean management, MAS in lean organisations and lean accounting, to develop the literature driven theoretical conceptualisation, which puts the discourse between actors involved in those literatures in context.

3.2 Background on Actor-Network Theory (ANT)

Actor-network theory relates to the work of Von Bruno Latour, Michel Callon and John Law with other colleagues on the sociology of science during the 1980s (Latour, 1987; Callon, 1986). ANT aims at providing an interpretation of social and technological developments using a balanced combination of both a socially and technically focused view of change (Lewis, 2007). According to Bruno Latour;

> As a first approximation, ANT claims that modern societies cannot be described without recognizing them as having a fibrous, thread-like, wiry, stringy, ropy, capillary character that is never captured by the notions of levels, layers, territories, spheres, categories, structures, systems. It aims at explaining the

> effects accounted for by those traditional words without having to buy the ontology, topology and politics that go with them. ANT has been developed by students of science and technology, and its claim is that it is utterly impossible to understand what holds society together without reinjecting in its fabric the facts manufactured by natural and social sciences and the artefacts designed by engineers. As a second approximation, ANT is thus the claim that the only way to achieve this reinjection of things into our understanding of social fabrics is through a network-like ontology and social theory (Latour 1996, p. 370).

As elaborated in Latour's definition, from an ANT's perspective, understanding a social or a technological development is not possible without analysing the natural, social and technical artefacts fabricating it. These artefacts can potentially develop a *'network'* which can be relatively stable for some time. Yet, it is also necessarily changeable through the continuous alliances between the network's contributors (Lewis, 2007). Those contributors are known as *"actors"* or *"actants"*– as Latour prefers to call them (Latour 1987, 1996). To Latour (2005), anything that is able to make a difference to the network is regarded as an actor. Accordingly, network actors can be human or non-human i.e. *'non-individual entities'* (Latour 1996, p. 369) such as technical artefacts, procedural arrangements (Lewis, 2007; Alcouffe et al., 2008), structures (Modell et al., 2017) and accounting calculations (Callon, 1998a; Briers and Chua, 2001; Makenzie, 2006; Mouritsen et al., 2009). Actors interactions with one another can form alliances which can then develop a relatively stable network of common goals through a process of *"translation"* (Callon, 1986; Chua, 1995). Latour defines a translation process as *"a displacement, drift, invention, mediation, the creation of a link that did not exist before and that to a degree modifies the original design"* (1999, p.179). ANT is mostly concerned about the relationships and processes established in this translation process through the coming together of all human and non-human actors to form alliances that add to the network *'relative stability'* (Law, 1999). The next section expands on the ontology of ANT and the reasons why it is chosen as the theoretical lens for this research.

3.3 Ontology of ANT and the Rational for Choosing it for this Research

Latour (1991, p. 128) explains that ANT is *"relationist"*. The ontology of ANT assumes that; *"..society is not what holds us together, it is what is held together"* (Latour 1986, p. 276). As discussed in the previous section, to Latour (1996, p. 370), the only way to understand what holds society together is to analyse the fabrics formed through the several interactions involving human and non-human actors. Explaining ANT's relationist ontology, Callon (1987, p. 93) views actor-network as *"simultaneously an actor whose activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of"*. Hence, actors' interactions attempt to stabilize what we perceive as a network and the dynamics of this network also form and/or reshape the characteristics of actors, each time they participate in those interactions. Accordingly, this ontology also involves a constructivism aspect where, reality is not only seen as relational, but also as being "constructed" (Modell et al., 2017). Moreover, such construction process is endless (Law, 1992). Callon and Latour (1981, p. 283) explain that reaching a stabilized network requires actors *"...to bring into play associations that last longer than the interactions that formed them"*. Latour considers this as a situation that requires explanation and results under some "unusual circumstances" (Latour 1986, p. 268)

A distinguishing feature of ANT is that it helps researchers place objects at the centre of their research (Justesen and Mouritsen, 2011, p. 161). Using ANT, non-human actors are as important in their study and analysis as human ones. Modell et al. (2017, p.68) explain that ANT has a *"flat ontology"* where *"...All actors are on the same level"*. In this sense, ANT does not set a priori for pre-existing structures or agencies. Actors are analysed not because of their agency, but only based on the connections they establish with their interactions. Justesen and Mouritsen (2011, p. 177) note that ANT:

> ---Rejects traditional sociological dichotomies, such as micro/macro, subject/object, structure/agency and technical/social. Instead of reducing the explanation to either side of such dualisms, ANT rehabilitates the detailed description of processes and actions at the empirical level.

This forms one of the main reasons why ANT is chosen as the theoretical lens for this thesis. With a focus on the developments in MAS involving interactions among people, calculations and perhaps technical systems, there is a need to use a theoretical lens which facilitates the understanding of non-human interactions as much as it does with human ones. A second reason is that, ANT's ontology of continual constructivism allows for exploring developments experienced in MAS and the role played by VSC as interactions change over time. This is quite helpful given the longitudinal nature of the case study conducted in this research. Using ANT, developments in an organisation's MAS are regarded as an ongoing process (Modell et al., 2017) that can only be understood by delving into the dynamics of the organisation actants' stories as they tell them, '*without imposing on them a priori definition of their world-building capacities'* (Latour 1999, p. 20). The research uses ANT together with Callon's (2007, 2010) performativity thesis to move beyond the idea of how MAS's reality is constructed, to analysing the trails and fabrics making up this construction. In doing so, the research applies Latour's (2005, p. 165) approach to 'slowciology' i.e. 'going slow'/ 'don't jump' (Latour, 2005, p. 190), to better understand the trail of events and interactions forming a construction. This is thought to help bring about rich interpretations of the organisation's MAS and practices, especially given the ambiguity of our knowledge of the developments and operation of MAS and lean accounting practices as VSC in a lean context (Fullerton et al., 2013).

Prior to settling on ANT as the theoretical lens for this research, considerations were given for other possible theoretical approaches; namely institutional theory, contingency theory and systems theory. However, they were found unsuitable for this research, given its objectives and research questions. Institutional theory focuses on the processes by which structures are infused to derive social behaviour (Scott, 2004). Structures within institutional theory include routines, rules, schemes, practices and norms (Scott, 1987). However, the theory does not pay any consideration to the roles played by non-human actors (Modell et al., 2017). Institulisation of practices, norms or rules are interpreted only via analysing humans' roles in this process (for a detailed discussion on institutional theory see: Meyer and Rowan, 1977; Scott, 1987; Scott, 2001). Hence, for its ignorance of the role played by non-human actors, institutional theory (Modell et al., 2017) was not suitable for this research, especially considering the second research aim

which focuses on the role of VSC calculations in a lean environment. Additionally, both the second and third research questions of this study do not seek to understand how VSC as a management accounting practice is infused. Yet, they mainly seek to understand the role played by VSC in a lean management environment, whether VSC accepted or not and what factors affect its acceptance or rejection.

Contingency theory[2] postulates that, the optimal approach to organise any organisation is dependent (contingent) on the nature of the organisation's surrounding internal and external environment (Scott, 1981). Even though this theoretical lens was extensively used to develop various management control frameworks which did enhance academics' understanding of the different types of controls, recent literature reports that contingency related frameworks were done in isolation from other contextual elements surrounding organisations' management accounting and control systems (Otley, 2016). Whereas, other left out contingent variables can be the real reason behind the development and operation of organisation's MAS's (Fisher, 1998; Chenhall, 2003). This has over the time created fragmented theoretical conceptualisations and affected theory building (Otley, 1980; Fisher, 1995; Langfield-Smith, 1997).

Recent management accounting literature has called for more context driven research (van der Stede, 2015) that also fleshes out the social associations and interactions affecting a MAS (Chenhall et al., 2011). Hence, treats accounting as *'interpretively'* (Otley, 2016, p. 45) constructed (Justesen and Mouritsen, 2011) and achieves a '*middle ground between taking a firm initial theoretical position - as a rule governed - and the attempt to build interpretations uncontaminated by prior beliefs, as is sometimes suggested by the proponents of grounded theory'* (Otley 2016, p. 55). Hence, considering the first research objective and its associated research question, contingency theory was not suitable for this research, since its narrow view of the concept of fit (Gerdin and Greve, 2004) fails to include specific organisations contexts as is the case with lean management in this research. More importantly, the predictive nature of

[2] For a thorough discussion on contingency theory, please see Otley (1980); Donaldson (2001) and Otley (2016).

contingency theory (Otley, 2016) does not allow for an interpretive understanding of the social interactions experienced within an organisation's MAS.

Finally, a consideration was also given to systems theory at the start of this research. Systems theory claims that; *"a system can be defined as any object of study that, although consisting of different elements mutually interconnected and interacting with each other or the external environment, reacts or evolves as a whole with its own general rules. The constituent elements of a system, the subsystems, are said to interact when the behavior of one of them influences the others. The reciprocal influence occurs through exchanges of energy, matter, or information."* (Andretta 2014, p. 1186).

An application of systems theory involves a system's modelling process. Such process depends predominantly on the description of the model's constituting elements. These elements are mainly: system's input/s, output/s, state variables, random variables, control variables and uncertain and exogenous variables (Laszlo and Kripnner, 1998). This system's modelling process with its elements was one of the main reasons for the unsuitability of applying systems theory in this research. This is because, the requirement to define the system's input/s, output/s and different variables technically means approaching the research field with predefined themes. This comes in absolute contrast to ANT's continual constructivism ontology, which allows for exploring the developments in lean organisations MAS as an ongoing process (Modell et al., 2017), as discussed earlier in this section.

In this research, viewing an MAS in a lean firm as a system where the researcher is expected to mainly identify its elements – as stated earlier – acts against understanding reality via actants' stories as they tell them, i.e.; '*without imposing on them a priori definition of their world-building capacities'* (Latour 1999, p. 20). Additionally, viewing lean firms within the context of a system's model comes in contrast with how lean management implementation shall be viewed as a philosophy (Comm and Mathaisle, 2000; Detty and Yingling, 2000) and a journey, which differs from one organisation to

another and can only be understood via comprehending the organisation's lean approaches used and interactions made (Shimokawa and Fujimoto, 2009)[3].

Having discussed the ontology of ANT and reasons why it is chosen as the theoretical lens for this research, the next section defines ANT concepts used in this research.

3.4 Defining Theoretical Concepts Used

This section provides a detailed discussion of three main concepts grounded in ANT. The section starts with a discussion of the term 'Actors', then follows in discussing the concept of Networks. The final subsection presents a discussion of Callon (1986, 1991) and Latour's (1996) concept of translations.

3.4.1 Actors

To Latour, *'(A)nything that modifies a state of affairs by making a difference is an actor'* (2005, p. 71) i.e. anything that has the ability to make a difference to the surrounding world is regarded as an actor. A distinctive feature of Actor-network theory is its emphasis on the *'radical indeterminacy'* of the term actor (Callon, 1999, p. 181). As explained in earlier sections of this chapter, actors can be anything: human or non-human (Latour 1996). Callon explains that actors:

> —may but need not be collectives. They may take the form of companies, associations between humans, and associations between non-humans. In this ontology actors have both variable content and variable geometry (1991, p. 140).

Hence, the term *'actant'* is commonly used in association with ANT to denote the inclusion of both human and non-human actors (Latour, 1987; 1996; 1999b). More importantly, ANT sets no priority to human actors over any type of non-human actors

[3] It is important to note that, some systems theory's experts may view Ashby's (1956) model of regulation and Beer's (1959) viable system model useful for this research. This is because these models could be claimed to help explain the 'literature driven theoretical conceptualisation' explained later in this chapter (See figure 3.3). However, it is crucial to highlight that, as the name implies, figure 3.3 is a conceptualisation of the current literature on MAS in lean organisations using ANT as the theoretical lens. Hence, the figure only serves the purpose of providing a theoretical conceptualisation of this literature to date. This conceptualisation does not serve as a 'research framework' whose building blocks are meant to be tested using the empirics of this research, as is the case with most positivistic type of research.

(Callon and Latour, 1981). No privilege is given to any actor over another. Actors are designated as such, only based on their ability to act i.e. their ability to make a difference to their surrounding world (Latour, 1987). Though ANT identifies micro and macro actors (Callon and Latour,1981), when it comes to their study and/or analysis, ANT makes no difference, nor prioritises any of the actors. The ontology of ANT is flat in the sense that, structures – (as an example of a macro actor) – takes no *'priori'* to any other micro actors such as; accounting practices or organisation employees (Latour, 1996a). The only distinction between a micro and macro actor is the number of associations each actor can make. According to Callon and Latour (1981, p. 299), a macro actor should have once been micro. Yet, this actor was capable of building many associations with the surrounding world which eventually established a 'long lasting force' to this actor. Hence, in the earlier example, organisation structures are viewed as a macro actor, while accounting practices and individuals are micro ones. Finally, it is important to note that in ANT terms, whatever is designated as an actor, is always viewed as being in a process of continuous construction (Latour, 1987). Actors characteristics are dynamic and continually evolving with different events, contexts and interactions. Modell et al. (2017, p. 66) note that;

> Instead of forming a pre-existing, immutable context for dynamic agency, structures are viewed analogously to any other actors: they are momentarily stabilised aggregates of local negotiations, controversies and other interactions involving humans and non-humans (Callon and Latour, 1981).

3.4.2 Networks

The concept of networks in ANT allows for studying large connections involving human and non-human actors. Briers and Chua report that, ANT's concept of networks *'emphasizes how borderless organisational life is'* (2001, p. 240). Such concept has a sound insinuation in the study of economics and analysing coordination in different economies (Callon, 2007). In defining the term 'network', Latour explains that:

> —The word network indicates that resources are concentrated in a few places – the knots and the nodes – which are connected with one another – the links and the mesh: these connections transform the scattered resources into a net that may seem to extend everywhere (1987, p. 180).

Hence, a network constitutes a collection of heterogonous elements that are kept together and translated by various types of associations (Callon, 1986a), these elements evolve and are crucial to the existence of the network in which they are all part of (Law, 1992). Callon explains that, in studying different economies, the focus is not simply on viewing any market as a network so as to allow for its analysis. Yet, Callon perceives markets as a type of borderless network which is explicitly organised in this manner to allow for *'the coordination of a large number of heterogeneous actors who define one another through the circulation of intermediaries'* (2007, p. 150). Callon's approach to viewing markets reinforces ANT's relational ontology promoting a continuous construction of objects and realities. Explaining this, Modell et al. (2017) comment that: *'An actor emerges from relational interactions and its characteristics are (re)defined each time it is involved in the dynamics of a network'* (p. 66).

3.4.3 Translations

"--The process of associations through which an entity emerges and acquires its characteristics is known as translation or construction, depending on which aspect of the process is emphasized" (Modell et al., 2017, p. 66). Callon (1991) views the translation process as a *'displacement'*, in other words, the process of capturing the various associations preceding an outcome that seemingly give the impression that not much has changed when change was actually witnessed to reach this outcome (Law, 1999). Hence, a translation process is viewed as a displacement in the sense that, an actor be it human or non-human (Latour, 1996) displaces others, acting or speaking on their behalf, with an intention in mind which the actors may or may not reach (Callon, 1986). According to Callon and Latour (1981, p. 279):

> By translation we understand all the negotiations, intrigues, calculations, acts of persuasion and violence, thanks to which an actor or force takes or causes to be conferred on itself, authority to speak or act on behalf of another actor or force....Whenever an actor speaks of 'us', s/he is translating other actors into a single will, of which s/he becomes spirit and spokesperson.

Modell et al. (2017, p. 66) note that ANT's notion of translation *"stresses the idea that a fact or an innovation does not emerge as a result of a linear development path but is transformed and modified along its unpredictable trajectory"*. Callon (1986) explains that translations involve tests of strengths, where objects and/or entities which persist against other actors are the ones that become real. However, as explained earlier; *'---not only the emerging entity that is modified during such a process, but the properties and interests of the actors connected to it are (re)defined as well'* (Modell et al. 2017, p. 66).

A translation process involves the four moments of: problematisation, interessment, enrolment and mobilisation (Callon, 1986). These four moments of translation are usually referred to as elements of the 'sociology of translation' (Callon, 1986). Ezzamel (1994, p. 219) defines problematisation as;

> problematisation refers to agents' efforts to make other agents subscribe to their own conceptions by demonstrating that they have the right solutions to, or definitions of, the others' problems. This is achieved by channelling the target agency through a set of unique and well-defined practices (obligatory passage points) that are under the control of the enrolling agency.

Alcouffe et al. (2008, p. 3) refers to the same definition in a slightly more elaborative way, replacing the word *'agents'* by *'actors.'* They also explain such 'obligatory passage points' to include other artefacts for example; *'external elements such as cultural and discursive resources.'* Interessement involves the process of constructing an interface between the interests of key network actors and efforts done to strengthen the links between these interests (Lowe, 1997). Enrolment involves the formation of alliances, through building agreements among key actors on their interests (Alcouffe et al., 2008). The monitoring of how actors' interests remain stable or change over time is then done through the final translation process of 'Mobilisation' (Mouritsen et al., 2001).

Within the concept of translations, Mouritsen et al. (2009) defines two forms of translations which relate to interactions between accounting calculations and an organisation's adopted innovation. Those forms of translations go through the same four moments of a translation process, yet the translation process can sometimes be called 'short translation' and in other times called, 'long translation'. Mouritsen et al. (2009, p. 749) defines short and long translations as:

> *A short translation relates the calculation with changes in innovators' conduct, but it does not question the innovation strategy. It is short when it economises innovation through influencing the time, resources and orientation of innovators. It bends the innovation to its context by presentation of financial effects in revenues, in contribution margins and gross margin.*
>
> *--In addition to the short translation, there are also long translations generated by competing calculations. These translations become longer because they develop complex problematisation of the role of innovation in the firm strategic consequences beyond the firm by taking many more entities into account.*

In Mouritsen et al.'s (2009) paper short translations are witnessed in situations associated with the use of a single accounting calculation. The translation process is *"short"* as it does not include complexities and mediates[4] between organisation's concerns and the innovation implemented i.e. it affects how the innovation is managed but, does not question it strategically. Whereas translation processes that are described as *"long"*, involve more complexities, for example, the use of multiple competing calculations as in Mouritsen et al.'s three case studies. Complexities affect the length of the translation process and initiate a more profound effect than is the case with short

[4] The research is using Miller and Power's (2013, p. 557) definition of accounting practices mediating role; i.e. "--that much of what accounting instruments and ideas do--to link up distinct actors, aspiration, and arenas". Yet, it is important to note that with a focus on performativity thesis and the analysis of the performative role of VSC, this research does not primary focus on how VSC mediates interactions between various actors in the case study conducted in this research. Yet, it focuses on how VSC performs or counter-performs in association with various interactions inside and outside the organisation.

translations. In Mouritsen et al.'s case studies, this is seen in terms of having competing calculations which lead to questioning the innovation used.

As mentioned earlier, management accounting calculations can be treated as an actor within an organisation's MAS. The research builds on Mouritsen et al.'s (2009, p. 740) view that, calculations do not only reflect the innovation adopted yet, by making things visible, *"Calculations influence how 'different spaces and different times may be produced inside the networks built to mobilise, cumulate and combine the world'* (Latour, 1987)". Accordingly, when discussing the developments in MAS following lean implementation the research is also concerned about how the accounting calculations affect/ create new interactions within the organisation.

3.5 Framing and Overflow

Callon defines the concept of framing as the development of *"...a boundary within which interactions – the significance and content of which are self-evident to the protagonists – take place more or less independently of their surrounding context"* (1998a, p249). Framing has been mostly used in association with the idea of "economization", more precisely "marketization" (Çaliskan & Callon, 2009, 2010; Callon, 2007, 2010). According to Callon (1998a), a frame of action should be in place for organisations to perform economic transactions effectively. In this sense, framing includes the coming together of all elements needed for time and space to form *"a set of stable assumptions, conventions, mechanisms and settings"* (Skaerbaek and Tryggestad, 2010, p. 110), that then allow for an economic transaction to occur (Boedker et al., 2019). The framing process is of dual nature (Callon, 1998a). That is, a frame *"--presupposes actors who are bringing to bear cognitive resources as well as forms of behaviour and strategies which have been shaped and structured by previous experience"* (Callon 1998a, p. 249). At the same time, interactions are not only dependant on actors, but are also mobilised by other organisational and physical or even virtual devices in our world which have been captured *"within an institutional framework...which helps to ensure their preservation and reproduction"* (Callon 1998a, p. 249).

Yet, the establishment of a frame is viewed as a reductionist process, more precisely an incomplete one (Callon, 1998a). Frames include some elements, assumptions, conventions and mechanisms associated with actants – (human and non-human) – in a given space and time and does not necessarily account for other interactions with the outside world. As Callon explains: *"--framing puts the outside world in brackets, as it were, but does not actually abolish all links with it"* (1998a, p. 249). That which was left out or put in bracket will always give rise to *'overflows.'* Relationships, events, links or connections – (with the outside world i.e. beyond the frame) – that transgress the boundaries of the frame are what Callon defines as 'overflows' (1998a, p.251). Connections defying the boundaries of a frame are what economists would have previously bracketed when a frame was constructed. In a sense, these are the 'externalities' which economists are supposed to analyse ways of containing them (Themsen and Skaerbaek, 2018). Callon (1998a) explains that, the approach of taking frames as the norm would always view overflows as the exception, which needs a pre-exerted effort to control and absorb, in the hope of avoiding any future 'reverse engineering' activities on a constructed frame of interaction. Such approach to dealing with frames directs our attention to the 'success or failure' of a frame (Themsen and Skaerbaek, 2018). However, Callon (1998a) reports that it makes more sense to focus on the 'existence or non-existence' of a frame. Callon explains that it is impossible to assume that actors' interactions with the outside world would have no bearing on the organisational frames which they are part of. Additionally, though instruments and devices might have a standardised way of work, they can still perform differently being in different hands, locations or contexts. Hence, Callon (1998a, p. 256) would suggest a focus on the 'omnipresence' of overflows, as he explains;

> "…By focusing on the omnipresence of overflows, on their usefulness, but also on the cost of actions intended (partially) to contain them, constructivist sociology highlights the importance of the operations required to identify and measure these overflows. It also encourages us to question the mechanisms used to create frames by suggesting ways in which the social sciences might help to develop or to confine such spaces of calculability." (1998a, p.256)

Hence, frames are always perceived as fragile (Callon, 1998a; Themsen and Skaerbaek, 2018) whose formation presupposes 'substantial investments' by various human and non-human actors associated with a frame (Callon 1998a, p.252). The framing process has always been discussed in conjunction with 'overflowing'. Overflows are viewed as the norm (Jollands et al., 2018; Themsen and Skaerbaek, 2018), in Callon words they are the 'rule', *"framing is expensive and always imperfect…. in short, is very costly to set up"* (1998a, p. 252). Accordingly, to Callon the term 'overflow' is usually preferred over 'externalities'. An overflow is a broader concept that goes beyond external organisational effects and how they are being quantified to include other matters of concerns (Callon, 2007) such as values and ethics and encourages us to further analyse these matters.

As Callon (1998a) explains in his quote above, understanding overflows requires their identification and measurement. In this process actors can have different views on how overflows are identified, quantified and dealt with. The extent of divergence in actors' views and approaches regarding overflows tells whether these overflows are 'hot' or 'cold' (Callon, 1998a). Hot overflows are those where *"...everything becomes controversial: the identification of intermediaries and overflows, the distribution of source and target agents, the way effects are measured"* (Callon 1998a, p. 260). Hence, actors' negotiations of their different approaches to identify and quantify overflows can create a disperse knowledge platform in which actors' interactions develop and extend affecting not only the overflow negotiated, but also the identities of actors involved.

In such situations of many controversies, framing becomes more difficult. Callon explains that: *"an agreement regarding the reality and scope of the overflows"* needs to be reached by actors to achieve a framing (Callon, 1998a, p261). Contrary to this situation, cold overflows are those in which the divergence between actors' views on quantifying and dealing with the overflow is small. In such case, actors' views and approaches lay down an almost similar knowledge platform from which they can move to an agreement regarding 'the reality and scope of the overflow' (Callon, 1998a). Explaining cold overflows, Callon notes that: *"Actors are identified, interests are stabilized, preferences can be expressed, responsibilities are acknowledged and accepted"* (1998a, p. 261). Hence, reframing becomes easier and there is a high

likelihood that experts from actors involved can arrive at an agreement on appropriate way/s to measure overflows (Callon, 1998a). Unlike cold overflows, hot situations invite the participation of more actors, perhaps non specialists, to help with developing the measurements needed *"to map out the externalities"* Callon (1998a, p. 262). As Callon (1998a, p. 262) defines the difference between hot and cold overflows:

> ―The distinction invites us to differentiate between two different types of negotiations: (a) negotiations aimed at identifying overflows, or 'hot' negotiations and (b) negotiations aimed at framing them, or 'cold' negotiations. The creation of commercial relationships presupposes that both kinds of negotiations take place, one after the other.

Accordingly, the dichotomy of hot and cold overflows always begs for an understanding of the performance effects of these overflows. This explains why Callon has usually linked his discussion of the intertwined concepts of framing and overflow with the discussion of the concept of "performativity" (Callon, 2007).

3.6 Socio-Technical Agencements and Callon's Performativity Thesis

Early discussions of the term 'performativity' relates the concept to the study of linguistics of performative utterances (Austin, 1962) and the social-cultural contexts associated with them (Bourdieu, 1998; Butler, 2010). To Austin (1962), the statement 'I pronounce you husband and wife' is a performative statement; i.e. an example of performative utterances, as it "does" something. It *"acts on the world to which it refers and helps to make this world exist"* (Callon, 2007, p. 9); i.e. it shows a change of marital status of two people. Yet, the statement 'It is sunny today' is an example of constative utterances, since it simply reports the fact that it is sunny on that day. Statements here are seen as actors or actants as defined earlier in this chapter. Hence, performativity is defined as actants' ability to "act upon" or *"actively engage in the constitution of the reality that they describe"* (Callon, 2007, p.12).

In his book "How to do things with words" Austin (1962, p. 5) introduced a framework of three levels to explain how most statements can have an enacting role. Austin explains that statements include:

1) “a locution”, which constitutes the actual words used by the speaker
2) “an illocutionary force”, which signifies what the speaker is trying to imply by his uttered locution
3) “a perlocutionary effect”, which is the actual impact that the speaker has on the interlocutor by using his locution

To demonstrate this, Callon (2007, p. 9-10) gives the example of telling someone that they have lied. According to him:

> ---“If we say to someone that they have lied, and we consider only the main meaning of the phrase, it is as if we told them that they knew the opposite of what they had said. But apart from the main meaning, these words convey an (accessory) idea of contempt, which makes them, insulting.” (Arnauld and Nicole 1970 {1662}).
>
> In this extract the notion of an accessory idea denotes that which, along with the propositional content of a discourse, constitutes what was later called its illocutionary force – in this case its value as an insult. The mere fact of saying: "You have lied" is at once a statement, a description of the state of the world (which may be true or false) and an act through which the enunciator acts on the enunciatee (the receiver) of the statement (by insulting him or her)

In Callon’s example, the perlocutionary effect relates to studying the actual effect that the locution ‘you have lied’ have had on the receiver i.e. has he felt insulted? Or what other effects/ feelings did the locution have on him? Austin reports that, perlocutionary acts constitute the “consequences” even when they are “unintentional”’ (Austin, 1962, p. 106)

Callon (1998b) builds on Austin’s (1962) framework to introduce the performativity thesis considering the idea of material assemblages (Callon, 2005; 2007; 2010) or what he prefers to call socio-technical agencements (Callon 1998b; 2007; 2010; Themsen and Skærbæk, 2018). Callon’s performativity thesis maintains that the collective contributions of theories, frameworks, technologies, human and other non-human actors produce the reality they are trying to describe. Caliskan and Callon (2010, p. 9) define

socio-technical agencements as *"…hybrid collectives…comprised of human beings (bodies) as well as material, technical and textual devices".* Callon (2007, p. 13) explains that, he is using the French term 'agencement' which – in his view – does not have an exact alternative in English. To him the term can be somewhat close to the term 'assemblages', where he is using it to *"...convey the idea of a combination of heterogeneous elements that have been carefully adjusted one another. Agencements are arrangements endowed with the capacity of acting in different ways depending on their configuration."*

With the idea of socio-technical agencement in mind, Callon (2007) explains that performation involves a pragmatic turn, a semiotic term and an ANT turn. The pragmatic turn involves studying the illocutionary force associated with whichever is performing, be it a statement or any other actor. The ANT turn relates to the analysis of all the contributions made by other actors in their interactions with the performer. Finally, the semiotic turn constitutes the study of the effect i.e. the perlocutionary effect which the actor actually had on the network in which they are interacting. Hence, unlike Judith Butler's use of Austin's (1962) ideas on performativity, where it is assumed that illocutionary forces can be analysed in separation from perlocutionary effects, Callon (2007, p. 13) argues that:

> ---there is nothing left outside *agencements*: there is no need for further explanation, because the construction of its meaning is part of an *agencement.* A socio-technical *agencement* includes the statement[s] pointing to it, and it is because the former includes the latter that the *agencement* acts in line with the statement, just as the operating instructions are part of the device and participate in making it work.

Callon (2010) argues that it is very difficult to separate illocutionary forces from perlocutionary effects, since if something did not act as intended, this means that an overflow had a high degree of divergency, i.e. it is a hot overflow. Accordingly, that thing has misfired. The dynamics and making up of such misfire form the semiotic turn of studying performation or what constitutes the perlocutionary effect.

In the 'I pronounce you husband and wife' example, Callon (2010) argues that conditions of felicity should be there for the statement to actually enact a successful marriage. Hence, an analysis of the marriage enacted here, cannot be done in separation from studying the effect/s it had on the actors involved. Given Callon's ideas on socio-technical agencements, these effects are the contributions of *"heterogeneous elements that have been carefully adjusted one another and are endowed with the capacity of acting in different ways depending on their configuration"* Callon (2007, p. 13). Since conditions of felicity might not always be there, misfires/ overflow or 'counter-performativity' effects can occur (Callon, 2010).

Bamford and Mackenzie[5] (2018, p. 99) define counter-performativity as;

> "--- a very particular form of misfire, of unsuccessful framing, when the use of a mathematical model does not simply fail to produce a reality (e.g. market results) that is consistent with the model, but actively undermines the postulates of the model. The use of a model, in other words, can itself create phenomena at odds with the model."

Studying the performative role of financial models, Mackenzie (2007) views calculative practices as engines with both an upstream that is formed of financial market data and a downstream that is formed by the calculative practice used. Cumulatively, these practices can be performative by luring people into taking actions to serve the purpose for which the practice is used. In a more recent study, Boedker, Chong and Mourtisen (2019) divide the accounting literature discussing accounting performation into two strands. A first strand which the authors call the 'performativity' strand, focuses on accounting transformative power, i.e. its ability to act as an engine trigging dialogues, affecting space and time, luring people into taking actions (Dambrin and Robson, 2011; Miller and Power, 2013; Vosselman, 2014; Revellino and Mouritsen, 2015; Themsen and Skaerbaek, 2018) and constructing reality rather than just representing it (Hines, 1988). The second strand includes the emerging literature on accounting

[5] They build on Mackenzie (2007, p. 55) and Callon's (2007) work defining counter-performativty as the process by which the *"practical use of a calculative model makes economic or organisational processes less like their depiction"*

'incompleteness'. This strand focuses on the power of accounting driven by the incompleteness of its calculative practices. It builds on the inherent ambiguity of accounting (McSweeny, 1997) and the fact that it does not capture all performance aspects needed by an organisation (Jordan and Messener, 2012; Busco and Quattrone, 2018). Boedker et al. (2019) explain that, in such situation managers will have to 'make do' of the outcome/s of an accounting practice given how divergent this outcome can be from the practice intended or promised outcome. Mackenzie and Spears (2014) note that, there are multiple ways in which the actual use of a model can challenge their empirical assumptions. The engine can be performative in a counter-active manner i.e. *"only by degrees and with caveats. --The engine still produces steam so that action happens, although not necessarily according to the precise prediction made by the engine, but instead by the fate of the engine in the hands of the many, each of whom may distort it a little bit"* (Revellino and Mouritsen, 2015, p. 34). Accordingly, there exists more than one form of counter-performativity, the identification of which involves a lot of uncertainty and needs further investigation (Boedker et al., 2019). This is because, such identification mainly depends on the actual (in other words; perlocutionary/ semiotic) effect models have on organisations or networks in which they are interacting. To give an example; upon discussing the attitude of modellers towards the Gausian coupla models, Mackenzie and Spears (2014, p. 436-437) explain that:

> It could be that here we have the beginnings of a typology of mechanisms of counter-performativity: models used for governance are undermined by being gamed; models used to hedge derivatives are undermined by the effects of that hedging on the market for the underlying asset.

Also, as Revellino and Mouritsen (2015, p. 34) explain:

> Sometimes models and calculative practices may not work partly because people are not effectively lured by them and partly because sometimes others also produce and mobilise calculative practices that may be stronger than the one in question; laboratories compete (Latour, 1987), just as calculations compete (Mouritsen et al., 2009), for attention.

Boedker et al. (2019) submit that neither the accounting performativity nor the incompleteness literature focuses on the counter-performativtiy of accounting practices and how powerful this can be. In case of Mackenzie's (2007) Black Scholes model, or in the example of Gausian coupla models (Mackenzie and Spears, 2014), other situations, or contexts along with investigating other finance and accounting models, can give rise to other counter-performative effects. The analysis of these effects and their making can be insightful in studying the power of accounting created via the counter-performativity of its practices. As Callon (2007, p. 11) notes; *"what is at stake is the success or failure of the performation, what is at stake is the realization of the socio-technical agencement inscribed in the statement"*. Callon (2010) expects the struggle between performation and co-performation (i.e. counter-performative effects) to always exist. To him, maintaining the illocutionary force of an actor or arriving at a successful performation where, all *'...the (material and institutional) conditions required for its success are met, --implies the active presence of appropriate socio-technical agencements';* i.e. *"--A successful illocution,* [is] *like a successful performation"* Callon (2010, p. 164). According to Callon:

> As such an adjustment is always fragile and rare, the general rule is a misfire. We can choose to call this misfire overflowing, when we equate perlocutionary performativity (i.e. performation) with a framing that, like any other, produces or, rather, ends up producing, its own overflowings. Illocutionary performativity is a successful performation because it is able to make inactive and invisible the overflowings or misfires that comprise any illocution but that will (perhaps) be discovered only later (2010, p. 164).

3.7 Misconceptions and Critique to ANT and Performativity Thesis

In his article *'On recalling ANT'*, Latour pinpoints some of the misconceptions associated with the use of some ANT terminology. Latour (1999) explains that creators of ANT should have been cautious in choosing to use a "technical metaphor" as the word network. According to him with the spread of using the term "network", especially after the creation of the world wide web, there seems to be a common understanding of what the term means. However, that is not what Latour and colleagues intended to designate by the word 'network' in their earlier work. Latour argues that:

> What is the difference between the older and the new usage? At the time the word network, like Deleuze's and Guattari's term rhizome, clearly meant a series of *transformations*--translations, transductions--which could not be captured by any of the traditional terms of social theory. With the new popularization of the word network, it now means transport *without* deformation, an instanteous, unmediated access to every piece of information. That is exactly the opposite of what we meant. What I would like to call 'double click information' has killed the last bit of the critical cutting edge of the notion of network. I don't think we should use it anymore at least not to mean the type of transformations and translations that we want now to explore (1999, p. 15-16).

Latour tried to explain that, by the time the word ‘network’ was chosen for ANT, it intended to mean the “series of transformations” or “translations” as defined earlier in sub-section 3.4.3 of this chapter. The intention was to settle on a word to convey the meaning of a “series of translations” and take such meaning away from others grounded in traditional social theory. Later on, this formed one of the critiques addressed to researchers using ANT, especially those employing Callon’s four moments of translation (Callon et al., 1983; Callon, 1986; Latour, 1987). Whittle and Spicer (2008, p. 618) explain that;

> The un-reflexive application of the four-stage model to other settings belies a positivistic attempt to verify the universality of Callon’s original account (Cordella and Shaikh, 2006). The danger is that studies of organization are reduced to a series of deductive tests that confirm or refute the four-stage model of translation, as opposed to being a process of inductive theory generation, theory that is grounded in and emergent from the empirical data.

This research take care of this by applying Latour’s (2005, p. 165) approach to ‘slowciology’ i.e. ‘going slow’/ ‘don’t jump’ (Latour, 2005, p. 190), to understand the trail of events and interactions forming an organisation’s MAS as a construction. As will be discussed in chapter 6, section 6.2, translation moments experienced in the case study conducted in this research are discussed and analysed in a non-mechanical way to show the “series of transformations” experienced in the organisation as they occurred.

In most of their work, Latour and Callon tried to emphasize that ANT adopts a constructivism research ontology, not a social constructivist one (Latour, 2005; Callon, 2007). Unlike the use of social scientists, the word 'network' as used in ANT is not meant to designate "Society" as the *"big animal making sense of local interactions"* nor is it intended to refer to *"an anonymous field"* of macro powers or forces such as cultures, structures, values and norms (Latour 1999, p. 17). According to Latour, saying that society is not "socially" constructed does not limit the work of social scientists, but it does open new venues of understanding the social (Latour, 2005). As Latour put it;

> ANT might have hit on one of the very phenomena of the social order: may be the social possess the bizarre property of not being made of agency and structure at all, but rather of being a *circulating* entity (1999, p. 17).

Hence, Latour would sometimes refer to the word network as a circulation (Latour, 1999; Latour 2005). To Latour, ANT is inspired by insights from ethnomethodology and semiotics, he had mostly used the word 'textual account' to refer to the process of understanding the social (Latour, 2005). Albeit, not literally mentioned in almost all management accounting literature using ANT, readers of this literature can sense that there are some usages of ANT in that literature which tend to treat reality as "socially constructed" not simply "constructed". According to Latour, perceiving reality as socially constructed implicitly means that a researcher has the social means or laws by which he/she can explore/ interpret this reality (Latour, 1996, 1999, 2005). Yet, saying that reality is just constructed – as ANT claims – means liberating researchers from any laws or pre-assumptions about this reality, which reinforces ANT's ontology of continual constructivism (Modell at al., 2017). ANT represents a way of *'delegitimating the incredible pretensions of sociologists who, to use Bauman's forceful expression (Bauman, 1992), want to act as legislators and to open yet another space for interpretive sociology'* (Latour 1999; p. 19). In Latour's terms, such definition has the notion of "unique adequacy" used in ethnomethodology (Latour, 2005), that is; in ANT terms, actors possess the knowledge of what they do, in addition to how and why they do it, *'…It is us, the social scientists, who lack knowledge of what they do, and not they who are missing the explanation of why they are unwittingly manipulated by forces exterior to themselves and known to the social scientist's powerful gaze and methods'*

(Latour 1999; p. 20). Accordingly, in this research a constructivism ontological stance is adopted to reinforce ANT's continual constructivism ontology. It also allows for understanding the interactions forming the developments in an organisation's MAS in the context of lean and the interactions identifying the role played by VSC, as they develop over the longitudinal period of the case study. This is discussed thoroughly in section 4.3 of the next chapter (chapter 4) on research methodology.

Most critique of ANT is based on the claim that it embraces a relativistic epistemology (Law, 1991). ANT's flat ontology presuming no agency for structures, cultures or any other actants – except via their own interactions/ associations with other actants – has resulted in describing ANT's ontology as "naïve realism" (Elder-Vass, 2008; Yang and Modell, 2015; Modell et al., 2017). With a believe that *'--may be the social possess the bizarre property of not being made of agency and structure at all, but rather of being a* ***circulating*** *entity'* (Latour 1999, p. 17), Latour (2005) does accept such description. Modell, Vinnari and Lukka (2017) responds to this critique by emphasizing that ANT embraces a mix of relationist, realist and constructivist ontology and that is what Latour and colleagues intended for the use of this theory. According to them:

> ----ANT deviates from classical realism by arguing that actors cannot be divided into permanent essential features and accidental superficial properties; an actor is simply the sum of all the properties that it has at a particular moment (Harman, 2009) (Modell et al. 2017, p. 66).

In response to this critique, this research embraces Callon and Latour's (1981) ontology that structures, norms or agencies are constructed and stabilised overtime, only on basis of local negotiations and interactions of both human and non-human actors.

Finally, the main critique to performativity thesis is based on the claim that "not all theories can be performative", this argument is quite common in economics literature (Brisset, 2016). This is what Vosselman and De Loo (2020) refer to as: working with performativity embracing an ontology of "becoming" instead of an ontology of "being". Basically, this critique directs researchers to the importance of considering the potential of the enlightening effect of counter-performativity. This is also what Boedker et al. (2019) perceive as the gains from the accounting "incompleteness literature". In other

words, when theories or models counter-perform, they can still develop useful insights, even if the model deviates from its expected prediction. This research strongly supports this notion of the benefits from counter-performative models. Accordingly, as discussed in section 3.3 of this chapter, in analysing the data related to the second research question on the performative role of VSC, the focus is not on how it is diffused. Yet, it is mainly on exploring and understanding the role played by this management accounting practice, whether it has been performative or even when it counter-performs.

3.8 Management Accounting Literature on Lean and Callon's four Moments of Translation

As discussed earlier, this research first provides a literature driven theoretical conceptualisation of the MAS in the context of lean using ANT as the theoretical lens of this thesis. In doing so, the following subsections utilise Callon's four moments of translation (Callon et al., 1983; Callon, 1986; Latour, 1987) to conceptualise how academic and consultancy literature discuss developments in MAS during and following lean management implementation. Key actors in such conceptualisation mainly include academics, consultants and management accounting practices and/ or controls.

3.7.1 Problematisation*: problematising traditional management accounting and control system*

Early academic efforts addressing the incompatibility of traditional management accounting and control system to work with process innovations such as lean, are attributed to the work of Kaplan (1984; 1986), followed by his book with Johnson (Johnson and Kaplan, 1987) to confirm the loss of relevance of such system to work with those innovations. Other academic work then followed (Kaplan, 1989; Ittner and Larcker, 1995) to support the same arguments Johnson and Kaplan (1987) put to problematise traditional control systems. Those authors built their arguments on the grounds that these systems fail to support and recognize payoffs from new production innovations (Kaplan, 1989; Berliner and Brimson, 1998). They argued that, because of their extensive focus on overhead allocation and end of period performance measures such as variance analysis, traditional accounting practices and controls provide aggregate (Ittner and Larcker, 1995) and distorted information, which are likely to drive

organizations to make decisions counter to the new innovation objectives (Johnson and Kaplan, 1987). Johnson and Kaplan have then concluded that a new management accounting and control system should be developed to work with JIT and process innovations such as lean (Johnson and Kaplan, 1987; Kaplan, 1988).

Other academic literature; (Ahlström and Karlsson, 1996; Ward and Graves, 2004; Johnson, 2006) also adds to the problematisation process in a lean-specific context. For example, discussing the role of management accounting and control system in lean organisations, Ahlström and Karlsson (1996) confirm the need for a more "lean-tailored" control system. Moreover, they report that, failure to do so can impede the process of lean management implementation. As shown in figure 3.1, Ahlström and Karlsson (1996) demonstrate that as organisations move away from managing single operators and functional machines to managing via multifunctional teams and flow lines or what is now well known as "value streams" (Fullerton et al., 2013), they will need to raise their accounting unit of analysis for example, from managing by individual product unit costs to handling total value stream costs. The same thing is expected to happen as lean implementation moves to higher organisation levels i.e. from the lower operating level to the whole production system and further up to top managerial levels as illustrated by the vertical arrow in figure 3.1.

Figure 3.1 does not only serve as a first indicator for the progression towards a value stream-oriented accounting and control system that we now know as 'lean accounting' (Tillema and van der Steen, 2015). Yet, from an ANT perspective on problematisation, figure 3.1 shows other factors used by actors of both academics and consultants to convince readers and managers *"to subscribe to their own conceptions/ view"* (Ezzamel 1994, p. 219; Alcouffe et al., 2008, p.3).

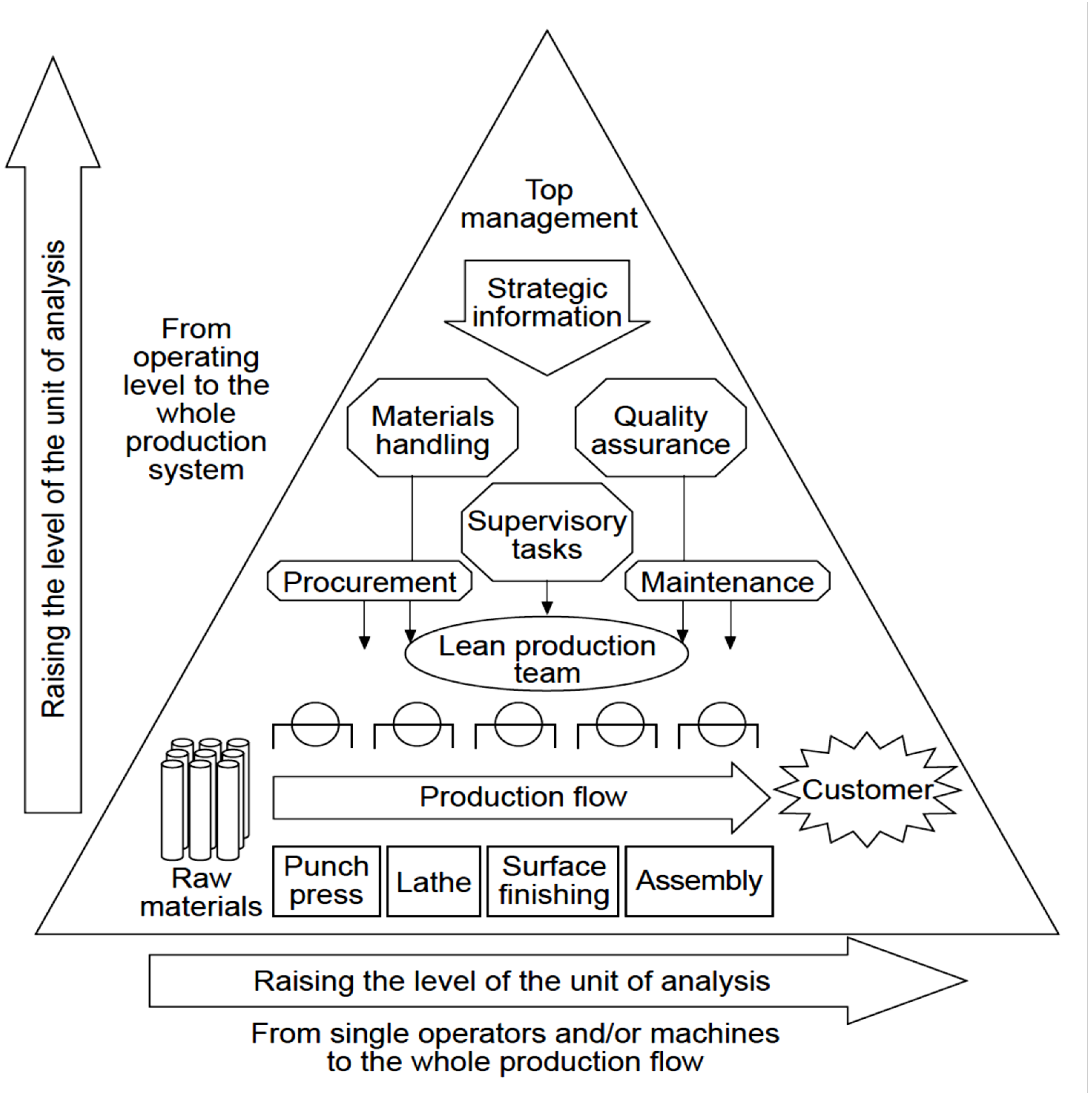

Figure 3. 1: **Raising the level of the unit of analysis in a management accounting system for lean production**

Source: Ahlström and Karlsson (1996, p. 53)

Factors including the need to move from a hierarchal oriented operating system to a more horizontal one, which targets customers and their value added activities, in addition to the increasing global competition were used by various authors as arguments to emphasize the need for a customer oriented operating system (Womack and Jones, 1990; Ward and Graves, 2004) and a corresponding management accounting and control one (Johnson and Kaplan, 1987; Maskell and Baggaley, 2004; Kennedy and Widener, 2008; Fullerton et al., 2013). Those factors highlighted a change in the competition rules of the game i.e. a move from thinking productivity, efficiency and

cost reduction to thinking in terms of customer demand variability and global competition as elaborated by Johnson and Kaplan (1987) and Womack and Jones, (1990). Such factors add more to problematising the relevance of the *'cost driven'* and *'accounting-based'* traditional management accounting and control system (Hansen and Mouritsen, 2007; Maskell and Kennedy, 2007; van der Steen and Tillema, 2018) to work with lean.

Consultants also played a key role in problematising the ability of traditional accounting and control system to work with new process innovations, mainly through introducing the lean accounting system (Baggaley and Maskell, 2003a; Maskell and Baggaley, 2004) or other consulting solutions similar to it (Darlington[6], 2013; Darlington et al., 2016) and drawing on some aspects from the Theory of Contraints (TOC) (Goldratt and Cox, 1986). This was followed by various texts explaining the traditional control system's drawbacks (For example: Maskell and Baggaley, 2004; Baggaley, 2006; Maskell and Kennedy, 2007; Brosnahan, 2008). In their book, Maskell and Baggaley (2004) provide a whole chapter explaining the reasons for the need for a lean accounting system. As explained in section 2.14 of chapter 2, many of these reasons are attributed to various pitfalls in the traditional management accounting system. Grasso (2005) questioned the ability of activity-based costing and resources-consumption accounting practices to work in a lean management environment. Other consulting literature (Baggaley and Maskell, 2003a; Baggaley and Maskell, 2003b; Baggaley, 2006; Debusk and Debusk, 2012) used numerical examples of lean accounting practices and controls as compared to traditional control ones not only to show lean accounting merits, but also to draw readers' attention to how a traditional management accounting and control system will default with new innovations as lean.

[6] John Darlington is a consultant who created 'flow accounting'; a suggested accounting solution to the drawbacks of traditional accounting and control system in a lean environment. Flow accounting builds on lean management principles and theory of constraints (TOC). Some ideas in flow accounting resemble those suggested by a lean accounting system, especially in costing, decision making and performance measurement.

3.7.2 Interessment: *Constructing 'an interface' between literature key actors*

Even though Ahlström and Karlsson (1996) did not use any theoretical approaches to try to conceptualise the role of management accounting controls in a lean environment, they did put such role in some context given their description in Figure 3.2. According to Ahlström and Karlsson (1996), a threshold of positive achievements on the performance measurements level is needed first, in order to justify lean implementation efforts and give a green light for more management accounting developments to take place. In their case study such green light was achieved using a productivity measure. Once productivity gives positive results to justify pay offs from lean implementation, more lean tailored management accounting practices can be triggered. If more congruence of management accounting system to the process innovation adopted is achieved, more performance enhancements are driven. Consequently, performance measures and management accounting practices act in a loop which supports the adopted innovation or as Ahlström and Karlsson put it;

> "By measuring in a new way, the manufacturing strategy and the management accounting system can become increasingly congruent. This can be likened to a self-reinforcing loop: better results point to the appropriateness of the changes, which further leads to changes in the management accounting system, which now is able to detect more positive results and so on" (1996, p. 51).

So, the overall message is that a green light from performance measures on the innovation used should be achieved first for more changes in management accounting system to occur. It is interesting how Ahlström and Karlsson's ideas can be further interpreted using Mouritsen et al. (2009) paper on management accounting calculations. In Mouritsen et al.'s (2009) terms, Ahlström and Karlsson (1996) idea on achieving a performance measurement threshold first can be explained via the view of management accounting calculations as short translations; i.e., the usefulness of management accounting calculations can only be appreciated through mediation.

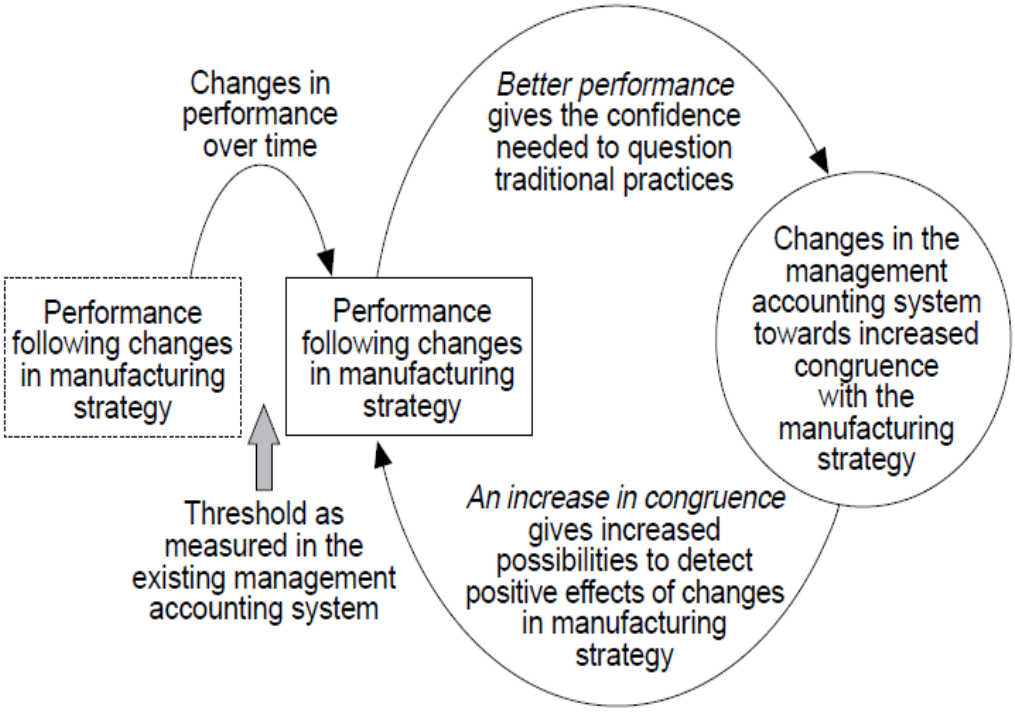

Figure 3. 2: **The impetus for changing the management accounting system**

Source: Ahlström and Karlsson (1996, p. 52)

Hence, management accounting calculations put innovation into context by linking them to organisational concerns. Within the context of Ahlström and Karlsson's study, achieving a positive productivity measure acts as the threshold for more management accounting system adaptations, since productivity represents one form of short translations which connect the innovation used in the case company i.e. lean, to firm's concerns of achieving better performance following lean implementation. In other words; *"(S)hort translations exist when management accounting calculations encourage extension or reduction of innovation activities when it proposes performance to be adequate or inadequate"* (Mouritsen et al. 2009, p. 752).

Yet, the development in Mourtisen et al. (2009) paper is that, it shows that the use of more than one calculation creates a state of tension. In such case management accounting calculations mediating role is done via acting as long translations i.e. having *"--multiple calculations that create tensions about the role of innovation. Here, calculations challenge each other and develop organisational tensions and dialogues*

beyond innovation activities" (p. 739). Accordingly, unlike Ahlström and Karlsson (1996) findings, congruence is not always assumed as a consequence of a performance measure driving the use of another management accounting calculation. As Mourtisen et al., (2009) conclude in their study, tension can exist extending or hindering innovation activities through affecting other technological artefacts and inter-organisation relationships. Hence, if a performance measure can drive the use of further management accounting calculations, these calculations are expected to create tension, which is either absorbed or is likely to obstacle innovation activities. Additionally, going back to Callon's performativity thesis, *"what is at stake is the success or failure of the performation" (Callon, 2007, p. 11).* Accordingly, how this tension is handled, its effect/s and which calculation/s are stabilised, depend on actors' interactions and the performativity or counter-performative effects of calculations or other actors involved.

Tillema and van der Steen (2015) discuss ways to absorb the tension created in lean organisations due to the use of lean accounting controls whilst having traditional accounting controls in place. The main contributions of their paper are that, they provide empirical evidence that traditional and lean controls can work together. More importantly, that the concept of 'decoupling' as suggested by Johnson and Kaplan (1987) is not the only possible way to absorb tension arising from the inconsistencies between lean and traditional management accounting controls. As shown in table 3.1, Tillema and van der Steen (2015) suggest that, in their case studies, the five mechanisms of: colonising, decoupling, compromising, implement incrementally and obscuring are used as non-mutual exclusive ways to absorb tension between controls. The appropriate mechanism to contain tension is determined on basis of the problem area created by the tension. These problem areas involved: a need to justify investments over lean implementation, an internal need from operating system to use more lean tailored performance measures and a need to validate the reliability of financial information.

	Colonising	Decoupling	Compromising	Implementing incrementally	Obscuring
• Investments			X	X	X
• Operations	X	X			
• Financial information	X		X		

Table 3. 1: **Problem areas and ways of containing tensions found in the case companies**

Source: Adapted from Tillema and van der Steen (2015, p. 80)

However, in the four case studies discussed by Tillema and van der Steen (2015), most of the efforts done to absorb controls' tension were mainly done on the performance measurement level. The paper merely tackles how management accounting practices for example; costing practices, are being handled in the case companies, whether these practices are lean tailored or following a traditional control system and whether this adds to or reduces the tension between traditional and lean controls. Organisations in the four case studies conducted by the authors, were always alarmed by the fact that top management are detached from local internal operations compared to lean proponents in operating activities. Accordingly, managers at upper hierarchal levels, either had less faith in lean success or were more bound to the use of traditional controls to measure performance and provide reliable financial information to comply with auditors' guidelines (Tillema and van der Steen, 2015). A situation which lead Tillema and van der Steen to conclude that with respect to the problem area handled; *"(T)he lean proponents in the case companies preferred the mechanisms which involve a higher degree of support from organisational levels"* (2015, p. 81).

Even though the studies by Ahlström and Karlsson (1996) and Tillema and van der Steen (2015) differ in whether the use of more accounting calculations creates tension or more accounting congruence to the process innovation adopted, both studies seem to agree on the idea that performance measures do give first green light or motivation for further management control adaptations. Yet, if more allies from academic and consultancy domains are to be integrated to this discussion, this idea would come in contrast to the work of other authors from both domains. For example, other academic

literature using contingency theory to determine factors affecting lean implementation and the use of a lean tailored accounting system (Kennedy and Widener, 2008; Fullerton et al., 2013; Fullerton et al., 2014), regards the use of a simplified accounting system and the lean accounting value stream costing tool as having a mediating role between lean implementation and the use of more lean tailored and visual oriented performance measures.

From a consulting viewpoint, Ahlström and Karlsson's (1996) and Tillema and van der Steen's (2015) findings also come in contrast to Maskell and Baggaley's (2004) description of the maturity path to the use of lean accounting. Value stream costing as a core lean accounting costing and decision-making practice (Kennedy and Widener, 2008; Fullerton et al., 2013) is regarded as a companion to lean firms managing by value streams and a pre-step to using the suggested lean accounting performance measures (Maskell and Baggaley, 2004).

3.7.3 Enrolment: *Trying to build an agreement between literature key actors*

Given Tillema and van der Steen's (2015) findings, if it is acceptable that both traditional and lean accounting controls work together and that decoupling is not the only available mechanism used to keep the use of both controls going, then what is the role played by other management accounting practices, for example VSC, in this lean environment? Previous academic work suggests that; *"accounting practices is an important intervening variable in the relation between the lean manufacturing strategic initiative and control components. Thus, studies that investigate the relation between lean manufacturing and use of non-traditional performance measures, or other social and behavioural controls, may leave out an important mediating variable"* (Kennedy and Widener, 2008, p. 320). More importantly, and perhaps looking at the bigger picture, how can we establish an understanding of the overall construction and developments in organisations' MAS in the context of lean?

Discussing the debates around centralisation and decentralisation, Quattrone and Hopper (2005, p. 736) comment that;

> "Divisional performance measurements and delegated budgets enable senior management to exercise 'decentralised centralisation'. General managers at HQ, assisted by staff specialists, can concentrate on strategy whilst retaining central control through periodic accounting representations of scattered units' performance and plans in budgets. Segments are treated as black boxes: line managers make operational decisions with little central intervention providing financial targets are attained"

Reflecting on Quattrone and Hopper's (2005) and findings from Tillema and van der Steen's (2015) paper on the relation between top management and internal lean proponents at the operational level, suggests that, we might be having a situation of two control networks in lean firms. One network revolving around operating activities with key actors of; lean proponents, lean tailored controls and other traditional accounting controls such as standard costing (Tillema and van der Steen, 2015). According to Rao and Bargerstock (2011), standard costing is still being used in most lean firms as a result of their inventory levels, extent of JIT implementation and number of monuments used. Chances are that, the second control network revolves around meeting top managers' and auditors' financial needs and includes actors of top-level managers, auditors and traditional accounting controls, as is the case in Tillema and van der Steen's (2015) four case studies. In a later paper focusing on the case of multidivisional lean organisations, van der Steen and Tillema (2018) report that, tension between accounting-based i.e. traditional and lean controls can even be detrimental to the progress with lean implementation. They suggest that multidivisional organisations take lean management implementation one step at a time and regard it as a piecemeal, rather than a whole project.

However, we are not sure whether the two control networks will be the case or not. All we have are the interpretations we can get from the very few detailed case studies available on lean and MAS, such as those discussed in Tillema and van der Steen's (2015) paper. Also, more details are needed on what happens after the tension – as Tillema and van der Steen (2015) calls it – or the competing calculations as described

by Mouritsen et al. (2009). If we move beyond the five suggestions for containing tension, the question then becomes: how do managers, operators, accountants and other human and non-human actors - (for e.g. accounting calculations, accounting information systems…etc) interact to make use of or move from the tension created. Additionally, is it still one management accounting and control network? In ANT terms, what actors' interactions form the fabrics of a MAS and developments it experiences in this context of lean. Additionally, what does this say about the performativity or counter-performativity of calculations or other actors involved.

In an attempt to develop a theoretical driven conceptualisation, which puts the previously mentioned views in context, figure 3.3, proposes that; current literature implies that there could be a chance that further progress with lean leads to having two sets of control networks one that is related to organisations' operating system and another one related to top managers and auditors' needs. Figure 3.3 represents a restructure of Ahlström and Karlsson's (1996) ideas on the role of management controls in lean environments shown in figure (3.2). It also integrates Mouritsen et al.'s (2009, p. 749) ideas on 'management accounting calculations in long term translation' and Tillema and van der Steen's (2015) results on the mechanisms to contain control tension, to show how both networks can be expected to interrelate. The upper part of figure 3.3 tries to integrate what is known from lean accounting studies using contingency theory (Kennedy and Widener, 2008; Fullerton et al., 2010; Fullerton et al., 2013), with both the findings of the case studies done by Ahlström and Karlsson's (1996) and Tillema and van der Steen (2015). Studies using contingency theory classifies top management support as a primary factor needed for initial implementation and progress with lean management (Kennedy and Widener, 2008; Fullerton et al., 2010; Fullerton et al., 2013). Tillema and van der Steen (2015) affirm this idea by concluding that maintaining support from top organisation's managers is a crucial element for the success of any of the mechanisms an organisation decides to use to contain the tension between traditional and lean controls.

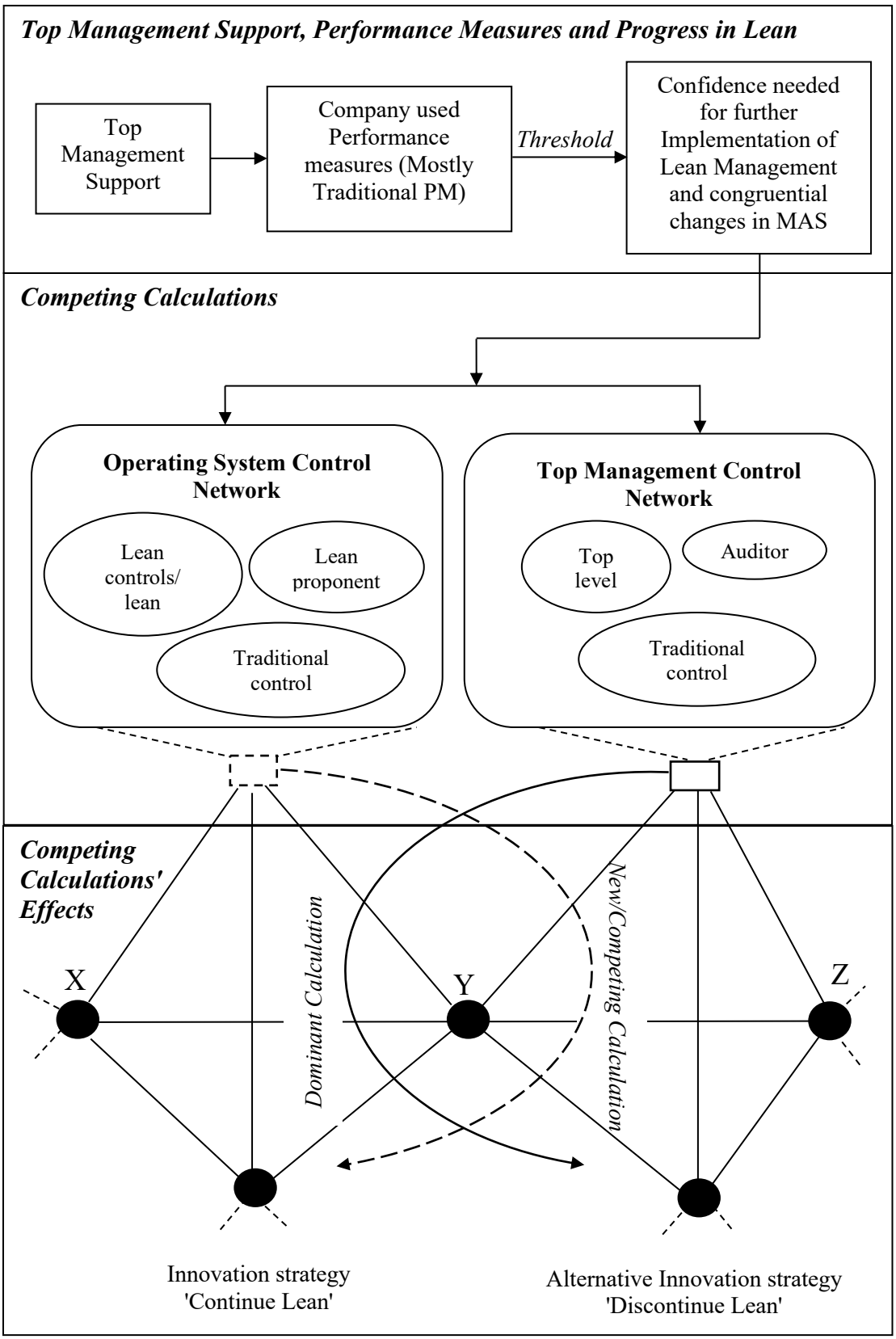

Figure 3. 3: **Literature Driven Theoretical Conceptualisation – Putting *'interessment'* arguments in context**
Source: Developed by the author

Top management support establishes a level of confidence within top level managers about prospective lean improvements, helping them to accept and be motivated about further progress with lean implementation (Tillema and van der Steen, 2015; van der Steen and Tillema, 2018). Revisiting Ahlstrom and Karlsson's (1996) ideas on the impetus for management accounting change in figure 3.2, having top managers support can be preceding changes in company used performance measures following lean. According, to Ahlstrom and Karlsson (1996) positive changes in one of the organisation's performance measures is then regarded as the threshold for more progress with lean implementation and further congruential changes in organisation's MAS to support lean.

Following Mouritsen et al.'s (2009) ideas on short and long translations, more progress with lean can trigger more calculations which are expected to create tension affecting the innovation adopted; i.e. Lean management. Hence, in figure 3.3, the two overlapping arrows are used to signify the expected tension between calculations. The bold arrow is used to point to the *'dominant calculation'* and the dotted one shows the new or *'competing calculation'* (Mouritsen et al., 2009, p. 749). Given the high percentage of lean firms still depending on traditional accounting practices (Rao and Bargerstock, 2011), the very low rate of lean accounting implementation (Fullerton et al., 2010; Rao and Bargerstock, 2013) and the limited likelihood to find an organisation that fully adopts lean tailored controls (Tillema and van der Steen, 2015), such dominant calculation/s is presumed to be the traditional accounting ones, while lean-tailored/ lean accounting practices and controls, are the new competing ones.

According to Mouritsen et al. (2009) competing calculations interact in long translations that influence the innovation strategy, leading an organisation to question the innovation strategy or propose an alternative one. This is shown in figure 3.3 through a proposition that tension between calculations developed from both control networks can either lead organisations to continue to use lean or it can impede lean implementation. Obviously, there can be a continuum of other alternatives in between. Yet, as mentioned earlier in this section this needs further investigation from both the academic and consultancy sides. Moreover, Mourtisen et al. (2009) report that the tension created by using multiple calculations is expected to affect the two elements of: other technological

artefacts within the organisation and inter-organisational relationships. The authors reached this conclusion on basis of the three case studies they conducted. However, in the literature driven theoretical conceptualisation shown in figure (3.3), those elements are denoted by three bold circles (X, Y and Z), since they can be are left for further exploration of more lean based case studies.

This section aimed at developing an agreement between literature key actors discussing the operation of MAS in the context of lean, following Callon's (1986) third translation stage of enrolment. Yet, as discussed earlier, the available literature fails to provide an agreed upon view on how MAS is constructed or reconstructed following lean management implementation. So, what this section tried to do is to put the arguments discussed in the *'interessement'* translation stage in context, using the ideas demonstrated in figure 3.3 to develop a literature driven theoretical conceptualisation. The empirics to the research hope to contribute to both knowledge and practice in demonstrating how MAS is constructed and develops following the move to lean management and the role played by lean accounting practices such as VSC. The next chapter introduces the path to the empirical analysis of this research through discussing the research methodology adopted.

Chapter 4: Research Methodology

4.1 Introduction

This chapter lays out the foundation for the research methodology adopted in this study. Identifying the methodology adopted requires an understanding of the different research paradigms, their ontological and epistemological assumptions and the available research approaches, strategies and methods with which this research can be associated (Shah and Corley, 2006). This is also consistent with the three aspects of good quality qualitative research as explained by Tong et al. (2007); i.e., explaining the research design, discussing research team/s and how data are analysed and reported. This chapter is divided into 8 sections, section 4.2 presents a summary of the main research paradigms and discusses their ontological and epistemological assumptions. Section 4.3 discusses the research design for this study and provides the rational for choosing its research paradigm and research approach. Research strategies are discussed in section 4.4, highlighting the strategy adopted in this study, together with the research method espoused and the reasons for its adoption. Section 4.5 identifies the data collection methods used in this research. Section 4.6 discusses the role of the researcher. Section 4.7 provides a discussion of the data analysis approach chosen for this research. Finally, section 4.8 concludes the chapter by providing a summary of its main ideas.

4.2 Research Paradigms and their Ontological and Epistemological Foundations

An initial step to discussing how this research is designed, is to go through some basic ontological and epistemological foundations to which this research design is related. A researcher's ontological stance is associated with their views about the nature of reality (Guba and Lincoln, 1994; Collis and Hussey, 2009). According to Creswell (2007), ontology relates to what constitutes reality. Crotty (2003) identifies objectivism, subjectivism and constructivism as the three different ontological positions. From an objectivist ontological stance, reality meanings can be explored as the objective truth about the world (Bryman and Bell, 2007). Whereas, following a subjectivism ontological position, reality constitutes the subjective meanings imposed on objects that the researcher studies (Bryman and Bell, 2007; Gibbs, 2007). As will be explained in detail in section 4.3 on research design, this research adopts a constructivism

ontological position. A constructivism ontological stance emphasizes that *"social phenomena and their meanings are continually being accomplished by social factors"* (Bryman, 2004, p.17). Constructivists view reality as multiple and constructed by individuals or groups who are continuously trying to make sense of their formed reality constructions (Guba and Lincoln, 1994). In other words, from a constructivism position, an interaction between the objective and the subjective bring reality to existence (Crotty, 2003). In this sense, a researcher is assumed to actively take part in understanding and presenting certain reality constructions (Delanty, 2005) which are related to the areas of his/her study. As Guba and Lincoln (1994, p.111) put it;

> Constructions are not more or less "true," in any absolute sense, but simply more or less informed and/or sophisticated. Constructions are alterable, as are their associated "realities".
>
> --The variable and personal nature of social constructions suggests that individual constructions can be elicited and refined only through interaction *between and among* investigator and respondents.
>
> --The final aim is to distil a consensus construction that is more informed and sophisticated than any of the predecessor constructions (including, of course, the etic construction of the investigator).

A researcher's epistemological assumption is *"--concerned with what we accept as valid knowledge"* (Collis and Hussey, 2009, p. 59). Epistemology relates to the nature of knowledge and "*attempt[s] to explain how we know what we know*" (Crotty, 1998, p. 18). According to Bryman (2004, p.11), the primary dispute around epistemological assumptions has to do with *"whether the social world can and should be studied according to the same principles* [and/or] *procedures"*. Historically, positivism and interpretivism formed the two major extremes of research paradigms for researchers' epistemological stances (Crotty, 2003; Bryman, 2004; Bryman and Bell, 2007). Yet, according to Collis and Hussey (2009, p. 57), there is *"a continuous line of paradigms that can exist simultaneously"* in a *'continuum'* of paradigms between the two *'extremities'* of positivism and interpretivism. As one moves along the line of the paradigms' continuum, the features of a paradigm are relaxed from the extreme positivism to interpretivism. New paradigms emerge in between the extremities and are

distinguished in accordance with their philosophical assumptions (Collis and Hussey, 2009).

Prior to discussing the differences in the philosophical assumptions underlying positivism and interpretivism research paradigms, it is necessary to go through the definition of a paradigm. In simple terms Collis and Hussey (2009, p. 55) define a research paradigm as: *"a philosophical framework that guides how scientific research should be conducted"*. Guba and Lincoln (1994, p. 108) refer to research paradigms as the 'inquiry paradigms', according to them:

> *Inquiry paradigms* define for *inquirers* what it is they are about, and what falls within and outside the limits of legitimate inquiry. The basic beliefs that define inquiry paradigms can be summarised by the responses given by proponents of any given paradigm to three fundamental questions, which are interconnected in such a way that the answer given to any one question, taken in any order, constrains how the others may be answered.

Guba and Lincoln then named those three questions as: *1. the ontological question*, *2. the epistemological question* and *3. the methodological question* (1994, p. 108). Their definition of what constitutes a research/inquiry paradigm can be described as more informative in the sense that, they highlight how an inquirer's i.e. researcher's ontological stance shall shape his/her views on what constitutes knowledge and the approach in which he/she shall go about in generating it. Likewise, an inquirer's view on what constitutes knowledge will imply his/her ontological stance, together with the methodological approach he/she intends to use. Collis and Hussey (2009) report that the word 'paradigm' has been used in different philosophical contexts and could imply different meanings. However, they quote Morgan (1979) who suggested three levels in which the word paradigm can be used;

- At the philosophical level, where the term is used to reflect basic beliefs about the world.
- At the social level, where the term is used to provide guidelines about how the researcher should conduct his or her endeavours.

- At the technical level, where the term is used to specify the methods and techniques, which ideally should be adopted when conducting research. (Collis and Hussey 2009, p. 57)

For this chapter, the first two levels are used in relation to the word 'paradigm', first at a philosophical level in order to identify the philosophical assumptions underpinning the positivism and interpretivism research paradigms. Secondly, at a social level in order to provide guidance on the design and methods of this specific research. Tables 4.1 and 4.2 represent the assumptions of the positivism and interpretivism research paradigms, as well as the main features of each paradigm as described by Collis and Hussey (2009, p. 58-62).

Bryman and Bell (2007, p. 16) report that, positivism is *"...an epistemological position that advocates the application of the methods of natural sciences to the study of social reality and beyond"*. As shown in tables 4.1 and 4.2, the positivism paradigm views social reality as objective and external (Easterby-Smith et al., 2002; Collis and Hussey, 2009). For positivists, there is only one reality (Collis and Hussey, 2009), whose properties are to be measured via objective, empirical and analytical methods (Smith, 2003). Knowledge constitutes the facts gathered by the researcher and which layout the foundations of laws and principles (Bryman and Bell, 2007). Hence, for positivists, theories are mainly used to develop testable hypotheses (Bryman and Bell, 2007; Collis and Hussey, 2009; Saundres et al. 2009). Positivists claim to be value-free/unbiased researchers, who are mostly detached from the subject matter being researched (Bryman, 2004). Proponents of the positivism paradigm seek to achieve generalisable and reliable results using large samples (Collis and Hussey, 2009) to increase the generalisability, reliability and replicability of their results (Gill and Johnson, 2002).

Philosophical assumption	Positivism	Interpretivism
Ontological assumption (the nature of reality)	Reality is objective and singular, separate from the researcher	Reality is subjective and multiple, as seen by participants
Epistemological assumption (what constitutes valid knowledge)	Researcher is independent of that being researched	Researcher interacts with that being researched
Axiological assumption (the role of values)	Research is value-free and unbiased	Researcher acknowledges that research is value-laden, and biases are present
Rhetorical assumption (the language of research)	Researcher writes in a formal style and uses the passive voice, accepted quantitative words and set definitions	Researcher writes in an informal style and uses the personal voice, accepted qualitative terms and limited definitions
Methodological assumption (the process of research)	- Process is deductive - Study of cause and effect with a static design (categories are isolated beforehand) - Research is context free - Generalisations lead to prediction, explanation and understanding - Results are accurate and reliable through validity and reliability	- Process is inductive - Study is of mutual simultaneous shaping of factors with an emerging design (categories are identified during the process) - Research is context bound - Patterns and/or theories are developed for understanding - Findings are accurate and reliable through verification

Table 4. 1: **Assumptions of the two main research paradigms**

Source: Collis and Hussey (2009, p. 58)

Positivism tends to:	Interpretivism tends to:
Use large samples	Use small samples
Have an artificial location	Have a natural location
Be concerned with hypothesis testing	Be concerned with generating theories
Produce precise, objective, qualitative data	Produce 'rich', subjective, qualitative data
Produce results with high reliability, but low validity	Produce findings with low reliability, but high validity
Allow results to be generalised from the sample to the population	Allow findings to be generalised from one setting to another similar setting

Table 4. 2: Features of the two main research paradigms
Source: Collis and Hussey (2009, p. 62)

On the other hand, proponents of the interpretivism paradigm view that, *"the world we experience arises from multiple, socially constructed realities"* (Gibbs, 2007, p. 7). For interpretivists meanings *"...are constructed by human beings as they engage with the world they are interpreting"* (Crotty, 1998, p. 43). Accordingly, interpretivists would question the applicability of natural science research methods to social studies, suggesting that having multiple realities in the world should necessitate a different logic of doing research (Bryman and Bell, 2007). Interpretivism requires researchers to understand that reality is subjective and could have multiple meanings as individuals and institutions are different from one another (Collis and Hussey, 2009; Saunders et al., 2009).

Interpretivism acknowledges the variation between individuals and objects in natural sciences and suggests that, such difference should be respected, so that social sciences are able to grasp the subjective meanings of social actions (Saunders et al., 2009). Hence, there is a high chance that an interpretivist research is value-laden and include some research biases as researchers interact with that being researched (Collis and Hussey, 2009, p. 58). Interpretivism view that the purpose of structures, patterns or theories developed through research, is to serve the understanding of social actions (Creswell, 2003). Interpretivists' research is "context bound" (Collis and Hussey, 2009, p. 58) in the sense that; the realities are *"culturally derived and historically situated interpretations of the social life world"* (Crotty, 1998, p. 67). Accordingly, replicability

of interpretivists' research could be difficult in many cases, as Johnson and Duberley (2000, p.9) point out;

> There are a multitude of truths each of which vies for attention but none of which has more validity than any other.

To sum up, ontological positions lie between the two extremities of positivism and interpretivism (Collis and Hussey, 2009). Other authors can also refer to these paradigms as the extreme objectivism versus the extreme subjectivism (Easterby-Smith et al., 2002; Creswell, 2003) where, constructivism lie between the two extremes and more towards the an interpretivism paradigm (Lincoln and Guba, 1985; Tashakkori and Teddlie, 1998; Easterby-Smith et al., 2002; Creswell, 2003; Collis and Hussey, 2009). Having defined the two main philosophical research paradigms, the next section presents a detailed discussion of the research design adopted in this study.

4.3 Research Design

Given the research's main objectives to conceptualise the developments of organisations' MAS in the context of lean and investigate the role played by the lean VSC practice, this research adopts a constructivism paradigm. As mentioned earlier, constructivists predicate that meanings and objects create knowledge (Maines, 2000). Accordingly, objects are merely found, but are rather made (Fisher, 1973) and hence meanings are not a researcher's discovery, but are a social construction (Crotty, 2003). In this sense, a MAS following lean implementation is regarded as a construction which involves various interactions between human and non-human actors, as explained in chapter 3. According to Guba and Lincoln (1994, p.113), within the constructivism paradigm;

> The aim of inquiry is *understanding and reconstruction* of the constructions that people (including the inquirer) initially hold, aiming towards consensus but still open to new interpretations as information and sophistication improve. The criterion for progress is that over time, everyone formulates more informed and sophisticated constructions and becomes more aware of the content and meaning of competing constructions.

Guba and Lincoln's comment on the aim of inquiry under a constructivism paradigm reinforces Latour's (2005) ideas on 'slowciology' promoting not only a study of how reality is constructed, but also, the trails forming this reality fabrications. A constructivism stance matches the use of ANT as the theoretical lens for this research with its continual constructivism ontology (Law, 1992; Modell et al., 2017). This allows for understanding the interactions forming the developments in an organisation's MAS in the context of lean and the interactions identifying the role played by VSC, especially given the longitudinal nature of the case conducted in this research, where several interactions are expected to occur over the study period.

Another reason forming the rational for choosing a constructivism paradigm for this research has to do with perceived role of the researcher in this specific type of research. Within a constructivism paradigm *"--The inquirer is cast in the role of participant and facilitator in this process"* (Guba and Lincoln, 1994, p. 113). 'Activism' forms one of the key concepts of constructivism (Guba and Lincoln, 1994). Hence, with most of the available lean literature reporting the need to change organisations' MAS following the use of lean (Åhlström and Karlsson, 1996; Ward and Graves, 2004; Maskell and Baggaley, 2004; Grasso, 2005; Fullerton et al., 2013; Tillema and van der Steen, 2015) and with the new lean tailored accounting system i.e. lean accounting receiving very low implementation rates (Fullerton et al., 2010; Rao and Bargerstock, 2011), it is very much expected that the researcher will have a role in explaining some lean tailored accounting practices such as VSC. A constructivism stance allows for such participative role by the researcher and hence facilitates their job in understanding the dynamics forming developments in lean organisations' MAS and investigating the role played VSC. This also matches Latour (1999, p. 18) views on ANT commenting that;

> This is already an important contribution of ANT since it means that when one explores the structures of the social, one is not led away from the local sites—as it was the case with the dissatisfied social scientist— but closer to them.

Figure 4.1 provides a diagram representation of where this research fits within different ontological and epistemological stances. The epistemology dimension is represented on the vertical axis and the horizontal axis represents the ontology dimension.

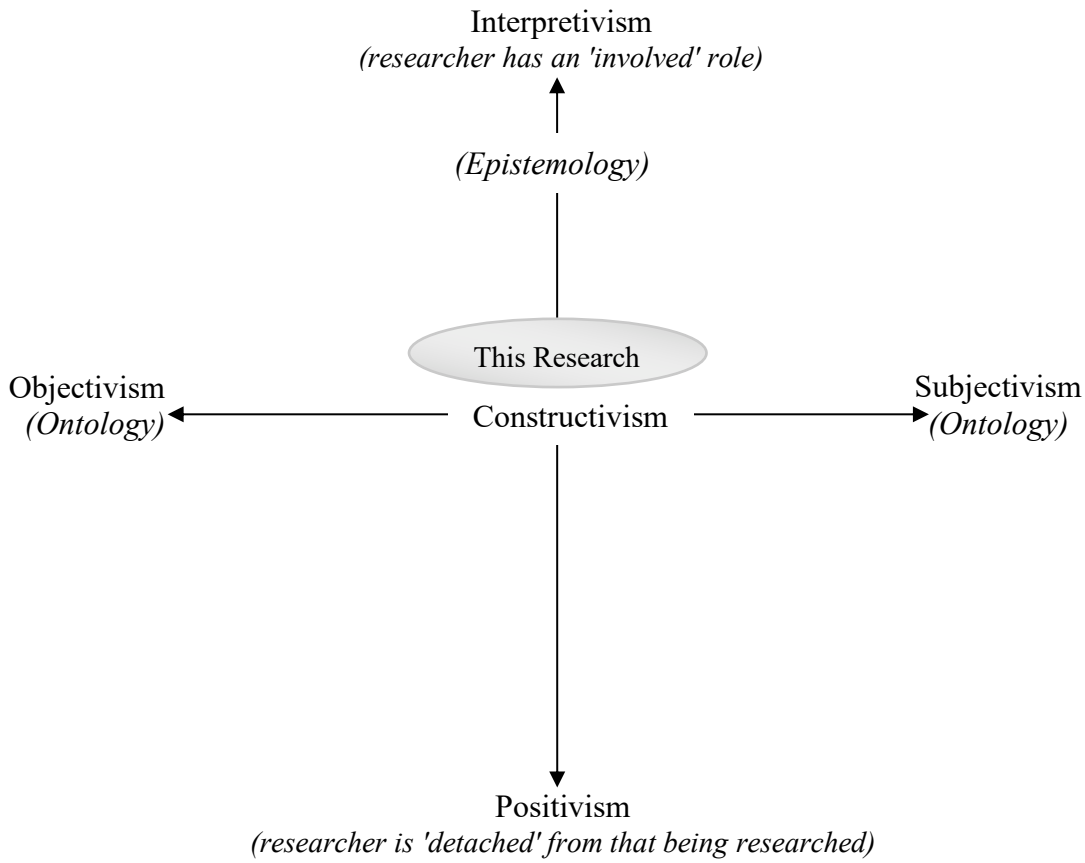

Figure 4. 1: **Representation of where this research fits within the Philosophical Paradigms**

Source: Adapted from Johnson and Duberly (2000)

A second step following the choice of the research paradigm adopted is to decide on the research approach to be used (Saunders et al., 2009). The deductive and inductive approaches form the two main research approaches used by researchers (Bryman and Bell, 2007; Collis and Hussey, 2009). According to Gibbs (2002), a deductive approach usually starts with the general and ends with the specific, using large sets of data to describe the logic behind objective realities. As a result, deduction begins with hypotheses formulation on basis of theories and general ideas. It then gathers data to test and assert these hypotheses to be able to come up with general conclusions (Cavana et al., 2001). In contrast, an inductive approach traces the logic behind arguments, leading to the move from the specific to the development of general statements, which relate to a certain phenomenon (Gibbs, 2002). Accordingly, induction requires an initial detection and analysis of patterns and meanings based on observations, with the aim of

formulating links and relationships for the development of general ideas/statements or theories (Cavana et al., 2001).

While the logical reasoning in research can be deductive or inductive or a combination of both (Dewey, 2011), this research adopts an inductive approach of paradigm of inquiry i.e. "...it attempts to establish patterns*, consistencies, and meanings."* (Gray, 2014, p. 18). More specifically, the research adopts an exploratory inductive approach in which general inferences and findings shall be driven by real life observations (Collis and Hussey, 2009). Because management accounting and control system takes different styles with respect to the used innovation (Bisbe and Otley, 2004) and lean management implementation takes various patterns depending on age, size, industry and other organisational factors (Shah and Ward, 2003), researcher is expected to identify patterns of the developments in organisations' MAS as relevant to the nature and degree of lean implementation to come up with her inferences on how MAS is constructed following the use of lean. This explains the reason for adopting an inductive research approach. This approach also fits with the chosen constructivism paradigm (Guba and Lincoln 1994, p. 110) suggesting that *'reality is not fixed or given'* (Ravn 1991, p. 97), but takes various formats (Guba and Lincoln 1994) requiring researchers to make their own inferences about it, based on their observations (Collis and Hussey, 2009).

4.4 Research Strategy and Method

Research strategy represents a general plan of how the researcher will go about developing answers to his/her research questions (Bryman and Bell, 2007; Saunders et al., 2009). The two main strategies for doing research in social science are namely: quantitative and qualitative research (Saunders et al., 2009). Research strategies and their associated methods are usually influenced by the chosen research paradigm (Collis and Hussey, 2009). Quantitative research mainly seeks to identify universal laws of nature so that they can be used to explain and predict different phenomena (Cavana et al., 2001). Consequently, it is usually associated with positivist and deductive research (Crotty, 2003), which mostly relies on large samples and the use of numerical data to produce findings by means of quantification or employing certain statistical procedures (Bryman, 1998).

Whereas qualtative research is mostly used for studies focusing on the in-depth analysis of single cases or small samples to develop interpretations of people's experiences through the researcher's interaction with that being researched (Flick, 2002; Gill and Johnson, 2002). For its focus on making inferences about people's understandings and developing meanings of different social contexts (Miles and Huberman, 1994; Heath, 1997), qualitative research is usually used by proponents of constructivism and interpretivism research paradigms (Guba and Lincoln, 1994; Ticehurst and Veal, 2000). Qualitative research using case study methods has also been used in various studies on the role of management controls in organisation learning (Kloot, 1997; Batac and Carassus, 2009), knowledge management (Ditillo, 2004), strategic change (Marginson, 2002), innovation (Chiesa et al., 2009, Mouritsen et al., 2009) and in research on the tension created between the different organisational controls (Frow et al., 2005; Mundy, 2010; Tillema and van der Steen, 2015). Qualitative research is found to be more approperiate for this research as a lean tailored MAS or what we now know as *the lean accounting system* is still regarded as an emerging concept (Chopra, 2013). There are various calls for empirical research clarifying researchers' and practitioners' understanding of the system's practices (van der Merwe and Thomson, 2007; Kennedy and Widener, 2008). Tillema and van der Steen (2015) call for more research on the operation of MAS following lean. Fullerton et al. (2013) also recognise the need for detailed empirical studies explaining the operation and role played by lean tailored accounting practices such as VSC. Generally, detailed empirical evidence on management accounting practices has often been missing from research on companies using advanced manufacturing techniques (Fullerton and McWatters, 2002), such as lean management. In this sense, trying to conceptualise the development in MAS in the context of lean implementation together with investigating the role played by VSC and factors affecting its acceptance or rejection, can be regarded as an attempt to gain understanding of a phenomenon that not much is known about, which justifies the adoption of a qualitative research approach in this research (Ghauri, 2004; Marshan-Piekkari and Welch, 2004).

Crotty (2003) explains that, research methods are the techniques used by the researcher to collect and analyse data related to his/her area of inquiry. According to Silverman (2009, p. 121), *"the choice of the method should reflect an overall research strategy."*

Additionally, the choice of a research method is highly associated with a researcher's philosophical stance (Long and Johnson, 2000). Reflecting on the philosophical stance of this research viewing MAS as constructed and following a qualitative research strategy that seeks to gain in-depth understanding of MAS construction or reconstruction in the context of lean, a case study research method is identified as most suitable for this research. Collis and Hussey (2009, p. 82) define a case study as: *"a methodology that is used to explore a single phenomenon (the case) in a natural setting using a variety of methods to obtain in-depth knowledge."* According to Yin (2003), a case study is best used when the objective of the research is not solely to explore a specific phenomenon, but also when the aim is to understand such phenomenon within a certain context i.e. obtain a rich understanding within a real life context using various sources of evidence (Morris and Wood, 1991; Robson, 2002).

A case study strategy is regarded as most appropriate for this research, since the focus is not only on obtaining an in-depth understanding of the development in MAS, but the research mainly aims at gaining such understanding within the context of a lean management environment. Also, looking at the available literature on MAS, case study method is reported as one of the best ways to bring more insights on the use MAS's practices (Ferreira and Merchant, 1992; Langfield-Smith, 1997; Otley, 2016). Jönsson (1998, p. 411) reports that, there is a lack of rich empirical evidence in management accounting research and that available research is *"limited to quick survey studies which fit into the publication requirements of mainstream"*. Hence, more case study designed research is encouraged to grasp the details of actual situations and provide deeper explanations of the complex accounting and control system in organisational contexts (Lillis and Mundy, 2005; Henri, 2006; Davila, 2009; Otley, 2016). Case study research method is favoured in management accounting research as it is mostly social, highly contextualised and malleable in a way that frequently reflects different changes over time (Chapman, 1997; Ittner and Larcker, 2001; Chenhall, 2003). Also, from a wider perspective, since the research is of an interdisciplinary nature between management accounting and operations management, both fields perceive case study research as useful to their development. According to Scapens (1990) case study research shall provide richer understandings of the management accounting practice and offer ways of thinking about hidden problems, which represents an essential tool for management

accounting researchers. From an operations management stand, case-study is considered as an important research method in the field of operations management, especially in the process of developing new general or theoretical ideas (Voss et al., 2002).

Yin (2003) reports that a case study is generally preferred when researchers are trying to address 'how' and 'why' questions. However, it does not preclude researchers to pose 'what' questions when conducting an exploratory case study on a phenomenon that not much is known about, as is the case with this research. Ghauri and Gronhaug (2005) assert this commenting that, case studies can be used to develop answers for 'what' questions in cases where an exploratory study is justified. Exploratory case studies are mostly chosen to tackle largely 'how' questions such as the first research question of this research, since they aim at gaining rich understanding of individuals experiences, rather than using random samples to derive statistically significant results (Norman, 2001). Concerns associated with conducting case studies include; difficulty to generalise from a single case study and that case study results can sometimes be driven by a researcher's bias to verifying his/her own assumptions or postulations. However, in his study on the misunderstandings about case study research, Flyvberg (2006) outlines that generalisation from a single case study is still possible. This depends on how carefully a study is chosen and conducted, in addition to how crucial it is to the field studied. Scapens (1990) also comments that, a focus on generalisation issues will only lead researchers to lose various potentials of gaining more useful insights from case study research.

On the possibility for researcher's bias in case study research, Flyvberg (2006) concludes that a researcher bias towards verifying his prepositions is a humanistic character which is possible to be found in any type of research strategies. On contrary, according to Flyvberg (2006, p. 237); '*experience indicates that the case study contains a greater bias towards falsification of preconceived notions than towards verification'*. Concerning this specific research, having a participating/active researcher type of research should not be perceived as a problem. As discussed in the previous section, having the researcher as one of the active participants sharing in the construction of the phenomenon being researched constitutes one of the assumptions of a constructivism research paradigm (Collis and Hussey, 2009). Additionally, this research uses a

triangulation approach to data collection in which various data collection methods are used in one study to help ensure the researcher of what the data are actually telling (Saunders et al., 2009).

There are four types of case study designs which include: 1. Holistic single case study covering one unit of study, 2. Embedded single case, which investigates more than one unit within the same case study, 3. Holistic multiple case studies, which involve more than one case study analysing the same unit but in different cases and 4. Embedded multiple case studies which tackle several cases of a number of unites within each case (Yin, 1994). Ghauri et al. (1995, p. 93) report that;

> A single case study is appropriate when a particular case is critical case and when we want to use it for testing an established theory (and)...when a single case is an extreme or unique case (or)...when is revelatory.

According to Lillis and Mundy (2005), holistic single case studies provide more in-depth insights compared to the other types of case study designs. Also, reflecting on the available management accounting and control literature, single case study method has been reported as a useful method facilitating the understanding of the various roles and uses of management accounting practices in single organisations (Ahrens and Dent, 1998; Birnberg, 1998; Otley, 1999, Otley, 2016). Given the complex nature of management accounting and control system as a social phenomenon/construction, holistic single case study is regarded as an effective method of studying the operation of organisations' MASs (Langfield-Smith, 1997; Chenhall, 2003; Ferriera and Otley, 2009). Given the previously mentioned reasons for adopting a qualitative research strategy and using a case study method together with the inherent complex nature of organisations' MAS, this research uses a holistic single case study design in order to gain in-depth details on the operation and developments of an organisation's MAS in the context of lean and on the role of played by VSC practice. The case study conducted is of a longitudinal nature covering a period of twelve years of lean implementation. The study is conducted on one of the factories of leading multinational organisation (LT), specialising in automation and supply of electrical power components. LT's headquarters is in Zurich, Switzerland. The organisation has subsidiaries in more than 90 countries across the world. The case study is conducted on one of factories of LT's

subsidiary operating in Egypt. The longitudinal case study covers the period from the start of lean implementation (year 2004) till end of year 2016. The next section provides a detailed discussion of the data collection process used in this research.

4.5 Data Collection

The data collection process for this research follows a triangulation technique by using a mixed data collection approaches of; semi-structured interviews, observation, focus groups[7] and a review of some documents of the case organisation (Yin, 2003; Creswell and Clark, 2011). Such use of mixed methods seeks to match the use of ANT, as the theoretical underpinning of this research, in:

> ——Following the actor but also recognition of the value of different forms of data, such as interviews, observations, document studies, etc. both represent resources that the researcher can exploit in terms of bringing translations / enactments of theoretical abstractions /conceptualizations into focus. More data – more resources. (Hansen, 2011, p. 120)

Semi-structured interviews are used to help probe answers on various aspects of the research and to allow the researcher to amend, omit or add some interview questions whenever needed (Saunders et al., 2009). Interview participants include key organisation actors associated with the organisation's management accounting and lean management systems. Using ANT as the theoretical lens of this research, organisation's actors include human actors who are identified in figure 5.1 of the next chapter on the background of the case organisation chosen for this research. Organisation's actors also include non-human actors (Latour, 1999; 2005), which involve management accounting calculations and controls used and other technical, procedural and/ or structural arrangements (Lewis, 2007; Alcouffe et al., 2008) which can be identified in the case organisation.

[7] Lists of all interviews, observations and focus groups conducted including data collection hours, are available in thesis appendices A and B.

Interviews as a data collection method is argued to be more beneficial the richer are the insights an interviewer can collect on the interviewee's knowledge, experiences and impressions (Fontana and Frey, 1994; Holstein and Gubrium, 1997). Additionally, Alvesson (2003, p. 31) report that;

> A theoretical understanding of the research interview means conceptualising what goes on in the situation and how the outcomes can be understood. It means a "thicker" understanding than the one provided by the interview as technique forgetting data or the interview as a human encounter leading to in-depth shared understanding.

Accordingly, in order to develop richer insights from interview data collected, and in consistence with the constructivism research paradigm chosen for this research, the researcher exhibited a participant role during the process of data collection and analysis (Guba and Lincoln, 1994; Collis and Hussy, 2009). This was done especially when handling the data related to the second research question, owing to the low implementation rates of lean accounting practices (such as VSC) (Rao and Bargerstock, 2011; Tillema and van der Steen) and the lack of its implementation knowhow (Debusk and Debusk, 2012). This was also needed given the research objectives, which required the researcher to interpret the data collected in reference to the situation and context in which they are gathered i.e. a certain pattern and maturity level of lean management implementation. In other words, to help the researcher adopt a "reflexive" approach to the interview i.e. *"address the broader contextual issues affecting interviews"* (Alvesson 2003, p. 30-31).

For this research interviews are regarded as the main data collection method. However, other supplementary methods including observations, focus groups and review of case organisation documents, are also used in the data collection process. Observations are used to obtain direct information on the organisation layout and the overall operation of its operating and accounting departments in the natural setting; i.e., within a lean management operating environment (Ghauri and Gronhaug, 2005). Such information is beneficial in understanding the level of advancement of the case organisation with lean implementation and the distribution of roles and technologies/ software used in its MAS. A review of organisation's documents including its costing and performance

measurement reports, is beneficial in gaining insights on its management accounting practices and controls used over time. This has the aim of facilitating the inferences made on the developments in organisation's MAS and on the traditional accounting practices used compared to the lean tailored ones. Finally, three focus group sessions are conducted. Two focus group sessions are conducted to discuss management accounting and control practices for LT transformers' factory. These two sessions aimed at discussing the organisation's management accounting practices in place in comparison to other possible alternatives for LT, such as VSC. The third focus group session aimed at discussing and updating data collected from accounting and finance representatives and sources, compared to data collected from operational team and sources. This has the objective of making sure different organisation representatives have shared all their views on the developments in LT's MAS throughout the study period.

A timeline for the duration of the longitudinal case study and data collection activities conducted are presented in figure 4.2. It is important to note that, the researcher has been engaged with the case study organisation in previous research that mainly aimed at testing the applicability of activity-based costing (ABC) in the organisation's transformers factory. This occurred in the period between year 2009 and the beginning of year 2010. Previous work with the case study organisation provided an understanding of the background of the organisation's costing system and the factory's layout during this period. The timeline presented in figure 4.2 shows the period covered in the case study from the start of lean management implementation in year 2004 till end of year 2016. The red circles in the timeline show the years in which data was collected. Majority of data collection activities in terms of interviews, observations, focus groups and document analysis were conducted in the period from end of year 2014 till the beginning of year 2017.

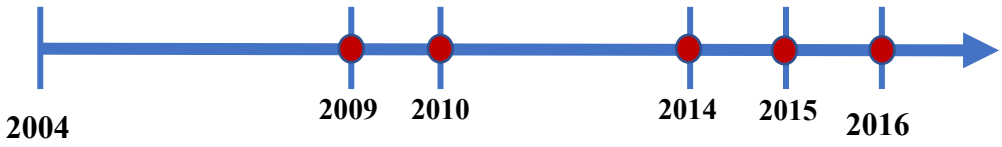

Figure 4. 2: Timeline of the Duration of Longitudinal Case Study and Data Collection Years

Data collected in years 2009 and 2010, were only used in this research to reflect on the organisation's costing system and the layout of its transformers' factory during this period. Appendices A and B of this thesis show the data collection activities done. Appendix A shows data collection activities done during the period of this research, i.e. from the end of year 2014 till beginning of year 2017. Data collected in years 2009 and 2010 and are reflected upon in this research, are included in appendix B of this thesis. It is worth mentioning, that information of the organisation's progress with lean management implementation from the start of its implementation in 2004, was discussed during the interviews with key participants included in the case study. As will be discussed in sections 5.5 and 5.7 of the coming chapter, interview participants were able to provide the researcher with documents related to this period in terms of factory first value stream, costing data and an extract of the performance measurements used. This is how an understanding of earlier periods of lean implementation was formed by the researcher. The next section discusses the data analysis approach used in this research.

4.6 Role of Researcher

Section 4.3 explains that, adopting a constructivism stance allows for 'activism', i.e. researcher is accepted to have a participatory and facilitating role in in the research process (Guba and Lincoln, 1994). This also matches Latour's (1999) view that unlike social scientists, ANT researchers are not perceived as interpreters of the pre-existing social structures. Yet, the contribution of ANT is that, researchers get closer to the reality they are exploring and can form one of actors in this reality. Hence, this section clarifies the role done by the researcher in exploring this longitudinal case study. As discussed in section 4.3, a low understanding and implementation of lean accounting and its core practice, VSC, meant that there is a high chance that the researcher will need to facilitate the understanding of VSC and procedures for its implementation. This is important specially in tackling the second and third research questions on the performative role of VSC and the factors affecting its implementation.

The researcher introduced VSC as a possible costing practice for the organisation in her earlier engagement with case organisation in 2009. This only served the purpose of the research done then, which mainly focused on evaluating the possibility of adopting

activity-based costing in the organisation's transformer's factory as compared to other possible costing practices. At that time, the role of the researcher mainly involved explaining how VSC works and doing the calculations for VSC. This is discussed thoroughly in section 6.5 of chapter 6.

As discussed in section 4.5, further calculations involving VSC, for example using VSC with features and characteristics costing, are done in the period from end of year 2014 till beginning of 2017. During this period, calculations and analysis of the role of VSC are done on basis of the demand from the organisation's finance and accounting controllers, given their earlier understanding of how the practice operates. During this period, the researcher participatory role was seen in doing the calculations for VSC with features and characteristics costing and comparing those calculations and facilitating the focus groups conducted and included in Appendix A of the thesis. In terms of interviews conducted during this period, observations and documents reviews and analysis, the researcher role was mainly to report actors' interpretations, feelings and inferences about their MAS system in the context of a lean management system.

It is worth mentioning that with the role played by the researcher in working out VSC calculations, an action research method might have been viewed as appropriate for this research. However, as Susman and Evered explain, an action research method involves; *"a cyclic process with five phases: diagnosing, action planning, action taking, evaluating and specifying learning."* (1978, p. 588). An implementation of those five steps technically means approaching organisation's actors with a deliberate plan of action to implement VSC as a management accounting practice. Yet, this contradicts with ANT's constructivist ontology, as discussed in section 3.3 of chapter 3. Champion and Stowell (2003) argue that, such five steps process seeks to promote the creation of "appropriate structures". However, as discussed in section 3.7 of chapter 3, with ANT, reality is constructed and interpreted only via an understanding of actors' interactions (Latour, 2005; Modell et al., 2017). Hence, with the use of ANT, a case study is perceived as most suitable for this research, given that the researcher did not have a major role in all data collected. More importantly, to keep ANT's promise to understand reality from actors' own stories without imposing on them a priori definition of their world (Latour, 1999).

4.7 Data Analysis

This research uses a constructivist form of a narrative analysis approach to develop '*a plot, as well as coherence'* (Myers, 2013, p. 173) between the *'spoken or written account of connected events' driven from the data collected to form 'a story'* (Soanes and Stevenson, 2004). Data collected via interviews and focus groups are transcribed and used with observation and documents' review and evaluation, to construct stories about the series of translation moments (Callon, 1998b; Latour, 1999; Latour; 2005) experienced in the case organisation. By using a constructivist type of narrative analysis, the narrator is assumed to construct narratives that represent the reality which he/she has seen whilst conducting their research, emphasising the uniqueness of each narrative (Myers, 2013). This approach matches Latour's (1998) views that in contrast to sociologists, actor-network theory does not assume to know how society is constructed or provide a prior tool to interpret it. Yet, ANT considers each network as unique and that only the network actors are able to describe how their networks are formed and/ or reformed.

A narrative analysis approach is used to develop three major plots of stories about the case organisation. These plots are discussed in chapter 6. Themes of these three plots were not set by the researcher beforehand. Fitting data within a predefined set of themes is perceived as counter to ANT's ontological and epistemological stances of having *'no-priori definition'* of actors' world (Latour 1999, p. 20). Arriving at these three plots followed a long iterative process given the large volume of data analysed. These plots were developed only on basis of the various actors' narratives, constructed using the different data collection sources used in this research (interviews, focus groups, document analysis and observations). This aimed at preserving the authenticity of ANT to not go and analyse a field with predefined themes or expectations of how it should look like or how actors are expected to behave.

It is worth mentioning that, codes are also developed for data collected through interviews and focus groups. Yet, unlike the use of coding in grounded theory, codes developed in this research do not seek to develop a theory (Collis and Hussey, 2009; Myers, 2013), nor are used to fit data into definite themes as is the case with the use of contingency theory in management accounting research (Otley, 1999; Chenhall and

Chapman, 2006; Otley, 2016). Codes developed here are only used to help simplify the large volumes of data collected, given the time span of this longitudinal case study. Coding was done manually and mainly aimed at facilitating the distribution of large volume of data collected across a number of organisation story plots as discussed in chapter 6, sections 6.3 to 6.7.

The three plots of stories are interpreted using ANT as the theoretical underpinning of this research with the aim of probing findings that develop answers to its research questions. Following ANT;

> ―The aim of analysis is to produce interesting descriptions of practice that illustrate the heterogeneous, performative, and relational character of theoretical abstractions and conceptualizations. The aim is to unlock established views on a phenomenon's significance and to illustrate ―the power of practice (Hansen, 2011, p. 120)

Hence, the translation moments traced in the stories are used to develop an understanding of how actors and organisational practices, structures and technologies, construct the organisation's MAS in context of lean management. The research then uses Callon's (1998a, 2007) concepts of framing and overflow to develop an empirical driven theoretical conceptualisation of the developments experienced in the organisation's MAS throughout the study period. Such conceptualisation together with the literature driven conceptualisation discussed in subsection 3.7.3 of chapter 3, are useful in developing an answer to the first research question of this research. Throughout the analysis of translation moments, together with framing and overflows experienced in the organisation's stories, Callon's (2007, 2010) performativity thesis is used to develop inferences on the performative role of VSC as required by this research's second research question. The overall empirical conceptualisation of the construction and developments in LT's MAS, together with the analysis of the role played VSC, give various insights on factors affecting VSC's acceptance or rejection, necessary for developing an answer to the third research question in this research. Chapter 7 presents a through discussion of the empirical driven theoretical conceptualisation and how it is used to develop answers for this study's research questions, in section 7.4 through to section 7.9.

4.8 Chapter Summary

This chapter discussed the research methodology adopted in this research. The chapter first provided a summary of the alternative research paradigms, research approaches, strategies and methods relevant to the study of social sciences. Sections 4.2 through to section 4.7 sought to layout the three aspects of a good quality qualitative research (Tong et al., 2007) in terms of discussing; research team/s and reflexivity (participants and key actors involved in the case study and how their interactions are discussed and analysed in later chapter), study design (research ontological and epistemological stances, research and data collection methods used) and finally, how data will be analysed and presented in this thesis. A summary of the research design discussed in this chapter is presented in Figure 4.3.

As shown in figure 4.3, this research adopts a constructivism philosophical stance with an inductive research approach. After defining the research objectives and questions, the research uses ANT as its theoretical underpinning together with Callon's (2007, 2010) performativity thesis. The research first uses ANT to develop a literature driven theoretical conceptualisation on the developments in MAS in context of lean as tackled by literature actors of both; academics and consultants. On the empirical side, a qualitative research strategy using holistic single case study method of a longitudinal nature, is found appropriate for this research, given its context and research questions focusing on a phenomenon – i.e. MAS in lean context and the role of VSC practice – that not much is known about.

Semi-structured interviews, observations, focus groups and documents review/ analysis are chosen as suitable triangulation techniques for data collection. Figure 4.3 provides examples of different types of information derived from each method of data collection, which were discussed throughout the chapter. For data analysis, the researcher uses a constructivist form of narrative analysis to construct three story plots driven from case study data. The analysis of these plots is used to develop an empirical driven theoretical conceptualisation on the developments in MAS in the context of lean, based on the conducted case study. This conceptualisation together with the literature driven theoretical conceptualisation developed in chapter 3, are then used to develop answers for this study's research questions.

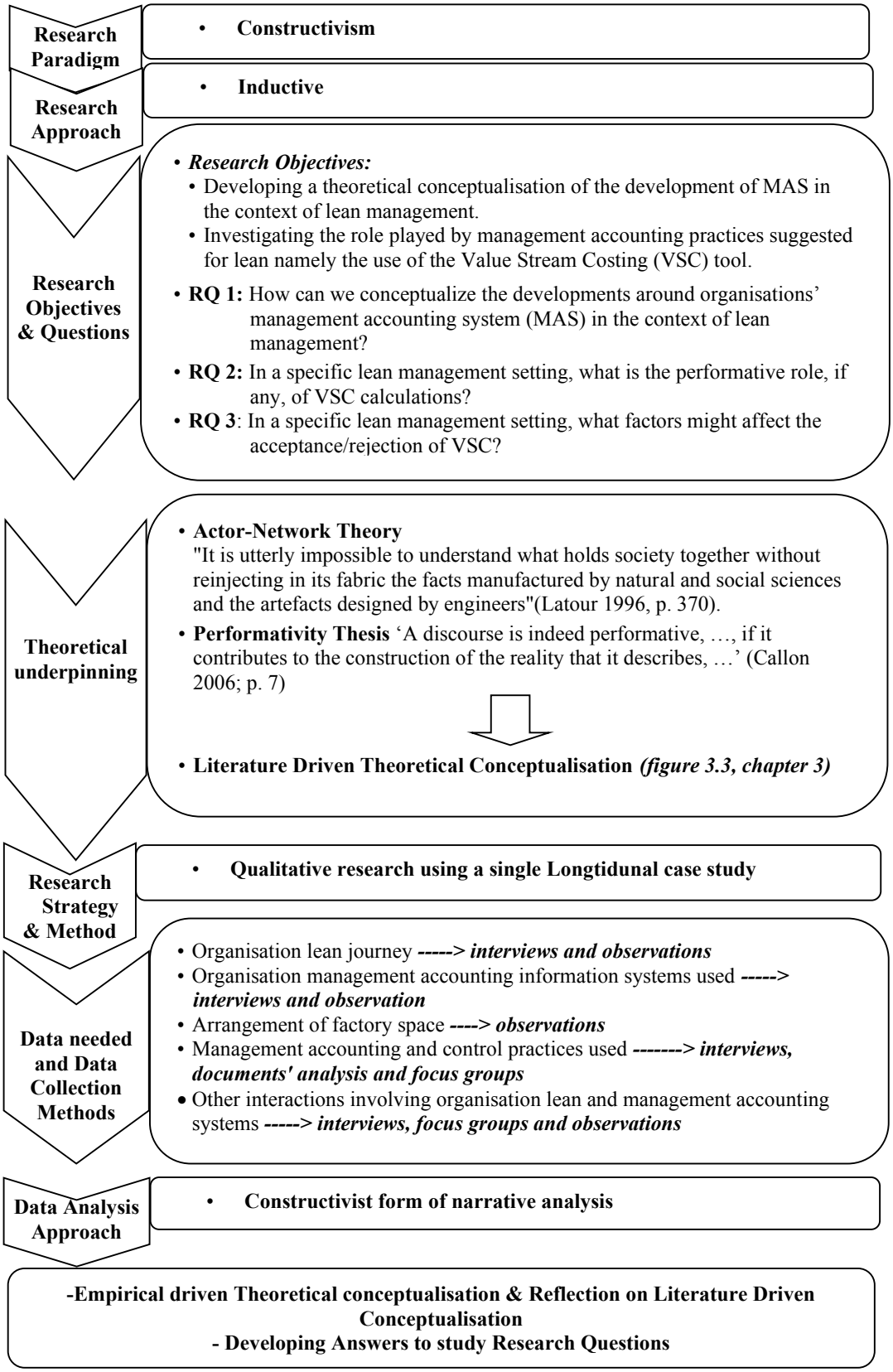

Figure 4. 3: Summary of Research Design

Chapter 5: Case Study Background and Findings Part I

As discussed in the chapter 4, this research adopts a qualitative research strategy, which uses a longitudinal single case study method covering a period of twelve years; from year 2004 till end of year 2016. This chapter discusses the details of the case organisation chosen for this research, in terms of; organisation's background, organisation chart and responsibilities of key actors involved in this study. Additionally, the chapter aims at discussing the primary key findings in terms of; how the organisation manages its management accounting information and the accounting information systems used for this, the organisation's progress with lean management implementation and the changes witnessed in its management accounting system throughout the study period. The chapter starts with the background of the case organisation discussed in section 5.1. Section 5.2 discusses the organisation chart and key organisation representatives with which this research is concerned. The chapter then presents the primary key findings in terms of how the organisation manages its accounting data, its lean journey and progress experienced with both the operating and management accounting system. Section 5.3 provides an explanation of the accounting information systems used in the organisation and the pattern in which its management accounting information is reported. Section 5.4 outlines the organisation's journey with lean management implementation. Sections 5.5 and 5.6 presents the developments experienced in the organisation's operating system throughout the study period, in terms of; the defined value streams, their layout and the lean practices used. A discussion of the organisation's management accounting system then follows in section 5.7. Finally, a chapter summary is presented in section 5.8. The discussion of the details of the case study organisation and primary findings presented in this chapter, seeks to set the scene for the analysis of the organisation's data that then follows in chapter 6.

5.1 Case Organisation Background

The organisation chosen for this study is a leading multinational organisation for automation and supply of electrical power components. Organisation's headquarters is in Zurich, Switzerland and it is responsible for supplying automation, electric safety and power components including; motors, generators, semiconductors, transformers, generators circuit breakers, power capacitors, sensors, insulation components, cables

and cables accessories as well as establishing safety control systems. The organisation's name is kept anonymous, as per agreement with its management to keep the confidentiality of its accounting and operating data. Accordingly, the organisation is referred to as LT. The case study is conducted on one of the organisation's factories operating in Egypt and is responsible for producing distribution transformers. LT's Egyptian plant started to supply its products to the Egyptian market in the beginning of the 1980's. The organisation has six factories in Egypt, producing and assembling power components. LT transformers factory started to implement lean management in its operation in year 2004.

The Transformers factory was established during 1998 and is responsible for producing distribution transformers ranging from 50 Kilo-Volt-Ampere (KVA) to 5000 KVA. A distribution transformer is used to distribute electric energy from high voltage power stations to low voltage substations to be supplied to different users. The factory produces transformers used for utility needs, contracting companies, Egyptian local industries, also to be exported to various countries outside Egypt. Transformers factory is currently supplying the Egyptian and foreign markets with more than three thousand transformers per year and has a market share of 41%.

The factory has the vision of becoming a major supplier of distribution transformers in Egypt and internationally. In order to reach this vision, the Transformers plant has the goal of always meeting customer demand preferences in the quality level and timely manner requested. Accordingly, the plant managers exert all efforts to sustain high quality levels on both the operational and the personnel's human aspects, in order to reach a good competitive marketplace and a high rate of employee empowerment.

The factory produces three main types of distribution transformers: small distribution transformers (SDT), medium distribution transformers (MDT) and large distribution transformers (LMDT). All transformer types are used to step down high voltage electrical energy to low voltage electrical energy, but the three types differ according to their power. The SDT group includes distribution transformers ranging from 50 to 300 KVA. These transformers are used in the countryside or in areas of low population densities. MDTs include transformers ranging from 400 to 1250 KVA. They are used in

cities and in various industrial applications. Finally, the LMDT group includes transformers ranging from 1500 KVA to 5000 KVA, which are used to supply electrical power from high voltage stations to low voltage ones or from high voltage stations to large industries and large cities directly.

LT transformers factory is chosen for this study, because it is the only manufacturing factory that has moved to lean management. The longitudinal case study covers the period from start of lean management implementation in 2004 till end of year 2016. As discussed in chapter 1 (section 1.4), LT is chosen for this study because of its suitability to develop rich data to help achieve the research objectives and answer the research questions. As will be seen in this chapter, LT's transformers factory has gone through different progressive stages of lean management implementation since its first adoption in 2004. Additionally, in most of the twelve years of the study period – more specifically from 2009 to 2016 – the organisation has been trying to grasp an understanding of how its MAS can operate with lean. This presented an excellent chance for the researcher to study the developments in MAS in context of lean, along with the role played by VSC as a key lean-tailored management accounting practice. Additionally, as will be explained in chapter 6, the researcher has been previously involved with the case organisation in analysing possible management accounting practices for LT factory, including VSC. This has established some understanding of the term 'lean accounting' and VSC among a sizable group of the organisation's actors. Such understanding is rarely found in most lean firms (Chopra, 2013; Rao and Bargerstock, 2013), yet it does facilitate the analysis of the role played by VSC practice and the factors affecting its acceptance or rejection. Also, being of a multinational nature, the data for the case organisation are thought to present different views from local organisational actors in Egypt and global actors in Zurich. All of this is sought to present a dynamic data set and enrich the findings of the study in order to facilitate the exploration of the study's research questions. The next section presents the organisation chart and discusses the responsibilities of organisation's representatives with a focus on the key actors chosen for this study.

5.2 Organisation Chart and Key Organisation Representatives

LT organisation has six divisions producing and assembling electric power components in the Egyptian market. Transformers represent a product group in the 'power grid' division, which includes the three product groups of; transformers, high voltage distribution panels and distribution panels' components. Hence, transformer products are denoted by '**PGTR**' as an abbreviation for; **P**roduct **G**roup: **Tr**ansformers. In the organisation, the words 'product group' and 'business unit' are used interchangeably to signify a group of similar product types produced within a certain division. Figure 5.1 presents the organisation chart for the transformers' product group in Egypt. The country managing director (Mr NJ) manages all the six divisions of the organisation. Each division has a division manager. Mr NN is the manager for the power grid division, and he is also the manager for the transformers product group (PGTR) in this division. Hence, as shown in figure 5.1, Mr NN is also known as the Local Business Unit (LBU) manager for the PGTR in Egypt.

As the division manager, Mr NN has an executive assistant and a health, safety and environmental manager who is responsible for handling health, safety and environmental risk issues related to all product groups in the division. Also, at the division level, a front-end sales team managed by a front-end sales manager (Mr M SH) is responsible for developing price lists for the division products, preparing offers to customers and receiving orders made in any of the divisions' product groups. At the local business unit level i.e. the transformers product group (PGTR), an HR business partner with a small HR team handles the HR issues related to the product group employees.

In figure 5.1 the frame outlined in black includes the organisation managers and employees who are responsible for or are having a direct or indirect impact on the PGTR operating and management accounting and control processes and data. Accordingly, all organisation representatives included in this frame form the interview participants in this research, except for the technical lead engineer and factory team of design engineers. Technical lead engineer and his team of design engineers are not included in the interviews conducted in this research, since they are mainly responsible for handling the development, graphing and execution of the transformers special

designs requested by the customers, as will be explained later in this section. Any costing or accounting issues experienced by the factory lead engineer and his team of designers, is handled by factory engineering and operations advisor (MR MF), who is one of the interview participants in this research *(see full interview participants in the list of interviews available in the appendix of this thesis)*. Because of their responsibilities handling or affecting organisation operating and management accounting and control data and processes, those representatives form the key human actors chosen for this research.

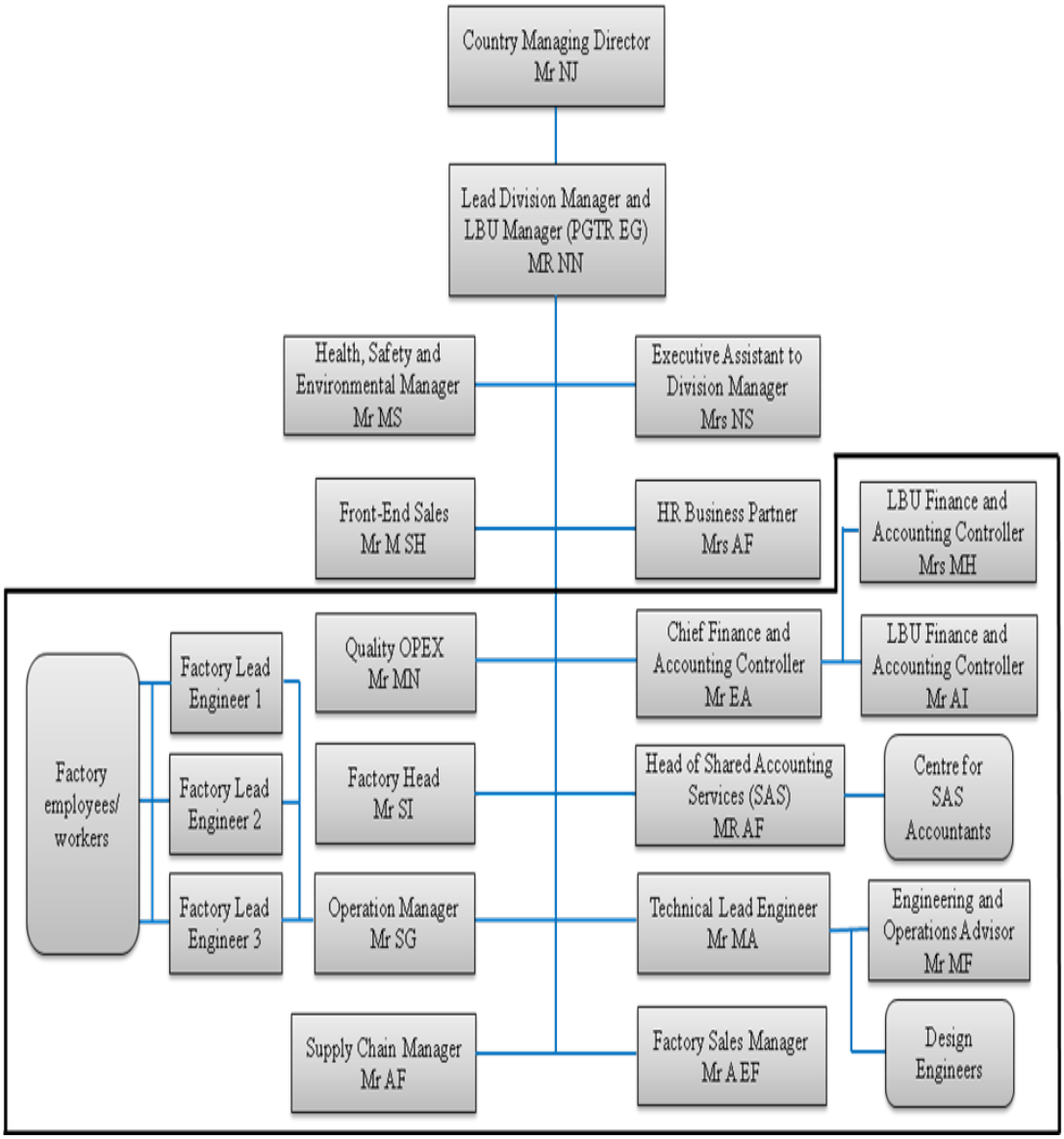

Figure 5. 1: Organisation chart for the Transformers Product Group in Egypt

Source: Local Business Unit Executive Assistant (Mrs NS) as per organisation guidelines on October 11th, 2016

All managers and employees included in black frame shown in figure 5.1 are located between the head office in Cairo and the Transformers factory in the City of 10th of Ramadan, which is located about 55 kilometres from the Egyptian capital. At the operating level the factory head is based in the transformers factory outside Cairo, he leads the factory with a team of: an operation manager, Quality-Operation Excellence (OPEX) manager, supply chain manager, some representatives from engineering and design department-*(mostly based in Cairo head office),* a group of factory lead engineers and factory workers.

The factory head together with the factory operation manager lead the main production processes in the factory, they follow up on progress with lean management, monitor factory key performance indicators (KPIs), develop and follow up on continuous improvement initiatives done in the factory. The factory head is also responsible for reviewing and implementing any new guidelines sent from the organisation's Swiss headquarters. Additionally, he reviews KPIs received from various sectors in the factory and the organisation head office in Cairo and confirms them on an organisation's internal information system known as the Operation Excellence (OPEX) analyser. A detailed explanation of how factory KPIs and other management accounting and control data are reported is presented in the next section.

The factory operation manager works with a team of three lead engineers who monitor the work of several employees on the factory production floor. Lead engineers report factory KPIs monthly on the visual management boards, available in the factory shop floor. They handle any production problems on the shop floor with guidance from the factory operation manager, if needed. They are also responsible for handling any issues related to the application of the 5S methodology. They monitor progress of shop floor workers with 5S and report results monthly on another board used to evaluate the use of 5S. Selected lead engineers receive trainings on annual basis from the Swiss headquarters, either online or if needed at the organisation headquarters in Zurich. Trainings are usually on the factory 'current state' of development versus how improvements can be integrated to factory's 'future state'.

The factory quality manager is responsible for handling quality issues such as; testing material quality and checking quality of produced transformers after certain production processes, before packing and before delivery to customers. In LT, the factory quality manager is also referred to as the operation excellence (OPEX) manager, as he is responsible for handling KPIs received from various organisation's sectors on the OPEX analyser. The KPIs are then available for review and confirmation from the factory head. As a quality manager, he is in charge of reporting those KPIs related to quality measures, for example; number of units tested, number of units shipped complete, total Cost of Poor Quality (COPQ) and number of test failures.

Factory supply chain manager is handles LT's relationships and deals with factory suppliers, who are mostly material suppliers. Supply chain manager handles price offers made by material suppliers, discusses factory material quality constraints set by factory quality manager and agrees with suppliers on material delivery dates. From a management accounting and control perspective, he reports supply chain KPIs to the Quality-OPEX manager to be reported on the OPEX analyser. Examples of supply chain KPIs include; number of supplier's deliveries and total number of supplier's on-time deliveries. Supply chain manager also provides the final agreed upon prices of material purchases made to the organisation finance and accounting controllers, these prices are then used for budgeting and costing transformer products.

A technical lead engineer is the head of the designers' team in charge of the transformers' product group. The design engineers are mainly handling the development, graphing and execution of the transformers special designs as requested by the customers. The technical lead engineer works closely with an engineering and operation advisor (Mr MF), who used to work as a technical lead engineer and then a factory operation manager for 17 years. For several years, Mr MF handled the reporting of KPIs data on the OPEX analyser as a previous operation manager to the factory, long before this data where handled by factory quality manager. The designers' team is mainly based in the organisation head office in Cairo, however some representatives from the PGTR design engineers are located at the factory.

At the management accounting and control level, there are two main functional units handling the management accounting data for transformer products; a finance and accounting controlling team and representatives from the organisation's centre for Shared Accounting Services (SAS). The finance and accounting controlling team is composed of three personnel: a chief finance and accounting controller (head of controlling team) and two LBU finance and accounting controllers.

Basic accounting transactions related to the transformers' factory are handled by the organisation SAS centre. Such transactions include data entry, financial reporting needed for financial statements preparation, handling general ledger accounts, managing payables and receivables transactions, accounting for employees' salaries, handling treasury accounts, letters of guarantee and letters of credit transactions. The centre for SAS is responsible for processing those accounting transactions for all the six divisions of the organisation. Accordingly, a team of the SAS representatives oversees the PGTR accounting transactions, which are reported to both the head of SAS together and PGTR finance and accounting controlling team.

Finance and accounting controlling team responsible for the transformers product group are in charge of preparing annual budgets and monthly forecasts for transformer products, preparing products costing data, reviewing final data reported by the SAS accountants, reporting costing data and other financial KPIs to OPEX analyser and making sure reported figures make sense in relation to other KPIs reported by different organisation sectors.

Finally, a factory sales manager works closely with the finance and accounting controlling team. The factory sales manager accounts for the actual orders of transformer products received from the front-end sales manager. He sets the plan for processing the production of those orders, based on customer requested delivery dates. This plan is passed on to the finance and accounting controlling team, so that they can forecast their expected monthly/ quarterly revenues. Hence, both the factory sales manager and the finance and accounting controlling team are held accountable for profit or loss forecasts.

The previous two sections (5.1 and 5.2) discussed the background for the case study organisation and discussed its organisational chart. Section 5.2 presented the organisation's representatives dealing with the PGTR operating and management accounting data and who also represent the key human actors involved in this research. Sections 5.3 through to the 5.6 provide a detailed discussion of the case study key findings in terms of: how the organisation manages its management accounting information and the accounting information systems used for this, the transformers factory journey with lean management implementation, a detailed discussion of the factory's operating data findings and finally, a thorough discussion of the changes done in the organisation's management accounting system.

5.3 Managing Organisation's Management Accounting Information

The previous section provided a thorough explanation of the organisation chart along with the responsibilities of organisation representatives affecting the factory operating and management accounting and control data and processes. Throughout this explanation a reference was only made to the internal system used in reporting factory KPIs; the OPEX analyser. However, other software/ accounting information systems are also being used by the PGTR finance and controlling team and the SAS centre. Therefore, this section is devoted to explaining how the reporting process is structured around organisation representatives and how management accounting and control information is finally reported to organisation headquarters in Zurich. Figure 5.2 presents an illustration of how management accounting and control information related to the transformers product group flows and is reported across different organisation representatives in Egypt and Switzerland.

As mentioned earlier OPEX analyser is the software/ accounting information system, where final figures of KPIs used by LT's transformers factory appear. The factory head receives raw data on these KPIs from supply chain manager, factory operation manager, representatives from the engineering department and quality manager located in the factory. Additional KPI data are also gathered from factory sales manager and finance and accounting controlling team. This data is checked by both the quality-OPEX manager and the factory head and are then processed by the factory head into required KPIs ratios, percentages and measurements. Once data are posted on OPEX analyser, it

is also available for review by the LBU PGTR manager in Cairo head office and the global product group manager and his team in Zurich.

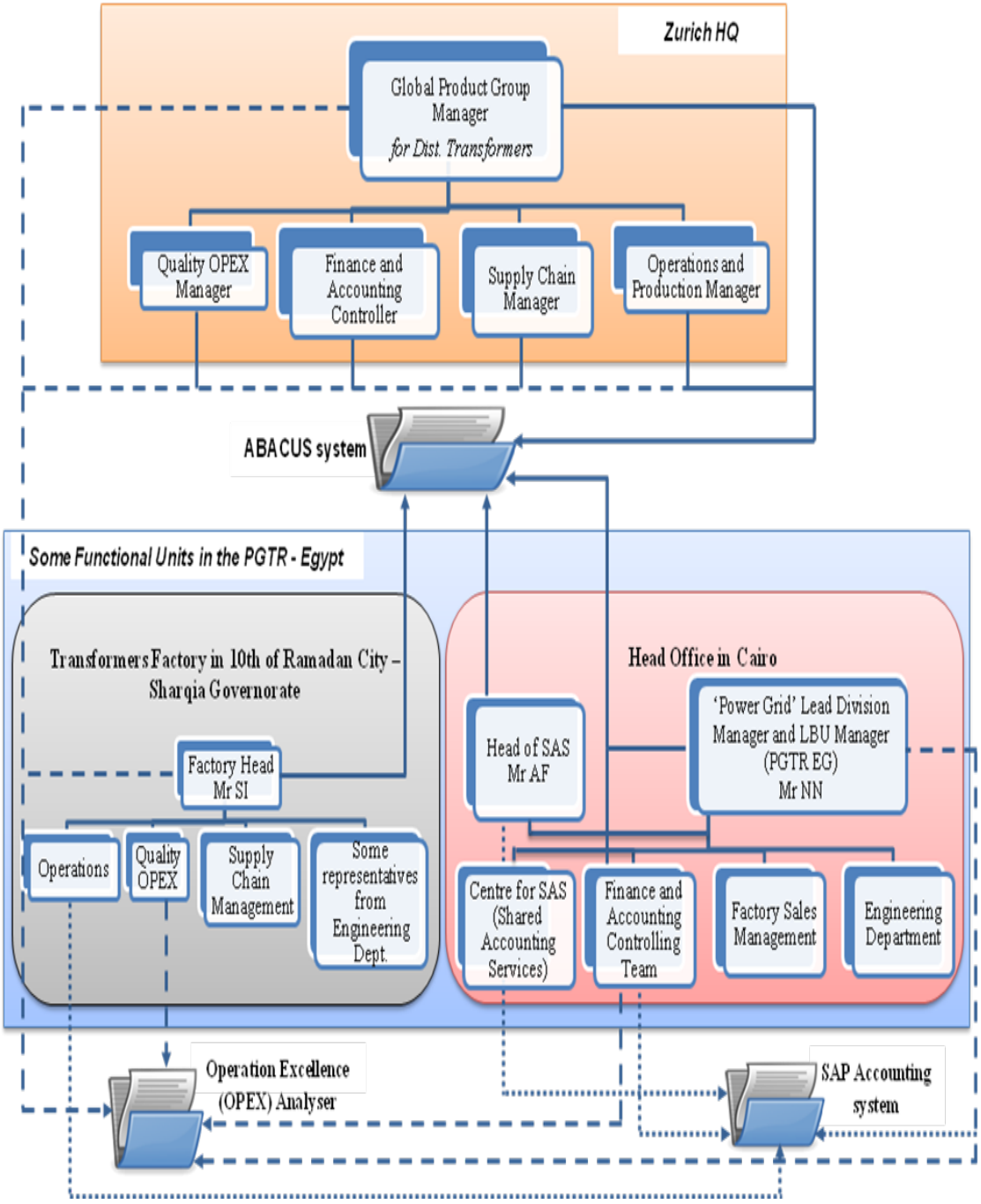

Figure 5. 2: An illustration of how PGTR management accounting and control information is reported

Source: Interviews conducted with factory head, head of SAS and LBU finance and accounting controllers in April, September and October 2016

In figure 5.2, the dashed arrows signify the organisation representatives who have access to the management control information available on the organisation OPEX analyser. The analyser is only accessed by the transformers' factory head and factory quality-OPEX manager at the factory, the LBU PGTR manager and the finance and accounting controllers' team in Cairo head office and the global product group manager and his team located in the organisation's headquarters in Zurich. The global product group manager is responsible for managing a certain group of products produced by the organisation in its various local business units (LBUs) in different countries. Accordingly, the global product group manager for distribution transformers manages the operation of the PGTR in Egypt in addition to 19 other LBUs i.e. 19 transformers factories, in 19 countries all over the world. The global product group manager manages PGTR with the help of a team of; a global quality OPEX manager, finance and accounting controller, supply chain manager and operations and production manager.

Annual and quarterly budgets, monthly forecasts, general ledger accounts, costing data, treasury accounts and monthly financial statements are accounted for and prepared using an SAP accounting information system. As mentioned in the section 5.2, basic accounting transactions including data entry, general ledger accounts, calculation of employees' salaries, treasury accounts and reporting data needed for financial statements' preparation, are managed by the organisation's centre for SAS accountants. This data is prepared and reported to the finance and accounting controlling team using the organisation's SAP accounting system. The finance and accounting controlling team then use this data for decision making and to prepare annual and quarterly budgets, monthly forecasts, costing reports, and review and confirm financial statements' preparation processes. Organisation representatives with access to SAP accounting system are shown using the doted arrows in figure 5.2. They typically include: the head of centre for SAS, SAS accountants, finance and accounting team of controllers, factory operation manager and the LBU PGTR manager in head office. It is worth mentioning that, in addition to these represented shown in figure 5.2, factory lead engineers use SAP accounting system. This is to report operating data, which is then used by the finance and accounting controllers' team to develop other management accounting and control information. Examples of this data include; actual working hours used for purposes of product costing, decision making and as benchmarks for future budgets.

Examples of operating data reported in SAP also include updates on direct material, work in progress and finished goods inventory– if any. LBU PGTR manager has access to both SAP accounting system and OPEX analyser to maintain a full picture of management accounting information related to the transformers product group.

A compilation of PGTR's management accounting and control information is available on a third accounting information system used by the organisation known as ABACUS system. ABACUS includes all KPI information available on the OPEX analyser together with, the final reports and figures of all other management accounting and control information processed on the SAP accounting system. As shown in figure 5.2, regular arrows denote the organisation representatives with access to ABACUS system. Finance and accounting controlling team, LBU PGTR manager, factory head, Head of centre for SAS, global product group manager and his team, all have full access to ABACUS. Monthly to quarterly meetings are held between those organisation's representatives, to discuss any comments on the management accounting and control information of the product group, in addition to future development plans. However, an earlier meeting is to be arranged, in case of having any problems with the reported accounting information, that is spotted by any of those organisation representatives. Problems or discussion issues regularly include unsatisfactory results, deviation from performance targets, a mismatch between operating results and financial results, concerns about budget targets or costing calculations or a need to pass on a suggestion to change any of operating or management control practices used. In such case, organisation's representatives associated with the problem/ discussion issue should also be available at the meeting.

It is noticeable that the different accounting information systems with organisation's representatives/ human actors, having access to some systems and not others, have over the time developed representatives who are more acquainted with some information systems than others. Eventually, some organisation's actors were internally and informally designated as the key responsible actors for those accounting information systems. Key responsible actors were designated as such, to imply that, they are the actors more acquainted and influential to this accounting information system. For example, finance and accounting team of controllers were designated as the key

responsible actors for SAP, Factory head and factory operation manager were internally perceived as the key responsible actors for OPEX. At the same time, LBU manager and LT's global managing team were viewed as the key actors, influencing ABACUS. Over the time, those designated key responsible actors have developed different perceptions on the objectives and strategies for management accounting information processed by the three accounting information systems. As will discussed in detail in chapter 7, those perceptions have influenced actors' interactions with other human and non-human actors in the organisation and had their implications on the developments experienced in LT's MAS.

5.4 Factory Lean Journey: An Overview

A timeline of progress in lean management implementation in LT transformers factory is presented in figure 5.3. Stages of progress with lean demonstrated in figure 5.3 are discussed in this section along with sections 5.5 and 5.6. Lean implementation started in September 2004. Prior to this, the operating system in LT transformers factory followed a mass production system. Products were produced annually and pushed to the market in order to introduce factory's products to market. More importantly, to cover the factory's start-up and establishment costs.

Eventually, LT transformer products achieved a considerable demand in the market. Factory executives sensed that a mass production system cannot cope with the plant objectives to meet customer demands effectively and maintain a good competitive position. The transformers factory head reports that;

> *Towards the end of year 2004, the transformers factory executives together with the Swiss headquarters started to think to apply some of Toyota's manufacturing system practices – the Lean management system. To apply lean, LT transformers factory did the following steps in sequential order:*
>
> ***September and October 2004:***
>
> - *The factory managers and lead engineers studied customers' preferences in order to identify the customer product value requested.*
> - *LT mapped the value stream for its transformers plant.*

- *The value stream includes all processes needed to supply the market with a value adding transformer from order entry till order shipment.*

November 2004:

- *The transformers factory started to apply a JIT/pull production system so that products produced are only those demanded by the customers.*
- *The plant integrated the 5S methodology to help optimize production flow and enhance workers movement between operating processes.*

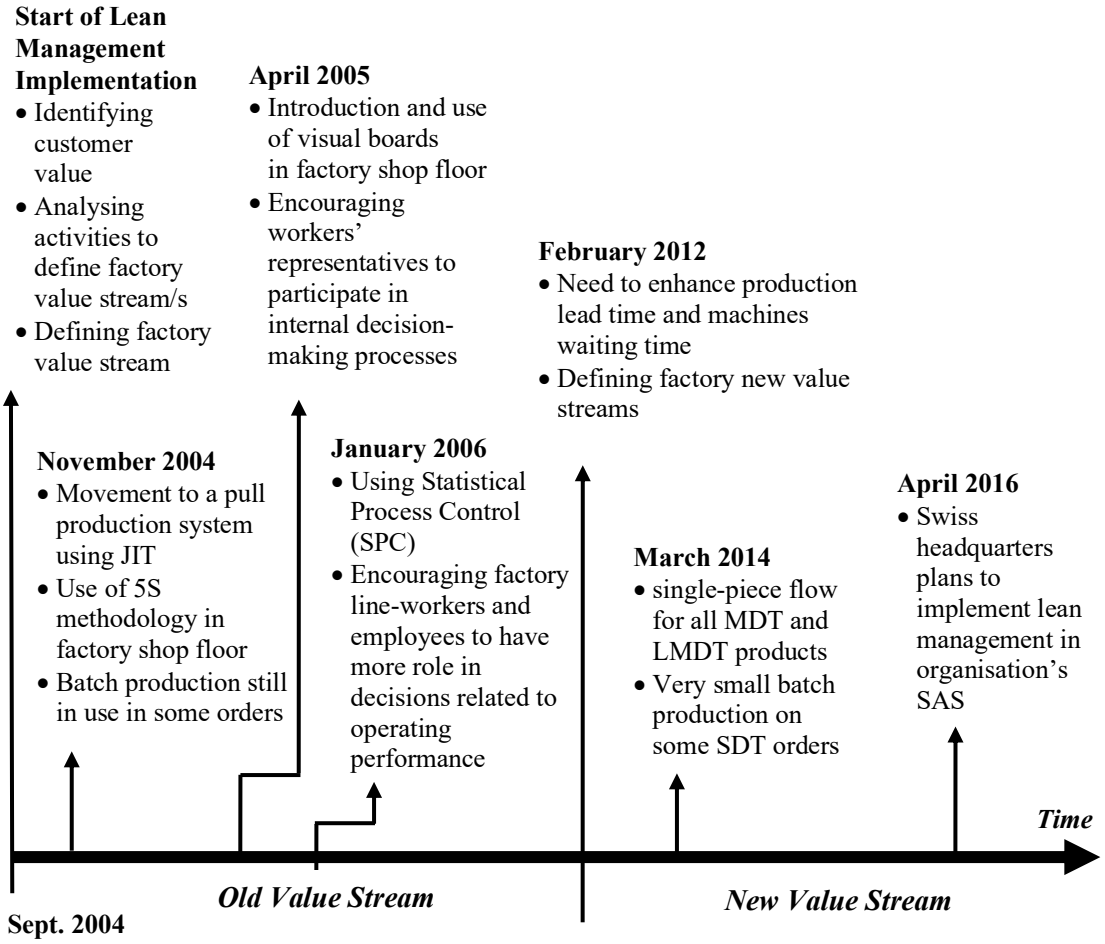

Figure 5. 3: Timeline of Progress in Lean Management Implementation in LT transformers Factory

As mentioned by LT's factory head, the above steps took place between September to November 2004. In April 2005, the factory introduced the use of visual boards in its shop floor. With the introduction of visual boards, workers were encouraged to take part in internal decision-making processes related to factory operation and to communicate any problems, ideas or recommendations to factory lead engineers. Early in 2006, the factory established a Statistical Process Control (SPC) program to be used for continuous improvement purposes. SPC inspects products at each production process to make sure they match LT's quality levels.

At the beginning of data collection processes, the researcher assessed the progress of LT with lean, to gain an understanding of how advanced the organisation is with lean management implementation. Literature discussing how progress with lean operations is assessed; i.e., how degree of companies' maturity with lean is evaluated, usually base such assessment on the degree of companies implementation of the five principles of lean and on the use of a number of key lean practices to support these principles (Ahlström and Karlsson, 1996; Sanchez and Perez, 2001; Soriano-Meier and Forrester, 2002; Staats et al., 2011). Most of this literature uses surveys to assess the degree of "leanness" or maturity with lean (Wan and Chen, 2008). However, since this assessment forms one of the steps towards reaching the objectives of this research, a simpler assessment method which matches the research needs was used. Maskell and Baggaley (2004) describe a three-stage lean management maturity path; the first stage starts with having successful lean production cells, a flow, pull and Kanban systems in place. The second stage focuses on maintaining visual systems, established continuous improvement teams, managing via value streams and having considerably low inventory levels. The final stage is having an entirely lean organisation, where lean philosophy is implemented as a whole organisation culture and is used with all organisation partners.

A recent study by Rao and Bargerstock (2013) uses Womack and Jones's (1996) literature on lean thinking and Maskell and Baggaley's (2004) lean maturity path to develop 6 key aspects, which are used to measure the degree of enterprises' leanness. According to Rao and Bargerstock (2013, p. 13) these 6 aspects revolve around the extent to which a manufacturing company adopting lean, has done the following:

1. Defined customers' values,
2. The plant streamlined activities on value streams,
3. The operations used the principles of flow and pull by adopting Just-in-Time (JIT) strategy,
4. The plant secured controls over shop-floor operations using visual controls,
5. The plant empowered employees through full authority and information, and
6. Continuous improvement teams strived to attain higher levels of perfection through continuous improvements (CI).

Those 6 aspects were used to analyse LT's factory manufacturing data collected during the early interviews with the transformers' factory head and factory operation manager, in order to assess the factory's maturity with lean implementation. Tables 5.1, 5.2 and 5.3 present Roa and Bargerstock's (2013) six aspects and the interview data provided by both factory head and factory operation manager in response to questions on those aspects. From the data collected on transformers factory relative to Rao and Bargerstock (2013) six aspects, the researcher was able to conclude that the factory inhibits an intermediate to advanced level of maturity with lean implementation. Most of the lean principles are implemented and most of the 6 aspects discussed by Rao and Bargerstock are maintained. LT moved steadily with the use of single-piece flow. As reported by the factory head and factory operation manager, batch production used at the beginning of lean implementation (for example, during November 2004) involved small batches of products. Overtime, those batches kept decreasing in size in order to maintain the flow of production.

As shown in the lean timeline presented in figure 5.3, between year 2004 and year 2016, the transformers factory has witnessed changes in how its value streams are constructed. This will be discussed in detail in next sections (5.5 and 5.6). However, it is worth mentioning that the factory was able to use single-piece flow for its MDT and LMDT since March 2014. As shall be explained in section 5.6, the new value stream identified in 2012 enabled the use of single-piece flow for those products. Currently, the factory managers are working on applying a pull system to be used with suppliers to minimize the materials delivery lead times. Additionally, they would like to give more concern to continuous improvement and employee empowerment efforts.

Rao and Bargerstock (2013) Aspects for evaluating Company's Maturity with Lean Implementation	Interview data provided by Transformers Factory Head and Factory Operation Manager
1. Company defined customers' values **Int. Q[8]:** What were the first aspects you focused on in your way to implementing a lean management system?	*"At the early stages of lean implementation, customer value was our main focus, the factory managers and executives studied customers preferences in order to identify the customer's key product values before moving to any further steps."*
2. Plant streamlined activities on value streams **Int. Q:** Is the factory currently managed via value streams?	*"Yes, a next step to adopting a lean management system was that, LT maps the value stream for its Transformers plant. The value stream currently includes all the steps needed to supply the market with a value adding transformer from order entry till order shipment."*
3.Operations used the principles of flow and pull by adopting JIT strategy **Int. Q:** How is the factory managing the flow of operations?	*"At the beginning of lean implementation, we were not operating in a 100% single-piece flow production system. We were still producing some transformers together, but our production process includes very small batch sizes. Batches kept decreasing overtime to maintain production flow. This is considered a huge advancement to our previous mass production and large to medium batch production system. In 2014, with the new value streams, we were able to have a single-piece flow production MDT and LMDT products. Also, the plant currently uses a 5S methodology in order to help optimize the flow of production and enhance workers movement between operations."*

Table 5. 1: Assessing LT's progress with Lean Management Implementation in its Transformers Factory – Aspects 1, 2 & 3

[8] Interview Question

Rao and Bargerstock (2013) Aspects for evaluating Company's Maturity with Lean Implementation	Interview data provided by Transformers Factory Head and Factory Operation Manager
3.Operations used the principles of flow and pull by adopting JIT strategy **Int. Q:** How are you maintaining a pull production system?	*"Our Transformers plant applies the JIT/pull production system so that products produced are only those demanded by the customer. We are working more on our planning and scheduling efforts since in some cases we have to plan for our material needs ahead, in order to supplement orders that are to be delivered in a long interval of time.*
4. Plant secured controls over shop-floor operations using visual controls **Int. Q:** Do factory workers and supervisors maintain any visual controls in operating shop-floor?	*"Yes, LT transformers factory is using visual measures that are displayed on the production floor for employees' and supervisors' control over the production process."*

Table 5. 2: Assessing LT's progress with Lean Management Implementation in its Transformers Factory – Aspects 3 & 4

Rao and Bargerstock (2013) Six Aspects for evaluating Company's Maturity with Lean Implementation	Interview data provided by Transformers Factory Head and Factory Operation Manager
5. plant empowered employees through full authority and information **Int. Q:** How do you manage to empower the factory employees? Do you succeed in providing them with authority and relevant information, which they can use for decision making or on day to day operations?	*"We offer periodic trainings to factory workers, employees and supervisors on regular basis. Additionally, visual controls displayed on factory visual boards provide workers and supervisors with timely control measures. Yet, I cannot claim that workers and junior supervisors are given full authority to handle shop-floor problems even though currently representatives from them are usually involved in decision making."*
6. Continuous improvement teams strived to attain higher levels of perfection through continuous improvements (CI) **Int. Q:** Does the factory maintain teams of factory employees to handle continuous improvement efforts? And what continuous improvement efforts are factory representatives engaging in?	*"For improvement purposes, the plant established a Statistical Process Control (SPC) program which inspects products at each production process to make sure they match the plant quality levels. We have not identified formal continuous improvement teams, but we have two representatives on average at each workstation who are responsible for keeping track of boards controls and immediately work with their supervisors on problem solving issues. They shall also meet weekly with their supervisors to discuss continuous improvements suggestions"*

Table 5. 3: Assessing LT's progress with Lean Management Implementation in its Transformers Factory – Aspects 5 & 6

5.5 Factory Old Value Stream – *2004 till end of 2011*

Following lean management implementation in 2004, the transformers factory identified its value stream map as illustrated in Figure 5.4. In 2004, the construction of factory first value stream was done in isolation from any finance and accounting representatives of the organisation. LT's global managing team and factory operating people, (factory head, factory operation manager, quality-OPEX manager, factory lead engineers and factory workers), were the main actors involved in constructing the value stream map for factory first/old value stream.

The map starts with the receipt of a customer order by the sales and marketing department. Engineering, planning and purchasing department develops the design for the order, sets its quotation and requests materials needed from suppliers. All materials are inspected before going into the production process which includes the production of the transformers' main component parts as well as the transformers tanks. The production process for the transformers main components includes the processes of; core slitting, core cutting, core stacking, low voltage winding, high voltage winding, active part assembly and connections. At the same time, the tanks production processes of; folding, welding, final assembly and leakage testing, shall also be running.

Finally, both the transformers components and tanks go through a painting and drying process. Then, they are passed through their final testing process. An order is finally shipped to customers after being completely tested for any defects. In this value stream map, managers in the Transformers factory identify production processes as: machine intensive/machine-based, labour-based and quality control production processes.

All power transformers from 50 KVA to 5000 KVA go through the same production process. Accordingly, factory managers and production line workers treat the three main transformer types (SDT, MDT and LMDT) as one product family. Only one value stream is identified for all transformer types. However, as reported by the transformers' factory head, the different power and size of the transformers produced entails that they do take different processing time in various production processes.

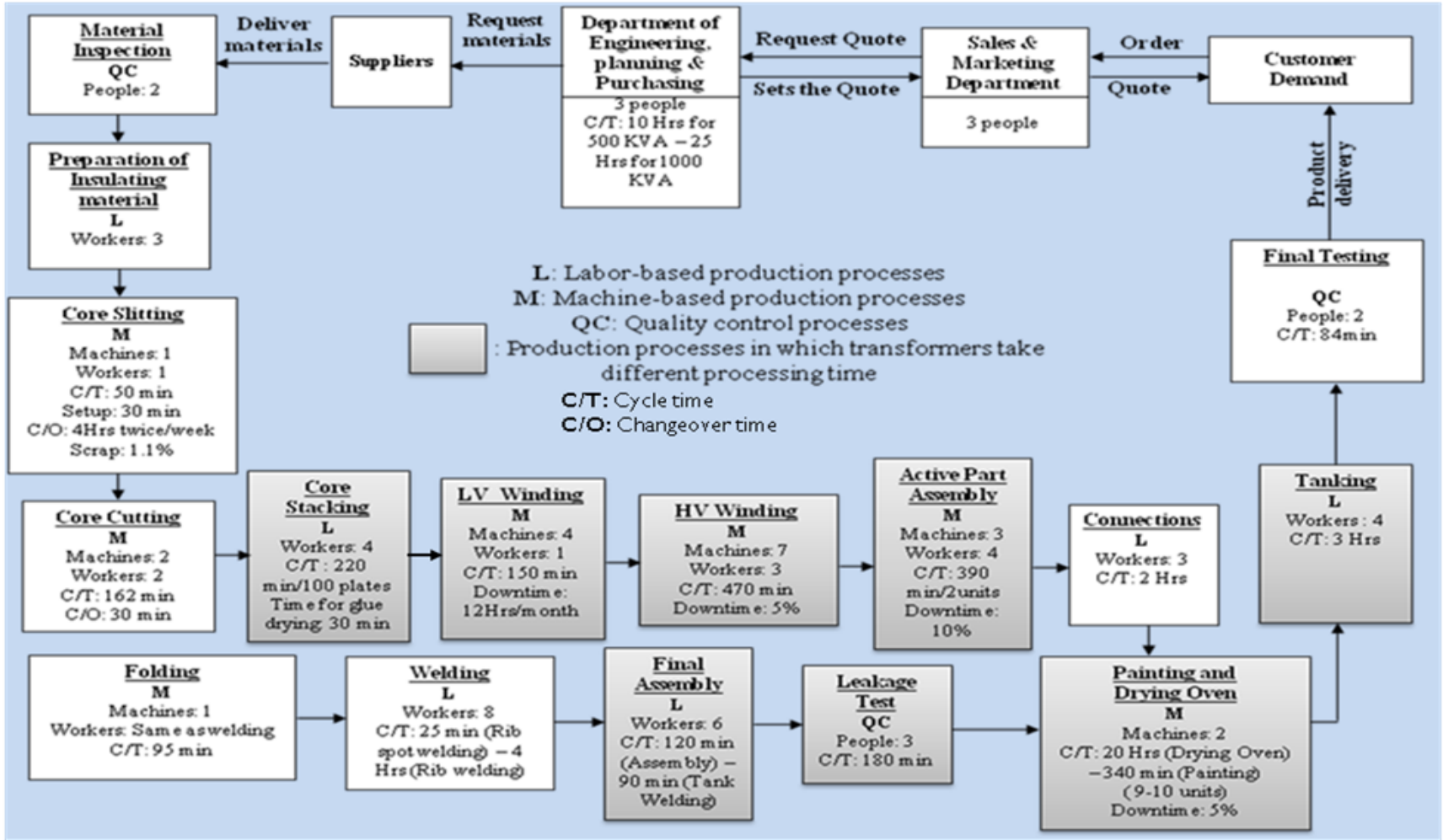

Figure 5. 4: Value Stream Map (old value stream) for LT Transformers Factory

Source: Factory operating documents provided by factory head and factory operation manager

In figure 5.4, shaded production processes are the ones in which different power transformers take different processing time. Additionally, the sales and engineering departments as well as any general and administrative departments involved in the execution of an order are located outside the factory in LT's head office and operate to support the production of all transformer types. Accordingly, the researcher was able to conclude that; even though the three transformer types take the same steps in the value stream and accordingly are considered one product family, such construction of the value stream creates a condition in which resources are being interrelated between products in the same value stream. In other words; all types of transformers are being supervised with the same production supervisors, inspected with the same quality controllers and are being processed through the same machines. However, they are using different processing time in most of the value stream processes.

5.6 Factory New Value Streams - *from year 2012 onwards*

As shown in the lean timeline presented in figure 5.3, the beginning of year 2012 witnessed a change in the factory value stream construction. During the interviews conducted with the factory operation manager in September 2016, he commented that:

> *At the start of 2012, we figured out that an immense enhancement in production lead time and machine waiting time can be achieved if a separate line of production cells is devoted to the production of the SDT transformers. An investment of around five million Euros was made for the acquisition of new machines, which has proved to be an investment worthwhile during the past couple of years.*

Figure 5.5 shows an illustration of LT's new value stream for its transformers' factory. All organisation actors affecting its operating and accounting data, *(shown in the frame outlined in black in figure 5.1),* took part in constructing the new value stream. As shown in figure 5.5, a new line of the production processes of; core cutting, core stacking, LV welding, HV welding, active part assembly and connections is currently developed to produce SDT types of transformers. Not only is the new line developed to achieve progress in production lead times and machine waiting times, but also according to the factory lead production engineer;

Some of the machines used to process the three transformers types needed replacement. At that time, we analysed the appropriate ways to undertake these replacements and a separation of the SDT production cells meant an expansion in the factory's capacity to produce this transformer type. We have perfectly reaped the fruits of this decision as we currently have a capacity to produce up to 3,600 of all transformers types a year, previously our maximum capacity has never exceeded 1,600 transformers. I can say that the development of the new line perfectly resonates with the increasing demands over SDTs that we are receiving since the beginning of 2014.

Currently the remaining line of production cells from core cutting to connections is used to produce the other two types of transformers; MDT and LMDT. This facilitated the use of single-piece flow production for both MDT and LMDT.

The new line for SDT, only produces this product in small batches. Figure 5.5 also shows that having a separate line of production cells for SDTs contributes to the decrease in the production processes in which different transformers types shared the factory resources. However, since all transformers types go through the parallel processes of folding to tanking, the transformer products still share factory resources in production cells such as: final assembly, leakage test, painting and drying and tanking, together with other production activities as material inspection and preparation as well as the administrative activities of sales and marketing and engineering, planning and purchasing. This new value streams' construction is still currently in use. Additionally, in April 2016, LT's global managing steam announced its plan to use lean in its centre for SAS and hopefully extend its use in other administrative departments in year 2017. Plans of lean implementation were not enacted till end of study period in year 2016. However, the decision was very welcomed by LT's finance and accounting controllers and SAS representatives. The next section discusses the impact of factory value stream identification, and its change in 2012 on the factory MAS.

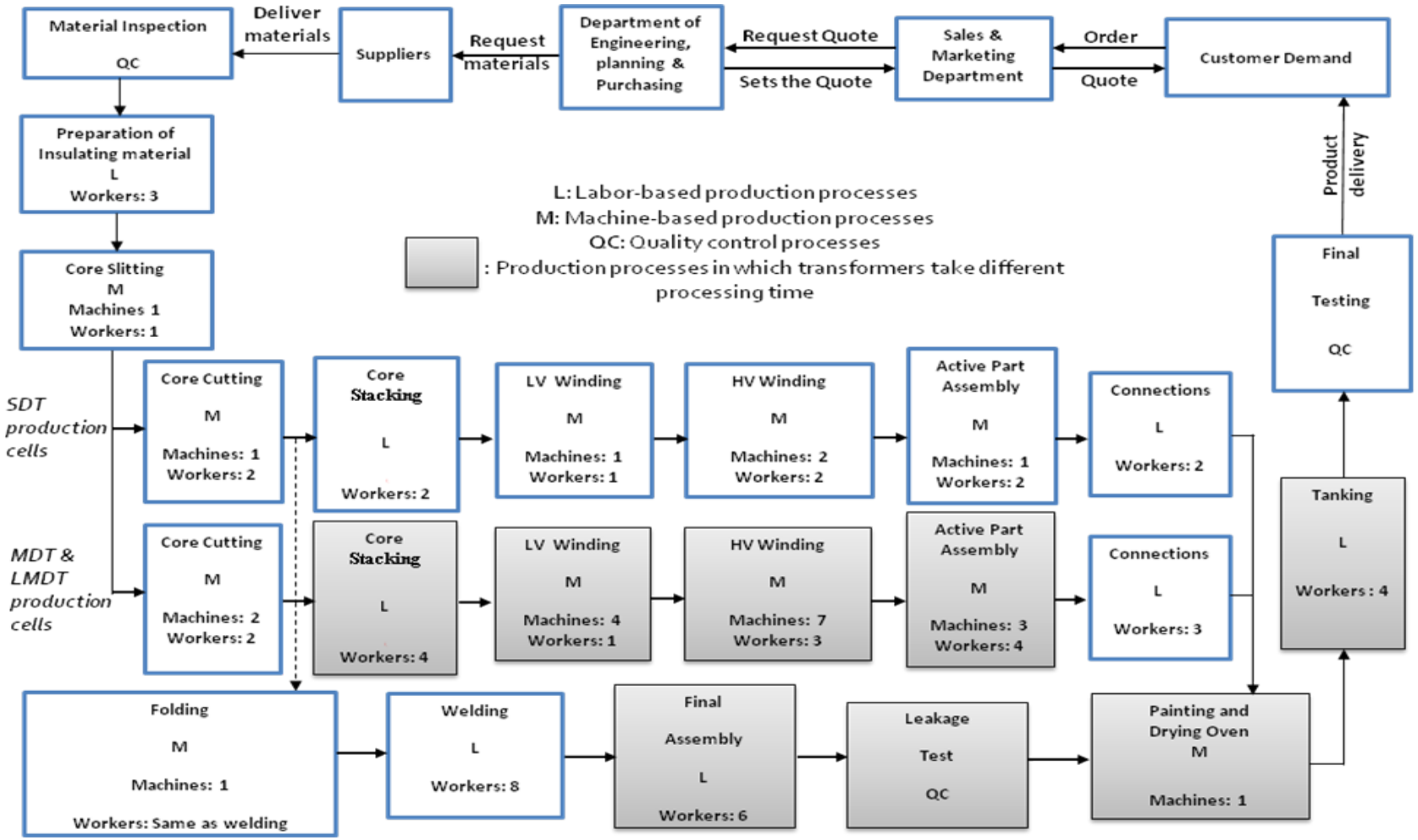

Figure 5. 5: Transformers Factory New Value Stream

Source: Factory operating documents provided by the factory operation manager and the factory engineering and operation advisor

5.7 Factory Management Accounting System

This section discusses LT's MAS during the study period (2004 till end of year 2016). The discussion outlines the costing practices and performance measures together with any other operating or internal KPIs used by LT's transformers' factory. Management accounting and control practices used by LT in its transformers' factors changed starting from year 2014. Hence, the following two subsections presented here discuss LT's MAS first; from start of lean implementation till end of year 2013 in subsection 5.7.1. Changes in MAS experienced starting from year 2014 till end of year 2016 are discussed in subsection 5.7.2. The making up of interactions constructing LT's MAS throughout the study period and how these interactions are related to other organisation actors are thoroughly discussed and analysed in chapter 6.

5.7.1 Start of lean management implementation till end of year 2013

With respect to costing, it was found from the interviews with LT finance and accounting controllers that, LT controllers kept using standard costing to cost the transformer product units even lean implementation. Hence, the factory accounted for the different usage of resources using a traditional costing allocation method. This was also obvious upon reviewing the factory cost reports. Tables 5.4 and 5.5 show the total manufacturing costs and full costs[9] for LT transformers' factory as of December 31st, 2009. The factory produces all types of transformers throughout the year, but due to the confidentiality of the organisation costing data, the data supplied by LT accounting and finance department included the calculations of the per unit costs for both the 500 KVA and the 1000 KVA transformers only during year 2009.

The chief finance and accounting controller reports that since lean implementation, there were many years in which the demand and consequently the factory production was in the ratio of forty percent of the 500 KVA transformers and sixty percent of the 1000 KVA transformers. During 2009, one thousand eight hundred transformers were

[9] Traditionally both costs are presented in one setting in LT Transformers factory. Yet, fitting all data in one tabular presentation was not feasible in this thesis. Hence, two tables are used here to present each cost category.

produced. Consequently, due to the restrictions on the costing data supplied for only two transformers, the same demand and production percentages were assumed for year 2009.

Cost Item	Basis	Total Cost in EGP[10]
1 Material		
1.1 Direct Material costs		154,872,426
1.2 Material Overhead	% of DM cost	1,471,289
Total Material Costs		***156,343,715***
2 Direct Manufacturing Cost		
2.1 Manufacturing Process Cost (MPC)[11]	No. of production units	4,875,099
Total Direct Manufacturing Cost		***4,875,099***
3 Manufacturing Overheads		
3.1 Engineering and Design	% of MPC	902,870
3.2 Quality Cost	% of MPC	407,069
3.3 Maintenance	% of MPC	1,247,060
3.4 Other Production OH[12]	% of MPC	4,704,956
Total Manufacturing Overhead Costs		***7,261,955***
Total Manufacturing Costs/TMC (1+2+3)		**168,480,769**

Table 5. 4: Total Manufacturing Costs for LT Transformers Factory for Year 2009

Source: Factory costing data provided by chief finance and accounting controller

[10] EGP stands for **Eg**yptian **P**ound

[11] Includes salaries of workers in labor-based and machine-based production processes as well as depreciation of machines in machine-based production processes.

[12] Costs for production supervision, factory energy and water, factory depreciation as well as costs for machines and factory insurance.

	Cost Item	Basis	Total cost in EGP
	Total Manufacturing Costs/TMC (1+2+3)		**168,480,769**
4	**Technology and Product Development**		
4.1	Product / System Development	% of TMC	5,896,827
	Total Tech. and Product Develop. Costs		***5,896,827***
5	**Other Special Direct Cost**		
5.1	Provision for warrantees	% of Total Material Costs	781,715
5.2	Financing Costs:		
	Calculated Interest	% of TMC	1,684,807
	Total Special Direct Costs		***2,466,522***
6	**Contingencies and Provisions**		
6.1	Contingency for material Increase	% of TMC	3,369,615
6.2	Provision for Currency Risk	% of TMC	1,684,807
	Total Contingencies and Provisions		***5,054,422***
	Total Production Costs/TPC (TMC+ 4+5+6)		**181,898,540**
7	**Sales & Admin Costs**		
7.1	Sales & Marketing Costs	% of TPC	3,637,980
7.2	General & Administration Costs	% of TPC	9,367,767
	Total Sales & Admin Costs		***13,005,747***
	Full Costs (Production Costs + Sales & Admin Costs)		***194,904,287***

Table 5. 5: Total Costs for LT Transformers Factory for Year 2009

Source: Factory costing data provided by chief finance and accounting controller

The cost items highlighted in Tables 5.4 and 5.5 represent the overhead costs for the factory. The “basis” column shows the criteria by which each cost is allocated to a transformer unit. Material cost constitutes around 74 to 75% of total costs, total labour and overhead costs constitute between 15 to 18 % of total costs and the rest could be categorized under selling and administrative costs. The main Manufacturing Process Cost (MPC) is computed on basis of the output units produced and the remaining overhead costs are allocated to individual transformer units as a percentage of the MPC. Consequently, it can be concluded that almost all the overhead costs are allocated on basis of the production units implying that the company uses a traditional costing overhead allocation method to cost its transformer products.

Factory used performance measures are reported from departments of sales, quality, supply chain management, operations (technical), production and finance and accounting to the quality OPEX manager and reviewed by factory head using the OPEX analyser. Table 5.6 shows an extraction of the KPIs used by the factory during years 2009 and 2010 as reported on the analyser. The different colours of each group of KPIs shown in Table 5.6 are the exact highlighting colours used by the factory on its OPEX analyser. These colours are meant to designate which department is responsible for reporting this group of KPIs, for example; light yellow is for KPIs handled/reported by sales department, light green is for KPIs reported by quality department and so on.

A review of KPIs in table 5.6 shows that, very few of them are driven from the lean accounting literature such as the first pass yield and accounting for value added. However, starting from year 2014, other performance indicators were used by the factory and would appear on the ABACUS system with the other KPIs on the OPEX analyser. Further internal performance measures were also used only inside the factory. More details on the changes done in the factory performance measures used are discussed in the next section.

Department	KPI
Sales	Order Received and Order Received no. of units
	Order Received MVA
	Quotation backlog (value)
	Number of units delivered on-Time
	No. of units delivered to customers
Quality	CCRP no of complaints
	Number of Emergency repair and Number of Scheduled repair
	Field Failures and Total COPQ per month in LE
	FPY (First Pass Yield)
	Number of units tested and Test Failures
	No of rejected deliveries and Number of units shipped complete
	Number of incoming consignments passed inspection
	Number of incoming consignments inspected
Supply	Number of Supplier Deliveries
	No. of Suppliers on time Deliveries
Technical	TTPT
	Inventory %
	Installed Capacity [hours] and Available manned capacity [hours]
	Workload from firm orders [hours]
	Workload from hot tenders [hours]
	Number of units in WIP
Finance & Accounting	Revenues and EBIT in KLE
	Personnel Expenses
	Material Stock, Direct Material Cost, Work in Progress and Finished Goods
	Sales in Excess of Invoicing
	Direct Material Cost
	Value Added
Production	Units
	Hours
	TPT

Table 5. 6: An extraction of factory used KPIs in years 2009 and 2010 as reported on OPEX analyser

Source: Factory management accounting documents provided by the factory head and factory engineering and operation advisor

5.7.2 From 2014 till end of year 2016

Starting from year 2014 LT organisation started to cost its transformers products using what we can refer to as a partial Activity-Based Costing (ABC) system. Manufacturing Process Cost (MPC) as previously shown in table (5.2) is now computed as the allocated costs of the activity cost centres of: cooling, welding and testing, painting, material preparation, LV winding, HV winding, active part assembly, connection, tanking, final assembly, core cutting, core slitting and core stacking. Costs incurred in these cost centres are allocated to transformer units on basis of the direct labour and machine hours worked in each activity. An example of the MPC calculation for the 500 KVA transformer is illustrated in table 5.7. Manufacturing overhead costs of; engineering and design, quality cost, maintenance and other production overhead costs as previously shown in table 5.4 has their own cost centres. However, overhead costs remained to be allocated to product units as a percentage of the newly computed MPC cost till the end of the first quarter of year 2016.

According to one of the local business unit (LBU) finance and accounting controllers;

> *We had a visit from the global finance and accounting controller in April 2016. Meetings conducted with him mainly aimed at discussing the change in the way manufacturing overhead costs are to be allocated. He indicated that the Swiss headquarters is concerned about achieving a more relevant representation of those costs and that it would better for them that they are represented in a per hour basis.*

Since then, cost centres for the other manufacturing overhead costs started to be allocated on per hour basis. However, LBU finance and accounting controllers were only able to use the direct labour and machine hours worked in the production activities involved in the calculation of the allocated MPC as these were the only available hours tracked using their ABC system.

	Time in Hours												
Transformer Design	Coolers	Weld/ Test	Painting	Material Preparation	LV-WDG	HV-WDG	Active Part	Connection	Tanking	Final Assembly	Core Slitting	Core Cutting	Core Stacking
500KVA	1.7	8.7	6.2	1.6	1.5	6.5	5.3	2.0	2.6	1.3	0.7	2.7	4.0
	Activity Cost/hour												
	Coolers	Weld/ Test	Painting	Material Preparation	LV-WDG	HV-WDG	Active Part	Connection	Tanking	Final Assembly	Core Slitting	Core Cutting	Core Stacking
	87.09	10.87	90.27	7.96	38.28	59.56	36.93	10.30	24.33	9.13	27.62	46.01	7.91
	Activity Cost												
	Coolers	Weld/ Test	Painting	Material Preparation	LV-WDG	HV-WDG	Active Part	Connection	Tanking	Final Assembly	Core Slitting	Core Cutting	Core Stacking
	148.05	94.57	559.67	12.58	57.42	384.2	195.73	20.60	63.26	11.41	19.33	121.93	31.64
	Manufacturing Process Cost (MPC) 1720.35												

Table 5. 7: An example of MPC calculation for the 500 KVA transformer

Source: PGTR cost statement as provided by LBU finance and accounting controller

Table 5.8 shows an example of a recent representation of some of different performance measures used by the Transformers factory in LT organisation from the beginning of 2014.

Type of Performance Measure	Name	Unit
Financial	EBIT Margin	%
	Orders Received Gross Margin	%
	Revenues Gross Margin	%
Operational	$/kVA (Orders)	USD
	(%) of Root Cause Analyses done within 1 week	%
	AOTD %	%
	Capacity utilization	%
	Direct Material Cost %	%
	Employee turnover	%
	Finished Goods %	%
	Hours/Unit	Hour
	Inventory Days	Day
	MTT (Material Throughput Time)	No#
	On Time Delivery	%
	OTD % (Shipments/Milestones)	%
	Productivity	
	Revenues/Employees	USD
	ROTD %: non stocked items	%
	Value Added Productivity	No#

Table 5. 8: An example of newly added performance measures used by LT transformers factory in year 2014

Source: MAS documents provided by the factory head

An analysis of these performance measures shows that more measures are driven from the lean accounting literature, for example; measures for on-time delivery (OTD), requested on-time delivery (ROTD), Inventory days, revenues per employee (Maskell and Baggaley, 2004; Baggaley, 2006) and the other highlighted performance measures shown in Table 5.8.

Other controls used by the case organisation can be classified as traditional/non-lean controls, for example; productivity measurement, earnings before interest and taxes (EBIT) and the measures for capacity utilization and employee turnover. The list of performance measures shown in Table 5.8 includes an example of the newly added controls reported to the Swiss headquarters annually. Since KPIs on the analyser, as well as the newly added controls are available/published to the global product group managing team, they are treated as *'published'* controls. On the other hand, the factory can use additional controls which the factory head refer to as *'internal'* controls. Such controls are developed by engineers, operation and production teams within the factory whenever an action is needed to resolve a deviation in any of the targeted 'published' performance measures or to keep track of improvements achieved from implementing a new or updated operating process. For example; figures 5.6 and 5.7 show how an analysis done on inventory levels in year 2014 resulted in factory managers dissatisfaction about the achieved inventory levels. Such analysis is done internally using an organisation known approach called the '4Q' which stands for the 'Four Quadrants' of; measure, analyse, improve and sustain.

The 4Q approach directs managers at the factory to take an appropriate measurement of any area of problem, analyse the root causes of the problem, suggest ways of its improvement, prepare an improvement implementation plan and then suggest techniques to be used to sustain these improvements so as to avoid problem recurrence. Hence, an application of the organisation 4Q approach in updating new targets of inventory percentages suggested its decrease to 19% as shown in figure 5.7. An improvement action plan was then put forward to achieve the new figure for inventory percentage and help sustain it during year 2015 and the last two quarters of 2014.

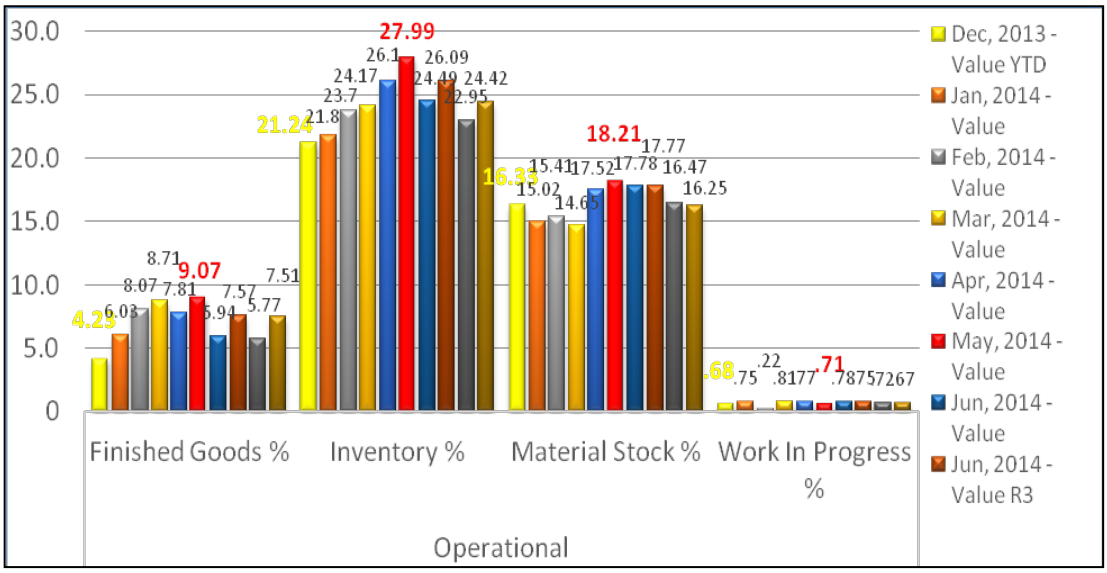

Figure 5. 6: Factory analysis of percentage level of inventory during first two quarters of 2014

Source: 4Q internal control documents provided by lead factory engineer

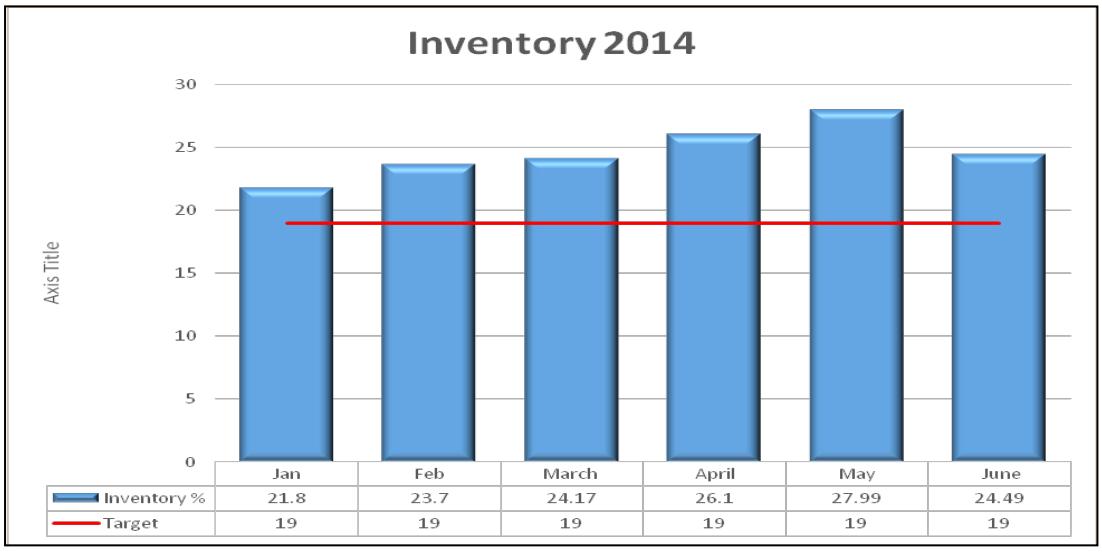

Figure 5. 7: Change in targets of inventory percentages following analysis of inventory levels

Source: 4Q internal control documents provided by lead factory engineer

Figure 5.8 also shows results of another 4Q analysis done by the end of the first quarter of year 2014, following the receipt of 13 customer complaints on oil leakage incidents from transformer products. Action plan includes a follow up on changing inventory levels and OTD delivery targets following the process of resolving oil leakage problem.

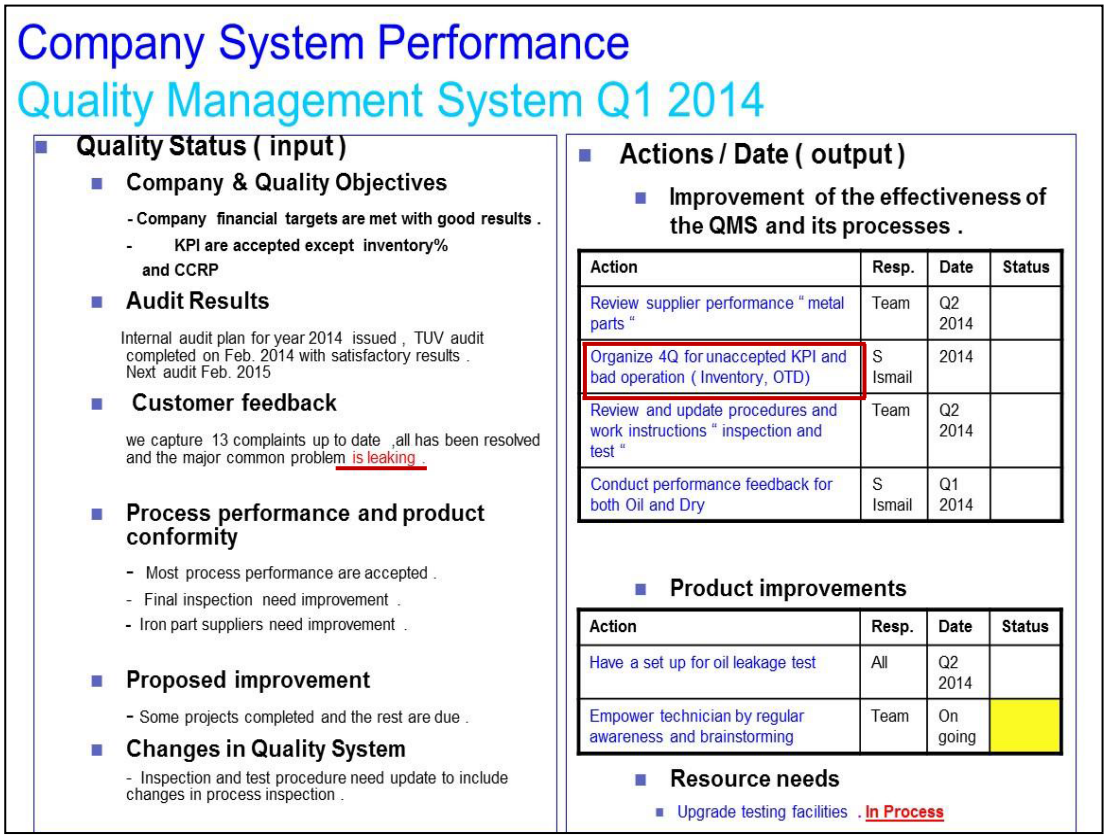

Figure 5. 8: Results of 4Q analysis following an oil leakage problem

Source: 4Q internal control documents provided by factory engineering and operation advisor and lead factory engineer

Figures 5.6, 5.7 and 5.8 serve to show how some internal controls can be developed within the factory following a reported problem. However not all 'internal' performance measures used affect the 'published' performance measures or are reported to the product group managing team at the Swiss headquarters. Transformers factory head report that;

> *Internal and published performance measures should work in a loop, but they actually do not. For example; improvements in cost of poor quality shall improve the overall cost savings, yet we treat cost of poor quality computed after an*

internal 4Q analysis as an internal performance measure that we keep for ourselves at the factory such as the cost of resolving the oil leakage problem. Overall cost savings are accounted for irrespective of indicators of progress achieved in costs of poor quality.

5.8 Chapter Summary

This chapter presented the background of LT organisation and its transformers factory as the chosen case study for this research. The chapter also presented the organisation representatives who are considered the key human actors and interview participants involved in this research. The chapter then detailed the primary key findings in terms of; how the organisation manages its management accounting information and the accounting information systems used for that. Primary findings also presented a timeline for LT's progress with lean implementation, with an overview of its transformers' factory journey with lean management. Primary findings show that early lean management implementation procedures were done in isolation from any finance and accounting representatives of LT. An assessment to factory progress with lean management implementation shows that, it inhibits an intermediate to advance level of progress with lean. Yet, the factory witnessed changes in its value stream construction throughout the study period. Although its first value stream used from 2004 till 2011 included some resources which are shared among products of the same product family, its new value stream constructed in 2012 do not seem to entirely solve this issue. The chapter then followed with a detailed discussion of the organisation's MAS throughout the study period. This discussion tackled the costing practices used and changes in the factory published (external) and non-published (internal) performance measures/KPIs. LT mainly depended on the use of standard costing to cost its transformer products from the start of lean implementation till end of year 2013. During this period LT also used some lean-tailored/ lean accounting performance measures. Starting from year 2014, LT moved to using activity-based costing mainly to manage the allocation of its manufacturing overhead costs. More lean accounting performance measures also started to be used. The data presented in this chapter are used in the next chapter to discuss and analyse the various events and interactions making up LT's MAS and how they are related to many organisation's actors. More findings from the case study are also elaborated in this discussion.

Chapter 6: Findings Part II and Analysis

6.1 Introduction

The previous chapter presented a detailed discussion on the case organisation (LT) background including the organisation chart, organisation's accounting information systems used and an explanation of the organisation's lean journey, together with a description of its MAS starting from lean implementation till end of year 2016. This chapter uses the theoretical lens chosen for this research i.e. ANT, to discuss and analyse the events and interactions making up LT's MAS and how they are related to many human and non-human actors in the organisation. In this discussion more findings driven from data collected via interviews, factory visits, focus groups and document analysis, are elaborated. Following this introductory section, the chapter is divided into eight sections. Section 6.2 explains the structure in which additional findings and analysis are presented in this chapter. Additional findings and their analysis are presented in the form of three major story plots. The first plot revolves around drivers of change in LT factory's performance measures. Section 6.3 presents the first plot and analyses it. Section 6.4 provides a summary of the analysis of the first plot. The second plot describes the negotiations around LT's costing practices. This is discussed in section 6.5. Analysis of the second plot is presented in section 6.6. Section 6.7 discusses the third plot on the tension incidents experienced between LT accounting controllers and engineering personnel. Two tension incidents are discussed in section 6.7 with their analysis provided in the same section. The chapter finally concludes with a chapter summary available in section 6.8.

6.2 Structure of Second Part of Findings and Analysis

The presentation of case study findings and their analysis is structured into three major story plots. Plots are driven from the organisation's data collected and follow a constructivist narrative approach to data analysis as mentioned in chapter 4, section 4.7. Plots are derived from actors' stories and narratives as they tell them. No themes were set by the researcher beforehand. Each plot is followed by an analysis, providing an interpretation and conclusion driven from the plot. These plots are explained using Callon's (1986) and Latour's (1987, 1996, 2005) four moments of translation. However,

as shall be seen in the next sections, these stories are not narrated in a way to show a distinct movement between one moment to another in what looks more like a technical manner of presenting the story plots. The reason behind this, is an attempt to follow Latour's (1999, p. 20) view on ANT as; *'a very crude method to learn from the actors* ***without imposing on them a priori definition of their world-building capacities****'*. Accordingly, the discussion referring to the four moments of translation is not headed or categorized as per the name of each translation moment. The description of the translation moments experienced in each story plot is interpreted via the flow of each story and the quotes used by its key actors to add to the story telling. In this way, the research is trying to match Latour's (1999) perspective on the restrictive effect of using specific vocabulary with ANT when he noted that;

> The ridiculous poverty of the ANT vocabulary--association, translation, alliance, obligatory passage point, etc.-- was a clear signal that **none of these words could replace the rich vocabulary of the actor's practice**, but was a simple way to systematically avoid replacing their sociology, their metaphysics and their ontology with those of social scientists who were connecting with them through some research protocol....I use this cumbersome circumlocution to avoid the loaded term 'studying', because ANT researchers cannot exactly be said to 'study' the other social actors.

As discussed in chapter 4, section 4.7, even though codes were developed from data collected through interviews and focus groups, coding did not aim at fitting the findings within a set of pre-defined themes. Codes developed were only used to help simplify the large volumes of data collected, given the time span of LT's longitudinal case study. Coding mainly aimed at facilitating the distribution of large volume of data collected across the 3 story plots discussed sections 6.3 to 6.7. In doing so, the researcher chooses to follow Latour's (1999, p. 19-20) ideas on how actors are the ones entitled to tell their stories, since they are the only ones who know them best or as he put it;

> For us, ANT was simply another way of being faithful to the insights of ethnomethodology: actors know what they do, and we have to learn from them not only what they do, but how and why they do it. It is us, the social scientists, who lack knowledge of what they do, and not they who are missing the explanation of

why they are unwittingly manipulated by forces exterior to themselves and known to the social scientist's powerful gaze and methods. ANT is a way of delegitimating the incredible pretensions of sociologists who, to use Bauman's forceful expression (Bauman, 1992), want to act as legislators and to open yet another space for interpretive sociology.

In discussing the 3 story plots presented in this chapter, key actors shown in the organisation chart illustrated in chapter 5, section 5.2 and are handling or having an impact on the organisation's management accounting and control information, are included. An extraction of those key actors from the organisation chart is shown in figure 6.1[13].

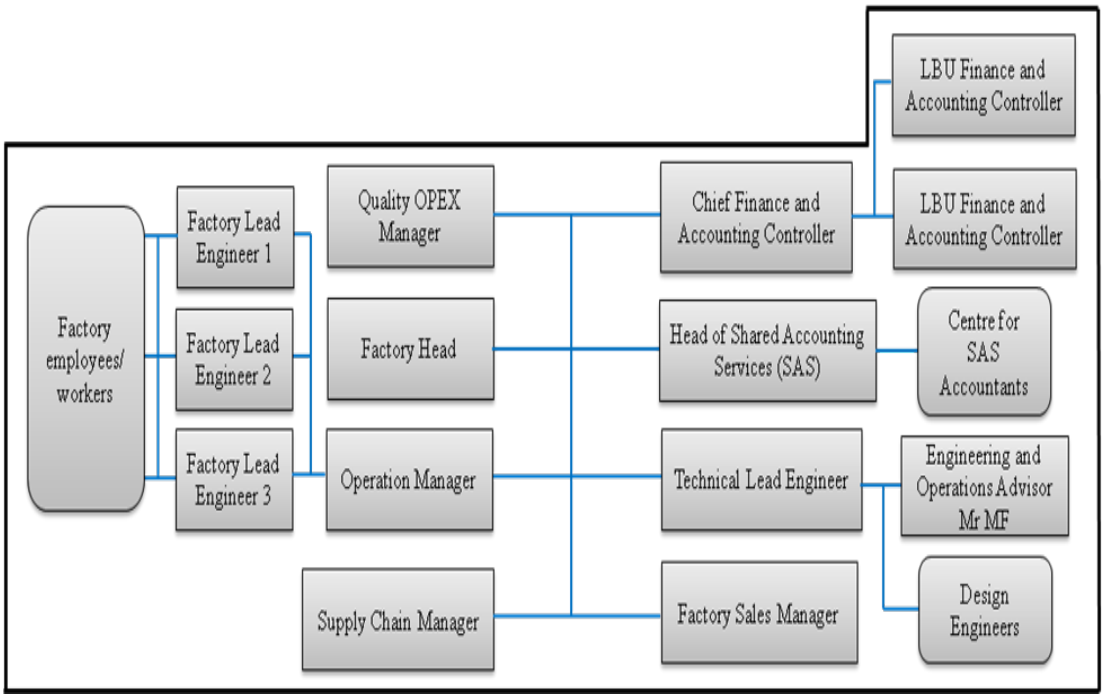

Figure 6. 1: An Extraction from Organisation Chart showing Organisation's Representatives handling or having an impact on its MA information

[13] As discussed in chapter 5, section 5.2, all organisation representatives included in figure 6.1 were interviewed, apart from technical lead engineer and his team of design engineers. Hence, all other organisation representatives in figure 6.1 form the human actors involved in the story plots discussed in this chapter.

Each plot of story discussed below has its key actors. Accordingly, not all organisation representatives shown in figure 6.1 are involved in every story. Additionally, for each individual story non-human actors are also identified, for example; management accounting practices, operating structures in place and technical or operating practices used. Finally, as discussed in chapter 4, section 4.3, following the constructivism paradigm adopted in this research, the researcher as 'an inquirer' is *"cast in the role of participant and facilitator"* (Guba and Lincoln, 1994, p. 113). Hence, the researcher is also considered as one of the actors, involved in some of the story plots discussed in the coming sections of this chapter.

6.3 Plot 1: Who Drives Changes in Factory Performance Measures?

As discussed in chapter 5, section 5.3, LT's factory performance measures are reported in the OPEX analyser and the ABACUS system. However, ABACUS includes detailed calculations of how OPEX performance measures are reported, in addition to other performance measures such as those shown in table 5.8 of the previous chapter. More specifically, as reported by head of LT factory;

> *The OPEX includes key factory KPIs that the global product group manager and his team would usually look at before the regular monthly meeting. If they would like to check further details on how these KPIs were calculated or would like to check more details on the factory performance in terms of other performance indicators, then the ABACUS is the source of such detailed information.*

This section discusses the changes that have occurred over the factory performance measures in both the OPEX and ABACUS and the key actors involved in and driving this change process. Starting with the factory OPEX, table 6.1 shows a comparison of KPIs used from year 2009 to year 2015 and till end of study period in year 2016, as extracted from factory OPEX analyser. An analysis of these KPIs shows that, two changes occurred during this period. The first change has to do with personnel handling the calculation of one of the KPIs, and the second change relates to the integration of new KPIs to the analyser.

	KPIs Year 2009	KPIs Year 2010	KPIs Year 2011	KPIs Year 2012	KPIs Year 2013	KPIs Year 2014	KPIs Year 2015 onwards
Sales	Orders Received and Order Received no. of units						
	Order Received MVA						
	Quotation backlog						
	Number of units delivered on-Time						
	No. of units delivered to customers						
	N/A			*Workload from hot tenders*			
Quality	CCRP no# of complaints						
	Number of Emergency repairs and Number of Scheduled repairs						
	Field Failures						
	Total COPQ per month in LE (EGP)						
	FPY (First Pass Yield)						
	Number of units tested						
	Test Failures						
	No of rejected deliveries						
	Number of incoming consignments passed inspection						
	Number of incoming consignments inspected						
	Number of units shipped complete						
Supply	Number of Supplier Deliveries						
	No. of Suppliers on time Deliveries						
Technical	TTPT						
	Inventory %						
	Installed Capacity						
	Available manned capacity						
	Workload from firm orders						
	Workload from hot tenders			*N/A*			
	Number of units in WIP						
Finance & Accounting	Revenues in KLE						
	EBIT in KLE						
	Total Employees						
	Material Stock						
	Work in Progress						
	Finished Goods						
	Sales in Excess of Invoicing						
	Personnel Expenses						
	Direct Material Cost						
	Value Added						
	N/A						*Cost of Sales*
							Trade Receivables
							Trade Payables
							DPO
							DSO
Production	Units						
	Hours						
	TPT						

Table 6. 1: Comparison of KPIs used from year 2009 to 2015 as extracted from factory OPEX analyser

Source: Extraction from factory OPEX - Information provided by factory head

As shown in table 6.1, starting from year 2012, calculation of the KPI named *'workload from hot tenders'* started to be done by sales, instead of factory engineers. Factory operation manager and one of factory's lead engineers mobilised this change. During the interview with factory lead engineer involved in this change, he explained how the problematisation of having this KPI reported by factory engineers started;

> *This KPI indicates the capacity needed for hot tenders which is calculated on basis of "the potential workload from outstanding quotes and orders", which is received by the sales representatives. Traditionally this was calculated by us as factory engineers, after obtaining the information on the number of received orders from sales. However, there were cases in which we encountered errors in calculating this KPI due to failure to keep up with latest updates or changes in orders received.*

Key actors moving the change here are mainly the factory lead engineers, factory operation manager and the KPI calculation itself as a non-human actor. It was reported that, when the KPI was handled by engineers, the KPI calculation showed unrealistic figures and did not match with the actual orders received. In ANT terms, one can say that an enrolment of these key actors was reached once the management of this KPI was moved to sales. As reported by one of factory's lead engineers;

> *When the responsibility of calculating this KPI was moved to sales, we were able to decrease, and sometimes avoid, the risk of having errors in the reported figures of this KPI. For us, it was a way to optimise the flow of information and get more reliable calculation of the workload needed from hot tenders.*

The second change in the performance measures reported using OPEX included the integration of five KPIs to be handled by the finance and accounting team, starting from year 2015 onwards. As illustrated in table 6.1, these KPIs are; cost of sales, trade receivables, trade payables, Days of Purchases Outstanding (DPO) and Days of Sales Outstanding (DSO). Cost of sales, trade receivables and trade payables were already being used by the factory but were only reported on the ABACUS.

Factory operation manager reported that, following the year end meeting with global product group manager and his team in 2014, global finance and accounting manager recommended that these KPIs – more specifically trade payables and trade receivables – move from ABACUS to OPEX. This is because global finance and accounting manager wanted to have a periodic follow up on these two KPIs, as they affect LT's calculated net working capital. The use of DPO and DSO measures was also proposed by the global finance and accounting manager during that meeting in 2014. A decrease in liquidity figures was the reason problematising the KPIs used by local finance and accounting team in Egypt. LT factory head reports that;

> *We were concerned about our liquidity figures by the end of 2014. During our meeting with the product group manager and his team, a suggestion came from our global finance and accounting manager not only to move some KPIs from ABACUS to OPEX, but also to use DPO and DSO measures. He wanted to get a better view of our monthly cash in and hence, our net working capital, so that we can pinpoint ways to enhance liquidity.*

Accordingly, it can be noticed that changes in KPIs used in the OPEX or the integration of new KPIs to it are mainly mobilised by the global product group managing team in Zurich. Yet, minor changes in the OPEX are mobilised and enrolled internally by factory operation manager and engineering team. Additionally, these changes are only limited to shifting the responsibility of KPI calculation from one responsible person to another.

On the other hand, during factory visits and upon inquiring about the role of local employees and managers in driving changes in performance measures used, it was noticed that, there are other performance measures that are proposed internally and reported either on ABACUS or on visual boards used inside the factory. Figure 6.2 shows pictures of visual boards used inside LT transformers' factory. The first picture shows three types of boards displayed in the factory; occupational health and safety measures *(left board)*, key performance indicators *(middle board)* and production plan status *(right board)*. Operation and accounting controls are displayed on the key performance indicators and production plan boards. The key performance indicators' board include KPIs extracted from the OPEX analyser.

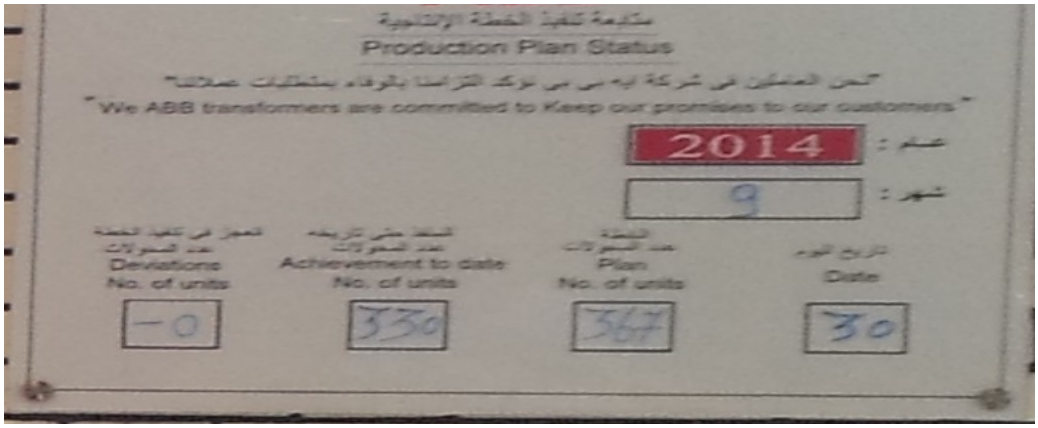

Figure 6. 2: **Pictures of some visual boards used inside the factory**

The board displays performance indicators supplied by sales, quality, supply chain management, operations (technical), production and finance and accounting departments. Information on the board are extracted by the quality and OPEX manager and are displayed and adjusted by him on weekly basis. Other internal operation indicators are displayed on the production plan status board, which is managed and adjusted daily by the line workers. This board shows information on current operating month and year. It displays the number of units ordered to date, achievements to date (in number of units) and deviations from production schedule.

Line workers and factory lead engineers also handle another visual management board set to display achievement in the 5S methodology. Measures on the 5S board include; change in storage space, percentage decrease in transportation time and percentage

decrease in motion. These measures are set by factory engineers and monitored by operation manager and quality-OPEX manager and they can change from time to time, depending on updates in factory layout.

An example of internal performance measures that proposed by local employees and reported on the ABACUS system is the *'First Pass Yield (FPY) for tanks'*. As per the interview with the factory engineering and operations advisor;

> *FPY is the measure for the number of transformers produced first time, with no scrap or rework. The FPY KPI on OPEX measures the first pass yield for the transformer product as whole. However, in 2009 we started using the FPY measure for transformer tanks, which are produced simultaneously with transformer products. The difference between both measures is that instead of waiting till the production of the whole transformer is completed and assembled to measure the number of transformer products produced first time with no scrap or rework, we stop after tanks' production to measure the FPY for tanks, before transformer components are inserted in their tanks.*

FPY for tanks measures the number of tanks produced first time without defects. Defects in tanks mainly relate to oil leakage, requiring further rework or additional welding efforts. FPY is reported on the factory ABACUS. Upon inquiring about actors and events driving the use of FPY, it was noticed that a non-human actor in the form of an operating problem of oil leakage problematised the factory tank welding processes. According to one of the factory's lead engineers;

> *In 2009, we had an oil leakage problem in transformers' tanks, not among the transformers' main components. When such product defects happen, we would gather line workers in the factory shop floor and report the defects and start listening to their suggestions on what might be the root cause of the problem.*

An interface between actors' different interests (interessment) occurred when factory engineers reported the oil leakage problem to factory line workers. The quality-OPEX manager in LT factory reports that;

Usually workers handling the tank's welding and testing processes would blame tank errors on the workers responsible for tank's production, so we usually look for production errors. However, this time one of the production line workers commented that; "the blame should not always be on us, oil leakage could be because of defects in welding". We usually have an acceptable number of faulty welding points, those that would normally occur but will not lead to oil leakage in tanks. Yet, with that worker's comment, the engineering team and I started to think that it is either that welding workers are not sticking to this acceptable number or that the number itself needs to be adjusted.

LT's factory head reports that, a meeting was then held between the factory engineers, quality-OPEX manager and factory head, to revise the acceptable number for faulty welding points. According to the factory head;

Acceptable number for tanks faulty welding points was then adjusted and it has been revised since then till it reached a maximum of 4 points in 2014. At that time, we then used the lean SPC - statistical process control - approach to help us set targets for an FPY measure for tanks. This measure has been designed since this incident, is still in use and is currently reported on the ABACUS.

Hence, the new FPY measure was mainly derived by oil leakage problem. Yet, interessment translation moment was experienced through allowing the interface between different interests of line workers and listening to their suggestions about the possible route cause of the problem. Key factory actors of line workers, factory head, factory lead engineers and quality-OPEX manager driven by the oil leakage problem, were then able to reach alliances on their interests (enrolment in ANT terms), by investigating tanks welding processes and taking the decision to minimise the number of acceptable welding points.

According to the factory head the FPY for tanks is not reported among the OPEX KPIs. This is because, global product managing team are more interested in reviewing the figure for FPY for the whole transformer products. However, the factory key actors involved in setting the FPY for tanks mobilised the use of this internal performance measure over time and continuously revised it to meet their operating requirements and

welding processes' needs. Updates in FPY for tanks figures can sometimes be reported to the global product managing team during the video conference meetings held monthly.

6.4 Summarising the Analysis of First Plot

It can be concluded that key performance indicators used in the factory OPEX are usually decided by the global product managing team in Zurich. Minor changes in the OPEX are mobilised and enrolled internally by the operations and engineering team. Such changes are only limited to shifting the responsibility of KPI calculation from one responsible person to another. However, factory representatives involving line workers, factory lead engineers, operation manager, quality-OPEX manager and the factory head, can still propose other KPIs. Some of these KPIs are reported internally using the visual management boards displayed in factory shop floor. Other KPIs are available on the company ABACUS system to be accessed by local finance and accounting controllers, local business unit manager, as well as the global product managing team. On the other hand, it was obvious that other than preparing the finance and accounting KPIs reported on the OPEX and shown in table 6.1, local finance and accounting controllers cannot be seen as having much of a participative role in deciding on or changing the type of accounting performance measures used specially those on OPEX. However as shall be seen in the coming sections they are more engaged in discussions on costing and reporting decisions.

6.5 Plot 2: Debates on Factory Costing Practices

During the period from year 2004 till end of 2011, the factory old value stream construction pattern problematised the costing practice used by LT. As discussed in chapter 5, section 5.5, the factory old one value stream was responsible for producing all transformer types as they formed one product family. Yet, different transformers' types took different processing time and varied in their use of the value stream resources. Such value stream construction problematised the factory used traditional costing system and questioned its ability to provide the costing information or even the lean supporting information required by the factory. As discussed in section 4.5 of chapter 4, the researcher has engaged with the case study organisation in previous

research in years 2009 and 2010. In 2009, the researcher discussed the possibility of a better construction of the factory value stream with the factory head, to account for the different use of resources among products of the same value stream. Creating more than one value stream can be a possible alternative that enables the use of a simpler costing tool to the factory used traditional costing allocation method, such as VSC. More precisely, constructing three value streams for the three transformer types can be an alternative to the factory old value stream. However, according to LT's factory head, the idea of identifying three value streams so that each value stream handles the production of one transformer type, is deemed quite impractical. LT factory head mentioned that;

> *It would be too costly to invest over space acquisition, equipment and machines purchases, cross training efforts and on recruitments, when all transformer types go through the same processing steps in the value stream!*

Given the situation with factory old value stream, a second step forward was to gain more details on how the factory costs its products compared to other possible costing alternatives, which the factory can used. Comparing other possible alternatives to the factory used costing practice, (mainly standard costing), showed how the old value stream problematised the traditional costing system in place. The comparison was then used to construct an interface between interests of key actors involved in handling LT's costing practices.

Given LT's level of advancement with lean implementation, the researcher first computed the average transformer unit cost using VSC. The use of VSC to compute product unit cost resulted in an average cost per unit of EGP 139,217.35[14]. This average product unit cost is based on 1,400 shipped units during year 2009. As per the lean accounting literature of VSC application (Maskell and Baggaley, 2004; Maskell and Kennedy, 2007; Fullerton et al. 2013), this average unit cost shall apply for all products within the transformers' product family transformer, i.e.; SDT, MDT or LMDT).

[14] Computed as value stream full costs (EGP 194,904,287 from table 5.5 in chapter 5), divided by the number of units shipped in 2009 (Maskell and Baggely, 2004; Maskell and Kennedy, 2007).

The researcher used the cost for one transformer type; 500 KVA transformer, to construct a comparison between possible costing practices for the transformer products. Using standard costing with a traditional overhead allocation method, the cost of the 500 KVA transformer totalled EGP 87,100 per unit at that time. Table 6.2 shows a comparison between LT current cost for a 500 KVA transformer and the average product cost computed using VSC and that should apply for the 500 KVA transformer as well. The cost computed using VSC exceeded the one computed by LT Transformer factory using the traditional standard costing by EGP 52,117.35. This represented almost 60% increase in the transformer's unit cost.

	Traditional Costing	**Value Stream Costing (VSC)**	**Difference**
Cost/one 500 KVA Transformer	EGP 87,100	EGP 139,217.35	EGP 52,117.35 (60%) increase

Table 6. 2: Comparison between Unit Cost of a 500 KVA Transformer using Traditional Costing and VSC.

The huge increase in the average unit cost of the 500 KVA transformer following the use of VSC, lead the researcher to investigate whether amendments are required over this cost, as suggested by the features and characteristics costing (FCC) tool (Huntzinger, 2007). As discussed in chapter 2 (section 2.15.2), FCC is the practice used to normalise the average VSC cost. FCC uses simple allocation techniques to account for the different use of resources among product units (Maskell and Kennedy, 2007).

The methodology explained by Maskell and Baggaley (2004, p. 158-166) on how to apply FCC was used, since their explanation is found to be the most – or almost the only – elaborative description of the operation of FCC. Following this methodology, the researcher conducted a capacity analysis for the value stream processes of LT transformers factory. This capacity analysis aimed at identifying the factory bottleneck process/pacemaker cell prior to using FCC. Researcher used data in the factory old value stream shown in figure 5.4 of chapter 5, to develop the value stream capacity analysis. Data used includes the number of workers and machines, as well as cycle time

(C/T), changer over time (C/O) and downtime for the production processes in which the different transformer types take different processing time. Table 6.3 presents the capacity analysis done for the factory value stream processes.

EMPLOYEES	Core Stacking	LV Winding	HV Winding	Active Part Assembly	Final Assembly	Leakage Test	Painting and Drying Oven	Tanking	Engineering, Planning and Purchasing Dept.
Productive	**73%**	**63%**	**62%**	**61%**	**44%**	**71%**	**0%**	**56%**	**89%**
Non-Productive	**2%**	**10%**	**3%**	**1%**	**2%**	**8%**	**0%**	**5%**	**0%**
Available Capacity	**25%**	**27%**	**35%**	**38%**	**54%**	**21%**	**0%**	**39%**	**11%**
MACHINES									
Productive	**0%**	**42%**	**75%**	**73%**	**0%**	**0%**	**94%**	**0%**	**0%**
Non-Productive	**0%**	**4%**	**6%**	**12%**	**0%**	**0%**	**5%**	**0%**	**0%**
Available Capacity	**0%**	**54%**	**19%**	**15%**	**0%**	**0%**	**1%**	**0%**	**0%**

Table 6. 3: Value Stream Analysis by Capacity Category for LT Organisation Transformers Factory.

Capacity percentages in Table 6.3 follow Maskell and Baggalley's (2004, p. 68) definitions of productive, non-productive and available capacities; productive capacity includes *"labour or machines time spent creating product at the pull of the customer"*. Non-productive capacity involves *"all other uses of time, for example, including non-value adding, time spent on changeovers rework, material movement, inspection, repair, maintenance, waiting for resources, scheduling, planning, procurement, management, administration, etc."*. While available capacity includes *"machine and labour time left over after the productive and non-productive time has been accounted for."*

In Table 6.3, percentages of non-productive capacity were developed using the data for changeover time, downtime and waiting time available for these processes in the factory old value stream map. However, these percentages do not include the time for inspection, administration and planning as estimates for such time were not provided by the factory representatives. Only the time needed for machines maintenance and movement of materials and component parts was estimated based on the nature of the production process, and the data collected on the wellbeing of the factory machines. A capacity analysis for the sales and marketing department could not be performed due to insufficient data on the average time spent on scheduling, receipt of orders, time spent during bids and in various activities conducted by this department.

From the capacity analysis presented in Table 6.3, it was noticed that the "Painting and Drying Oven" process represented the primary bottleneck of the value stream, being the process with the least available capacity (1%). As a second step to applying FCC, the researcher started identifying the features of the product, which made transformers take different processing time in the bottleneck process. It was found that the size of transformer product units is the feature leading them to take different processing time in the painting and drying process. A transformer size is determined by its power; the higher the power of the transformer the bigger its size is. Therefore, the average time needed for different transformers in the painting and drying process was categorised according to the transformers power and size in the pattern shown in Table 6.4.

Transformers Size Intervals based on Transformers Power	**Average Time needed in the Painting and Drying Process**
< 750 KVA	23 Hours 40 min (for 9 units)
750 – 1400 KVA	25 Hours 40 min (for 9 units)
> 1400 KVA	27 Hours 40 min (for 7 to 8 units)

Table 6. 4: Time needed to Process Different Power Transformers in the Bottleneck Process

The 500 KVA transformer fell in the first interval identified in Table (6.4), where processing an average of 9 units of this transformer type requires an average time of 23 hours and 40 minutes. Given the capacity of machines – (approximately 4,160 hours per year – 2 machines working for 1 shift of 8 hours per day) – in the bottleneck process, 1,581 units of the 500 KVA transformer could be produced, if cycle time of 23 hours and 40 minutes was needed to produce the 500 KVA products. Total conversion cost for LT factory totalled EGP 40,031,861 (full cost EGP 194,904,287 minus direct materials cost 154,872,426 EGP). Accordingly, a unit conversion cost for the 500 KVA transformer is EGP 25,320.59 (40,031,861/1,581). Adding the transformer material unit cost (EGP 67,881.63) gave a total cost of EGP 93,202.22.

The average product unit cost computed using VSC totalled EGP 139,217.35 based on 1,400 shipped units. Table 6.5 provides a comparison between this average product cost, the cost developed using standard costing (traditional costing) and FCC product unit cost. It was noticed that the use of FCC incurred substantial amendments to the average product unit cost computed using VSC. Considering the time taken by different types of transformers in the bottleneck process shall create different unit costs for each transformer type. Also, from Table 6.5 it could be seen that, FCC provided a lower product unit cost for the 500 KVA transformer which is almost 33% below the average VSC unit cost.

	Traditional Costing	**Value Stream Costing (VSC)**	**Features & Characteristics Costing (FCC)**
Cost/one 500 KVA Transformer	EGP 87,100	EGP 139,217.35 60% above traditional costing	EGP 93,202.22 7% above traditional costing 33% below the average VSC

Table 6. 5: Comparison between Unit Cost of a 500 KVA Transformer using Traditional Costing, VSC and Features and Characteristics Costing

6.6 Analysing Plot 2

The analysis of the second plot discusses the interactions between different actors involved in deciding on the relevant costing practices for LT factory, given its old value stream. However, this analysis cannot ignore other actors' interactions affecting factory costing practices after the construction of new value streams in 2012. Hence, this section is divided into two subsections. Subsection 6.6.1 analyses the data in plot 2 relevant to the factory old value stream used from 2004 till end of 2011. Subsection 6.6.2 builds on this earlier analysis to explain actors' interactions involving factory costing practices after the construction of new value streams.

6.6.1 Situation with the Old Value Stream (2004 – till end of 2011)

During that period, key actors involved in handling and negotiating the organisation's costing practices were; the factory used costing calculation (standard costing using traditional allocation method), the researcher, LT factory head, factory operation manager, finance and accounting controllers team, representatives from the centre for shared accounting services (SAS) and global managing team in headquarters in Zurich. The calculations of transformer products unit costs using VSC and FCC were passed on to these key actors and discussed with them in subsequent interviews and a focus group session. This was done in the context of a third translation moment of enrolment aiming at building agreements among key actors on their interests. Upon discussing the results from the VSC calculations with key actors mentioned above, they argued that the average cost was unacceptably high and seemingly distorted or inaccurate. Additionally, factory head and finance and accounting controllers team commented that:

> *It will be illogic and financially inaccurate to set the same product unit cost for all types of transformers when they actually use LT resources differently, even if they form one product family.*

Factory head and the chief finance and accounting controller also reported that, more consideration of how resources were being used in processes other than the bottleneck was needed. It was found that the factory still depended on product unit costs mainly for pricing decisions, some inventory valuation, detailed profitability analysis, and for cost

reduction purposes. Unit costs were expected to be needed for transfer pricing decisions at some stage after updating organisation's policies in line with Egyptian taxation law. A dependency on unit costs for such a variety of purposes indicated that the factory would, to some extent, rely on unit costs. One of the comments received from LT's chief finance and accounting controller was;

> *At a management level, we tend to use total costs and total profitability figures. At an operations level, we need to analyse decisions on basis of the breakdown of costs. We currently use a pull production approach, nevertheless we still need product unit costs for some ending inventory valuation purposes. The factory receives large orders some of which require a long production execution period that may reach one year. As a result, computing an accurate product unit cost is of much importance to the factory operations and to ensure accurate product pricing decisions*.

A focus group session with the factory head, factory operation manager, chief finance and accounting controller and two factory lead engineers highlighted how LT's European headquarters exhibited a strategy of cost reduction following the uprising political and economic conditions in Egypt in 2011. More specifically in late 2012, LT sales decreased drastically in Egypt. The European headquarters were forced to focus on cost cutting solutions. This did not involve a change in LT's costing system, but it implied a strategic focus on cost reduction more than cost accuracy. During this time, the chief finance and accounting controller reported that:

> *We will usually focus on adopting a costing practice that gives a lower unit cost. An accurate cost is good, but we understand how our global headquarters currently weigh cost reduction objectives.*

Hence, with the old value stream, the factory's need for more consideration of how resources were used in non-bottleneck processes and the headquarters' focus on achieving lower product unit costs, the researcher suggested activity-based costing (ABC) as another costing alternative for LT products. The ABC suggestion illustrated in figure 6.3 aimed to convey to key actors involved that, given their level of progress with lean management and their old value stream identification, a possible solution to use a simple costing practice as VSC (Maskell and Kennedy, 2007; Fullerton et al.,

2013) would be to identify more than one value stream. In such case there will be three value streams; one for each transformer type. LT can then depend on an average VSC calculation, since the separate value streams would resolve the need to account for resources shared in the old value stream. Yet, creating three value streams was not feasible as discussed earlier. Hence, the use of ABC was suggested to help account for resources shared in all value stream processes, not just those shared in the bottleneck/ pacemaker cell as suggested by FCC. In this sense, ABC can be used with the organisation's old value stream. Additionally, it can develop what the key actors perceived as a 'more accurate' cost calculation for their transformers given their dependency on product unit costs.

The ABC suggestion in figure 6.3, projected that old value stream cells/ processes are divided into value stream activities to which value stream resources are distributed. Cost of value stream resources in each activity were then allocated to transformer product units (cost object) on basis of cost drivers, which are relevant to each type of value stream activity. A comparison between the cost calculations of the 500 KVA transformer product using ABC, VSC, FCC and standard costing using a traditional allocation method, is shown in table 6.6.

Given the cost reductions achieved using ABC compared to other costing practices in table 6.6 and the key actors' perception about its accuracy, they were quite motivated to move to ABC. ABC was viewed as the costing practice which can succeed on both objectives of cost reduction and accuracy. Yet, even with such motivation from different human actors to adopt ABC, the researcher came to realise that they do not have the authority nor the freedom to enact this practice. In this respect, LT's chief finance and accounting controller mentioned that;

> *We follow certain global guidelines regarding our cost calculations. We call them the 'LT guidelines'. Our transformers factory head can pass the calculations of a new costing tool to our accounting shared service centre for their feedback. However, enacting a new costing practice or changing a costing system requires a committee meeting between global division controllers. If a global approval came to us to change our regional costing practices, then we can enact the new costing tool other than this it's out of LT Egypt controller's hand!*

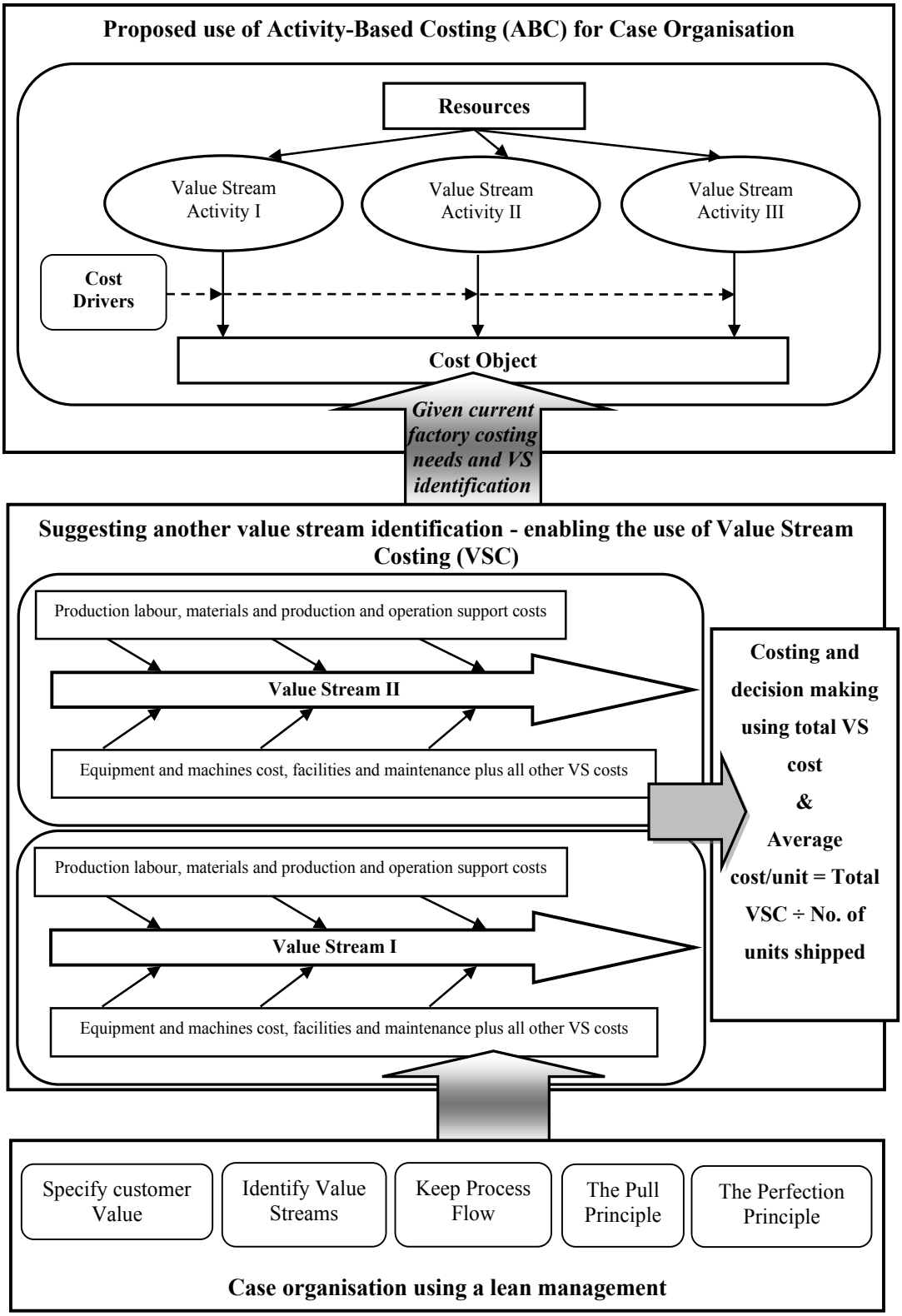

Figure 6. 3: Proposed alternatives for case study organisation given its factory old value stream

Source: Adapted from Gamal et al. (2012, p. 104)

	Traditional Costing	Value Stream Costing (VSC)	Features &Characteristics Costing (FCC)	Activity-Based Costing
Cost/one 500 KVA Transformer	EGP 87,100	EGP 139,217.35 60% above traditional costing	EGP 93,202.22 7% above traditional costing 33% below the average VSC	EGP 85,211.4 2% below traditional costing 38.8% below VSC 8.6% below FCC

Table 6. 6: Comparison between Unit Cost of a 500 KVA Transformer using Traditional Costing, VSC, FCC and ABC

As mentioned earlier, the uprising political events happening in Egypt in 2011 promoted a focus on cost reduction from LT global managing team. Accordingly, local actors in Egypt were not able to implement ABC, albeit their most preferred costing practice. A costing system depending on standard costs using a traditional allocation method was mobilised by key actors to continue being in use. Enrolling standard costing meant ruling out other alternative calculations including VSC, VSC with FCC and ABC. This was attributed to reasons associated with the old value stream construction pattern, the organisation's dependency on product unit costs and local managers lacking power and authority to enact new costing practices. Yet, it is worth mentioning that, the debates on LT's costing practices discussed here, form one of the first incidents where finance and accounting personnel were actively involved in discussing organisation's accounting practices relevant to its needs and operating layout. Such findings will be used in the discussion on the performativity of VSC as a costing practice and the factors affecting managers willingness to implement it, covered in the next chapter.

6.6.2 Situation with Factory New Value Stream – (Costing Practices following the use of ABC in 2014 onwards)

As discussed in chapter 5 *(section 5.7.2)*, a partial use of ABC was in place in 2014 and this followed the new value streams created in 2012. More identification of cost centres and more efforts on using relevant cost drivers was then made in 2016. Having two value streams gave more room for simplifying the costing practices used,

applying principles of eliminating wastes from the costing transactions as aspired by the lean accounting definition (Crandall and Main, 2007). Hence, once again one of LT's finance and accounting controllers discussed with the researcher the possibility of implementing VSC as a costing practice. This time key actors involved included; the researcher, VSC calculations, ABC calculations used by the factory, LBU finance and accounting controllers, head of SAS, representatives from SAS centre, factory operation manager and chief finance and accounting controller. ABC calculations in place problematised VSC calculations. VSC calculations showed how after the new value stream identification, ABC calculation of the per unit cost of an SDT transformer is the same as the VSC calculation. Yet, applying VSC is simpler, given the effort needed to deal with multiple cost centres associated with the use of ABC. However, upon constructing an interface between key actors via a focus group session, they ended up refusing the move to VSC albeit it the simpler costing practice.

Factory operation manager reported that the factory still needs a 'reliable' figure of product unit cost for the other transformer types (MDT and LMDT) sharing the second value stream. As reported by the one of the LBU finance and accounting controller;

> *Now that we have our activity-based costing system in place, a logical use for VSC will only be applicable to one type of transformers; SDT. However, we will still need to go back to our activity cost centres to determine the costs for the other two transformers types.*

Head of SAS and SAS representatives reported that;

> *It is obvious that VSC is a simpler practice and more time saving than ABC. Yet, perhaps when we as an accounting shared service centre move to lean by the beginning of 2017, lean management will be more perceived as a culture. Then, we might be able to initiate the move to less wasteful costing practices such as VSC.*

Hence, ABC remained as the costing calculation enrolled by the key actors identified earlier. For the second time, VSC calculations were rejected but this time it was the effect of another calculation (ABC), that stopped VSC from luring actors into taking any action towards its implementation.

6.7 Plot 3: On the Tension between Accounting Controllers and Factory Engineers

As mentioned in chapter 5 section 5.3, information on the SAP is handled by both SAS employees and finance and accounting controllers in Cairo head office and the operation manager and lead engineers at the factory. Hence, incidents of having tensions or conflicts between accounting personnel and factory engineers were discussed during the interviews conducted with them. Both parties - (accountants and engineers) - confirm that most incidents of conflict of interest/ tension were resolved. However, perception of each actor on how the other reacted varied immensely, especially upon comparing comments from the accounting versus the engineering side on the same incident. This section presents two incidents in which tensions between those actors was sensed. The section aims at showing how incidents of conflict of interests/tension were handled, how different parties had different opinions on the same incident and areas where LT's MAS was affected by the tension and others where the management accounting calculations initiated the conflict.

6.7.1 Factory lead Engineers and Reflections on Costing Calculations

The organisation depends on a budgeted allocation rate to apply its indirect costs either after the move to ABC in 2014 or before that. For the organisation the use of ABC meant multiple budgeted rates to account for the various cost pools/ centres identified. Yet, in the past, a budgeted rate was still developed to allocate indirect costs using the traditional allocation method. Accordingly, as costing calculations are done over SAP, the system includes the annual budgeted rates for each activity cost centre and two columns: one displaying budgeted hours per production activity and another blank column where, actual hours should be reported. The tension incident discussed here relates to a problem experienced when LT was using the traditional overhead

allocation method. However, such problem was brought to the surface with the various calculations associated with the use of ABC.

Problematisation started when two LBU finance and accounting controllers began to find difficulty computing total production costs for each of the transformer types. At first, one of the LBU finance and accounting controllers noticed that, when lead engineers at the factory use more or less hours in any of the production cells, instead of filling in the actual hours they used in the SAP column designed for that, they update the 'budgeted hours' column with the actual hours consumed. Hence, the LBU controller finds it quite hectic to compute 'total manufacturing costing' on every quarter. This is because, she does not have a reliable figure for 'under' or 'over' applied overhead costs, given that she is unable to have an appropriate representation of the actual hours worked versus the budgeted ones. The issue exaggerated with the use of ABC, having to deal with the same problem occurring for various allocation bases. According to the LBU finance and accounting controller:

> *By the end of each quarter, the budgeted column I have for the expected allocation bases almost disappears. Factory engineers post their actual labour, machine hours and other actual cost drivers in the column designed to include the budgeted drivers. So, in the end of the period, total cost figures I get appear as if they are distorted. I cannot guarantee that the update I do over production costs did really include a comparison between actual drivers and budgeted ones. I still urge factory lead engineers to report their actual hours consumed in the SAP column designed for that. To me this shall provide a more reliable representation of the actual resources used in the factory. It is not only about costing, having actual figures of resources consumed even mid of the quarter, will be of major help to me to take other decisions which are related to capacity utilisation.*

6.7.2 Analysing the First Tension Incident

With the use of ABC such problem was noticed by the two LBU finance and accounting controller who reported this to the chief controller. An interface between actors' different interests was done when a meeting was conducted between the three controllers, the factory operation manager and factory lead engineers. Factory lead

engineers turned out to have a different reasoning for reporting actual cost drivers in the way they did. Additionally, they did not have the full understanding of how drivers were then used either for total costs computation or for decision making. As reported by the factory operation manager:

> *We leave the budgeted column unchanged for production cells in which we had used the exact figure of the budgeted working hours or the estimated cost driver. In cases where the actual resources used differ from the budgeted ones, it usually has to do with reasons that go beyond the line workers control, for example; cases in which machines took more time to load.*

Hence, from the engineering viewpoint, updating the column for budgeted cost drivers was acceptable, since changes in expected use of cost drivers also acceptable because it had to do with non-controllable factors. However, at the accounting controllers' end, updating the budgeted column for actual results meant receiving vague data on the actual consumption of production resources. Additionally, controllers were not convinced that a 'non-controllable' factor is deemed responsible for all cases in which an update in the 'budgeted hours' column was made. According to the second LBU finance and accounting controller:

> *The chief finance and accounting controller, my LBU controlling colleague and I find it illogic to trust that line workers either stick to the expected working hours/ resources set to be used in each cell or only deviate from them for reasons that go beyond their control. We are not engineers, but we have some understanding about lean management principles. In my view, managing with actual data not only facilitates our work as management accountants, but also, I understand that having prompt real data provides a more reliable basis for any of our improvement initiatives, which matches the lean principle of continuous improvement.*

Upon interviewing three of the line workers working in different production cells and inquiring about how used resources are reported, they all confirmed that in many cases a deviation for set budgeted cost drivers was for reasons beyond their control such as; an increase in machine down time or loading time. Yet, in one of the discussions on the

implementation of lean 5S methodology with one of these line workers, he commented that:

> *The implementation of 5S methodology changes frequently. The objective is that we continuously try to improve our organisation skills, production structure and motion to save effort and time. As we moved from one implementation plan to another, we were able to decrease the gap between the actual processing hours worked in our cell and the budgeted hours on the SAP.*

Consequently, it was understood that some deviations from the planned working hours could be related to reasons related to line workers for example; the way they organised their tasks and how they moved between production cells. Additionally, one of the line workers reported that, in some cases, increase in machine down time had to do with delay in periodic machine maintenance, which the line workers deemed as something beyond their control. However, accounting controllers mentioned that delay in machine maintenance should not be regarded as an acceptable reason to allow for deviations from expected hours needed. Instead, it should be treated as a waste, which in lean terms; requires elimination.

As reported by one of LBU finance and accounting controllers, alliances between controllers, factory operation manager and lead engineers occurred when they went through the details of various cases in which the deviations occurred. Inclusion of comments from line workers proved influential in enrolling an action plan between controllers and engineers. Even though engineers remained reluctant to change the way they report the actual cost drivers used, they agreed to report actual resources used in cases where deviations are related to wasteful activities. However, controllers are still urging factory lead engineers to report actual used resources in their designated SAP column, for all the production cells. In spite mobilised to be handled this way, the reporting of information affecting costing calculations is still undergoing negotiation trials from the controllers' side to emphasise to engineers the benefit of managing via actual data. A final comment made by the LBU finance and controller was:

> *At least we made some progress reaching this agreement with lead engineers, but I will keep on urging them to report in the SAP column for actual drivers used.*

Also, I cannot guarantee that they do account for all variations subsequent to a wasteful activity, as I still witness very few entries on the actual column even after we made this agreement. What I am currently negotiating with the LBU manager is having some of the SAP accounting experts who currently work at the SAS, moved to the factory. I think the presence of 3 to 4 SAP accountant at the factory and having them paying visit to the shop floor can bridge the gap between our perception on the need for actual data and the engineers' perception on it. Potentially, I do expect this to help reach a situation where all actual data are reported in the right SAP column.

6.7.3 Processing Sales Orders and Managing On-time Delivery in Full

During the last quarter of 2016, one of the finance and accounting controllers at LT Cairo head office received a lot of complaints from customers, who had paid various instalments for their orders and did not received any. According to this finance and accounting controller copies of instalment payments were sent to the factory head to confirm cash collection and direct orders production accordingly. At the same time, the head of SAS notified finance and accounting controllers that, he has been noticing a decrease in the figures for on-time delivery KPIs reported on both OPEX and ABACUS during October till end of November. Traditionally, finance and accounting controllers do not keep track of the developments in on-time delivery (OTD) figures, but an increase in customers complains together with the reported decrease in OTD did problematise the case, at least for them. Explaining this incident, one of finance and accounting controllers reported that:

We are usually concerned with the OPEX KPI information that we are responsible of reporting. As finance and accounting controllers, the number of units delivered on-time is a KPI that is reported via the sales department. Calculation of delivery KPIs, for example; AOTD and ROTD percentages, is then done by the factory quality-OPEX manager and reported on the ABACUS. So initially I was more concerned about the non-processed orders, whose customers had already paid the instalments. Yet, a decrease in the figures for on-time delivery witnessed at the same time, pushed me to investigate with the factory operation manager, the reasons why both were happening simultaneously.

Finance and accounting controller noted that, upon discussing this with factory operation manager, he informed her that production is delayed because of delays in the shipment of other orders. To the finance and accounting controller, this explained the decline in on-time delivery figures. However, to her surprise, the factory operation manager informed her that delays in orders' shipment should be blamed on sales department and supply chain management. He requested that she contacts the supply chain manager to request a speed up in the delivery of material, so that he can process new orders for which instalments were paid. As described by the finance and accounting controller;

> *It was surprising to me that he did not want to release the finished goods he had at the factory until he receives the requested material. Our finished goods warehouse is not this big and the fact that he is not releasing the finished goods meant that some transformer products are actually stored on the shop floor. When he told me to check with sales, I thought that our retailers are the ones who are late in picking up their goods. However, I discovered that the operation manager was the one instructing employees to delay the release of orders, so that we push material shipment from our end. Not only did this bothered me as well as the head of SAS and created many distractions, but it was also quite strange that, the operation manager is directing employees to trigger 'wasteful' activities and behaviours, by delaying production and storing finished goods around the value stream! The factory health, safety and environmental manager also confirmed on me that such situation is contra-lean and accordingly value stream operations were stopped to safeguard line workers, given that finished goods are displayed on the shop floor!*

6.7.4 Analysing the Tension Incident

Hearing about this specific incident first from the finance and accounting controller was a process that did put various pits that the researcher witnessed into perspective. The researcher made an earlier visit to the factory on the 3rd of October 2016 and no goods were seen during the researcher's tour in the factory shop floor i.e. going through the value stream production cells. However, many finished and packed transformer units were lined up alongside the door leading to the production shop floor.

When the researcher inquired about these transformers with one of the factory's lead engineers, he replied that they are just about to be out for delivery to their customers. Nothing was mentioned about delivery delays or late production processing then. Additionally, the researcher found it sensible to hear from other key actors involved in negotiating this incident, after hearing about it from the finance and accounting controller. Those key actors are; head of SAS centre, factory sales manager, factory operation manager, some representatives from line workers and supply chain manager.

Three of the line workers interviewed confirmed that some goods were placed in the shop floor as the factory warehouse was full and factory retailers were late in picking up their orders. Factory operation manager also confirmed that the reason for calling off production during some periods is that, value stream cells cannot proceed with the production process when finished good are on the shop floor. He also noted that they are experiencing delays in materials delivery from the supply chain management end, in addition to retailers' delay in collecting their finished orders. On the other side, according to factory sales manager:

> *It is not a retailers' problem! it did not turn out to be the case when I contacted factory retailers, whose delivery dates were due around that time of the year. Because I am based at the factory, it is always forgotten that I have to work directly with the finance and accounting controllers, since they plan their quarterly budgeted cost rates on basis of the number of orders I receive and notify them about. It was quite contradictory to me to observe finished goods being moved to the shop floor more than once for two consecutive months and at the same time, being informed about customers delivery complains received by the controllers at the head office. The factory retailers who I contacted reported that, when they called the factory few days before their delivery date to check on their orders completion, employees at the factory warehouse informed them that not all orders were complete. However, when the finance and accounting controllers informed me about the details of some of the customers complaining from late delivery, I discovered that those customers goods were among the ones finished and moved to the shop floor. I then became suspicious that it was an engineering balloon intended to push materials delivery dates, even though a substantial delay*

in materials delivery was already discussed and expected by lead engineers and our operation manager for this quarter of 2016 as a result of the increase in exchange rates!

At the supply management end, the factory supply chain manager noted that:

The government policy related to currency evaluation has raised exchange rate between the Egyptian pound (EGP) and the US dollar. Accordingly, we cannot currently import the same quantities of material that we used to import all at once, as we need to do some checks on our foreign currency reserves since our liquidity situation and savings are mostly in EGP. Hence, at the beginning of the last quarter of 2016, it was agreed in a meeting held among factory operation manager, LT engineering and operations advisor, finance and accounting controller and factory sales manager, that material needs will arrive in batches of small amounts to compensate for the time needed to manage currency needs. So, some effect on production processing was expected and should be understood given that the situation we are in this quarter had to do with an overall governmental policy

An interview with LT's engineering and operations advisor confirmed the information provided by the factory supply chain manager. Engineering and operations advisor also added that, when he was notified about customer complaints received by finance and accounting controllers, he reckoned that a 'late delivery' problem was made up by factory operating team to force supply chain to speed up delivery of materials. According to him;

This is a strange protocol to handle such situation. I am now regarded as one of the factory consultants and in my view such reaction from factory operating team can be described as an anti-lean one. To be more precise what happened is the real definition of a 'wasteful' activity. The factory health, safety and environment manager share this same opinion with me, and I had already notified the finance and accounting controllers about it in case they do not see it like that, being non-engineers.

A meeting was then held between the engineering and operations advisor, factory operating manager, supply chain manager and the finance and accounting controllers. Different interests and expectations of these people were put forward as highlighted in some of their quotes mentioned above. Alliances between interests were achieved when the finance and accounting controllers drove the operation manager attention to the deteriorating figures OTD. Additionally, as reported by the enterprise head of SAS, LT started to receive warnings on these figures from the global finance and accounting manager. Operation manager blamed controllers for not being cooperative enough to manage currency issues, while controllers blamed the factory operating team lead by the operation manager, for trying to take advantage of the controllers' lack of full comprehension of lean principles to encounter non lean behaviours. As reported by one of finance and accounting controllers:

> *For this last quarter of the year, we reached an agreement on how to handle this situation on basis of cooperation and compromise from both ends and I do hope they stick to it in similar situations. I agreed to do more efforts on managing currency issues and to follow up with supply management on materials delivery. However, I had to include the global finance and accounting manager to make sure delivery of finished goods and future processing of customer orders are not to be handled this way again. In the presence of the global finance and accounting manager we have agreed that, till lean is being implemented as a whole culture and its implementation includes us in addition to the SAS centre, factory operating team should not undermine the effect of their behaviours in the shop floor on the organisation's accounting system. What we all learnt from this issue was that a wasteful activity at the shop floor can be wasteful at many and various other ends.*

6.8 Chapter Summary

This chapter discussed and analysed the events and interactions making up LT's MAS and how they are related to many human and non-human actors in the organisation. In this discussion more case study findings were elaborated. The chapter is mainly structured around three major story plots in which Callan's (1986) and Latour's (1987, 1996, 2005) four moments of translations were experienced. The three plots

detailed the stories related to changes in organisation's performance measures, debates associated with the choice of organisation's costing practices and the tension incidents experienced between organisation's accountants and engineers. Analysis of these stories showed that major changes in organisation's performance measures are mostly driven by the organisation's global managing team in Zurich. At the same time, internal KPIs can also be developed as a result of operating issues experienced at the factory. These internal KPIs are mobilised only by the effort of organisation's actors identified in this chapter. Analysis also showed situations in which the organisation's operating shop floor, more specifically its value streams, affected the choice of its costing practices and was able to rule out a 'lean tailored' practice such as VSC. Other incidents showed how competing calculations such as ABC and VSC can enrol one calculation at the expense of the other and affect managers acceptance of its implementation. Finally, stories about tension experienced between organisation's accountants and engineers provide evidence on how the organisation's finance and accounting controllers can understand lean needs and take actions that not only facilitate their work as accountants, but also supports a lean management environment. The next chapter builds on the details of actors' interactions discussed in those story plots and uses Callon's (1998a, 2007) concepts of framing and overflow to develop an empirical driven theoretical conceptualisation of the developments in LT's MAS. Various implications are driven for this conceptualisation and are then used to develop answers for the study research questions.

Chapter 7: Discussion

7.1 Introduction

The previous chapter analysed the details of three major stories revolving around drivers of change in case organisation's performance measures, the choice of organisation's costing practices and the management of tension situations between accountants and engineers. Throughout the discussion of these stories, Callon's (1986) and Latour's (1998, 2005) four moments of translation were experienced. The discussion in this chapter uses Callon's (1998a, 2007) concepts of framing and overflow to develop an empirical driven theoretical conceptualisation of the developments in LT's MAS. Various implications are driven from this conceptualisation and then used to develop answers for the study research questions. This chapter constitutes ten sections. Section 7.2 presents a timeline of both LT's progress with lean implementation and changes in MAS witnessed throughout the study period. The timeline summarises lean and MAS changes presented in chapter 5 and discussed in the three plots in chapter 6. The timeline seeks to show how organisation's MAS influences and is influenced by progress in lean implementation and change in LT factory space. The empirical conceptualisation developed in this chapter builds on LT's timeline and on the use of different accounting information systems (OPEX, SAP and ABACUS) and actors' different perceptions on management accounting practices and controls reported using each information system. Actors' different perceptions on LT's management accounting practices and controls are presented in section 7.3. Section 7.4 then discusses the empirical driven theoretical conceptualisation using concepts of framing and overflow. Implications driven from the conceptualisation are discussed in sections 7.5, 7.6, 7.7 and 7.8. Section 7.9 reflects on the both the empirical conceptualisation developed in this chapter and the literature driven conceptualisation developed in chapter 3 to develops answers for this study's research questions. The chapter then concludes with a chapter summary in section 7.10.

7.2 A Timeline of Both Lean and MAS in Case Organisation

Figure 7.1 builds on the timeline of LT's progress in lean management implementation presented in chapter 5 (section 5.4), to present a cumulative timeline of both progress in lean and changes in organisation's management accounting system throughout the study period.

The two dark black horizontal arrows show the timeline for the period during which, organisation's operating and accounting data are analysed (from 2004 to 2016). The descriptions and boxes below the bottom arrow pertain to the changes experienced in the organisation's MAS. Data above the top arrow relate to actions affecting progress with lean implementation. The statement *'old value stream'* is meant to indicate changes experienced in lean management implementation and MAS during the use of factory old value stream as illustrated in figure 5.4 of chapter 5 (section 5.5). Changes experienced from beginning of 2012 till 2016, occurred after identifying the new value stream shown in figure 5.5 of chapter 5 (section 5.6). Figure 7.1 tries to link developments in MAS to the new design of factory space (Miller and O'leary, 1994), where the factory is regarded as *'a veritable laboratory'* in which *"...accounting exerts an influence on, and is influenced by, a multiplicity of agents, agencies, institutions, and processes"* (Miller, 2001, p. 392).

Beginning with the period during which the organisation was managing using its old value stream, i.e. from the start of lean implementation (2004) till end of 2011, one can say that organisation's MAS did not show much changes with lean management implementation. Before a suggestion of alternative costing practices – (VSC and ABC) – was put forward by the researcher in 2009, LT depended on a traditional accounting system, using standard costing. Regular budgeting data were prepared on quarterly and annual basis. Almost all performance measures were traditional or non-lean, except for a couple of lean-tailored KPIs namely: FPY for products and cost of value added[15].

[15] Examples of KPIs used during this period are shown in Table (5.6) of Chapter 5.

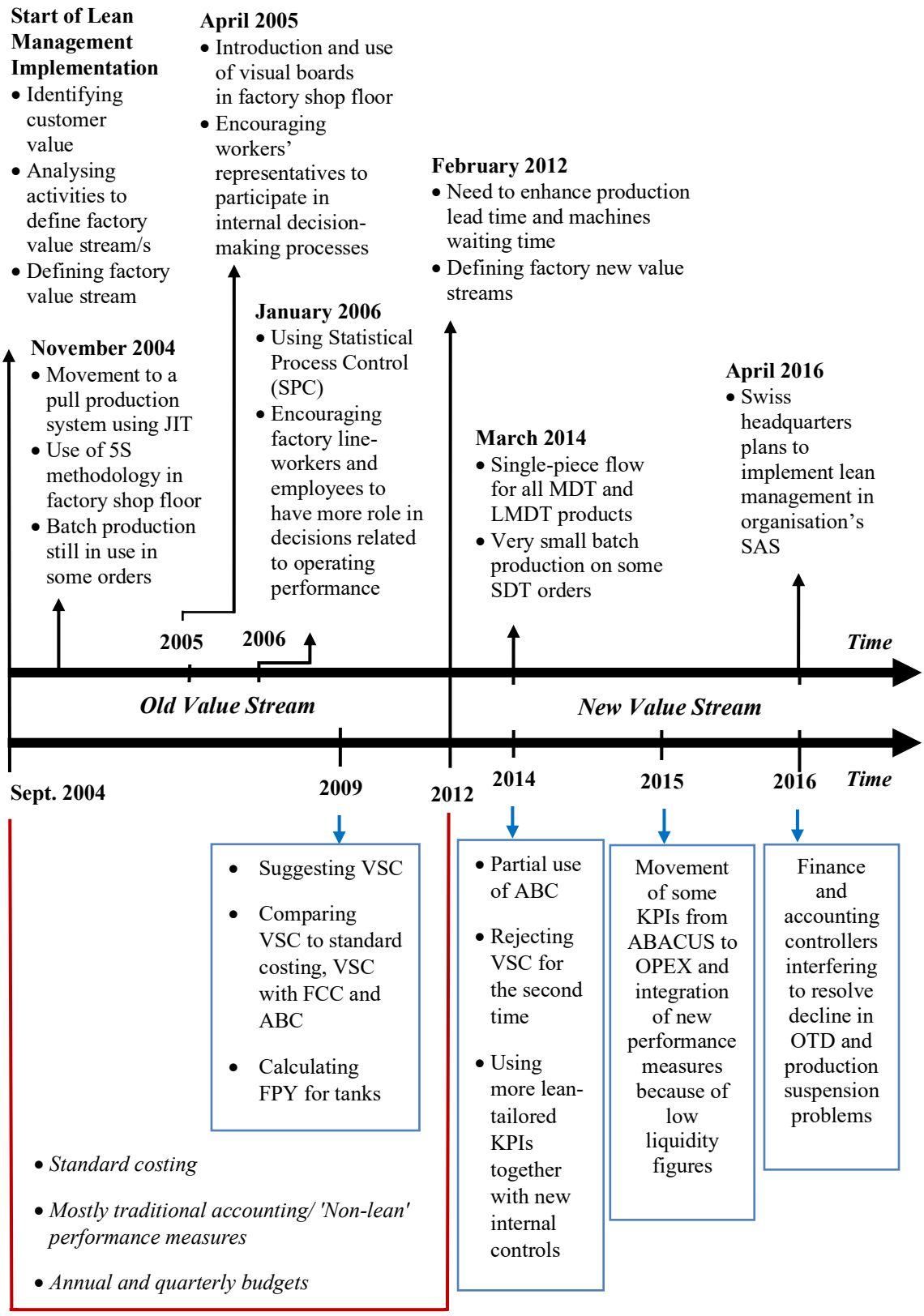

Figure 7. 1: Timeline for Organisation's MAS and Lean Management over the Study Period

Looking at the progress in lean during the same period shows that, actors involved mainly focused on a achieving a speedy progress with lean implementation. LT successfully moved to a pull production system before the end of 2004 and moved ahead with using visual boards, continuous improvement methods as SPC, and empowering employees by encouraging them to have a role in decision making. The two lean-tailored KPIs were mainly mobilised by an operating need to show progress with lean, in terms of products' quality and the cost of value added. Construction of the value stream was done in isolation from any finance and accounting member of the organisation. During this period organisation's MAS with its calculations can be viewed as a neutral *'Camera'* i.e. a mere representation of the world activities (Mouritsen, 1999; Revellino and Mouritsen, 2015) or according to Vosselman (2014, p. 182)*, 'a representation of something' and 're-presentation for someone'*.

It was only in 2009, that finance and accounting people become aware of possible costing alternatives that can work with LT's level of progress with lean. Comparing VSC and ABC to standard costing calculations broadened the understanding of finance and accounting people of the relationship between what is happening at the factory and how it can be calculated. As discussed in plot 2 of chapter 6 (section 6.5), almost all organisation actors – human and non-human – were involved in negotiations on possible costing systems for the factory. As will be discussed later in this chapter, this marked one of the first incidents where finance and accounting representatives as well as management accounting calculations had a role in reaching an agreement on the way forward. Finally, in 2009, organisation's MAS was influenced by the way lean implementation has progressed in the factory to empower line workers and consider their suggestion to develop FPY KPI for tanks and report it in the organisation's ABACUS.

As discussed in chapter 5, section 5.6, a need to enhance production lead time and machines' waiting time pushed for identifying a new value stream in 2012. The use of ABC - even partially - was triggered by global finance and accounting manager in 2014. ABC was viewed as a more suitable costing system after the change in factory value stream, also after a move to a single-piece flow for production of both MDT and LMDT products. Though initially mobilised by Swiss finance and accounting managers,

management accounting calculations in the form of ABC, continued to play a key role in deciding the way forward for factory's costing system. As will be discussed later in this chapter, ABC calculations were the main reason why VSC was rejected for the second time. The period from 2012 to 2016, witnessed more developments in MAS than in lean management. The main advancement in lean implementation following the construction of new value stream and use of single piece flow, was a plan to extend lean implementation to organisation's centre for SAS. However, advancements in MAS continued in conjunction with finance and accounting controllers' enhanced understanding of lean as a whole culture/philosophy. This was seen in the use of internal lean tailored controls in 2014 and finance and accounting controllers resolving tension issues experienced with engineers in 2016.

7.3 Actors Different Perceptions on Organisation's Management Accounting Practices and Controls

As discussed in chapter 5, section 5.3, LT manages its management accounting information using three information systems; SAP, OPEX and ABACUS. Though organisation actors can have access to more than one information system or to all of them – *for some actors* –, each information system still had an informally designated key responsible person/s. Over the time, this has made some human actors more acquainted with some systems and their practices than others. Eventually, those key responsible persons developed different perceptions about the organisation's management accounting practices and controls. This section discusses the different perceptions that organisation's human actors have on MAS practices and controls used during the longitudinal study period. Table 7.1 lists the organisation actors handling LT's accounting information systems, the accounting information systems they manage, together with, the accounting calculations processed by each system.

Table 7.1 shows that, each group of human actors handling a certain accounting information system, has a key responsible person. For example; finance and accounting controllers are the key responsible people managing SAP, factory head and quality and operations excellence manager are the key persons handling information on OPEX analyser, while LBU manager and the global managing team form the key persons

managing the ABACUS. As will be seen in the next section, different perceptions of key responsible persons on organisation's management accounting practices and controls, affected their interactions with other organisation's actors– *human or non-human*. This also had a bearing on the developments experienced in organisation's MAS.

Information Systems Used	**SAP**	**OPEX Analyser**	**ABACUS**
Human actors	• Finance and accounting controllers • Head of SAS • Centre for SAS employees • LBU manager • Factory operation manager • Line workers from factory operations	• Factory head • Quality and OPEX manager • Factory operation manager • Finance and Accounting Controllers • LBU manager • Global managing team	• Global managing team • Head of SAS • Factory head • Finance and Accounting controllers • LBU manager
Management accounting calculations	Costing calculations Budgeting data	Published (external) KPIs	Internal KPIs and lean accounting KPIs
Key responsible human actor	Finance and Accounting controllers	Factory head and factory operation manager	LBU manager and Global managing team

Table 7. 1: List of human actors chosen for the study, the accounting information systems they handle and the key responsible actor for each system

A representation of different perceptions of key responsible persons over different years of the study period is shown in tables 7.2, 7.3 and 7.4. Each table shows a representation of these different perceptions with respect to a type of management accounting

practice/control used by the organisation. In the three tables, the abbreviation 'F&Acc. Controllers' is used to denote the finance and accounting controllers as the responsible team handling SAP. 'OP.' abbreviation is used to denote the factory head and quality and OPEX manager representing the operating team handling OPEX analyser. The abbreviation 'GMT' is used to denote the global managing team who with the help of LBU manager are handling control information on ABACUS.

Several frameworks of management control system (MCS), were discussed in chapter 2, section 2.8. However, the choice of a framework for this research – *if needed* – was left till data is analysed. This aimed at freeing the space for organisation actants to tell their stories with no attempt to enforce on them a definite framework or as Latour's (1999, P. 20) notes to *'learn from the actors without imposing on them a priori definition of their world building capacities'*. Accordingly, in table 7.2 through to table 7.4, Otley's (1999) framework of analysing management accounting practices/ controls is chosen to demonstrate the different perceptions of key responsible persons on organisation's management controls. This framework is chosen, since it is suited for *'evaluating practical developments'* in management control systems practices (Otley 1999, p. 366) and is best suited for use in *'case based, longitudinal studies'* (Otley 1999, p. 363) as the case study discussed in this research.

Costing Practices				
		From 2004 till end of 2011	**2012 – 2015**	**2016 onwards**
Objectives	F&Acc. Controllers	• Inventory valuation objective • Budgeting and decision-making objectives	• Inventory valuation objective • Budgeting and decision-making objectives	• Inventory valuation objective • Meet lean management needs
	OP.	• Inventory valuation objective • Cost reduction objective	• Inventory valuation objective	• Inventory valuation objective
	LBU Manager & GMT	• Inventory valuation objective • Cost reduction objective	• Inventory valuation objective	• Inventory valuation objective • Cost reduction and waste elimination
Strategies	F&Acc. Controllers	Developing an accurate cost calculation that considers how resources are being used across organisation's defined value stream	Develop an accurate unit cost that matches new identified value streams and simplifies accounting calculations	Integrating more cost drivers with cause and effect relationship with cost centres in compliance with directions from global managing team Using costing practices that better matches with lean management
	OP.	Achieving the lowest product unit cost preferably one the considers most of bottleneck processes in organisation's value stream	Using a costing practice that matches newly identified value streams	Using a costing practice that matches newly identified value streams
	LBU Manager & GMT	Achieving the lowest possible product unit cost	Develop an accurate unit cost that matches new identified value streams	Integrating more cost driver with cause and effect relationship with cost centres
Targets	All groups	An interval of costs as a percentage of sales is provided annually by global finance manager to act as a benchmark	An interval of costs as a percentage of sales is provided annually by global finance manager to act as a benchmark	More flexible targets now that the use of multiple cost drivers is encouraged
Rewards	All groups	No direct reward assigned for good achievements on costing practices used. However, employees are rewarded on progress in cost savings	No direct reward assigned for good achievements on costing practices used. However, employees are rewarded on progress in cost savings (if any since focus moved to developing accurate costs)	No direct reward assigned for good achievements on costing practices used.
Feedback	All groups	Local monthly meetings to analyse cost reports and discuss costing issues. Quarterly meetings are held with global managing team.		

Table 7. 2: Different Perceptions of Organisation Key responsible actors on Costing Practices used during different Periods of the Study

KPIs in OPEX Analyser (Published KPIs)				
		From 2004 till end of 2011	**2012 – 2015**	**2016 onwards**
Objectives	F&Acc. Controllers	• Financial objective	• Financial and liquidity objectives	• Financial objective • Measure and convey progress with lean management
	OP.	• Financial and operating objectives	• Financial and operating objectives • Measure progress with lean management	• Financial and operating objectives
	LBU Manager & GMT	Financial and operating objectives	• Financial, operating and liquidity objectives • Measure progress with lean management	• Financial objective • Measure and convey progress with lean management
Strategies	F&Acc. Controllers	Using appropriate financial indicators (e.g. EBIT, value added cost, sales in excess of invoices)	Using appropriate financial indicators and integrating new liquidity measurement to OPEX KPIs	Using appropriate financial indicators and have more accounting participative role in managing OPEX KPIs
	OP.	Using appropriate financial and operating indicators	Using appropriate financial and operating indicators and integrate lean-related KPIs if needed	Follow up on used KPIs and amend those requiring updates
	LBU Manager & GMT	Using appropriate financial and operating indicators	Using appropriate financial and operating indicators, new KPIs to monitor progress on liquidity and integrate lean-related KPIs if needed	Engaging with finance and accounting controllers to agree on control updates needed to better convey progress with lean management implementation
Targets	All groups	A range of target intervals is set by global managing team to act as benchmark for both operating and finance and accounting controllers teams		
Rewards	All groups	Employees are rewarded on positively surpassing benchmark targets.		
Feedback	All groups	Local monthly meetings to analyse cost reports and discuss costing issues. Quarterly meetings are held with global managing team.		

Table 7. 3: Different Perceptions of Organisation Key responsible actors on OPEX KPIs used during different Periods of the Study

ABACUS and Internally reported KPIs				
		From 2004 till end of 2011	**2012 – 2015**	**2016 onwards**
Objectives	F&Acc. Controllers	• Not quite sure of the exact objective but generally to meet operating demands	• Operating objective and to measure progress with lean management	• Financial and operating objectives and to measure progress with lean management.
	OP.	• Not quite sure of the exact objective but generally to meet operating demands	• operating objective and to measure progress with lean management	• operating objective and to measure progress with lean management
	LBU Manager & GMT	• Support operating team and help provide a more lean tailored environment	• Financial and operating objectives • Measure progress with lean management	• Financial and operating objectives Measure progress with lean management
Strategies	F&Acc. Controllers	Not defined	Using appropriate operating and lean-related indicators	Using appropriate financial and operating indicators, integrate more lean tailored controls and have more accounting participative role in managing OPEX KPIs
	OP.	Not defined	Using appropriate operating and lean-related indicators	Follow up on used KPIs and amend those requiring updates
	LBU Manager & GMT	Operating team is free to choose convenient internal KPIs and report it on ABACUS	• Using appropriate financial and operating indicators and integrate lean-related KPIs if needed • Operating team is free to choose convenient internal KPIs and report it on ABACUS	• Using appropriate financial and operating indicators and integrate lean-related KPIs if needed. • Engaging with finance and accounting controllers to agree on control updates needed.
Targets	F&Acc. Controllers	Not defined	Factory head and operation manager are to set targets for internally developed KPIs. Opinions of line workers are to be taken in consideration whenever possible.	Factory head and operation manager are to set targets for internally developed KPIs. Opinions of line workers are to be taken in consideration whenever possible. Finance and accounting controllers are to set targets for financial controls developed.
	OP.	Not defined		
	LBU Manager & GMT	Factory head and operation manager are to set targets for internally developed KPIs. Opinions of line workers are to be taken in consideration whenever possible.		
Rewards	F&Acc. Controllers	Not defined	Operating team is to be rewarded on positive achievements in internal controls.	Accounting and operating teams are to be rewarded on positive achievements in internal controls.
	OP.	Not defined		
	LBU Manager & GMT	Operating team is to be rewarded on positive achievements in internal controls.		
Feedback	All groups	Line workers and lead engineers should compare records achieved with their set targets and report progress to factory operation manager.	Line workers and lead engineers should compare records achieved with their set targets and report progress to factory operation manager.	Line workers and lead engineers should compare records achieved with their set targets and report progress to factory operation manager. SAS employees compare their financial records and report to F&Acc. controllers

Table 7. 4: Different Perceptions of Organisation Key responsible actors on ABACUS and Internal KPIs used during different Periods of the Study

Table 7.2 illustrates the different perceptions responsible persons had on the costing practices used throughout the study period. Table 7.3 shows the different views of these responsible persons on the organisation's published KPIs via OPEX. As can be seen from both tables the three teams of responsible human actors share the same views on the targets, rewards and information feedback loops used for both costing practices and KPIs on OPEX. In Table 7.4, an illustration of the different perceptions of key responsible persons on both ABACUS and internally reported KPIs is presented. It can be noticed that with this type of controls different responsible teams had different views on the controls' objectives, strategies, targets and rewards across different study periods. Illustrations of different perceptions by key responsible persons are discussed in detail in the next section in conjunction with the changes in MAS presented in figure 7.1, to show how both can be used to conceptualise the developments around LT's MAS in the context of lean.

7.4 MAS between Framing and Overflow

The previous section introduced the different perceptions which key responsible persons handling organisation's accounting information systems, had on the organisation's management accounting practices used, throughout the study period. In this section, Callon's (1998a, 1998b, 2010) ideas on framing and overflow are used to conceptualise the developments around MAS in the context of lean using LT empirical data. Figure 7.2 represents an illustration of this conceptualisation, which will be discussed in this section and in relation to the literature driven theoretical conceptualisation discussed in chapter 3– *(see figure 3.3, section 3.7.3).*

As shown in figure (7.1) representing the timeline of lean and MAS, in LT, a positive progress on the performance measurement level was not needed to trigger more efforts to enhance the implementation of lean. Unlike Ahlstrom and Karlsson's (1996) framework, a positive result on the accounting performance measures side – *(for example; 'productivity' in their paper)* – did not trigger adaptations or simplifications in the organisation's MAS. Findings would agree with Ahlstrom and Karlsson's (1996) case study on the idea that, a level of confidence is needed for top management to embark on lean management implementation in the first place. As figure 7.2 shows, in

LT, support from global managing team, transformers factory head and operation manager and their conviction of the benefits from lean, were the main drivers for its implementation and further advancements with it. This also coincided with Fullerton et al.'s (2013) findings confirming the importance of top management support to motivate lean management implementation.

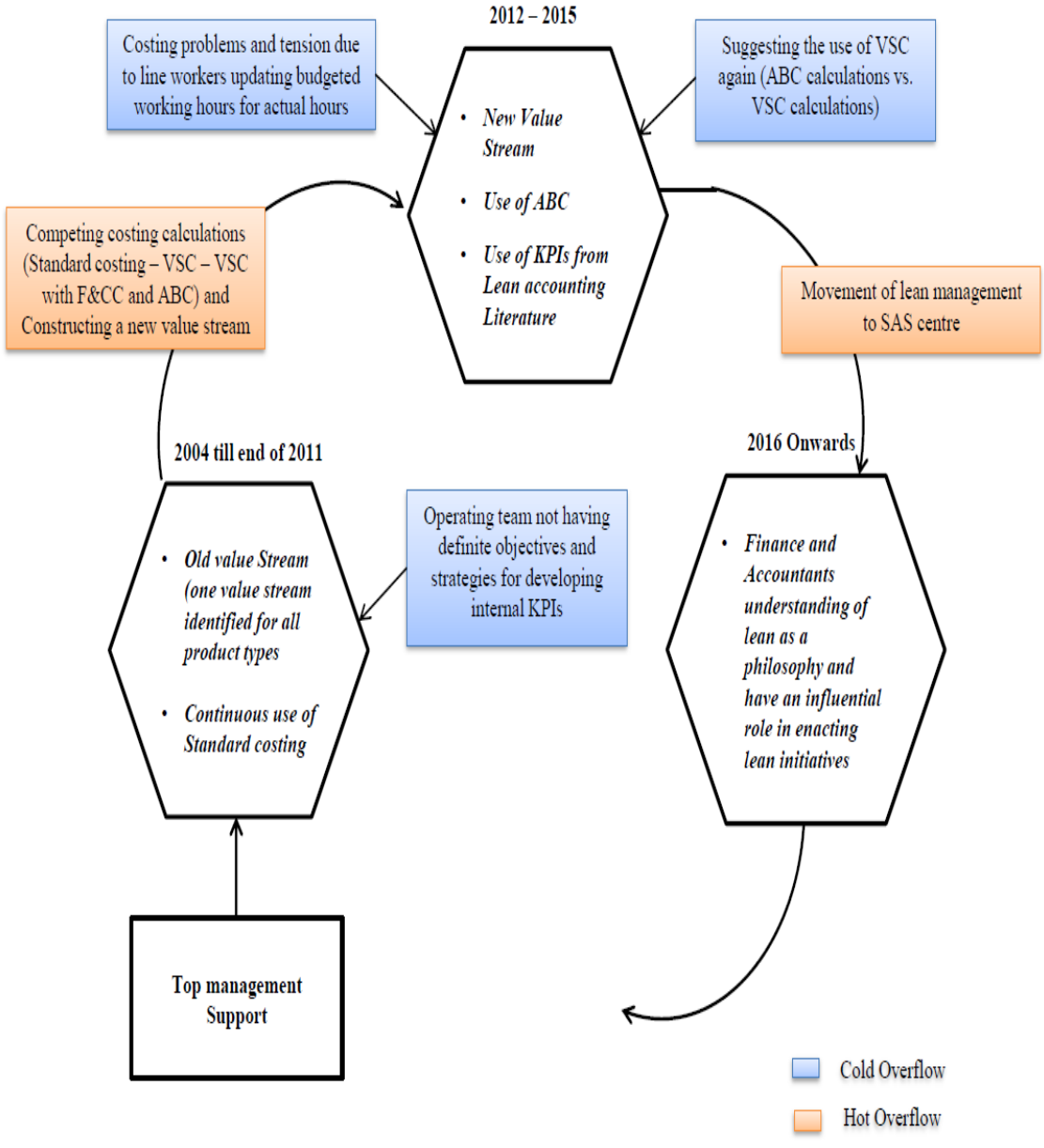

Figure 7. 2: Empirical driven Theoretical Conceptualisation of Developments in Organisation's MAS based on LT Case

In the period between year 2004 – (the start of lean implementation) – till end of year 2011, organisation actants have mostly succeeded to stabilize a frame of interactions that in many cases was able to keep *"a set of stable mechanisms and settings"* (Skaerbaek and Tryggestad, 2010, p. 110) for the organisation's MAS and channel successive 'cold' overflows experienced during this period. 'Cold' overflows contained during this period included; the operating team not having definite strategy or objectives for developing internal KPIs when tanks oil leakage problem occurred, initiating the need for internal KPIs to measure oil leakages in tanks. As shown in table 7.4, between 2004 and 2011, both finance and accounting controllers and operating teams did not have a definite view on the objective of using internal KPIs. At the same time, global managing team in Zurich, perceived internal and ABACUS KPIs as used to support lean initiatives and the operating team's work. Divergence in actors' perceptions on the development of internal KPIs was easily channelled then, since global managing team has consistently encouraged participation of factory workers and employees in decision making. Swiss managing team oversaw a potential need to use internal KPIs and has set objectives and strategies for them. The global team has usually motivated a socialising form of relationships and accountability (Roberts, 1991) among factory and local business unit personals. Hence, factory workers were encouraged to actively participate in designing FPY KPI for tanks.

A second 'cold' overflow was contained when operating team felt the need to move the responsibility of handling some OPEX KPIs from technical team to sales. As shown in table 7.3, finance and accounting controllers perceived OPEX KPIs to solely have a financial objective. Yet, operating team as well as LBU manager and global managing team used these KPIs for both financial and operating objectives. Agreement was easily reached since operating and managing team had a common understanding of the objective and strategy for using OPEX KPIs.

In both overflow incidents, the finance and accounting controllers lack of knowledge of the objective of using internal KPIs and the operational objective of using OPEX KPIs, did not obstacle the containment of overflows whenever they were experienced. As mentioned earlier, at these early stages of lean implementation, the finance an accounting team had no established knowledge of the management control practices

associated with lean or of any lean accounting practices. As discussed in section 7.2, the construction of factory value stream was done without consulting the finance and accounting team. Their first incident of being involved in discussions about LT management accounting practices only started in 2009.

On the other hand, competing calculations of standards costing, VSC, ABC and VSC with features and characteristics costing, towards the end of year 2009, have created a situation in which negotiations between interacting actors to decide on a way forward became quite controversial. As shown in figure 7.2, this situation ended in identifying – *without containment* – a 'hot' overflow, where divergence in actants views and mechanisms of treating different costing calculations created a discrete understanding of what needs to be measured or done (Callon, 1998a). As discussed earlier, prior to 2009, finance and accounting team was not involved in discussions on lean and management accounting and control practices. At that time, finance and accounting controllers had different objectives and strategies for using costing practices than those adopted by operating team and LBU and Global managing team as can be seen in table 7.2. While the former group aimed at using accurate costing practices, which considers how resources are being used, the latter group mostly focused on inventory valuation and then cost reduction strategies, especially after the uprising political events in Egypt in the beginning of 2011.

As discussed in plot 2 of chapter 6 (section 6.5), the researcher calculated possible costing alternatives which can suite the organisation. However, standard costing kept being used and was mainly regarded as a 'mere reflection of the innovation in use' (Revellino and Mouritsen, 2015) i.e. a camera, reflecting accounting calculations after a move to lean. The overflow caused by competing calculations in 2009, was not resolved. Accounting controllers favoured activity-based costing as the accurate costing calculation. Yet, they needed approval from global managing team to mobilise it. On the other hand, the operating team were happy to continue using standard costing, as long as it achieved their inventory valuation and cost reduction objectives. At the same time, as Callon notes; what is kept in brackets will always tend to give rise to matters of concern (Callon, 2007, p. 139). The unresolved hot overflow had brought the problem of identifying a single value stream of transformer types to the surface. This then

implied that, given LT's old value stream, the organisation has only two alternatives: either to construct three value streams or to use a costing practice that does a good deal of cost allocations. No agreement was reached on a practical solution to this problem when it was discussed in 2009.

A common knowledge base was only established between actants, when the global managing team prioritized cost reduction over cost accuracy in 2011, after the uprising political events in Egypt. Accordingly, standard costing continued to be used – or was indeed enforced – even after the discussions of other possible alternatives that are more capable of considering how resources are being used in organisation's value stream. Standard costing was chosen not because it was the calculation with *"higher levels of representation faithfulness"*, but more importantly it was the calculation which was able to *"hold diverse facts and interests together that these facts will become true"* Briers and Chua (2001, p. 267).

Hence, during the period from 2004 till end of 2011, organisation key actors were able to identify overflows, agree on ways to measure them and reach a common understanding of current and future statuses in many overflow incidents. Yet, controversies and divergence between actors' opinions regarding alternative costing practices for LT, were quite big to be channelled without a top-down decision from global managing team. In all of these overflows, the global managing team focus on cost reduction objectives, their support of the lean management implementation initiative together, the identification pattern of factory value stream, together with the uprising political events experienced in the beginning of 2011 were the main instruments allowing actors to frame negotiations on the MAS's practices used.

As illustrated in figure 7.2, an identification of two operating value streams in the period starting year 2012 created a new frame of interaction between organisation's actants in the period from year 2012 till end of year 2015. A new frame was gradually established in this period, since actors' identities and their pattern of measuring overflows have developed in accordance with the change in their knowledge and perceptions about the management accounting and control practices to be used in the

organisation. Also, the new layout of value streams had its influence on LT's management accounting practices, specially the costing ones.

A change in the perception of finance and accounting controllers about the strategy for using costing practices, from just focusing on computing accurate product costs to encouraging the use of costing practices which simplifies accounting calculations, has enabled the channelling of cold overflows experienced in this period. Cold overflows included suggesting the use of VSC again in 2014 and comparing VSC calculations to those of ABC. A second cold overflow was experienced when operation line workers updated budgeted labour and machine hours for the actual hours worked as discussed in plot 3 of chapter 6 (section 6.7). In these overflow incidents, channelling was mainly facilitated through a better understanding by finance and accounting team of lean and the possible management accounting practices working with it and with their organisation's constructed value streams. The new layout of the operating floor including two value streams still prioritised the use of a costing practice that does some allocation. Though finance and accounting controllers preferred and suggested VSC as a possible costing tool, ABC calculations acted as an engine which lured organisation's actors into rejecting VSC implementation for the second time (Revellino and Mouritsen, 2015). Finance and accounting controllers' understanding of the organisation progress with lean, helped contain any divergence between their opinion to use VSC and the operating and global team preference to use ABC. Such understanding also facilitated the agreement on how hours are reported by factory workers on SAP. Also, as shown in table 7.3, an agreement between the operating team and the LBU manager and global managing team that the objective of the OPEX KPIs is to measure progress with lean, has facilitated the integration of new KPIs driven from the lean accounting literature in the end of 2014.

Hence, though a new value streams layout created a new frame for actors' interaction, more inclusion to finance and accounting team created a better understanding of the operating environment and of relevant management accounting and control practices. This understanding helped contain overflows and kept a steady state around interactions related to organisation's MAS in which actants were usually capable of reaching *'...an agreement regarding the reality and scope of the overflows'* (Callon, 1998b, p. 261).

Finally, the announcement of the global managing team the move of lean management implementation to the organisation's Shared Accounting Service (SAS) centre in 2016, represented a second hot overflow experienced by the organisation actors as can be seen in figure 7.2. The beginning of 2016 witnessed a large divergence between organisation's actors on the consequences of lean implementation in the SAS centre. While the operating team did not regard this as making a difference in their role, the finance and accounting controllers believed that they can have a more lean-related role given the understanding of lean and MAS's needs. The change in finance and accounting understanding of management accounting needs in a lean environment, together with the amendments they integrated on the ABC calculations in the beginning of 2017, reframed the actors' interactions around the organisation's MAS. That is not to say that, controversial issues around the use of lean principles in SAS has been fully contained. Yet, a reframing of actors' interactions was once again experienced from the last quarter of 2016. The new frame implied more influential role played by finance and accounting controllers even in lean related concerns. Examples included, finance and accounting controllers resolving issues related to negative OTD figures and suspension of production problems in 2016. As shown in figure 7.2, it was difficult to identify overflows from year 2016 onwards, since interactions between actors is currently more or less stabilised on having a more participative role in the move of lean to centre for SAS and the enactment of lean related management controls if needed.

As can be seen from the discussion of figure 7.2, throughout the study period, LT's MAS experienced episodes of framing and overflow. Those framing and overflow incidents gave rise to various implications on the relationship between MAS and lean as a process innovation and horizontal organisation arrangement, and on the performative role of operating structures and management accounting calculations. Those implications are discussed in the coming sections.

7.5 On the Performativity of Operating Structures

The case of LT's transformers factory provides evidence on how operating structures can be performative. While the study of performativity has been used in many areas including linguistics (Austin, 1962), economics (Mackenzie, 2006), the study of financial models (Mackenzie and Millo, 2003; Makenzie and Spears, 2014), role of

technologies (Revellino and Mouritsen, 2015; Themsen and Skærbæk, 2018), we can rarely find a detailed study highlighting the performative role of operating structures. Using Callon's (2007) ideas on performation, when LT factory identified its old value stream the 'illocutionary force' they implied or the 'pragmatic turn' they took in this action, was to construct a value stream which accounts for all value adding activities (Kennedy and Brewer, 2006) and includes products that form one product family (Maskell and Baggaely, 2004, Fullerton et al., 2013). However, the 'perlocutionary effect' or the 'semiotic turn' that this value stream did had, is emphasizing the need for a costing practice which does some allocation, i.e. accounts for how resources are used differently among the three transformer product types. The way the factory old value stream is identified, has consistently mobilised the use of standard costing or activity-based costing– *(perceived as a more accurate allocation method by factory finance and accounting controllers).* This means that such value stream identification can effectively mobilise the use of some costing practices and limit others, irrespective of how these practices might be 'theoretically' compatible with the organisation's progress with lean management.

A complete study of the performative role of factory's old value stream, also entails taking an ANT turn in understanding all the contributions made by actors involved in this socio-technical agencement (Caliskan and Callon, 2010). As discussed in earlier sections, the construction of such value stream involved many organisation actors, yet, it involved no consultation from any finance and accounting member of the organisation. Additionally, as shown in table 7.2, from the start of lean implementation till the beginning of year 2011, key responsible actors from operation perceived the use of a costing practice as a tool for mainly managing inventory valuation. Finally, the lack of knowledge about alternative costing tools suitable for lean by the accounting and finance team and an OPEX which mainly reports traditional accounting controls, supported the continuous use of standard costing without discovering any problems with value stream identification. Hence, this structure of old value stream has been quite performative to stabilise a frame of interaction (Skaerbaek and Tryggestad, 2010), between all actors around lean and factory management accounting practises used between years 2004 and 2011. Operating structures in the form of the newly constructed value streams, have also proven to be quite performative in establishing a new frame of

interactions around the new value streams and their supporting KPIs and management accounting practices from year 2012 to 2015.

7.6 Horizontal Organisation Arrangements and the Desire to Control

The translation processes mainly shaping plot 1 discussed in chapter 6 (section 6.3) and witnessed during the negotiations on factory suitable costing practices, show a continuous desire from Swiss global managing team to be full hands-on the control practices enacted at the headquarters in Egypt. In a horizontal organisation arrangement such as lean, one would expect an inclination towards more lateral co-ordinations between actors at the headquarters in Egypt and the Swiss global managing team, in addition to the lateral relations between the local actors themselves (Chenhall, 2008). Throughout the study period, global managing team has encouraged lateral accountabilities in LT Egyptian factory, emphasizing socialising relationships, where all actors are motivated to take part in decision making (Roberts, 1991). However, the team has mostly exhibited a hierarchal (top-down) form of accountability in their dealings with representatives from the Egyptian factory. Accounting calculations reported and easily accessed by global team via OPEX and ABACUS, have consistently enabled the team to maintain a very good control of what is happening in the Egyptian headquarters. Though this has to do with the role of calculations acting as inscriptions – which will be discussed later in this chapter – it facilitated the global team's control at a distance (Robson, 1992). As discussed in plot 1 of chapter 6, the global team directs which KPIs are to be published on OPEX and which remain internal. They also enact new KPIs to be used, for example; DPO, DSO and cost of sales following the liquidity problem in 2014. Yet, this form of top-down control has its consequences, in terms of limiting global team's ability to make use of the contribution of lateral arrangements at the factory shop floor, for example; the cost savings achieved after using FPY for tanks. In case of LT, this type of maintaining control did not only inhibit progress with lean management implementation (van der Steen and Tillema, 2018). However, the case study shows that it can inhibit progress with management accounting. In LT, standard costing was enforced by global managing team after turning down VSC and then ABC in 2011, as both did not achieve their cost reductions objectives, though ABC was favoured by the organisations controllers and was viewed as suitable with the factory old value stream.

7.7 On the Performativity of Calculative Practices and Management Accounting Relational Ontology

As much as LT's old value stream was performative enough to stabilise actors' frame of interaction between 2004 and 2011, VSC calculations were counter-performative to unravel the problems associated with the construction of such value stream. The pragmatic turn VSC calculations intended to have in 2009 (Callon, 2007), was to provide a simple costing tool (Maskell and Kennedy, 2007; Fullterton et al., 2013), which can compute an average cost that serves a family of products (Maskell and Baggaley, 2004) represented by LT's value stream. Yet, the semiotic turn that the calculation had, was the creation of an extremely high cost which cannot be used as an average cost for all types of transformers. As much as VSC did not perform in the same direction in which it was expected, the calculation – alone and with features and characteristics costing – highlighted the problem LT had with its value stream identification pattern. Such problem with value stream construction then questioned whether standard costing is the best costing practice to continue with and motivated actors to investigate other possible costing alternatives. VSC counter-performed in the sense that, its own calculations did not encourage anyone to use it and acted against its own merits. Yet, VSC calculations created 'traces' which invited more interactions among actors and disentangled further costing and operating issues which needed to be assessed (Revellino and Mouritsen, 2015). VSC calculations were inscriptions that did not *"--stand as representations of a distant reality but rather act[ed] as the instauration of their reference"* (Busco and Quattrone, 2018, p. 16). Though the intention from using VSC was not attained, the calculation formed a trajectory (Revellino and Mouritsen et al., 2015) for questioning and testing possible costing practices, also for investigating alternative ways of constructing LT value streams. This trajectory expanded in both space and time. VSC calculations have broadened the cognitive boundary (Latour, 1986) for LT's finance and accounting team. Prior to its calculation, finance and accounting team had no idea about the link between the way factory value stream is constructed and relevant costing practices and they were not involved in any decisions regarding the factory operating structure. Calculating product costs using VSC in 2009, pushed finance and accounting team to have a role in analysing factory space and suggesting suitable management accounting practices. This role extended over time,

where the finance and accounting team suggested the use of VSC once again in 2014 with an understanding that VSC can be more compatible with the new factory space.

This time, ABC calculations were performative enough to rule out the possibility of adopting VSC. ABC's pragmatic and semiotic effects were the same, i.e. ABC intended to provide a cost calculation which considers how resources are used among different transformer types and it effectively did so. ABC achieved high level of 'representation faithfulness' (Briers and Chua, 2001) and was performative because it considered the new factory layout composed of two value streams, where one is devoted for SDT and another for both MDT and LMDT. ABC was able to achieve the global managing team's objective of providing more understanding of how resources are used – specially in hours – in both value streams. VSC calculations represented a computation of an average product unit cost which LT could not depend on to cost all its products even when it can used to effectively cost SDT product.

In his description of the *'performativity of accounting'* Vosselman (2014, p. 183) notes that; 'accounting is active and has an impact in a collective of humans and other-than-humans. It is made to act by others in a relational network, that is; it performs'. VSC calculations did not only accumulate traces that developed a trajectory for future developments in LT's MAS, but they have also brought up management accounting relational ontology (Vosselman, 2014). With more understanding of lean and management accounting needs, LT's finance and accounting team had more influential role in interactions involving LT MAS. Additionally, they have used controls – for example; OTD – to understand relationships and behaviours exhibited by other organisation's actors from sales, to supply chain to line workers. This has then helped the team to actively participate in decisions affecting the elimination of non-lean (wasteful) behaviours in the factory shop floor.

7.8 On the Role of Management Accountants and Consultants

The case of LT emphasises the role of management accountants, not only in understanding control practices suitable for a level of progress with lean, but also in positively contributing to lean environment through eliminating non-lean behaviours. Agreements on solutions to the two major tension problems discussed in plot 3 of

chapter 6 – *(see section 6.7)*, were mobilised by the organisation finance and accounting controllers' team. In the two tension stories, finance and accounting controllers had influential 'lean roles' in both enacting the use of actual hours - *at least partially* - and stopping a wasteful non-lean behaviour in the form of suspending production and stocking finished goods around the production value stream. More involvement from finance and accounting controllers as well as LT's SAS members is also expected following lean implementation in the organisation's SAS centre. This actually comes in contrast with some of Seal and Herbert's (2013) findings showing that developing accounting shared service centres can marginalise the role played by management accountants. Unlike what some operation management literature would suggest (see Hassen and Moruitsen, 2007), LT case shows that a space which is mostly managed by operation managers is not necessarily better than one managed by management accountants. In those tension cases, non-lean behaviours encountered by factory engineers and line workers were not attributed to the use of the traditional management accounting practices be it standard costing or ABC (Johnson, 2006; Kennedy and Widener, 2008; Fullerton et al., 2013). However, as discussed in chapter 6, section 6.7, such tension cases were experienced as a result of operating actors' participation in wasteful activities grounded in mass production (Emiliani and Stec, 2005) - such as stocking finished goods around production value stream - and more importantly due to their inability actors exhibit a 'no blame' environment (Hines et al., 2004; Maskell and Baggaley, 2004) in the way tension was handled. The role played by LT's finance and accounting team came in contrast to the findings of Tillema and van der Steen (2015) case studies in which 'lean tailored' controls were mostly driven by 'lean advocates' i.e. lean experts and operators on the shop floor.

The case also emphasised the role played by consultants/ academics. In LT, the researcher had an influential role in bringing the attention of finance and accounting team of possible costing alternatives, which may be suited for their operating space. This was seen in how the finance and accounting team were happy with VSC calculations with features and characteristic costing and were motivated towards ABC implementation as they were not aware that there might be other suitable costing calculations for their level of progress with lean management. As Callon (1998a) notes, dealing with externalities in hot overflows – competing VSC, standard costing and ABC

calculations in this case – invites participations from more actors even non specialists. In LT case seeking help from the researcher opened venues for new management accounting possibilities for LT and better understanding from finance and accounting team.

7.9 Between Literature driven and Empirical driven Theoretical Conceptualisation – *Developing answers to study research questions*

The literature driven theoretical conceptualisation in figure 3.3 of chapter three attempted to put arguments made by both academic and consultancy literature on lean management and the developments in MAS, in context. In doing so, the conceptualisation used Callon's (1998b) and Latour's (1998, 2005) four moments of translation. Using those four moment of translation and Callon's (1998a, 2007, 2010) ideas on framing and overflow, this research development an empirical driven conceptualisation presented in figure 7.2 of this chapter, based on the LT case. A second look at the theoretical framework developed in chapter three and the conceptualisation of interactions between actants associated with the organisation's MAS presented in figure 7.2 can help develop answer for this study's research questions.

7.9.1 On the Developments in Organisations MAS in the Context of lean

The first research question asked: *How can we conceptualize the developments in organisations' management accounting system (MAS) in the context of lean management?*

Concerning the conceptualisation of the developments in MAS in light of the use of a process innovation as lean management, first it can be concluded that; lean management as a form of horizontal organizational arrangement (Kastberg, 2014) involves various interactions and relationships that are not expected to have a stabilised or definite entity that actants will tend to agree upon (Quattrone and Hopper, 2006). These interactions also become less specific when they include those interactions related to the MAS used. Hence, reframing chances are not only expected to be high in a lean environment being a horizontal form of organisation arrangement (Chua and Mahama, 2007), but more

overflow and reframing efforts can also be expected in the interactions related to that organisation's MAS.

Unlike studies reporting on the role of innovation used in affecting MAS directly or even indirectly through multiple contextual variables (Chenhall and Moers, 2015), results of the case study shows that determinants of change or developments in the organisation's MAS were mainly the interactions between human and non-human actants handling management accounting and control information, and how they were able to deal with overflows experienced.

In contrast to some lean and management accounting literature (Ahlstrom and Karlsson, 1996, Van der Steen and Tillema, 2018), a positive result on the accounting performance measurement side did not necessarily trigger adaptations or simplifications in the organisation's MAS. Only top management support is needed for an organisation to embark on lean management implementation and continue progressing with it. In LT change in MAS were mainly triggered by more inclusion of the finance and accounting actors, both human and non-human. Such inclusion, if guided by some help from consultants or academics, can enhance accountants' cognitive awareness of lean as a process innovation and open venues to explore possible management accounting practices which can be more relevant to lean organisation.

A change in cognitive awareness of some actors affects their identities and accordingly their interactions with other actors. Such enhanced awareness and knowledge of accountants can lead to them having more influential role not just in discussing suitable management accounting practices, but also in enacting more lean-tailored operating decisions. At the same time, with more knowledge of possible management accounting practices suitable for lean, comes more overflows. The case of LT shows that not only management accounting practices compete for existence (Mouritsen et al., 2009), but also competition can evolve between the performative power of organisation's operating structure and that of the management accounting practices used. As discussed earlier in this chapter, in LT, the organisation old value stream construction implied that some costing practices can only be used while others are inhibited.

Additionally, more inclusion and a broadened cognitive knowledge of accounting actors, both human and non-human – (for example accounting calculations) – bring about the relational ontology of management accounting practices and controls.

The empirical conceptualisation developed using LT data also shows that, as much as a lateral form of accountability motivating socialising relationships, is encouraged in lean organisations, benefits of such lateral accountability can be limited by a continuous desire to control from top managing teams especially, in multinational organisations. A hierarchal form of accountability adopted by top managing team and local headquarters does not only limit chances of understanding further developments with lean but, it can also inhibit possible chances of improving organisation's management accounting practices. As discussed earlier, in LT, the global managing team desire to control have limited the possibility for implementing ABC in year 2009. The case of LT also shows that such desire to control can also be driven by political situations which together with an organisation's production layout can be quite performative to stabilise actors frame of interaction around some management accounting practices, even if they are not the most relevant ones.

One of the unique things about LT's data and the empirical conceptualisation developed based on it, is that the conceptualisation does not only show the misfires/overflows affecting MAS in lean, but it also highlights the reasons for such misfires. As mentioned earlier overflows affecting interactions on lean and MAS are caused by increased cognitive awareness and more inclusion of accounting actors. Additionally, a change in organisation operating structure also has its effect on the identities of interacting actors, especially when those actors – human and non-human, accountants and operators – have more understanding of lean management and the type of controls it may need. A change in organisation's operating structure coupled with better understanding of lean and MAS, specially from accounting actors, help channel possible overflows and easily develop common interests between various organisation actors. This was seen in how LT channelled most of cold overflows experiences between 2012 and 2015. Finally, spread of lean implementation to more non-operating units specially finance and accounting ones – for example SAS centre in LT – re-shapes actors' identities and can be a reason to develop a new frame of interaction. Spread of lean to more finance and

accounting organisational units emphasizes the relational ontology of management accounting. With more understanding of lean, controls used my management accountants – for example OTD in LT – do not only act as indicators of what is happening in factory shop floor but also, push accountants to relate those controls to different behaviours adopted by other organisation actors. Creating this relation, develops a better coordination between accountants and other organisation actors in which managements accountants can have an active role in eliminating wasteful non-lean behaviours.

Linking the empirical driven conceptualisation to the literature driven one in chapter three, shows that in LT, organisation's actors involved in lean management and MAS were mostly working as one network. It was only when finance and accounting team were excluded from discussions on lean implementation and construction of factory old value stream, that Swiss managing team and operating team in Egypt formed one network of lean proponents (Tillema and van der Steen, 2015). Yet, inclusion of finance and accounting team in the discussion on possible costing practices for LT, gradually developed one organisation network around lean and MAS. Also, in contrast to the literature driven theoretical conceptualisation, competing accounting calculations were not triggered by operating actors versus top management actors. Competing calculations were witnessed within the same MAS network. In some incidents one calculation ruled out another calculation and in other incidents the competition itself created a controversial knowledge base making it difficult for actants to reach an agreement on a course of action to be taken. As discussed earlier, tension was always between management accounting calculation. Yet, competition also rose between operating structures and accounting calculations. There was no case in which such competition meant a discontinuation of lean implementation. However, in case of LT, tension between operating structures and accounting calculations and between accounting calculations themselves was enlightening in the sense that; it emphasised the need for consultants, enhanced the cognitive awareness of organisation's actors and facilitated interaction between them.

7.9.2 On the Performative Role of Value Stream Costing

The second research question asked: *In a specific lean management setting, what is the performative role, if any, of VSC calculations?*

Based on the actors' assessment of the performativity of VSC and in response to the second research question concerning the performative role of VSC; the use of VSC either alone or with FCC in the old set up of the factory value stream in the period from 2004 till year 2011 does not yield the accurate costs that the organisation required. Additionally, at that time the organisation's need for an accurate product unit costs decreased the urgency to shift to a costing tool that places less emphasis on product unit costs or computes an average unit cost applied to most of the products. When VSC was suggested again 2014, ABC calculations ruled out the new VSC calculations, since ABC calculations were able to consider how resources are being used even in the newly identified value stream. At the same time, VSC calculations still represented an average calculation of product types sharing one value stream (MDTs and LDTs). In conclusion, LT transformers factory could not depend on VSC to cost its products. However, one cannot say the VSC calculations were not performative at all. In Revellino and Mouritsen's (2015, p. 34) terminology, VSC being one of the accounting calculations can be viewed as an engine that in this case study, had performed in some way, albeit in an opposite direction to *'the precise prediction made by the engine, but instead by the fate of the engine in the hands of the many, each of whom may distort it a little bit'*. As Revellino and Mouritsen put it:

> Sometimes models and calculative practices may not work partly because people are not effectively lured by them and partly because sometimes others also produce and mobilise calculative practices that may be stronger than the one in question; laboratories compete (Latour, 1987), just as calculations compete (Mouritsen et al., 2009), for attention. Therefore, there can be counter performativity or misfire (Callon, 2010). Consequently, the engine is performative only by degrees and with caveats. (2015, p. 34).

This coincides with calculative practices being of *'variable geometry'* nature (Latour 1991, p. 153). In case of the LT factory, it was VSC 'fate' with the organisation's old

value stream construction pattern and the way it continues to depend on unit costs calculations even with their level of advancement with lean management, that made VSC counter-performative. Even with a new value stream, some traces of shared production resources remained in place in one of the value streams, making it also difficult for organisation's actors to accept VSC and made ABC more appealing. VSC was performative in a counteractive manner in 2009, when its calculations showed that there are other possible venues for the organisation costing practices which can be more suited to lean. More importantly, it helped to show that the old value stream construction has problems that act against finance and accounting controllers' desire to account for how production resources are being used. Hence, even though VSC has not acted in the expected direction pertained to it, it mobilised other operating opportunities i.e. the possibility of a better construction for factory value streams and stimulated the use of alternative management accounting practices; for example, ABC.

Hence, with respect to the second research question, one cannot conclude that VSC calculations were not performative or did nothing just because it was not able to lure people into taking an action to change their costing system. Calculative practices can *'...become iridescent that is, they can be either ally or antiprogram'* (Grottke and Obermaier 2016, p. 12). Even though being lured towards an opposite direction to the one suggested by most lean accounting literature, the calculations pushed most accounting actors in LT to re-consider the way they constructed their value stream. VSC calculations even pushed the researcher to consider possible costing alternatives to provide to the organisation, (such as identifying more than value stream), and triggered the computation of the approximate cost of doing so. More importantly, if one is to say that VSC calculations lured people into any new action, it would be that its calculations with FCC – as much it acted against its adoption – did work to develop actors' interests towards other costing calculation such as ABC. VSC calculations accumulated traces that developed a trajectory for analysing LT possible costing practices and enhancing accountants understanding of accounting lean needs.

Unlike Maskell and Baggaley's (2004, p. 14) description of the maturity path to lean accounting practices, in LT, advancement with lean management implementation did not lead to a simplified accounting system or to one that is managed by simple

accounting practices such as VSC. Also, a move to single flow production system does not necessary imply of a simply cost calculation such as VSC. Organisation's operating structures can be quite performative to stabilise interactions and interest around alternative calculations. Yet, experimenting with VSC calculations would still be advisable even if the tool failed to achieve its expected pragmatic effect. Based on LT case, the semiotic effect that VSC calculations have on actors' identities, knowledge and understanding can be quite enlightening to build a trajectory for future lean and management accounting changes and/or improvements.

7.9.3 Factors Affecting VSC Acceptance or Rejection

The third research question asked: *In a specific lean management setting, what factors might affect the acceptance/rejection of VSC?*

One could not say that VSC represented the best practice to mediate between actors (Vosselman, 2014), in a lean management network. Analysing the role of discounted cashflow models in analysing investment appraisals, Warren and Seal (2018) emphasized the role played by the presence of 'conditions of felicity' in supporting an accounting calculation to perform as predicted. However, in LT's case, conditions of felicity were not there for VSC to provide a simple costing practice which managers can depend on for their costing decisions. Quoting Boedker et al. (2019, p. 18); *"Felicity conditions may prompt attention to who, what and how resistance is performed*". For LT factory managers could not use VSC calculations for decision making processes because, first; it did not provide the detailed cost break down that the company needs. A tool which treats all items equally may not be as effective in view of long-term decisions (Ruiz-de-Arbulo-Lopez et al., 2013). Second; it did not meet company cost reduction objectives. Even after year 2011, the acceptance of VSC as a costing practice was also affected by the new constructed value stream and the use of ABC, perceived as better costing practice to meet finance and accounting controllers need for accurate costs.

Accordingly, for LT transformers factory, the set-up of its value streams either before or after year 2011 resulting in products using resources differently, has demotivated managers and accountants from using VSC or any other costing tool that computes costs the same way. This was also coupled by the organisation's continuous dependency on product unit costs computations to evaluate its products. Additionally, the global team's desire for control, gave no authority for finance and accounting team to enact a new costing practice. Finally, a broader reason for managers' reluctance to use VSC, which is beyond the tool's performativity, is the European headquarters prioritising a strategy of cost reduction following the uprising political and economic conditions in Egypt in 2011, implying a strategic focus on cost reduction rather than cost accuracy.

Hence, factors affecting managers willingness to accept VSC in LT included; the construction pattern of the factory value streams, even if they succeed to mirror the production for one product family. Also, LT's dependency on product unit cost even with low levels of inventory and many enhancements on single-piece flow production. Additionally, the findings of LT case study highlight other variables affecting VSC acceptance, like the cost of defining new value streams and external political conditions prioritising one costing strategy over another coupled with lack of local authority and top management desire to control.

7.10 Chapter Summary

This chapter used Callon's (1998a) concepts of framing and overflow to develop a conceptualisation of the developments in MAS that is based on the longitudinal case study findings discussed in chapter six. The chapter first started by presenting a timeline for both progress in lean management implementation and changes in organisation's MAS. The timeline showed how MAS influenced and was influenced by organisation's progress with lean management. Callon's (1998a, 2007, 2010) concepts of framing and overflow were then used to develop an empirical driven theoretical conceptualisation which explains the development in MAS in the context of lean. This conceptualisation showed that LT's MAS witnessed episodes of framing and overflow which has given rise to various implications. These implications emphasized the performative role of organisation's operating structures and the performative role of accounting calculations and how it highlights the relational ontology of management accounting. Discussion of

empirical driven theoretical conceptualisation also highlighted the relation between horizontal organisation arrangements and managers desire to control. Finally, the discussion explained the role played by management accountants and consultants in MAS of lean organisations. Empirical driven theoretical conceptualisation was then used to develop answers for this study's research question. Discussion of answers to study research questions was also done in relation to the literature driven theoretical conceptualisation developed in chapter three to show how analysis of empirical data have sometimes varied from conceptualisations available in current lean and management accounting literature. The next chapter presents the overall conclusion of the thesis, together with the research limitations and direction for future research.

Chapter 8: Conclusion

8.1 Introduction

The starting point of this research was to achieve two main objectives; (1) develop a theoretical conceptualisation of the developments in management accounting system (MAS) in the context of lean management and (2) to investigate the role played by VSC as the main management accounting practice suggested for lean management organisations. The objectives of this research are motivated by management accounting literature calling for the development of an overall conceptualisation of MAS that is more context driven and places more emphasis on the social aspects of accounting and succeeds to treat it as a construction. Research objectives are also motivated by lean management literature calling for developing in-depth empirical and theoretical investigation of; (a) the operation of MAS in the context of lean and, (b) of the role played by key lean accounting practices as VSC and the reasons for its acceptance or rejection. A longitudinal case study with a timespan of twelve years was conducted on one of the factories of a leading multinational organisation (named LT), for automation and supplying electrical power components operating in Egypt. LT is of Swiss origin with its main headquarters in Zurich and has other subsidiaries in Africa, Asia, Europe and North America. The longitudinal case study on the Egyptian headquarters, covers the period from year 2004 (the start of lean implementation) till end of year 2016. The organisation was chosen for its suitability to meet the research objectives. LT has been trying to grasp an understanding of how its MAS can operate with lean for most of the twelve years of the study period. This presented a suitable environment to conduct this research and help achieve its first research objective. LT's multinational nature resulted in having dynamic views from both global and local actors associated with its MAS. Also, there has been a strong desire from some of LT's representatives to learn about 'lean accounting' and VSC, which was found quite useful in meeting the second objective of this research.

Actor-network theory (ANT) was used as the theoretical lens for this research in order to trace the associations between both human and non-human actors (Latour, 1998; Latour, 2005) related to the case organisation MAS and its operating system using lean. Using ANT, the developments in the organisation's MAS were viewed as an

ongoing process (Modell et al., 2017) that only became understood by delving into the dynamics of the organisation actants stories as they tell them, without having any prior rules or theoretical understandings imposed on them (Latour, 1999). The research also used Callon's (2007, 2010) performatively thesis, to help understand the performative role of VSC as intended by the second research question. Also, to help interpretive other performative effects influencing or are influenced by the organisation's MAS.

ANT was first used to develop a conceptualisation of the current discourse in both consultancy and academic literature on the MAS associated with lean. More importantly, this literature driven theoretical conceptualisation aimed to put such discourse in context to demonstrate what messages the current literature on lean management, MAS and lean accounting seem to suggest to its users.

On the empirical side, organisation's key actants including human actors – (local and global) – handling the organisation's MAS and non-human actors – (accounting calculations, accounting information systems, organisation structures and any other technical or procedural arrangements) – were identified. Data collection used semi-structured interviews, observation, documents evaluation and focus groups with the semi-structured interviews being the primary source of data collection. Data analysis followed a constructivist form of narrative analysis. Narrative analysis was used to develop *'a plot, as well as coherence'* (Myers 2013, p. 173) between the *'spoken or written account of connected events'* derived from organisation's data collected to form three main plots of *'stories'* (Soanes and Stevenson, 2004). Three plots were constructed by the narratives of the organisation key actors representing their unique view of the reality of their MAS (Myers, 2013). Themes of those plots were not predefined by the researcher in order to keep the ANT's authenticity of letting actors tell their own stories without imposing on them any priori definition of their world (Latour, 1999). Plots were then interpreted and analysed using Callon's (1986) and Latour's (1986, 1996) four moments of translation. Callon's (1998a) concepts of framing and overflow together with performativity thesis (Callon, 2007, 2010) were then used to develop an empirical driven theoretical conceptualisation of the organisation's MAS in the context of lean. Various implications were driven from this

conceptualisation which were discussed in chapter 7 and used to develop answers for this study's research questions.

This chapter summarises those implications and concludes the thesis. The chapter is divided into five sections; following this introduction section, section 8.2 discusses the main conclusions reached from answering the study research questions. Section 8.3 discusses the research contributions. Research limitations and directions for future research are finally presented in sections 8.4 and 8.5 respectively.

8.2 Main Conclusions associated with Study Research Questions

This section summaries the main conclusions driven from answering the three study research questions identified in the introduction to the thesis and discussed thoroughly in section 7.9 of chapter 7. First in terms of conceptualising the developments around MAS in the context of lean management. The literature driven theoretical conceptualisation developed in chapter 3, demonstrated that the current state of lean management, MAS and lean accounting literatures seems to suggest that when it comes to organisation's MAS, lean organisations can have two networks of management accounting practices and controls: an operating system's control network and a top management's control network. The first network revolves around operating personnel who have the understanding of lean i.e. the lean proponents (Tillema and van der Steen, 2015) and the accounting calculations they use. This network includes a mix of lean tailored/ lean accounting and traditional accounting practices that match their lean needs. The second network mainly revolves around meeting top management's and auditors' financial reporting needs and would mainly include those organisational personnel and the traditional accounting calculations they use. The conceptualisation shows that, we need to understand the fabrics developing those networks – if they existed. Additionally, if we are currently well aware that tensions may occur between traditional and lean controls (Mouritsen et al., 2009; Tillema and van der Steen, 2015) then, there is a need for empirical analyses showing the effects of those tensions, not just on lean implementation, but also on the development in organisations' MAS. The literature driven theoretical conceptualisation shows that, as much as the previous literature have contributed to our knowledge on the contingency factors supporting lean implementation (Kennedy and Widener, 2008), ways to contain tension between

different controls (Tillema and van der Steen, 2015; van der Steen and Tillema, 2018), and the effect of lean management on firms' financial performance (Fullerton et al., 2013), we do not know much about the actors' interactions forming the fabrics of the MAS and how its calculations interact with each other and with other actors in a process innovation, with a horizontal organisation arrangement, such as lean.

The use of ANT to develop the empirical driven theoretical conceptualisation in chapter 7, unpacked new insights on the social and technical aspects of the developments in an organisation's MAS in the context of lean. This conceptualisation showed that, lean management as a form of horizontal organizational arrangement involves various interactions and relationships that are not expected to have a stabilised or definite entity, which the organisation's actors would agree upon. Those lean interactions become less specific and more complex when they include other interactions associated with the organisation's MAS. In the case organisation, MAS experienced several episodes of framing and overflow. Unlike previous research reporting on the role of technological innovations – such as lean – in affecting organisations MAS's through multiple contextual variables (Chenhall and Moers, 2015), results of the case study show that determinants of developments in the organisation's MAS were mainly the interactions between human and non-human actants associated with both the operating and MA system used. The findings of the case study showed that, a lean organisation's MAS will not succeed in supporting the ontology of lean unless various organisation human actors have a common understanding of the objectives and strategies for the use of the organisation's management accounting practices. Different perceptions between human actors associated with lean implementation and the organisation's MAS will always create overflows, whose degree of divergence will determine whether the lean organisation succeeds or fails to channel them. Also, the adoption of lean tailored practices or those mobilised by a lean accounting system such as VSC do not only require an understanding of the nature of the MAS that suits lean, but also prominently requires the exertion of effort from operating actors with respect to the pattern in which they define the organisation value streams, even if each defined value stream serves one product family. In a horizontal form of organisation arrangement as the one in a lean organisation, more interactions are expected to develop including human and non-

human actors associated with the organisation value streams and MAS. In these interactions not only calculations will compete for existence, but also competition between management accounting calculations and operating structures will affect the number and degree of divergence in the MAS overflows. Finally, the more is the spread of lean management as a philosophy among various organisation departments, the more influential is the role of organisation's management accountants and the more is their responsibility towards adopting management accounting practices that meet their lean needs.

According to the case study conducted, VSC was performative even though it acted as an engine that had performed in an opposite direction to the predictions made for it. Instead, the tool's role was mobilised by the factory layout and intentions of the organisation actors; both locally and globally, which may have distorted the expectations (Revellino and Mouritsen, 2015) from VSC implementation. However, in the case organisation, VSC was still performative in a counteractive manner, first when its calculations pushed organisation's actors to re-think the way they identified their value stream and a second time when the calculation was able to mobilise other costing calculations such as activity-based costing (ABC). As per the results of the case study conducted, VSC can be viewed as a calculating practice that does support lean as a philosophy. However, it would always be a question as to whether the conditions of 'felicity' (Callon, 2007, Warren and Seal, 2018) are available for it to be accepted for implementation. Committing to a lean accounting tool as VSC may be difficult in the context of headquarter pressures and political unrest. Additionally, prior to a move to VSC implementation, considerations should be given to reviewing the reasons why lean organisations use product unit cost. Successful implementation of VSC requires organisations to become ready to manage mainly by total costs or to depend on an average calculation of product costs. Finally, the use of VSC requires companies to revise their value stream identification even if such identification include products that do form one product family.

8.3 Contributions

Being of interdisciplinary nature between management accounting and operations management and using ANT and Callon's (2007, 2010) performativity thesis, this study contributes to lean management, management accounting and ANT literature in number of ways. First; the research contributes to ANT literature through combining both the sociology of translation from ANT and Callon's performativity thesis in one study. This study is one of the very few – if not the first – to use Latour's (1981) four moments of translations together with Callon's concepts of framing and overflow and ideas on performation. Combining these concepts have enabled this research to move beyond the idea of how reality is constructed, i.e. ANT's *'background/ foreground reversal'* (Latour, 1996, p. 370) and idea of *'the order out of disorder'* (Latour 1996, p. 370), to understanding the trails forming this reality fabrications i.e. applying Latour's (2005, p.165) approach to 'slowciology'. By doing so, the research also successfully avoided critiques to the use of ANT's four moments of translation in a positivistic and/ or mechanical way (Whittle and Spicer, 2008). Also, as discussed in section 3.7 of chapter 3, the research adopted a constructivism ontological stance instead of a 'social' constructivism one. Using a constructivism ontological stance, actors are believed to possess the knowledge of what they do, in addition to how and why they do it (Latour, 1999; 2005). Such use of ANT reinforces the theory's embracement of the mix of relationist, realist and constructivist ontologies and helps avoid critique to ANT's ontology being perceived as that of "naïve realism" (Elder-Vass, 2008; Yang and Modell, 2015; Modell et al., 2017).

Using the four moments of translations to discuss and analyse the three plots in LT organisation was useful in demonstrating how LT's reality in terms of lean management operation and its MAS is constructed over the study period. Yet, interpreting those construction plots using concepts of framing and overflow and Callon's performativity thesis has allowed for a 'go slow', 'don't jump' ontology (Latour, 2005, p. 190) in understanding the details of incidents, tensions, matters of concerns and stabilisation efforts forming this construction. It is expected that more research combining those concepts can help provide a better understanding of the making up of process innovations, MAS and related actors' interactions. Second; this research contributes to ANT and performativity thesis by developing reader's understanding of the

performative role played by consultants/ academics. A recent, study by Themsen and Skærbæk (2018) uses ANT to demonstrate the power of consultants in containing hot overflows experienced in risk construction. This research contributes to this stream of literature by developing our understanding of the role of consultants/ academics in enhancing cognitive awareness of various actors in lean organisations.

Third, the research contributes to both lean management and management accounting literatures, through developing a literature driven theoretical conceptualisation which accounts for how different actors from both lean management and management accounting literatures have constructed the current view which readers have on the relation between both systems. Previous literature has mainly focused on one or two aspects of the relationship between lean management and MAS, – [(for example; containment of tension among different controls (Tillema and van der Steen, 2015), contingent operating and accounting factors to lean implementation (Kenney and Widener, 2008), effect of lean implementation on firm performance (Fullerton et , 2014)] – without providing a conceptualisation of the current understanding of the link between lean and MAS. Reflections on this literature driven conceptualisation and revisiting it several times in the future, can give directions to future researchers on what needs to be investigated in relation to lean as a process innovation and management accounting practices and controls. Additionally, the empirical driven theoretical conceptualisation in chapter 7 is the first to theoretically conceptualise the developments in MAS in the context of lean. Further investigation of other case studies and using different theoretical lenses can also contribute to our understanding of changes in MAS in a process innovation such as lean.

Fourth, specific to lean management literature, findings of this study contribute to this literature in showing the performative role of operating structures. The use of ANT enabled the treatment of structures as actants whose agency is constructed. This helped in understanding the role played by different LT's operating structures moving from its old value stream construction from 2004 to 2011 to the newly constructed value streams in 2012. Findings of this study also contribute to both academic and consultancy literature on lean management, through providing one of the first detailed empirical analysis of the use of value-stream costing (VSC). Findings also contribute to this

literature via exploring the factors affecting VSC implementation. Previous consultancy literature has only provided guidance on the path to using VSC and some conditions for its implementation (see Maskell and Baggaley, 2004). Academic literature has mainly suggested VSC as a more lean-tailored accounting practice (see Kennedy and Widener, 2008 and Fullerton et al., 2013), yet there are no empirical analysis of the actual factors affecting its acceptance or rejection.

In terms of management accounting literature, findings of this study contribute to the literature on management accounting and innovation through explaining the relational ontology of management accounting calculations. While Miller and Power (2013) discuss the mediating role of accounting and how its practices come with different ontologies, this study contributes to the emerging literature exploring the relational ontology of management accounting (Vosselman, 2014). Findings of this study, showed that in a process innovation such as lean management, management accounting calculations can create new understandings and roles for management accountants that not only influence the accounting system in place, but also extends to affect relations and behaviours in the organisation's operating shop floor.

Findings of this study also contributes to practitioners in many ways. First, the empirical driven theoretical conceptualisation provides practitioners with real life data on the actual developments experienced in an organisation's MAS using lean management. This data is essential in developing practitioners' understanding of the role played by management accounting calculations, consultants, management accountants and organisation's operating structures. In addition to, the different forms of controls used locally and globally and their effects on both lean management and the MAS in place. Second, with the low implementation rates of VSC that is mainly attributed to lack of knowledge of the practice and lack of implementation know how (Rao and Bargerstock, 2013), this study provides first-hand detailed empirical data on the use of VSC for costing purposes. This provides practitioners with a rich understanding of the mechanics of using this practice, together with the factors affecting managers willingness to implement it. In addition to the available 'lean accounting' literature, which is mainly driven by consultancy literature, practitioners can make fruitful use of the findings of this study to benchmark the appropriate management

accounting practices for their operating structures and interpret the different interactions affecting their actors, together with their MAS-lean network. Finally, the literature driven theoretical conceptualisation developed in chapter 3, provides practitioners with a thorough analysis of the contributions of both academic and consultancy literature to our understanding of MAS in the context of lean. This understanding is crucial for organisations implementing lean and those experiencing problems with their MAS, also to help practitioners provide more real-life examples on how to move forward with this understanding.

8.4 Research Limitations

This section discusses the limitations associated with the research conducted in this study. First, as is the case with most qualitative research using a case study method, the generalization of the research findings should be taken in consideration given that they were driven from a case study of one factory of the multinational organisation studied. A second empirical limitation relates to the difficulty in getting access to conduct interviews with the case organisation's global managing team in Zurich. It should be noted that most of the data relating to the global managing team views and perceptions about their MAS, were driven from the review done on the organisation global policy and guidelines documents and the PowerPoint presentations of its accounting and operating training sessions conducted quarterly in the Swiss headquarters. Additional data were also obtained from the semi-structured interviews conducted with top management organisation actors (for example, factory head, head of centre for shared accounting services (SAS) and chief finance and accounting controller) on basis of their monthly meetings with the global managing team.

Also, as mentioned in chapter 4 section 4.7, the three plots discussed in this research were mainly driven from actors' own stories, as they tell them. Working with no predefined themes was needed to keep the authenticity of ANT, where data is analysed without imposing on actors 'a priori definition of their world-building capacities' (Latour 1999, p. 20). For this research actors' data told stories that shaped three plots on; "who drives changes in factory performance measures", "debates on factory costing practices" and "the tension between accounting controllers and factory engineers". Different case studies adopting ANT as a theoretical lens can produce different stories

and tailor new plots, which are worth exploring in future research. Additionally, action research as a research method is deemed not suitable to the current theoretical underpinning of this research. However, future research adopting an action research approach to explore the role played by VSC, can arrive at different outcomes.

The last two limitations for this research relate to the second research aim to investigate the role played by VSC in the case organisation and its respective research questions (i.e. RQ2 and RQ3). Even though the VSC calculations proposed to the organisation in 2009 and later in 2014, provided rich details that were enough to develop answers for the second and third research questions, the organisation's failure to implement VSC places some limitation on the findings achieved. Different conclusions might have been achieved in terms of the performative role of VSC and the factors affecting its acceptance or rejection in case the lean organisation has succeeded to adopt VSC. However, finding an organisation that understands VSC or have adopted it was a very difficult target to meet at the time of conducting this research. Finally, the analysis of the propositions to use VSC were done with the objective of using the tool only for costing purposes. This was viewed as being suitable for the case organisation given its previous struggles to cost its products in light of the construction pattern of its value stream/s. Hence, the conclusions made with respect to the second research aim and its associated research questions are limited to the use of VSC as a costing tool. The use of VSC for decision making or profitability analysis was deemed beyond the scope of this research.

8.5 Directions for Future Research

The findings of this research highlight various possible venues for future research in both management accounting and lean management research areas. The theoretical conceptualisation developed in figure (7.2) of chapter seven using ANT and a case study method has generated in-depth empirical data and unpacked new insights on the social and technical aspects of the developments in an organisation's MAS in the context of lean. From a lean specific perspective, more case study research is required at the intersection between both research areas (MAS and lean management) to help expand academics' and practitioners' understanding of the operation and development in the MAS's of lean firms. From a management accounting research perspective,

similar context specific conceptualisations - preferably of qualitative nature - are also called for to provide more realistic view (Vosselman, 2014; Modell et al., 2017) of the MAS developments in other process innovation contexts. If this type of research is to use ANT, it is suggested that obtaining more data from various organisation actors – representing different organisational units, both locally and globally if applicable – will provide more real stories of how actors view their MAS and enrich the research contribution.

Unlike the majority of lean literature promoting abandoning accounting practices (Johnson, 2006) or using new lean 'tailored' accounting practices (Kennedy and Widener, 2008; Fullerton et al., 2013; Fullerton et al., 2014), this study findings showed that lean 'tailored' KPIs were used with traditional accounting performance measures. Additionally, all costing practises adopted by the case study organisation were traditional accounting ones. Hence, more understanding is needed on the nature of the MAS's practices that are actually being used by lean firms. Moreover, more empirical analysis is required on why lean firms still depend on individual product costs, together with whether this is related to the pattern in which those firms define their value streams. It would also be beneficial if future case studies can explore the way organisations define their value streams and analyse whether this continue to have implications on the accounting practices used or not. Finally, from a lean accounting perspective, the literature on lean accounting is still evolving and future research in this research strand needs to seek consensus or develop a certain codification of what management accounting practices are to be included in a lean accounting 'system'. Also given the findings of this research, the conditions for VSC implementation as suggested in some consultancy literature (Baggaley and Maskell, 2003a; 2003b; Maskell and Baggaley, 2004) may need to be revised. Additionally, future research shall also revise some of the claims problematising traditional accounting system to work with lean.

Appendix A: List of Data Collection Activities

1: List of Interviews

Date	Organisation Actor/Actors	Location	Duration
13-09-2014	Factory operation manager	Factory	1 hour
23-09-2014	Factory lead engineers (3 engineers)	Factory	2 hours and 15 minutes (approx. 45 each)
18-12-2014	Factory head and Chief accounting controller	Head office	3 Hours
30-07-2016	Factory head	Factory	2 hours
31-07-2016	Head of SAS	Head office	45 minutes
04-08-2016	Chief accounting controller	Head office	1.5 hours
08-08-2016	1st LBU finance and accounting controller	Head office	1 hour
11-08-2016	Head of Shared Accounting Services (SAS)	Head office	2 hours
19-09-2016	Factory operation manager	Factory	1 hour
20-09-2016	Factory head	Head office	1 hour
29-09-2016	Engineering and operations advisor	Head office	1 hour 40 minutes
05-10-2016	2nd LBU finance and accounting controller	Head office	1 hour 30 minutes
11-10-2016	2nd LBU finance and accounting controller	Head office	1 hour 40 minutes
19-10-2016	Factory lead engineers (3 engineers)	Factory	1 hour and 30 minutes (30 minutes per interview)
25-10-2016	Factory controlling SAP consultant	Head office	1 hour
26-10-2016	Factory Quality and OPEX manager	Factory	1 hour
05-01-2017	Representatives from SAS centre (5 members of the SAS centre)	Head office	3 hours (average of half an hour per employee)
15-01-2017	Representatives from factory line workers (3 workers)	Factory	2 hours 15 minutes (average of 45 minutes line worker)
15-01-2017	Factory operation manager	Factory	1 hour
15-01-2017	Supply chain manager	Factory	45 minutes
06-02-2017	Factory sales manager	Head office	45 minutes
Total interview hours			***33 hours and 15 minutes***

2: List of Observations

Date	Nature of factory visit	Duration
11-03-2015	Investigating layout and operation of factory value stream	2 hours
07-09-2016	Factory tour and introductory presentation of factory new value streams lead by factory operation manager	3 hours
19-10-2016	Exploring the operation of new factory value streams versus the old one – *factory visit lead by factory lead engineers*	2 hours
Total hours		*7 hours*

3: List of Focus Groups

Date	Actors Involved	Location	Duration
25-02-2015[16]	- Factory head - Factory operation manager - Two factory lead engineers - Chief finance and accounting controller - Researcher (Sarah Mohamed)	Head office	2 hours
31-01-2017	- Head of Centre for Shared Accounting Services (SAS) - The 2 Local Business Unit (LBU) finance and accounting controller - Organisation's engineering and operations advisor - Researcher (Sarah Mohamed)	Head office	1 hour and 30 minutes

[16] Following this focus group, the researcher lead a presentation session on the 18th of April, 2015 at the organisation head office which involved factory Head, factory operation manager, two factory lead engineers, the chief finance and accounting controller and one of local business unit (LBU) finance and accounting controllers. The presentation explained the possible costing practices available for the organisation given its old value stream. The presentation included the VSC calculations alone and with features and characteristics costing together with the activity-based costing framework which were discussed in detail in chapter five. The session took two hours; 45 minutes for the presentation and one hour and fifteen minutes for discussion and feedback.

15-02-2017[17]	- Head of Centre for Shared Accounting Services (SAS) - Local Business Unit (LBU) finance and accounting controller - Factory head - factory Co (controlling) SAP consultant - Researcher (Sarah Mohamed)	Head office	2 hours
Total hours			***5 hours and 30 minutes***

[17] Following this focus group, the researcher lead a presentation session on the 20th of February 2017, at the organisation head office which involved the factory head, Head of Centre for Shared Accounting Services (SAS), Five representative from the SAS employees, Chief finance and accounting controller, the two local business unit (LBU) finance and accounting controllers, in order to communicate and validate the full study findings. The session took one hour and thirty minutes; thirty minutes devoted to the research presentation and an hour for the receipt and discussion of audience feedback.

Appendix B: List of Data Collection Activities in Years 2009 and 2010 providing the Background for Case Study

1: List of Interviews

Date	Organisation Actor/Actors	Location	Duration
15-01-2009	Factory head and Chief finance and accounting controller	Head office in Cairo	1 hour
23-01-2009	Chief finance and accounting controller	Head office	2 hours
08-02-2009	Factory head	Head office	1 hour
24-02-2009	Factory operation manager	Factory - outside Cairo	45 minutes
02-03-2009	1st LBU finance and accounting controller	Head office	1.5 hours
02-03-2009	2nd LBU finance and accounting controller	Head office	1.5 hours
12-03-2010	Chief accounting controller	Head office	1 hours
Total interview hours			***8 hours and 45 minutes***

2: List of Observations

Date	Nature of factory visit	Duration
28-11-2009	Production tour in factory shop floor	1.5 hours

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