AN INVESTIGATION OF MANAGEMENT ACCOUNTING CONTROL SYSTEMS IN THE PALM OIL INDUSTRY: A SOCIOMATERIAL APPROACH TO PRACTICE CHANGE

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Doctor of Philosophy

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THESIS SUMMARY

The primary aim of this research is to understand what constitutes management accounting and control (MACs) practice and how these control processes are implicated in the day to day work practices and operations of the organisation. It also examines the changes that happen in MACs practices over time as multiple actors within organisational settings interact with each other. I adopt a distinctive practice theory approach (i.e. sociomateriality) and the concept of imbrication in this research to show that MACs practices emerge from the entanglement between human/social agency and material/technological agency within an organisation. Changes in the pattern of MACs practices happens in imbrication processes which are produced as the two agencies entangle. The theoretical approach employed in this research offers an interesting and valuable lens which seeks to reveal the depth of these interactions and uncover the way in which the social and material imbricate. The theoretical framework helps to reveal how these constructions impact on and produce modifications of MACs practices. The exploration of the control practices at different hierarchical levels (i.e. from the operational to middle management and senior level management) using the concept of imbrication process also maps the dynamic flow of controls from operational to top management and vice versa in the organisation. The empirical data which is the focus of this research has been gathered from a case study of an organisation involved in a large vertically integrated palm oil industry company in Malaysia specifically the refinery sector. The palm oil industry is a significant industry in Malaysia as it contributed an average of 4.5% of Malaysian Gross Domestic Product, over the period 1990 -2010. The Malaysian palm oil industry also has a significant presence in global food oil supply where it contributed 26% of the total oils and fats global trade in 2010. The case organisation is a significant contributor to the Malaysian palm oil industry. The research access has provided an interesting opportunity to explore the interactions between different groups of people and material/technology in a relatively heavy process food industry setting. My research examines how these interactions shape and are shaped by control practices in a dynamic cycle of imbrications over both short and medium time periods.

Key words: Management Accounting and Control, Practice, Sociomateriality, Sociomaterial Practice, Imbrication, Palm Oil, Malaysia.

DEDICATION

~ To Allah the Almighty and my beloved parents ~

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I pray that Allah reward all of you for your kindness.

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GLOSSARY OF TECHNICAL TERMS

Agitation
The action of mixing the oil that is being processed with sub-materials.

Bleaching Earth
Volcanic earth used to capture foreign particles and gums in the refining process.

Breaking
Separation of elements within Crude Palm Oil.

Colour
Red colour from natural Carotene content in Crude Palm Oil.

Crystallization
A process where Stearin from the Refined Bleached Deodorized Palm Oil is separated into a pure solid crystalline phase (Stearin solidifies and forms small crystals like sand).

Degumming
Extraction of natural gums in Crude Palm Oil.

Grubbing
An action where a rod/plate is used to dig out the crystals that are stuck in the filter leaf of the membrane at the fractionation plant.

Latent heat
Heat that is kept within the oil (during the cooling process) which can cause a sudden increase in the temperature of the oil.

Oil Loss
Wastage of oil in the production process.

Polymerised Oil
The state of oil which has been burnt where quality such as colour cannot be reversed anymore.

Repackers
Companies which buy processed oil such as Olein in bulk and re-pack it as their own brand.

Retention time
Time given to enable Crude Palm Oil and sub-materials to blend.

Sparging
Technique of introducing steam to agitate the oil.

Sub-materials
Other materials/ingredients that are used in addition to the main raw material in the production process.

LIST OF ABBREVIATIONS

ABC	Activity Based Costing
ANT	Actor Network Theory
B/E	Bleaching Earth
BPO	Bleached Palm Oil
CEO	Chief Executive Officer
CP	Cloud Point
CPKO	Crude Palm Kernel Oil
CPO	Crude Palm Oil
DOBI	Deterioration of Bleachability Index
EMPA	East Malaysia Planters Association
ERP	Enterprise Resource Planning
FELCRA	Federal Land Consolidation and Rehabilitation Authority
FELDA	Federal Land Development Authority
FFA	Free Fatty Acid
FFB	Fresh Fruit Bunches
FMCG	Fast Moving Consumer Goods
GCC	Golden Crop Co.
H/E	Heat Exchanger
HPKO	Hydrogenated Palm Kernel Oil
HPO	Hydrogenated Palm Oil
ISP	Incorporated Society of Planters
IV	Iodine Value
MACs	Management Accounting and Control
MEOMA	Malaysian Edible Oil Manufactures Association
MOMG	Malaysian Oleo Chemical Manufacturers Group
MPOA	Malaysian Palm Oil Association
MPOB	Malaysian Palm Oil Board
MPOPC	Malaysian Palm Oil Promotion Council
MT	Metric tonne
Olein	Refined Bleached Deodorised Palm Olein
P/A	Phosphoric Acid
PFAD	Palm Fatty Acid Distillate
PKO	Palm Kernel Oil
PLC	Programmable Logic Control
POMA	Palm Oil Millers Association
PORAM	Palm Oil Refiners Association Malaysia
PORIM	Palm Oil Research Institute of Malaysia
PORLA	Palm Oil Registration and Licencing Authority of Malaysia
PPMMM	Palm Oil Packers Association Malaysia
PV	Peroxide Value
RBDPO	Refined Bleached Deodorised Palm Oil
RISDA	Rubber Industry Smallholders Development Authority
Stearin	Refined Bleached Deodorised Palm Stearin
VM	Volatile Matter

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CHAPTER 1
INTRODUCTION

1.1 RESEARCH BACKGROUND

In a rapidly changing and competitive market environment, organisations around the world often rely on technology to cope with the changes and competition they face within their industries. Increasingly, in fact, commercial tasks, activities and practices within organisations can only be completed using some sort of material or technological support. This includes the management accounting and control (MACs) practices exercised in a dispersed function of the organisation (Ahrens & Chapman, 2007; Jørgensen & Messner, 2010; Nama & Lowe, 2014; Wagner et al., 2011).

Research examining MACs practice has attempted to conceptualise material and technology in a certain way, and has typically addressed technology as something that has an independent identity, basing its central understandings on the idea that implementing it may have an impact on organisational activities (Cadez & Guilding, 2008; Chenhall, 2003; Mohamad et al., 2013). Others have addressed material and technology (specifically accounting technology) as something that mediates the social in exercising management and controls (Briers & Chua, 2001; Chua, 1995; Scapens & Jazayeri, 2003).

This research adopts a sociomateriality perspective. Sociomateriality research moves beyond the ontology of separateness (Leonardi, 2011; Orlikowski, 2010; Scott & Orlikowski, 2012), of either giving primacy to the material/technology that focuses on the deterministic nature of material/technology towards organizational behaviour, or to the social constructivist view that gives primacy to human agencies involved in determining the control practices. Exploring a set of concerns related to MACs practices within an organisation, this research study specifically looks at the interactions and entanglement of material/technology with social groups. The focus is to examine the context in which MACs operate and try to understand how the material/technology together with the people involved in their daily work and control activities. In explaining the sociomaterial phenomena of MACs, a framework using the notion of *imbrication process* is utilised to provide a theoretical framework that focusses the researcher's attention on the entanglement process between people and material/technology in the organisation, with such entanglements resulting in the emergence and modification of MACs practices.

This research attempts to provide an enriched understanding of MACs practice within a sophisticated socio-technical environment by examining what constitutes MACs practice and how these practices are implicated in the day to day organisational activities in the setting of a complex, capital intensive palm oil refinery.

1.2 RESEARCH CONTEXT AND MOTIVATION FOR THE RESEARCH

This research is conducted in a vertically integrated palm oil organisation that is involved with palm oil refining and distribution (the midstream and downstream part of the palm oil industry) activities in Malaysia. The palm oil industry is a very significant industry in Malaysia. It contributed 4.5% of the country's Gross Domestic Product in 2012 (Department of Statistics, 2013). As the biggest palm oil exporter in the world, Malaysia also contributed a significant portion of the world's oils and fats production and exports (Carter et al., 2007). As a very significant industry for the country, the government has also been placing a lot of emphasis on this industry.

Although Malaysia is one of the major players in the global oil and fats industry, there is an issue of declining productivity and rising costs of production in the plantation and processing sectors of palm oil throughout its value chain, including mills, refineries and manufacturers of palm oil based products and specialty oils and fats (Amna Awad & Fatimah, 2007; Carter et al., 2007; Chandran, 2005). Over the years, Malaysian palm oil has been able to succeed in capturing the global market because "it is cheap to produce, which provides a sustainable basis for its relatively low price" (Carter et al., 2007, p.311) as compared to the other major alternative oils such as soybean oil, sunflower oil and rapeseed oil. Recent rising costs of production and decreasing productivity of the industry has put pressure on Malaysia's competitiveness in the palm oil industry. To sustain its competitiveness, people in the industry including the refineries (which will be the focus of this research) have made considerable effort to shift from labour intensive processing to more advanced automated processing technologies equipped with high capability to meet the quality standards demanded by world markets with lower effluent discharge (Khoo et al., 2005).

This research joins the debate in the management accounting literature that has considered how controls are exercised among actors (including human and material/technology actors). However, the MACs practice literature that debates issues related to the influence of material/technology on organisational work practice and productivity mainly focuses on accounting related technology such as the enterprise resource planning (ERP) system and

other MACs accounting software packages (Dechow & Mouritsen, 2005; Quattrone & Hopper, 2005; Scapens & Jazayeri, 2003; Wagner et al., 2011). There are very limited studies that have considered other kinds of technology (such as the production processing system employed in the palm oil industry) and its role in influencing the day to day practice and overall control of the organisation.

As high investment and government support has been provided to develop technology in this sector to maintain and increase productivity and competitiveness, there is an interesting opportunity here to provide insights on the role of control systems and the ways in which material and technology influence MACs and work practices. This research is based on a motivation to enrich our understanding of the MACs practices in a highly technological, intensive processing industry; this differs from the frequently studied manufacturing industry - namely, the palm oil industry. The case organisation is a large palm oil company with a significant market presence and extensive production, marketing and distribution facilities. This context provides an opportunity to see how the interaction between groups of people and material/technology of different kinds together shape and are being shaped by control practices in a dynamic cycle of complex interaction among material and human actors.

1.3 RESEARCH QUESTIONS

My research addresses the limitations and gaps in the MACs practice literature as well as provides some insights on control practices in the palm oil industry, which can be seen as representative of other complex refining industries. The research will argue that MACs practice can only be fully understood by focusing on how accounting practices (such as budgeting, production and control practices) involving people and technology in close contact with refinery plants and electronic control systems become entangled. In this spirit, this research seeks to investigate the following research questions:

1. How do humans and material/technological agencies interact in constituting the management accounting and control practices?
2. How are management accounting practices and control techniques implicated in the day to day control practices in the context where material/technology and social actors imbricate?
3. How do the interactions between material/technology and humans influence the development of management accounting and control practices?

1.4 RESEARCH PHILOSOPHY AND METHOD

According to Bryman & Bell (2011), the way research is conducted in business and management studies should always be closely related to the way a researcher envisions organisational reality. Chua (1986, p.604) states that the formation of scientific knowledge "is circumscribed by man-made rules or beliefs which define the domains of knowledge, empirical phenomena, and the relationship between the two". These rules or assumptions in forming scientific knowledge are grounded in the concepts of ontology, epistemology and methodology (Burrell & Morgan, 1979; Morgan & Smircich, 1980; Searcy & Mentzer, 2003).

Bryman & Bell (2011, p.20) state that "social ontology are concerned with the nature of social entities", whether being considered as objective and external to social actors or socially constructed "buil[t] up from the perceptions and actions of social actors" (Morgan & Smircich, 1980; Searcy & Mentzer, 2003). The two common ontological positions in business and management research are objectivism and constructivism. The objectivist ontology can be described as a position that "asserts that social phenomena and their meanings have an existence that is independent of social actors", therefore implying that "social phenomena and the categories that we use in everyday discourse have an existence that is independent or separate from actors" (Bryman & Bell, 2011, p.21). Constructionism is a position that "asserts that social phenomena and their meaning are continually being accomplished by social actors", which implies that "social phenomena and categories are not only produced through social interaction but that they are in a constant state of revision" (Bryman & Bell, 2011, p.22).

The ontological perspectives reflect directly on the epistemological considerations that impact on a piece of research. The epistemological stance concerns the way in which knowledge is acquired or "what is (or should be) regarded as acceptable knowledge in a discipline" (Bryman & Bell, 2011, p.15). Morgan & Smircich (1980) and Searcy & Mentzer (2003) provide an overview of the link between ontological positions and epistemological considerations within social science research. These authors suggest that the objectivists incline to the positivist/functionalist epistemological stream where the researcher "advocates the application of the method of the natural sciences" (Bryman & Bell, 2011, p.15). They place emphasis on an "'objective' form of knowledge that specifies the precise nature of laws, regularities, and relationships among phenomena" (Burrell & Morgan, 1979, p.493) and "any subjective consciousness [within the phenomena under study] is meaningless" and not relevant (Searcy & Mentzer, 2003, p.135).

While that is the relationship between objectivist ontology and positivist/functionalist epistemology, the constructivists tend to favour an interpretive/relativistic view of knowledge. The interpretive/relativist epistemological stance "emphasises the importance of understanding the processes through which human beings concretize their relationship to their worlds" (Morgan & Smircich, 1980, p.493). The "explanation is based on causal laws inferred from actors' subjective perceptions of their social world" (Searcy & Mentzer, 2003, p.135).

The inquiry undertaken to form an understanding of MACs in this research is broadly in line with this description of the constructivist ontological perspective and an interpretive/relativist epistemological perspective. Specifically, the sociomaterial approach of this research takes the perspective that social events, such as an organisation, involve the constant interweaving of human and material agencies; the social processes such as MACs are conceptualised as the outcome of the constitutively entangled social and material agencies.

Myers (1997, p. 2) states that "all research is based on some underlying assumptions about what constitutes 'valid' research and which research methods are appropriate". Darlaston-Jones (2007) states that it is very important to identify the relationship between one's ontological stance and the meaning of knowledge (epistemology), so that one is able to articulate the rationale for the research design and, finally, identify and use an appropriate methodology to answer the research questions. Similarly, Hopper & Powell (1985, p.446) emphasise that "[t]he important thing is that the form of inquiry adapted in any investigation […] should be logically consistent and appropriate given the aims of the research and the values and assumptions that lie behind it".

According to Searcy & Mentzer (2003, p.143), an ontological and epistemological stance "assumes a certain worldview […and] ways of looking at that worldview [which includes] accepted ways of investigating phenomena included within that worldview, and accepted ways of interpreting results". In other words, methods employed in a research study are also closely determined by the ontological and epistemological perspective of the research (Bryman & Bell, 2011). A range of qualitative methods such as in-depth interviews, (participant) observations, analysis of archival documents, case/field study, ethnography, grounded theory and historical analysis are among the methods that are most 'appropriate' to an interpretive/relativist epistemology. In line with the ontological and epistemological stance of this research, an extensive case study was conducted to investigate the concerns outlined in the research questions. In-depth interviews, formal and informal observations, as well as analysis of organisational documents were conducted in this research study. Ahrens

& Chapman (2006) listed five basic concepts, namely theory, domain, methodology, hypothesis and method, which are central to the practice of qualitative field studies in management accounting. Table 1.1 below defines the meaning of each concept and outlines the focus of this research according to the concepts. More details on the research methodology and chosen methods are provided in chapters 3 and 4.

Table 1.1
Basic concepts of qualitative field studies

Concepts	Definition of concepts based on Ahrens & Chapman (2006, p821)	Focus of this research
Theory	A set of explanatory concepts	Imbrication Process
Domain	A space in which data is collected	Management Accounting and Control Practices
Methodology	A general approach to studying research topic	Sociomateriality Approach
Hypothesis/ Proposition	A testable proposition	The entanglement of social and material in the emergence of management accounting and control practices.
Method	A specific research technique	Case study and analysis of interviews and participant observations, and texts/documents from the organisation.

1.5 RESEARCH CONTRIBUTION

This research provides an opportunity to develop further insights on MACs practices in respect of both theoretical and empirical aspects. The study seeks to investigate the ways in which material/technology and social actors are engaged in the emergence of MACs practices within an organisation, and how, in turn, the MACs practice then influence or get implicated in the way they get entangled in performing the work and control practices. According to some authors (e.g. Jørgensen & Messner, 2010; Wagner et al., 2011), much of the literature in accounting treats technology as an external force that influences and

mediates socially constructed control practices. The theoretical framework that this study employs (i.e. the imbrication process) would extend the existing MACs literature, particularly that which examines the role of material/technology (Dechow & Mouritsen, 2005; Quattrone & Hopper, 2005; Wagner et al., 2011), by uncovering the process in which the sociomaterial entanglement between the two agencies (human and material/technology) occurred in addressing the concern. This will provide a new lens for scholars interested in understanding MACs phenomena in organisations.

The research also contributes empirically by exploring the control practices at an operational and managerial level and examining the flow of control practices at both levels within a technically sophisticated midstream palm oil refinery. In doing so, managers who are in charge of deciding on technological changes and controlling organisational productivity might be given the opportunity to become aware of the interconnectivity of the two imbrication building blocks (human and material/technology) of the organisational activities and practices in evaluating their decisions in the future.

1.6 RESEARCH OUTLINE

The remainder of the thesis is structured in the following manner:

1.6.1 Chapter 2: Literature Review

Chapter 2 reviews the literature on MACs practice. The chapter starts with discussion on the different paradigms/worldviews that have been applied to MACs literature, with detailed emphasis being given to the interpretive management accounting research as it is closely related to the way in which this research is conducted. Following this, a section on several practice approaches that have been employed in the MACs literature are described. The chapter ends with a discussion of various empirical studies that have been conducted on MACs previously, including highlighting the problem and gap in the studies that take material and technology into consideration in the research.

1.6.2 Chapter 3: Research Methodology

The research methodology chapter discusses in detail the particular practice approach which this study is taking - i.e. the sociomateriality practice approach. Then, the imbrication process metaphors and concepts within it are discussed in great detail as it is used to frame

the analysis and discussion of the empirical data of this research. The descriptions include the process of how the entanglement between social and material agencies happens, how they influence each other, how the practices become stabilised and how they change over time. In short, the discussion in this chapter shows how the sociomaterial imbrication process helps to uncover the sociomaterial control practice phenomena which are the main concern of this research.

1.6.3 Chapter 4: Research Method

This chapter outlines the research design and the data collection procedures and techniques that are applied in this research and which are in line with the philosophical assumptions underpinning this research. The steps taken during data collection, the duration and the kind of data that was collected during the field visit and the way it was analysed are also described.

1.6.4 Chapter 5: The Palm Oil Industry in Malaysia and Organisational Context

The first part of Chapter 5 gives an overview of the industry in which this research was conducted - i.e. the palm oil industry in Malaysia. The historical context and the value chain of the industry are outlined. This is followed by a detailed description of the organisation in which the case study is conducted. The historical background, geographical locations and its operations are discussed.

1.6.5 Chapter 6: Sociomaterial Control Practices: The Entanglement of Human and Material in the Refining and Fractionation Process

Chapter 6 is the first of three empirical chapters. Chapter 6 focuses on the operations that occur in the two main processes of the midstream palm oil production plant, namely refining and fractionation. A detailed, step-by-step explanation starting from the processing of the raw material to production of the final product is provided. Within this discussion, the empirical data are theorised using the concepts drawn from the imbrication concept to show the entanglement process between the material/technology and the people that are working at the production plant. A specific focus concerns the attaining of the quality specification of the refined palm oil in the refining and fractionation process. This is considered paramount in the company because production concerns about quality are closely interrelated with the

achievement of budgeted yield and cost targets. In this chapter, the ways in which sociomaterial control practices emerge at the operational level through the imbrication process are made clear. The illustrations also show how performance targets built in the budget such as the yield from the process and cost of production becomes implicated in the daily control practices at the plants.

1.6.6 Chapter 7: Chain of Sociomaterial Control Practice: The Temporal Change Across Multiple Social Arrangements

The discussion in Chapter 7 proceeds from Chapter 6 by focussing in more detail on the emergence of control practices. Here, the discussion is on the short term operational practices and controls that have an impact on the flow of production. These practices involve different social actors and arrangements such as the laboratory officer, plants operators and supervisors, and the refinery's management team who are directly and indirectly involved with the production processes and decision making. The discussion revolves around the chain of imbrications that form a pattern of operation and managerial controls within the interactions of these groups of people in concert with the material and technological objects they engage with at different times and locations. The concept of chain of imbrications is utilised to illustrate the interactions and also make clear how previous imbrications may influence the present and also impact future imbrication processes.

1.6.7 Chapter 8: The Dynamic of Management Accounting Controls: The Link Between Budget Construction and Day To Day Control Practices

Chapter 8 discusses the MACs practices at a more abstract level and considers longer term imbrication processes as compared to chapters 6 and 7. This chapter describes the cyclical way in which the budgets get implicated and influence the way that imbrication takes place as daily control practices are exercised at the plant by the refinery management. The discussion also considers the way that day to day imbrication processes are implicated in the building and development of forthcoming budgets. Both the imbrication process and chain of imbrications are used to explain these phenomena and describe the dynamic nature of these processes.

1.6.8 Chapter 9: Management Accounting Control Practices, Sociomateriality and Imbrication

This chapter first discusses the empirical and theoretical contributions and key findings of this research and relates them to the aims and objectives of this research. I highlight the point that control practices are fundamentally related to, and emerge from sociomaterial imbrication processes. The construction and modification of MACs practice patterns occur in relation to the imbrication process between the human/social and material/technology within the context in which they co-exist, and these temporal changes are dynamic and typically unpredictable. Besides this, I provide some reflections on the experiment of using the imbrication metaphor here.

1.6.9 Chapter 10: Conclusion

This chapter concludes the whole thesis by summarising the research and highlighting the limitations of this research. This is followed by some suggestions for future research that can be undertaken to further develop our understanding of the methodology and MACs areas that are not addressed by this research. Lastly, reflections on my own personal research journey in completing this PhD research concludes the thesis.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews the literature on management accounting and control (MACs). First, the discussion focuses on the paradigms that MACs scholars use in examining accounting phenomena which contain the assumptions underlying their research. Broadly, these schools of research are typically designated as positivist/functionalist, interpretive/relativistic and radical/critical (Chua, 1986). The interpretive paradigm is discussed in more detail as it is most closely related to the theoretical framework on which this research is based. Following this is a section where several practice approaches that have been employed in the MACs literature are discussed as the research is going to be theorised from one of the practice approach variants – i.e. the sociomaterial approach. The last section of this chapter provides a review of the areas of MACs research that have been discussed in the literature.

2.2 MANAGEMENT ACCOUNTING AND CONTROL RESEARCH PARADIGMS

Research on MACs is seen to have developed from multiple theoretical roots (Berry et al., 2009; Chua, 1986; Locke & Lowe, 2008; Lukka, 2010). Some researchers (e.g. Chenhall, 2003, 2011; Ferreira & Otley, 2009; Fisher, 1995; Merchant & Otley, 2007; Otley, 1980) regard MACs as a passive tool that provides managers with information on effectiveness and efficiency which is claimed to be used to help managers in the decision making process. However, other writers (e.g. Ahrens & Chapman, 2004, 2007; Ahrens & Mollona, 2007; Ahrens, 1997; Hopwood, 1983; Roberts & Scapens, 1985; Scapens, 1990; Searcy & Mentzer, 2003; Wagner et al., 2011) place emphasis on the unique phenomena present within the complex social and cultural environments found in organisations by highlighting the interactions, judgements and interpretations of people in these complex settings. The former are based broadly on the positivist/functionalist school while the latter are closer to a qualitative/interpretive/relativistic intellectual tradition (Berry, et al., 2009; Chua, 1986; Lukka, 2010; Searcy & Mentzer, 2003).

2.2.1 The Mainstream Management Accounting and Control Research

The discipline is claimed to be dominated by the positivist/functionalist perspective (Berry et al., 2009; Chua, 1986; Hopwood, 2002; Lukka, 2010; Searcy & Mentzer, 2003), especially within the North American MACs studies tradition (Baker & Bettner, 1997; Hopwood, 2002;

Merchant, 2010). The dominance of the positivist/functionalist tradition is much less clear among the UK and European accounting scholars. Studies of MACs and accounting generally in the UK and Europe are more of a balanced mixture of various traditions of positivist/functionalist and the alternative (interpretive/relativist) studies (Ahrens et al., 2008; Locke & Lowe, 2008) which will be discussed in the coming section. The focus of studies within the positivist/functionalist tradition is on how the world works and is bound by assumptions about the constancy of social structure and the predictable nature of social relationships (Morgan & Smircich, 1980) so that effects can be anticipated, controlled and regulated (Chua, 1986; Searcy & Mentzer, 2003). The MACs research within this school of thought views accounting systems as "stabilizing and programming behaviour by allocating to positions sub-goals derived from the organizational goals, and monitoring performance by formal feedback. Compliance is reinforced by tying performance to economic reward structure" (Hopper & Powell, 1985, p. 434). A related view of this stream of research can be found in Merchant & Otley (2007, p.790), who suggest that the main objectives of research in the MACs discipline are to better understand "how and why control systems work in various situations and what can be done to improve them from the perspective of organizational goal attainment". Besides this, they also try to understand "how and why specific sets of controls are not effective in specific settings" (ibid, p.790).

Based on this notion, the theory most commonly claimed to be used is contingency theory (Bartol et al., 1995; Chenhall, 2003; Fisher, 1995; Lawrence & Lorsch, 1967; Otley, 1980). The primary objective of the MACs research within this view seeks to model an accounting system while making assumptions about the objectivity and constancy of the real state of economic affairs and organisational relationships (Ferreira & Otley, 2009; Malmi & Brown, 2008; Otley, 1999; Tillema, 2005). For example, Ferreira & Otley, (2009, p.264) define MACs as

> the evolving formal and informal mechanism, processes, systems, and networks used by organizations for conveying the key objectives and goals elicited by management, for assisting the strategic process and on-going management through analysis, planning, measurement, control, rewarding, and broadly managing performance, and for supporting and facilitating organizational learning and change.

Studies therefore seek an ideal accounting framework/design to achieve the goals of the particular settings of organization and it is assumed that this particular framework will work in similar situations (i.e. is broadly generalizable).

This stream of research has been widely used to explain the adoption and design of MACs. Contingency theory has enabled factors such as the external environment, strategy, technology, structure, organisational culture and size to be identified as having an impact on MACs adoption (Abdel-Kader & Luther, 2008; Cadez & Guilding, 2008; Chenhall, 2003; Henri, 2006; Mohamad, 2013). For example, Abdel-Kader and Luther (2008) examine the relationship between several factors which includes external characteristics (perceived environmental uncertainty and customers' power), organisational characteristics (competitive strategy, structure, and size), and processing characteristics (complexity of process system, advanced manufacturing technology, implementation of total quality management and just in time techniques and product perishability) with the level of MACs sophistication adopted by the surveyed organisations. Among the ten contingent variables examined, they found that the level of MACs sophistication adopted can be significantly explained by environmental uncertainty, customer power, decentralized structure, advanced manufacturing technology, size, and the implementation of total quality management and just in time techniques. This kind of research is claimed to help "accountants and managers [who] may have difficulty deciding which of the numerous novel techniques to embrace" (ibid, p. 22) as they "provide organisations with practical information about the accounting practices that others, in similar circumstances, have adopted" (ibid, p. 22).

While some authors, such as those discussed above, have claimed to find the fit between the level of MACs usage/adoption and organisational characteristics; other authors within contingency-based research have indicated that the different level and design of MACs sophistication has a correlation with the performance of the organisation, such as its effectiveness, efficiency and profitability when the right match between the characteristics and types of MACs is implemented (Cadez & Guilding, 2008; Chenhall, 2003; Geuser et al., 2009; Grafton et al., 2010; Mohamad et al., 2013). The fundamental assumption of the contingency approach is that "company performance is a product of an appropriate fit between the structure (SMA system [i.e. referring to the MACs in place]) and context (contingent factors) […] [which means] good fit implies enhanced performance, while poor fit implies diminished performance" (Cadez & Guilding, 2008, p.842). Cadez & Guilding (2008) attempted to model the effect of a number of contingent factors (i.e. strategic choices, market orientation, company size and accountants' participation in strategic decision making processes mediated by the usage of MACs techniques - 16 techniques are considered) on organisational performance. They found that in the Slovenian business environment, the MACs usage was "not necessarily related to superior performance, but that superior performance is a product of an appropriate match between contingent factors and SMA

application" (ibid, p. 855). The authors claim that this shows that in specific environments, certain techniques are more appropriate than others.

This type of research tends to be based on positivist/functionalist assumptions including the constancy of social structure and the predictable nature of relationships between selected variables. With these somewhat sweeping assumptions in place, the objective of this type of research is said to be to reveal answers about how and why certain MACs systems work and to model MACs systems in order to manoeuvre social behaviour and monitor and improve performance.

2.2.2 Critique of Mainstream Management Accounting and Control Research

Though positivist/functionalist research has undeniably given us insights about MACs, "they do not explicitly aim to help us to understand what is at stake in the organizational practice of accounting… even though [understanding it will] provide so many of the rationales for the accounting craft" (Hopwood, 1983, p.288). While acknowledging the insights contributed by mainstream research to the broader MACs literature, Hopwood (2002, p.783) suggests that "different bodies of knowledge seem to be capable of providing insights into different aspects of the emergence and functioning of accounting practice… [such as the] more culturally based modes of emergence and functioning for calculative systems". This conception of a calculative system is part of the focus of my research as calculation and representations of the material/technology studied in this research play an important role in the analysis of control systems discussed in the empirical chapters.

The basic assumption of objectivity in accounting has been challenged by alternative streams of research in management accounting as being superficial, clean and far too simplistic in explaining the emergence, functioning and impacts of MACs systems and practices (Ahrens & Chapman, 2007; Hopwood, 2002). In practice, individual accountants always need to make their own judgement and interpretation in complex scenarios (Ahrens & Chapman, 2004, 2007; Hopwood, 1983; Scapens, 1990; Searcy & Mentzer, 2003). Thus, human beings have a role in shaping the way the world works or how they experience it. In addition, "management accounting is neither unitary nor homogeneous phenomena. In practice it usually consists of a bundle or assemblage of different practices and techniques… capable of being linked in different ways in different organizations… [and] the extent of actual implementation and use can and does still vary, making research even more difficult" (Hopwood, 2002, p.782) and absolutely not objective. The tendency of the contingency

literature and economics influenced research on MACs within the broader positivist/functionalist view with their focus on discovering law-like regularities ignores this unique phenomena of the existence of the environment and the interaction among various elements of an organisation (Lukka, 2010; Puxty, 1998). Therefore, claiming the world as objective in explaining human action is also considered misleading by some as it fails to recognise how the researcher's perceptions of reality affect the research act and also fails to understand people, and the social and cultural context within which they live (Chua, 1986; Myers, 1997).

The extensive literature on MACs and accounting within the alternative stream which is inspired by diverse theoretical views is commonly referred to under the broad term of interpretive/relativist and radical/critical research (Baxter & Chua, 2003; Chua, 1986; Hopper & Powell, 1985). My research is a specific application of interpretive research, and will be developed more fully in Chapter 3. I will focus on this broad stream of research next.

2.2.3 The Interpretive Management Accounting and Control Research

In general, interpretive researchers hold an assumption that the social world can only be fully understood as an intricate and complex social construction that is consequent on action, discourse and language which produces shared meanings and understandings. This is in contrast to positivist/functionalist accounting research which assumes an objective base for social reality, external to the subject. Interpretive research is based on the assumption that "social reality is emergent, subjectively created, and objectified through human interaction" (Chua, 1986, p.615). Interpretive methodologies are broadly based on the idea that social order is generated and changed through the interactions and activities of human beings in specific contexts (Ahrens & Chapman, 2006; Easterby-Smith et al., 2008; Hopper & Powell, 1985; Scapens, 1990).

The focus of an interpretive study is "to enrich peoples understanding of the meanings of their actions, thus increasing the possibility of mutual communication and influence" (Chua, 1986, p.614). It also describes the way subjects make sense of their place within their world and how it is "constructed and negotiated" (Hopper & Powell, 1985, p. 446; Morgan & Smircich, 1980). It emphasises the subject's perceptions of what constitutes the reality they experience rather than assuming that reality is independent and external to them (Hopper & Powell, 1985). Therefore, interpretive research helps develop an understanding of "human thought and action in social and organizational contexts" (Klein & Myers, 1999, p.67) and

can produce deep insights on social phenomena including MACs. “The researcher starting from the viewpoint that does not assume any pre-existing reality aims to understand how people invent structures to help them make sense of what is going on around them [and] consequently, much attention is given to the use of language and conversations between people as they create their own meanings” (Easterby-Smith et al., 2008, p.63). Further to that, interpretive research which typically draws on a social constructionist and related approaches assumes “that there is no absolute truth… the job of the researcher should be to establish how various claims for truth and reality become constructed in everyday life” (Easterby-Smith et al., 2008, p.93). Therefore, the MACs researcher within the realm of the interpretive view seeks to explain people’s different perceptions of accounting systems when used at different times and in different situations (Hopper & Powell, 1985).

MACs research within this view attempts to understand the day to day life of practitioners by having a “close contact analysis of human interaction” (Ahrens et al., 2008, p. 844) i.e. within the context in which the accounting practice is undertaken. MACs practices are not treated as natural phenomena (phenomena that is ‘out there’) but are seen as socially constructed (Scapens, 1990). This is to say that MACs practices are viewed as “grounded in the social process of the organization and its environment” (Chua, 1986, p.617), rather than a tool to shape behaviour in order to achieve goals in organisational settings, as typically claimed by positivist/functionalist researchers. This means that it is “meaningful in relation to other objects and processes of organizational life, being completed only in the interaction of individuals that constitute an organization. Accounting systems are created, interpreted and changed in an historic process” (Boland & Pondy, 1983, p.233-234). Thus, based on these assumptions, the objective of interpretive researchers is to focus on the social agency of organizations within which individuals and groups “create their social reality and give meaning to their ongoing stream of experience” (ibid, p. 223) in order to explain accounting phenomena.

Besides understanding the human interactions within organisations and how “accounting is constituted through this complex organisational process” (Chua, 1988, p.67), interpretive accounting researchers are also concerned to answer questions such as “how accounting infuses action” and constructs reality (Ahrens & Chapman, 2006, p.829; Chua, 1988). While positivist/functionalist researchers try to help decision makers understand the interaction of variables in the real world (that are external to the participant) (Scapens, 1990), interpretive accounting research tries to explore the use of accounting “as a symbol that structures ongoing day to day organizational action” (Ahrens & Chapman, 2006, p.832).

2.2.4 The Practice Approach

Recent reviews of alternative management accounting research generally include discussions on interpretive management accounting research (Baxter & Chua, 2003; Englund et al., 2011; Englund & Gerdin, 2014; Justesen & Mouritsen, 2011; Lowe, 2001; Malsch et al., 2011), suggesting that interpretive research in accounting is typically informed by a number of key social theorists. Influential contributors to the first generation of practice theories include Anthony Giddens, Bruno Latour, Pierre Bourdieu and Michael Foucault whose focus was broadly on providing alternative theoretical foundations on the role of human agency and the (re)production of social structure (Baxter & Chua, 2003; Orlikowski, 2010b). According to Orlikowski (2010b), the first generation of practice theorists "emphasized agents' actions, interactions and improvisations and focused on how these produce/reproduce/transform social structures, while also acknowledging the imprinting of structure and power on the human body and recurring forms of human activity (e.g. habitus, discipline)" (Orlikowski, 2010b, p. 25; Bourdieu, 1977; Foucault, 1977; Giddens, 1984).

These traits of the first generation social theorists are evidenced in MACs research from within the broadly interpretive perspective. For example, reviewing the accounting research that is informed by Giddens' structuration theory, Englund et al. (2011, p.495, p.505) found a threefold contribution of the theory - i.e. "the introduction of a duality perspective that dissolves the separation of human and structure, the conceptualisation of accounting as an interwoven social structure, and the contribution it makes to an understanding of the continuity and change that occurs in organisations due to accounting practices". Similarly, research employing actor network theory (ANT) (mostly based on the work of Bruno Latour) has provided insights in understanding accounting phenomena by aiming to show "how accounting practices and technologies partake in construction processes and how multiple […] effects are generated as a consequence. Constructions [of accounting phenomena] are on-going […] and any stability achieved is, in principle, temporary and fragile" (Justesen & Mouritsen, 2011, p.165). Most importantly, ANT acknowledges the "'symmetrical' treatment of human and non-human actors" such as accounting technologies in the social network (Justesen & Mouritsen, 2011; Lowe, 2000, p.327).

While much has been learned from the rich interpretive MACs research as mentioned above, in the recent development of this research some authors have begun to adopt other perspectives on practice based theorising. Drawing upon the work of Theodore Schatzki, it has been suggested that "a more explicit formulation of a practice theory approach to management accounting" (Jørgensen & Messner, 2010, p.187) might be valuable (Ahrens &

Chapman, 2004, 2007; Jørgensen & Messner, 2010; Nama & Lowe, 2014). According to Orlikowski (2010b), the work by Schatzki (2001a, 2001b, 2002, 2005) and other second generation practice theorists (such as Pickering, 2001) takes up and extends "the first generation's theory by focussing on "producing analyses, building extensions and generating elaborations" (Orlikowski, 2010b, p.25) where theorists have developed new concepts for understanding the interplay of social structure and agency. Drawing their work from Schatzki (2002), Ahrens & Chapman (2007, p.2) argue that

> [w]hilst early interpretive studies were theoretically well-founded and supported by field research and archival study, they also portrayed accounting often as 'just political', 'unintended', 'temporary', etc., foregrounding its political, symbolic, and ritual functions. They left relatively unexplored the practical, commercial and strategic uses of accounting.

They suggest that the work of Schatzki offers a solution in enabling the researcher to theorise the situated functionality of accounting and suggest that "practice theory seeks to delve into the details of the functioning of subsystems. Practices are about the specific relationships forged between understanding and traditions of social groups and their aspiration and pressing problems" (Ibid, p. 3). In a different account, Ahrens (2009) defines accounting from a practice theory perspective as

> an array of activities that is ordered by practical understandings, rules, and objectives and projects, and that forms a nexus of practices, reporting practices, bookkeeping practices and suchlike
>
> (Ibid, p. 31).

He further emphasises that

> [b]y analysing the key components and influences on practices and the various ways in which they interact with other practices, a practice lens emphasizes the complexity of seemingly mundane everyday accounting. It also underlines the variability of accounting and, thereby, the highly specific ways in which accounting can be practiced in different places and times.
>
> (Ibid, p31).

This in turn will help to "shed light on the ways in which accounting and control practices are embedded in dense meshes of other organizational practices and arrangements" (Ibid, p. 35).

Discussions on the practice theory perspective (both the first and second generation of the practice approach) above denotes that the practice approach of studying MACs provides useful insights for our understanding of the way in which these accounting practices are

embedded in and influence everyday organisational practices. My research provides a fine grained analysis of MACs practices in a single case organisation engaged in the palm oil industry in Malaysia. My focus is specifically on the matters concerning the production process and related activities. However, I take a slightly different variant of practice theory - i.e. sociomaterial practice (Leonardi, 2011, 2012a; Orlikowski & Scott, 2008) - which will be discussed in great detail in the methodology chapter – Chapter 3.

The next section will review some of the examples of the empirical work that has been conducted within the broad interpretive stream of research which not only employs the practice approach mentioned above but a mixture of other theoretical approaches such as institutional theory and concepts drawn from social constructivist perspectives.

2.3 MANAGEMENT ACCOUNTING AND CONTROL

Scholars studying MACs within interpretive research have examined various aspects of these systems including the design, implementation, applications, changes and stability of MACs as well as the broader roles that MACs play in organisations. This section will discuss the empirical studies on these areas.

2.3.1 Management Accounting and Control: The Emergence of MACs from Interactions between Actors and Context

As mentioned in section 2.2 above, the sharp contrast between mainstream MACs studies and interpretive studies is around the way in which reality is perceived. While the positivist/functionalist research position assumes organisations and its accounting/MACs practices can be regarded as objective discrete elements within a broader system, the interpretive researcher sees the broader system as complex and socially constructed and MACs as being an inseparable and embedded part of organisational practices. Continuous interactions, actions, language use and discourses between actors are what constitute MACs rather than MACs being a distinct, objective tool that can be used to stabilise behaviour and give predictable outcomes.

Emsley (2008) studied the introduction of a MACs technique (Juran's 'cost of quality') at two different petrochemical plants and found that the outcome of the implementation was not the same at both plants even though the MACs technique was considered as having 'fixed' characteristics. The intention of replicating the MACs technique from one plant to another failed because, as he concluded, "'[f]ixed' techniques are not fixed and are unlikely to be

implemented in ‘textbook’ fashion. To manage the innovation process better, practitioners need to understand the heterogeneity of actors’ interests, the variety and complexity of context and the iterative, recursive nature of the innovation process” (p. 375). Similarly, after close examination of day to day operations of a restaurant chain, Ahrens & Chapman (2002), employing structuration theory, suggest that even in a highly standardized environment such as a restaurant food chain, accounting is an operational tool that functions in a non-deterministic way and is shaped and also at the same time is shaping the social and its organizational environment and practices. These empirical examples suggest that there is no such thing as one particular form of MACs which fits a specific context. MACs emerge as the actors within a context interact with each other.

The assumption of MACs practices, that organisations and its actors are continuously being shaped and are shaping each other (Ahrens & Chapman, 2007; Alcouffe et al., 2008; Ezzamel et al., 2012), has inspired scholars to examine the practices closely to try to understand what constitute MACs and the organisational arrangements within which they operate (Ahrens & Chapman, 2007; Ahrens & Mollona, 2007; Wagner et al., 2011) instead of trying to find the ‘fit’ or ‘match’ of the factors and specific design of MACs, such as research within contingency theory. In this tradition, organisational practices, including MACs, are seen as inherently complex and fluid. Scholars challenge the conventional thinking of the pure classification of organisations and types of MACs application and usage for this specific type of organisation. For instance, Ahrens & Chapman (2004) found that there are no pure organic or mechanistic organisations in practice, therefore the traditional dichotomy between the two should be resolved in order to understand the MACs and usage to better support the objectives of efficiency and flexibility of organisations. In line with this argument, my research seeks to examine what constitutes MACs in an environment where human actors intermingle with material and technology objects in a highly sophisticated and complex production environment and see how they influence and shape each other.

Studies which examine the usage and constitution of MACs used in organisations show that the performative nature/roles of MACs and accounting in general, such as its dispersed (Ahrens & Chapman, 2007; Jørgensen & Messner, 2010; Nama & Lowe, 2014), calculative (MacKenzie, 2009; Miller & O’Leary, 2007; Mouritsen, 1999), classification (Chua & Mahama, 2007; MacKenzie, 2009; Miller & O’Leary, 2007), simplified (Jørgensen & Messner, 2010; Mouritsen & Thrane, 2006) and self-regulating (Mouritsen & Thrane, 2006) nature interact with the actors within the context of its usage and shape each other and create practice.

For instance, highlighting the dispersed nature of accounting, Ahrens & Chapman (2007, p.22) mentioned that “management control practices are central to organising because they help to bring about connections between the diverse activities of organisational members” . These authors found that through accounting inscriptions, MACs render visible members’ daily activities and, drawing upon the performance metric, members in the organisation were able to establish “shared understanding of what it is meant to do well” (Ibid, p. 22). We can observe the dispersed nature of accounting practices beyond organisational boundaries in the role of MACs systems that help to ‘mesh’ functions and practices through its calculative role and thereby enable work practice across the value chain of industries (an example can be found in private equity – e.g. Nama & Lowe, 2014). Nama & Lowe (2014, p.15) found that

> [a]s dispersed practices, [management] accounting cuts through and intersects/meshes with several other PE practices […] accounting and associated calculative practices ‘constitute’ (i.e., form an integral part of) the various PE practices. Skilful and knowledgeable actors actively draw accounting information and reports to perform their day to day projects and tasks in accomplishing the ‘teleologies’ of the respective [integrative] practices they contribute to.

It is important to see that MACs are the result of interactions between the actors and the organisational context and environment. As discussed above, the nature of MACs and interactions with the context also have an effect in defining organisational boundaries. For example, Mouritsen (1999) shows that different versions of MACs and their associated calculations tend to direct attention to specific areas of an organisation rather than others. These attention directing effects can lead management to give attention to these areas and also have an effect on actions taken. In the case research, Mouritsen (1999) describes that the competing calculative focus of contribution accounting and activity based costing provide alternate motivation and decisions on production activities in terms of whether to outsource or have an in-house production. This study indicates that organisational boundaries are not as static as is typically assumed and are “mediated and partly constructed by accounting calculations, although calculations, in turn, are also translated by the organizational actors” (Justesen & Mouritsen, 2011, p. 175). Mouritsen and Thrane (2006) investigated the role of accounting in the negotiation of organisational boundaries between a network of three enterprises comprising an IT company, an electrical installation company and a management consulting company which work on projects together and found that “accounting can be conceptualised as an actor helping to mediate, shape and construct inter-organisational relations” (p. 241) because of the self-regulating and orchestration nature of accounting. These characteristics of accounting help facilitate interactions between the different entities and enable them to develop a network which works towards a common objective.

Other than examining the micro practices at the intra and inter organisational level, researchers may also assess the role of accounting at a more macro level such as at the market level. Researchers such as Callon (2009) and MacKenzie (2009) examined the recently developed Carbon market and found that the calculative and classificatory nature of accounting (and other specialist and professional actors) not only played in important role in the creation of the market but also the functioning of the market.

Although the above examples show that the characteristics of MACs shape organisational and work practice, it is not unidirectional. At the same time, MACs are also shaped and affected by the context in which they are used. Studies found that the MACs are not only constituted of mere techniques but are also influenced by the social context and environment (Ahrens & Mollona, 2007; Alam et al., 2004; Jones & Dugdale, 2002; Jack, 2005; Jayasinghe & Thomas, 2009; Lowe & Jones, 2004; Preston et al., 1992; Uddin & Tsamenyi, 2005). Ahrens & Mollona (2007) show how MACs are constitutive of organisational culture and its subcultures. From their point of view, understanding subcultures within organisations can help understand the diversity of MACs. Jayasinghe & Thomas (2009), in an investigation of accounting practices among a strongly class divided fishing community in Sri Lanka, found that the accounting practices were significantly embedded in and affected by historical social arrangements. Despite the changes that happened in the community, such as improvements in literacy levels among the lower class groups and support from the NGOs and the state, accounting practices still reflected the social arrangement such as the strong domination of an upper class group within the community and various local bodies (see also Alam et al., 2004). Some other researchers focus on the way in which MACs are constructed when they move across sectors or international boundaries and are translated by the local actors (Quattrone & Hopper, 2005). Preston et al. (1992) studied the introduction of budgeting practice in UK healthcare and concluded that MACs are not a “package system” that can just be put in place and work but instead a “management budgeting initiative is modified, strengthened and undermined in the process” (p. 578) through its interactions with the actors in the context.

Besides showing that MACs shape and are shaped by the context in which they are utilised, other studies also show that MACs result in imperfect information systems. MACs become the organisational practice not necessarily because it is a perfect system that promises a specific outcome, but it is used as deemed necessary by its adopters and because the users feel it is useful or appropriate for their purposes and helps them make sense of their work practices (Everett, 2003; Lowe & Koh, 2007). In other words, MACs are not mere tools, but they are practices that emerge from the different ways actors translate them within the

context (Ahrens & Chapman, 2007; Briers & Chua, 2001; Chua, 1995; Jones & Dugdale, 2002; Emsley, 2008; Ezzamel et al., 2012; Gendron et al., 2007). MACs systems produce a continuous process of interactions of actors within which tend to be constitutive in the disembedding and reembedding or institutionalising or deinstitutionalising processes in organisations (Ezzamel et al., 2012; Hyvönen et al., 2006; Jack, 2005; Preston et al., 1992; Ribeiro & Scapens, 2006; Sharma et al., 2010).

These studies show that MACs are not only affecting and shaping the organisational context in its day to day practices, but also at the same time are affected and shaped by the actors within the context in which they operate. The MACs emerge from the interactions between multiple actors in the organisation or business environment with the MACs and dynamically they shape each other. This research has investigated the interrelations between multiple actors (human and non-human/material) in explaining the emergence of MACs practices within organisations. However, little detailed scrutiny of situated MACs practices has been given to the interrelations between social actors and materials within the sophisticated processing production environment in which the controls are exercised. Corresponding to this argument, this research aimed to investigate the way in which MACs are implicated in and are shaping the day to day practices in the organisation which are highly reliant on a high variation raw material input, advanced computer controlled processing plants and complex operational systems. It also examines, in turn, the influence that the day to day work and control practices in this context have towards shaping the MACs across different hierarchical levels of the organisation, from the operational/production to the managerial level.

2.3.2 Management Accounting and Control Change and Continuity/Stability

Besides understanding the crucial role of MACs and what constitutes MACs, another area of study that gets focused on is the changes in MACs practices in organisations. Some areas that are being focused on by the MACs change scholars are the introduction and implementation process of new MACs techniques (Alcouffe et al., 2008; Caglio, 2003; Ezzamel et al., 2012; Hyvönen et al., 2006; Ribeiro & Scapens, 2006; Sharma et al., 2010), changes that happen over time (Alam et al., 2004; Jack, 2005; Neu et al., 2008), different usage of MACs techniques (Emsley, 2005; Moilanen, 2008; Mouritsen, 1999), the outcome of this implementation and changes (Lowe & Locke, 2008) and the reasons for success or failure of the implementation and changes (Alcouffe et al., 2008; Baxter & Chua, 2008; Briers

& Chua, 2001; Caglio, 2003; Chua, 1995; Lowe & Koh, 2007; Lowe et al., 2012; Quattrone & Hopper, 2005).

Studies by these authors show that MACs implementation and change do not follow a linear and predictable pattern. For instance, Ezzamel et al. (2007) and Sharma et al. (2010) found that the implementation of MACs went through a process of conflict and negotiation with the existing logics or practices familiar to organisational actors over a period of time (i.e. they go through the process of de-institutionalise the existing practice and re-institutionalise the new practice) before they become accepted. Similarly, Hyvönen et al. (2006) show that the change processes that happen when a new technique such as ABC and ERP is implemented produce these processes of dis-embedding and re-embedding before they settle to become the present practice. The newly introduced techniques do not become a mutually exclusive practice from the previous ones but they are reflective of previous practices and interactions across organisational members and the context.

Research that has looked at the reasons for the success or failure of certain implementation of MACs has found that achievement is an outcome of the complex interconnections of many actors in the implementation context. Alliances and support among the actors and 'actants' within the network - borrowing the concept of actor network theory - has been claimed to explain the success or even failure of MACs (Briers & Chua, 2001; Chua, 1995). Sometimes, the MACs might not even work in the way they are intended or provide 'accurate' information, but because a group of people support and find the MACs to be appropriate and perceive them as helpful to their work, they are sustained. For example, Lowe and Koh (2007) examined the effort of standardising management accounting records in a manufacturing organisation and found that the MACs become influential not because of the accounting logic such as 'accuracy' and 'reliability' but the power of inscription which derives from establishment of a network of support within the organisation. The MACs outcome is only considered as 'true' because a network of allies support the practices and not because the MACs can be said to represent reality.

In the effort to understand the changes that happen in MACs, research also finds that whilst changes happen, certain MACs also sustain and become stable over time (Baxter & Chua, 2008; Jack, 2005; Jayasinghe & Thomas, 2009; Lowe & Koh, 2007; Rahaman et al., 2007; Uddin & Tsamenyi, 2005). The reasons given in the literature for the stability of MACs include lack of expertise (Jack, 2005), the taken for grantedness of the practice (Ahrens & Chapman, 2002), domination such as economy and/or power (Jayasinghe & Thomas, 2009), history (Alam et al., 2004; Jack, 2005) and also, as mentioned above, allies within a network

(Lowe & Koh, 2007). Some (Lukka, 2007; Quinn, 2011; 2014) are also of the opinion that change and stability of MACs coexist. In line with these literatures, the present research also attempts to look at changes in the control practices exercised within the case organisation. However, instead of looking from the macro perspective, such as the major (management) accounting and control system changes, the focus of this research is more on the micro and gradual changes in exercising controls at the operational/production level as well as in the related managerial controls at the day to day level. This is because a relatively short term control such as continuous hourly and/or daily control practices are critical in this sophisticated and highly variable processing/refining context in which this research is conducted. The variability of the inputs in the production processes warrant rapid and fast adjustments and decisions to be made to ensure stability in production productivity. Therefore, instead of looking at macro changes such as changes in the MACs systems or formal practices, this research examines this short term modification of the control practices.

To recap what has been discussed so far, MACs studies within interpretive research treat MACs as complex and socially constructed practices. It does not provide a tool that works in a deterministic way to provide predictable outcomes in terms of guaranteeing certain kinds of behaviour or performance. Instead, MACs shape and are shaped by the context in which they operate through continuous interactions with actors in organisations. The nature/characteristics of MACs, such as calculative, classifying and simplified, self-regulating and dispersed, influence the social structures and work practices just as much as they are influenced by the actors within the organisation.

2.3.3 Materiality, Accounting and Control Practices

Though looking at the interactions between management [accounting] and controls and the social has aided understanding of the complex, non-deterministic and socially constructed nature of MACs, some authors argue that research in contemporary organizations is overlooking important characteristics of social and organisational life (D'Adderio, 2008; Dechow & Mouritsen, 2005; Howard-Grenville & Carlile, 2006; Leonardi, 2013; Nicolini et al., 2012; Orlikowski, 2007, 2010b; Wagner et al., 2011). These authors argue that looking only at these predominantly social interactions and focussing on social construction provides only partial understandings of organisational reality (Dechow & Mouritsen, 2005; Leonardi, 2011, 2013; Orlikowski, 2007, 2010a; Wagner et al., 2011). A group of practice theory researchers in organisational studies and information systems and technology has developed increasing interest in the role that material artefacts and technology play in organisational practice and

work (Bijker, 2001; Carlile, 2002, 2004; Leonardi & Barley, 2008; Leonardi, 2011, 2012; Nicolini et al., 2012; Orlikowski, 2007, 2010b; Orlikowski & Scott, 2008; Xavier de Vaujany & Mitev, 2013).

Within MACs research, efforts have also been made to recognize the role of material objects and technologies in understanding MACs (Jones & Dugdale, 2002; Dechow & Mouritsen, 2005; Nama & Lowe, 2014; Quattrone & Hopper, 2005). Dechow & Mouritsen (2005) incorporated the technological dimension (an enterprise resource planning – ERP system) and its interactions with the human actors and the way they influence each other in achieving integrated control practices in two case study organisations. They examined "the connections that can be traced by exploring how actors are related to other actors of various kinds [such as technology] and swap competencies" (ibid, p. 696). They found that the 'infrastructure' of the technology matters as it "force[d] other actors to take its categories seriously" in the effort of implementing and using the ERP system to provide integrated control practices, and that "these effects of technology […] have significant consequences for future approaches to technology mediated accounting research" (ibid, p. 730).

In another paper, Quattrone & Hopper (2005) examined the effect of implementation of an ERP system in two multinational organisations in terms of how an idea of a fixed accounting technology (an ERP system – SAP) is implemented in the organisations and how it affected order, distance and control in the organisations. They found that as the actors employed different strategies in the implementation efforts, the configuration and usage of this ERP system was different at the Japanese and American multinational companies. These differences then formed controls between the HQ and subsidiaries. Therefore, it is important to understand that technology is not fixed and can provide similar solutions across space and time.

These findings highlight the importance that material objects and technologies are taken into consideration in attempts to understand the MACs phenomena in organisations as they provide a significant explanation of the MACs. For example, discussing ANT studies and the role of technology in the MACs in terms of construction of space and time, Justesen & Mouritsen (2011, p.174) conclude that technology is precarious, flexible and fluid and "move[s] management agendas in surprising ways". They also added that "technology is not stable; it does not produce stable organizational practices" (ibid, p. 174). In the MACs literature, ANT studies (among others) have promoted the idea that material objects and technology may explain MACs phenomena in organisations.

However, although material artefacts and technology have been examined in management accounting research (often these studies use ANT, which treats MACs as technology), some authors suggest that they basically only "seek to explain order by looking at how entities ('actants') connect to each other […] they do not rely on the idea of practice as a distinct ontological category" (Jørgensen & Messner, 2010, p.186). Thus, examples of studies such as Dechow and Mouritsen (2005) and Quattrone and Hopper (2005) provide the idea that the interactions between various actants may significantly explain MACs, such as how the configuration of the MACs systems affects the way management accounting and controls are generally exercised. The way in which the materiality of such technology/materials works and how the social reacts to this materiality remains unexplored. It is important that this question is explored in order to understand how practices emerge from the interactions and negotiations between the human and non-human (material/technology) to produce different practices in different contexts and at different times.

Recently, researchers from information studies (Leonardi, 2012a; Orlikowski, 2007, 2010a; Orlikowski & Scott, 2008) have suggested that in order to understand the organisational reality fully, one should see organisational work practice such as management accounting practice as a sociomaterial practice. Instead of looking at either humans or materials and technology separately, or giving primacy to either one, or just looking at materials and technology as mediating the work practice, they propose that the researcher should examine organisational reality from the relational ontological perspective, which means, social and material and technology as both constitutively entangled and creating organisational practice. Compared to the approaches to the study of MACs that have been discussed in this chapter, the sociomateriality approach might provide another perspective for looking at MACs as "it provides a way to understand how meanings and materialities are inextricably related and influence the form of (accounting) practice" (Wagner et al., 2011, p.183). Although similar to the argument made by actor network theory in terms of giving symmetrical importance to the human and non-human actors, the sociomateriality approach helps uncover the process in which MACs practices emerge from the entanglement between the two agencies (i.e. human/social and material/technological aspects of organisations) (Leonardi, 2011, 2012a) by opening the black-box of the entanglement process to show the 'what and 'how' of these interactions.

There has been some research that has sought to employ the sociomateriality approach in explaining MACs practices and change (Wagner et al., 2011). Wagner et. al. (2011) studied the changes in the ERP (re)configuration over a period of 10 years resulting from particular assemblages between the users of the technology and the technology itself. However,

though portraying the general idea of sociomateriality (i.e. control practices emerge from an entanglement of the social and material), the study does not detail the capability of each agency separately and how one enables and/or constrains the other in a dynamic process. Therefore, the intersection points at which these agencies engage and the processes through which the (management) accounting and controls practices emerge remain hidden and unexplained (Dechow & Mouritsen, 2005a). In other words, the conclusion leaves us with the idea that the outcomes of the entanglements produce the specified practices but the process that produces these outcomes remains a 'black-box'.

Dechow and Mouritsen's (2005: pp.730-731, emphasis added) study highlights this similar concern:

> … control cannot be studied apart from technology and context, because one will never get to understand the underlying 'infrastructure' – the meeting point of many technologies and many types of controls that at the same time are pragmatic and yet sophisticated. **These cannot be accounted for with the current tools of research where things are reduced to simply being present either at the centre or at the periphery of a calculation.**"

In relation to the gap identified in the discussions of the studies, and as pointed out by Dechow and Mouritsen in the quote above, research has shown that material object and technology are important in playing a role and/or mediating controls – thus answering the question as to what and why technology and its configuration is important. Consequently, this calls for increasing efforts to find an answer to the question of 'how' [management] accounting and control systems emerge and the constitutive effects of multiple actors, including materials/technology within the context. As mentioned earlier, the sociomateriality approach offers a lens to uncover the 'underlying infrastructure' of [management] accounting and control systems, explaining 'how' materials/technologies constitute control practices.

This thesis employs a similar approach to that used by Wagner et al. (2011) - i.e. a sociomaterial practice based approach to examine MACs practice within the organisation under study. However, the theorising of this research is somewhat different from the work of Wagner et al. (2011). In this research I operationalize and make clear the interactions and points of intersection between the various actors (multiple social and materials/technology groups) using the imbrication process advocated by Leonardi (2011, 2012a, 2012b). This sociomaterial approach, its ontological and epistemological perspective and the concept of the imbrication process that is used to theorise the sociomaterial practice of MACs will be discussed in detail in the following chapter. The concept within the sociomateriality approach will be used to uncover the process in which material and technological objects together with

the human/social element within an organisation constitutes MACs practice and how this contributes to the gradual modification and stability of the MACs.

This research will also add insights to the existing MACs literature by examining MACs practices and interactions with other organisation practices at the operational level and also at the middle and higher management levels. This is in contrast to most MACs research that examines the role of technology while focussing primarily on the macro level analysis of change and its longer term effects. A specific focus of this research will be on the interactions that take place between individual actors in carrying out the micro day to day practices that impinge on the use of MACs targets and other operational production information. The research will show the way in which MACs are entangled within the daily work practices and discussions which the people engage in and which, in turn, are interactively implicated in the construction of the MACs. The sociomaterial practice approach will make clear how MACs together with the organisational context which not only consists of people but also material artefacts and technology iteratively influence each other. This approach brings the material artefacts and technology to the surface of the discussions about and understanding of MACs practice. Lastly, the imbrication process illustrating the sociomaterial practice will also demonstrate the process of MACs practice at different levels of management in the organisation and its constitutive elements.

2.4 CONCLUSION

To summarize, this chapter first provides a general review of the different paradigms of which MACs research are conducted. As the present research is closely related to the interpretive paradigm, description of research within this paradigm especially the practice approach research has been discussed. This is followed by discussion on areas of MACs research in the literature. The last section emphasize on the importance of material/technological objects in the understanding of MACs, which will be the focus of this present research. The next chapter focuses on the research methodology. The sociomateriality framework will be discussed in detail along with the imbrication metaphor and related concepts that are applied in theorising the empirical chapters that follow.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter will outline the methodology and concepts that are used in framing the analysis and discussion of the empirical data. I will start by first explaining what has become known as the sociomateriality approach and follow this by outlining in some detail Leonardi's (2011, 2012a, 2012b) take on sociomateriality. I will also discuss the concept of imbrication, which is used to conceptualise and operationalize an important element of the sociomateriality approach adopted in this thesis. Other concepts which are used to make clear how the imbrication happens, including affordance and constraints, and agency, will also be discussed briefly.

3.2 THE SOCIOMATERIAL PRACTICE APPROACH

It is indisputable to say that both simple and complex materials and technologies are being used in most of our everyday activities (e.g. putting on our glasses, setting our alarm clocks, combing our hair and using the hairdryer, using our mobile phones and cars). This is perhaps even truer in the complex settings of the modern organization where almost no task can be completed without the aid of technology and/or material objects. Technology is omnipresent in every part of an organization - as Orlikowski & Scott, (2008, p.434) suggest, "technology has arguably become an integral aspect of most business operations… and it is hard to think of any contemporary organization that does not, at some level, depend on some kind of technologies". The realization about the importance of technology has been noted by previous researchers who have studied the impact of technology on organizational activities, as well as the interactions that people have with technology within the organization which creates work practices, including the management accounting and control (MACs) practices as discussed in chapter 2 (Dechow & Mouritsen, 2005; Orlikowski, 2007, 2010; Orlikowski & Scott, 2008; Quattrone & Hopper, 2005; Wagner et al., 2011).

3.2.1 Ontology of Separateness

More broadly, despite there being rather limited organisation, management and information system research addressing the impact of technology, Orlikowski and Scott (2008) found that there are two primary trends in which management research addresses the role of technology in an organization.

The first stream of technology research focuses on the impact of technology on social change (Kallinikos et al., 2012). This stream of research, which Orlikowski (2010, p.127) calls “exogenous force”, views technology as an entity that is independent and not shaped by social interactions generally or the environment in the organization. The use of the technology is assumed to influence the way work is done and the users are treated as accepting the technology as it is without having any resistance to, or any kind of interpretation of, the technology.

While the first stream of research emphasises the technology, the second stream of research, which Orlikowski (2010, p.134) terms “emergent process”, focuses its attention on “the social and the often accompanying exploration of multiple, emergent and situated human–technology interactions over time”. This stream of research started in the 1980s, when social constructivist perspectives started to emphasize the social interactions where “any effect that new technologies had on the way people worked were mediated by a variety of social processes [which was a] result of people’s choices about how to design and use the technology as attributable to the artifact itself” (Kallinikos et al., 2012, p.4). This is to say that “people’s work is not determined by technologies they employ … [but] people often enact their human agency in response to technology’s material agency” (Leonardi, 2011, p. 148).

A similar trend is evidenced in the MACs literature. As discussed in considerable detail in Chapter 2, the first group of research studies on the MACs either attempted to look at the impact of various technologies in organisations (such as operational/production technology, or management technology – Total Quality Management, ISO Quality Standards) on the MACs adoptions and implementations (Abdel-Kader & Luther, 2008; Ferreira & Otley, 2009; Otley, 1980) or treat the MACs system as some form of technology and see the impact it has on performance (Cadez & Guilding, 2008; Chenhall, 2003; Mohamad et al., 2013). The other group of researchers focused on the non-deterministic, non-linear, unpredictable nature of the MACs and how the MACs practices are an emergent result of the interactions and interpretations of actors within the organisation that use MACs as technology mediating their work practices (Ahrens & Chapman, 2007; Alcouffe et al., 2008; Neu et al., 2008).

Obviously, the two streams of research differ in the way they treat technology with regards to its role in shaping organizational activities. The former focuses on explaining the way change in organizational structure is influenced by the technology – where the technology is playing the main role that brings changes to the organization. On the other hand, the latter focus on explaining how social/human agencies shape and are shaped by its interaction with technology over time – in which the human actors play the main role in influencing the way

the technology is being interpreted and used (Orlikowski, 2007, 2010; Orlikowski & Scott, 2008). Although it looks like both streams study technology from a diverse perspective, Orlikowski (2010) points out that they both share a similar ontological perspective about the separateness of the human and material agencies. They both put more emphasis on one side of agency as opposed to the other.

3.2.2 Critique of the ontology of 'separateness'

Undeniably, both streams of research have made a contribution to our understanding on how technology plays a role in organizational life. However, some researchers have started to make the point that the way they treat human agency and material agency as being separate is problematic in the sense that it does not reflect the real happenings occurring nowadays in organizational contexts (Kallinikos et al., 2012; Leonardi, 2012a; Orlikowski, 2007, 2010; Orlikowski & Scott, 2008).

In terms of the first stream, Orlikowski (2007, p.1437) points out that the "techno-centric perspective" only focuses on the primacy of technology in shaping the way work is done in organizations where technology is conceptualised to be "exogenous, homogeneous, predictable, and stable, performing as intended and designed across time and place". She further says that this stream of research has been critiqued on the ground that "this perspective reifies technology, ignores how technology is bound up with historical and cultural influences, and thus produces technologically deterministic claims about the relationship of technology with organizations" (ibid, p.1437).

While the first stream of research overemphasizes the role of technology, the other stream, which Orlikowski (2007) calls "the human-centered perspective", finds it important to focus attention on the human actors that use technology. However, by bringing in the role of humans, the second stream of research is also seen, by some, as introducing limitations where they are/or may be tempted to overemphasize the human interactions and "technologies themselves cease to be important in studies of social change" (Kallinikos et al., 2012, p.4). In this stream of research, technology is only seen as something that human actors interpret it to be and use in their own way as they find fit to achieve their goals. Research from this perspective is done with the assumption that technology is what humans understand it to be and has no identity by itself. Different people or groups of people assign different meaning to the technology based on their social context and background. The development of this stream of research to a certain extent suggests that "technologies

themselves matter[ ] very little in the way people work[ ], but people's interpretations of the technology matter[s] a lot" (Leonardi, 2012, p.27).

3.2.3 Relational Ontology

The diverse focus of the research discussed above, though it looks different, has one similarity in that both streams focus on either one of the aspect of the relationship i.e. either focusing on the material aspect of the relationship, or the social/human aspect of it. This ontology of separateness is seen as problematic to certain scholars (Kallinikos et al., 2012; Leonardi, 2011, 2012a, 2013a; Orlikowski, 2010; Orlikowski & Scott, 2008) as "they overlooked the ways in which organizing is bound up with the material forms and spaces through which humans act and interact" (Orlikowski, 2007, p.1435). Orlikowski & Scott, (2008, p.466) have said that "evidence from contemporary organizations suggests that work practices are constituted by an array of sociomaterial agencies" – thus, either one of the agencies plays a central role in the practice of organizational work. In their opinion, if this limitation is not addressed, we will be unable to understand the "contemporary forms of organizing that are increasingly constituted by multiple, emergent, shifting, and interdependent technologies" (Orlikowski, 2007, p.1435).

As mentioned earlier, similar trends can be evidenced in the studies within the MACs literature. Although the two streams of research have different ontological assumptions and take different epistemological approaches in acquiring an understanding of MACs practices, both treat human and material agencies as separate – that is, either MACs and the related technology determines social happenings/events, or people and context determine MACs practices. Therefore, the same concern applies to our understanding of MACs practices as one of the important work practices in organisations.

Recently, a number of researchers have started to consider not only social or material/technology, but how both agencies constitutively create organizational practice (Kallinikos et al., 2012; Leonardi, 2011, 2012a, 2013a; Orlikowski, 2007, 2010; Orlikowski & Scott, 2008; Pickering, 1995). Orlikowski (2007, p.1437) suggests that a growing stream of research, which views the social and material as "inextricably related – [where] there is no social that is not also material, and no material that is not also social" - has become increasingly significant. Orlikowski and Scott are currently the most prominent management scholars who propose that the concept of sociomateriality is the way forward in helping us to frame, conceptualise and understand better the working processes and arrangements we observe in organizations. This is because "work practices are inherently sociomaterial…

[and] these practices don't just mediate work, they perform organizational realities" (Orlikowski & Scott, 2008, p.467).

The relational ontology of the sociomateriality approach takes the perspective that social events such as organizations are the consequence of the constant interweaving of human and material agency (Leonardi, 2011, 2012a, 2013a; Nicolini et al, 2012; Orlikowski, 2010). This new way of thinking within social constructivist research involves recognising the material and social as the way that "they mingle in an indissoluble bundle of iterative or recursive relations that removes human agency from the center stage, making it just one more force among the dance of forces that express and govern social life" (Kallinikos et al., 2012, p.11). In short, within the sociomateriality approach, human and material/technology are inseparable and not distinct realities. This inseparability is what constitutes reality. The epistemology of the sociomaterial approach conceptualises social processes and events (such as organizational practice including managerial practices aimed at the control of the organisation) as the outcome of the constitutively entangled social and material agencies. Rather than claiming that it is either material objects such as technology that impact activities in an organization, or that it is people's interpretations that make things work despite the influence of technological and material objects, the sociomaterial approach takes the view that both the social and the material create the events/happenings in an organization. My research is built upon this third view (the sociomateriality approach) which departs from either privileging material agency or human agency, but instead takes the human and the material as being imbricated to produce organizational realities.

3.3 THEORETICAL FRAME

Until recently, the concept of sociomateriality has been described by some (e.g. see Leonardi, 2013b) as being too abstract and highly philosophical. Leonardi (2013a) states that scholars "should move beyond simple descriptions of entanglement to develop a deeper understanding of the process of entanglement because it is these processes in which organizations themselves are so implicated" (Leonardi, 2013a, p.163).

Orlikowski (2007) and Orlikowski & Scott (2008) proposed the *notion of constitutive entanglement* for researchers to try and understand the way to study the relationship between the two agencies (i.e. social and material) involved in the creation of work practices. The notion of constitutive entanglement "presumes that there are no independently existing entities with inherent characteristics" by themselves (Orlikowski, 2007, p.1438). From the

inseparability assumption, the relationship between social and material agencies are not analysed as one-way or two-way interactions but “instead social and material are considered to be inextricably related” (Ibid, p.1437). Orlikowski suggests that researchers should “give up on treating the social and the material as distinct and largely independent spheres of organizational life [and treat them as]… recursive intertwining [agencies as they] emerge in ongoing situated practice” (Ibid, p.1438).

In contrast to the way Orlikowski and Scott operationalize the relationship between social and material by eliminating the line between the two agencies, Leonardi (2011, 2012a, 2012b) and Leonardi and Barley (2008, 2010) suggest an alternative way of looking at the entangled relationship between the two agencies – i.e. *the imbrication process.* They claim that this approach offers “researchers an opportunity to “see” more clearly *how* the social and the material becomes constitutively entangled” (Leonardi, 2012a, p.42). They argue that “instead of weaving the social and the material together conceptually, researchers should begin unravelling them empirically in order to study how each contributed to the whole” (ibid, p.42). Employing this second perspective for analysing his work on the “crashworthiness analysis” of technology in an automotive company/industry, Leonardi (2012a, p.42) argues that the concept has the advantage of explaining “how the social and the material become ‘constitutively entangled’ so that we can… account more precisely for how the process of organizing unfolds”. This approach uses the *metaphor of imbrication* to explain the process of entanglement of social and material agencies which makes clear the emergence of work practices.

Building upon the same objective of showing the detailed, interweaving process of social and material in explaining the emergence of controlling practice in a palm oil industry production site, I employ the said imbrication process concept (Leonardi, 2011, 2012a, 2012b). The concept of imbrication is expected to be useful in describing the sociomaterial management and control practice at various levels of the production process (i.e. at the plant, and by the plant management as well as the senior management at the head office) and their interactions with each other (between different social groups as well as between social and material agencies). All portray the entanglement of the two agencies. The concept of imbrication will be described in the next section.

3.3.1 Sociomaterial Practice as Imbrication Process

Leonardi (2012a, 2012b) mentioned that previous research on sociomateriality has so far argued that materiality and the social are entangled, but very little is known about how this intertwining occurs. Building on the work of Ciborra (2006), Sassen (2002), and Taylor (2001), he suggests that the metaphor of imbrication is a useful operationalization tool to explain the sociomaterial entanglement process.

In picturing the imbrication metaphor, Leonardi frequently refers to the simple construction of an ancient and still used type of roof tile which consists of ‘tegula’ and ‘imbrex’ (two different shapes of tile) arranged in such a way that interlocking occurs, leading to waterproofing of the roof (see first image in Figure 3.1 below). Besides this, he also makes use of several other images to make clear the imbrication process: the settlement of rocks in riverbeds (see middle image of Figure 3.1) and the arrangement of bricks in walls (see third image of Figure 3.1).

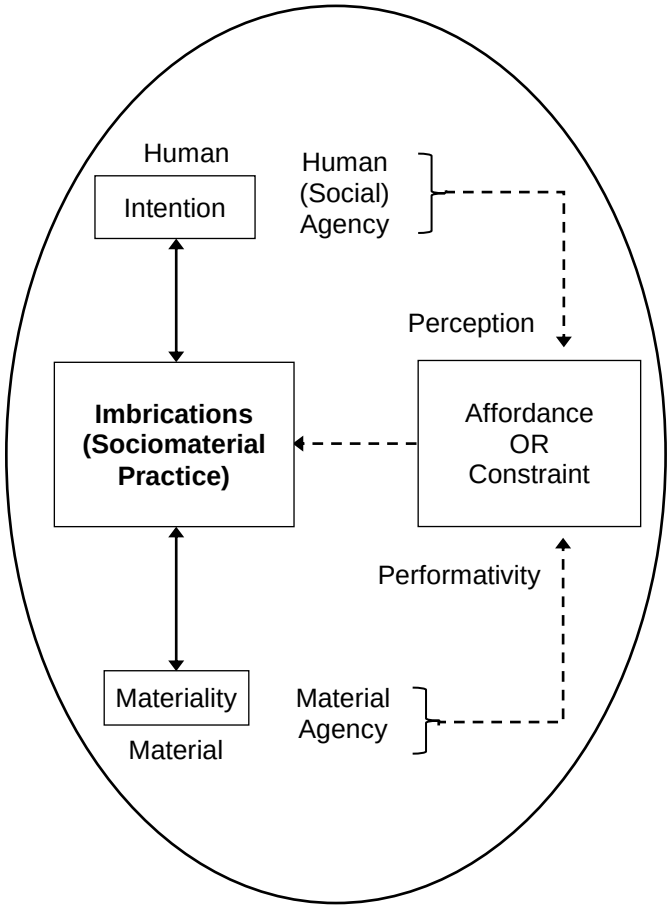
Figure 3.1
Images of Imbricated Roof, Riverbed and Wall

Source: Leonardi, 2012a, p.43

All the images above show that there are distinct characteristics of the tiles, rocks or bricks in terms of their sizes and shapes that when arranged in a certain way they create a pattern or structure whose outcome illustrates some kind of functionality, such as the waterproof roof, the riverbed and the wall. The illustration of these images highlights a few important points: first, there are at least two distinct elements; second, they are arranged (or imbricated) in an interlocking or intertwining manner with each other; and third, the outcome of the arrangement forms some kind of pattern so that the structure performs a specific function. This metaphor can be related to the work practice in organizations: referring to the image of the roof structure, the “tegula and imbrex [or different types, sizes, and shapes of

rocks on the riverbeds, and bricks on the wall]… [the social and material agency] have distinct contours and through their imbrication they come to form an integrated organizational structure" (Leonardi, 2012a, pp.36-37, 2011; Taylor, 2001). Diagram 3.1 (see also Leonardi, 2012b, p.43) provides an illustration of the imbrication process, which will be discussed next.

Diagram 3.1
Imbrication Process



Source: Developed by Author

The first point that needs to be highlighted from the imbrication metaphor is that there are two distinct elements that are involved in the imbrication process. It is important to point out here that this understanding differs from the *notion of constitutive entanglement* associated with Orlikowski & Scott (2008). The imbrication perspective indicates that, inherently, human and material agency has its own capacity of action. According to Leonardi (2012a, 2012b), social and material agencies have the capacity of action by themselves. As he stresses, if one tries to examine the "communication pattern and technology features under a

microscope, one would find communication patterns and technology features are made up of the same building blocks: social and material agencies" (Leonardi, 2012a, p.45). This indicates that rather than saying that the material and social are inherently interdependent, as suggested by the notion of constitutive entanglement, the imbrication concept holds that these two agencies are distinct, independent entities.

Similar to Pickering (1995), Leonardi (2012b, p.35) defines human agency as the "ability to form and realize one's goal". He further says that human agency has "intentionality [that is] formed in partial response to preconceptions of a technology's material agency" (ibid, p.42). This means that people exercise their ability to act by pursuing their goal as a response to the perception of the material's agency.

While human agency is the capacity of actions initiated by response towards material agency, Leonardi defines material agency as "the capacity for nonhuman entities to act [in the] absen[ce] sustained human intervention" (Leonardi, 2012b, p.35). This means that inherently the nonhuman entity (i.e. the material or technology) has its own capacity for action without having to interact with humans. It is temporally constant over time and context. It is there and will be "activated as humans approach technology with particular intentions and decide which elements of its materiality to use at a given time" (ibid, p.42). The material exercises its agency through its performativity, that is, "through the things they do that users cannot completely or directly control" (ibid, p.36). For example, whether or not somebody is using it, a calculator has its own program which does not change. The calculator program performs its job to calculate a maths exercise when approached by a human who keys in the numbers. However, the human does not have control of how the programming works. Although the material's agency is activated by a human, the artefact (in this case the calculator) itself has its own performativity that is not controlled by a human. Therefore, as Leonardi concludes, human agencies and material agencies "represent capacity for action, but they differ with respect to intentionality… [that is] even though social and material agencies might be equally important in shaping one's practice, but they do so in qualitatively different ways" (ibid, p.36).

Having said that, although Leonardi emphasized that human and material agency have their own inherent characteristics, the concept of imbrication "suggests that social and material agencies **are effectual at producing outcomes only when they are joined together**" (Leonardi, 2012a, p.46, emphasis added). This leads to the second point mentioned earlier, that the two distinct agencies are 'arranged' or imbricated in an *interlocking or interweaving manner and produce some kind of pattern or structure***.** In explaining the manner in which

human and material agencies become entangled, Leonardi (2011, 2012a, 2012b) employs the concepts of affordance and constraint.

The concept of affordance, introduced by Gibson (1986) in the field of ecological psychology, suggests that the affordance of material lies in the perceptions of users. He suggests that even though material has its own properties, humans may interpret/perceive its affordability differently according to the context they are in. In contrast to Gibson, Norman (1999, 2013), who brought the concept of affordance to the design of technology research, suggests that it is the job of the designer to make technology affordance obvious for the users to perceive and use (Faraj & Azad, 2012; Leonardi, 2011; Robey et al., 2012). He suggests that affordance is built into the technology itself which is waiting for the users to engage with it and perceive its affordability. This is where he differs from Gibson's definition of affordance – they are similar in saying that affordance lies in the agency, but while Gibson suggests that affordance lies in the perception of the user, Norman claims that it lies in the material itself.

Moving away from placing affordance in either humans or material, Hutchby (2001) describes the concept of affordance in a more relational way. For Hutchby (2001), affordance is seen as not being inherent in humans or material but emerging from the possibilities of action that users perceive the technology has. In terms of the concept of affordance, Leonardi takes such a relational perspective where humans "draw attention to the material [and/or technology] constraints on social action that cannot be removed through social interpretation" (Faraj & Azad, 2012; Leonardi, 2011; Robey et al., 2012, p.222). Following this relational view, Leonardi argues that the perception of either affordances or constraints are constructed when people attempt to use such material to pursue their goal(s). As they approach the materiality of the material to achieve their objective, the perception of affordance (or constraint) is constructed and based on that, they will decide the manner in which imbrication will happen.

As mentioned above, material properties of an artefact remain the same across time and space, but the affordance does not. Affordance of the materiality will depend on how humans perceive the materiality or function of the artefact. Leonardi (2011, p.153-154) elaborates on this, stating that

> affordances and constraints are constructed in the space between human and material agencies… The argument is that as people attempt to reconcile their own goals with the materiality of a technology, they actively construct perceptual affordances and constraints. Depending on whether they perceive that a technology affords or constrains their goals, they make choices about how they will imbricate human and material agencies.

By saying this, Leonardi is concluding that neither human nor material agencies are 'reconfigurations of the world' but only when both engage with each other (where, in such engagement, human agency approaches material with its intentions and perception of materiality as either affording or constraining them in achieving their goal, and the material exercises its performativity) can sociomaterial practice emerge. This makes clear the second point I mentioned above: the reconciliation of human intention and material's materiality constructs the perception of affordance and constraint, and this then decides the way in which they arrange, or become entangled. As an outcome of such entanglement, a pattern/structure emerges (i.e. the sociomaterial practice).

This part of the imbrication process will be illustrated especially in chapter 6. The concepts of affordance and constraint will be used to interpret the entanglement between the operators and supervisors at the plant and various material/technology within the production system and how this entanglement brings about the emergence of sociomaterial control practice. The concepts will also be used in the discussions found in chapter 7 and 8 which focus on how the sociomaterial practices happen within the interactions of groups of people regarding their daily/short term operations and long term target settings which reflect the imbrication process of human and material agencies.

Now that I have explained the imbrication process – how the social and material imbricates with each other and creates sociomaterial practice – I will move to the third point in order to explain the 'pattern' or 'sociomaterial practice' as a structure that performs specific functions, and the changes that happen over time. As explained above, the imbrication process is when the entanglement between the social and material happens in a certain manner depending on the way affordance and constraint are perceived, and which then eventually creates a pattern or structure – i.e. the sociomaterial practice, such as the waterproof roof, the riverbed and the wall.

There are three important points to highlight with regards to the pattern/structure that is created from the process of imbrication. First, that once the imbrication process settles, the overlapping arrangement will form a structure which is arbitrary in terms of its starting and ending point. Second, although the imbrication process seems to form a structure, it is temporal in nature and changing. Lastly, the changes that happen are influenced by the previous sets of imbrications and will then influence the future imbrication process but not in a predictable way.

On the first point, although I have been explaining that the social and the material are independent entities, as the imbrication process settles the overlapping arrangements start to create a *stabilized pattern that has an arbitrary starting or ending point*. To illustrate this, Taylor (2001, p.282) explains the imbrication outcome using the analogy of a brick wall:

> the wall has now become interpretable as a parallel adjunction of imbrications, each overlaid on the previous (think about how you would lay bricks to construct a wall). The problem is that the theoretical choice of a left-handed versus a right-handed orientation is arbitrary… There is no 'right' way to read the tiling strategy.

This is re-emphasized by Leonardi (2012a, p.52), who states:

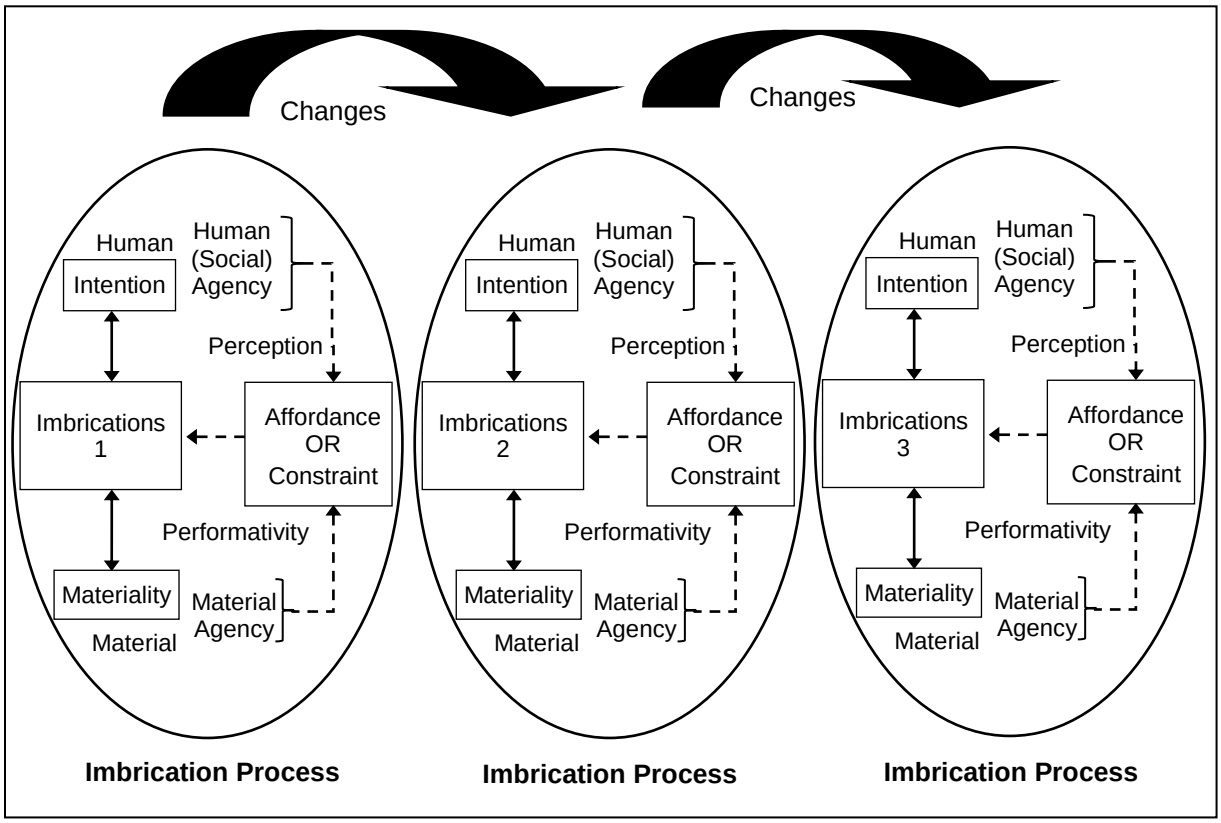
> of course, where one begins reading the chain of imbrications (whether from a material-agency starting point or from a social agency starting point) is somewhat arbitrary, and the chain of imbrications certainly stretches out in either direction. In other words, it is arbitrary to look for a beginning point or an end point in an imbricated system. Instead, the researcher should be more interested in explaining how imbrications occurs, and in how earlier sequences of imbrication affect future actions.

This implies that in contrast to the "image of causality provided by the metaphor of impact", the imbrication metaphor gives the impression that "there is no way of knowing what is cause and what is effect… In fact, the metaphor of imbrication should drive researchers away from attempting to identify the causal nature of a structure – of a brick wall or an organization" (Leonardi, 2012a, p.44). The imbrication process captures the gradual process of continuous interrelations of human and material in the dynamic and cyclical way of work practices in organizations.

In short, as illustrated in the diagram 3.1 the imbrication process shows the way in which sociomaterial practice emerges from the interweaving of the human and material agencies. The two inherently distinct elements with their own capacity of action, just like the tegula and imbrex or the different forms of rock or different shapes of brick, become entangled and emerge as a sociomaterial practice. Human agency is expressed through its intentionality (that is, to form and achieve certain goal(s)), while material expresses its agency through performativity (that is, the function that the material has that is not within the control of humans). The way in which humans decide on how to use the materiality of the material is based on the perception of affordance or constraint that the material can perform. This entanglement between the two agencies is imbricated in the space where the sociomaterial practice is enacted and becomes a pattern that serves a specific function.

So far, the first point that I have discussed about the outcome of the imbrication process seems to indicate that once a structure/pattern is built, it is quite solid and has an element of resistance to change (Taylor, 2001). The second point that I will now highlight explains that this is actually not the case. Although the structure/pattern seems unchangeable, Sassen (2002) and Leonardi (2011, 2012a) explain that change is possible by illustrating imbrication through the analogy of the arrangement of rocks on a riverbed. Specifically, Leonardi (2012a, p.44) writes: “Just as an overflow of water in a river can upset existing patterns of rock imbrication along its shore, new policies or strategies within an organization may reconfigure existing patterns of social and material agencies”. This implies that as the imbrication process happens, a pattern (sociomaterial practice) emerges, but this pattern only stabilizes temporally. This is similar to what Pickering (1995, p.22) says about scientific practice - that it emerges temporally when the “goal-oriented and goal revising dialectic of resistance and accommodation [happens]... [where] resistance denotes the failure to achieve an intended capture of agency in practice, and accommodation [is] an active human strategy of response to resistance”. Leonardi (2012a) claims that as people work with technology, their goals change and their needs change. The perception of affordance and constraint either changes the routine in which people imbricate with the features of technology to achieve their goal or change the technological material feature itself. Leonardi goes on to suggest that if people perceive the technology as affording them the opportunity to do certain things, they will change their routine, but if they perceive technology as constraining them, they will change the technology. Therefore, the imbrication process not only illustrates the entanglement of human and material agencies to form a “figuration [that] ha[s] staying power” (ibid, p.46) but also captures the dynamic process of organizational work by showing that the perception of affordance and constraints also leads to a gradual process of interrelation between the agencies. This results in a sequence or chain of imbrications. Diagram 3.2 below provides an illustration of the chain of imbrications that happen in organizational work.

Diagram 3.2
Chain of Imbrications Process



Source: Developed by Author

Each of the ovals in Diagram 3.2 represents the imbrication process that happens between human and material agencies that form a pattern of sociomaterial practice based on the affordance and constraint perception. However, these imbrication processes do not happen in isolation of the other imbrications that happen within the context. Each imbrication that happens is influenced by the previous imbrications that happened before the present one. Leonardi (2012a) emphasizes that it is not just new humans and new material that are involved in each of the imbrication processes. Every time the imbrication process happens, the agencies are "interwoven with an entire history of imbrication that came before it. [For instance] one might consider that the tiler of a roof doesn't just imbricate a new imbrex with one existing tegula – she imbricates an imbrex-tegula relations that came before it and that history influences, to an important degree, where and how she can place the newest tile" (Ibid, p.52). Thus, the metaphor indicates that although the manner in which imbrication happens is based on the perception of affordance or constraint of the material or technology, the perception itself is influenced by the previous manner of imbrication. However, as reflected earlier, the arbitrary nature of the starting and ending point of the imbricated

structure indicates that the influence of previous imbrications on the present one does not happen in a causal and predictable manner.

In short, the third point tries to highlight the idea that the present imbrication is affected by the previous chain of imbrications and continues to influence future imbrications. However, as Leonardi (2012a, p.47) stresses, each and every one of the imbrication processes is not "replicated in the same way over time and doesn't necessarily have inertial tendencies". Therefore, although it means that present imbrication is affected by previous imbrication and also affects future imbrication, it is not a predictable, causal relationship.

Using the concept of chain of imbrications, Chapter 7 illustrates the changes that happen in the short term within the production plants - i.e. it explains the changes that were made in the production control activities which also reflects the interactions between different groups of operations team and management team and how one imbrication influences the other. While chapter 7 illustrates the micro and short term operation activities, chapter 8 will illustrate the long term changes in the management planning that happen, reflecting the influence of previous sociomaterial imbrication processes on the new imbrication process.

3.4 CONCLUSION

In summary, the concept of the sociomaterial imbrication process offers some insights into our understanding of the interweaving process of the social and the material in explaining the sociomaterial practice. The first point to be made using the metaphor of imbrication is that there are two distinct elements arranged in a way that they overlap each other to function interdependently in creating a practice. This captures the elements of the social and the material with their inherent ability of action but only interdependently will they create organizational realities – i.e. sociomaterial practice. The perception of affordance and/or constraint decides the manner in which imbrication between the two agencies happens. Second, the overlapping arrangement of these elements (social and material) results in a creation of a stabilized 'pattern' or structure of functionality. The pattern is arranged in such a way that it is not important to see where it starts or ends because of the continuous interweaving of the two agencies. This implies the gradual process of interrelation which therefore captures the dynamic element of organizational work and realities. This is not the same as the causal relationship that shows one element impacting on another, but rather shows the way two agencies interrelate with each other to create work realities. Third, although the 'pattern' suggests a 'structure' which might indicate an element of resistance to

change, Leonardi (2012a) and Sassen (2002) have emphasized that change is possible just like the “overflow of water in a river can upset existing patterns of rock imbrication along the shore” (Leonardi, 2012a, p.44). The sociomaterial practice is temporal and this captures the continuous dynamic in the organization where when changes happen within the organization, it will reconfigure the previous pattern and recreate the new sociomaterial pattern continuously. Lastly, the changes that happen over time produce chain of imbrications between the social and the material, and the imbrications in the present are affected by a series of previous imbrications and also affect the way in which future imbrications will happen. However, the nature of influence of each imbrication to another is not a linear or predictable one.

As I have noted this in Chapter 2, there is a concern that our understanding of the MACs practices from the existing literature is rather limited. We either see how the technology (e.g. other independent technology such as operation technology, or accounting technology such as budgeting, ABC or ERP system) is impacting the MACs practice, social behaviour and organisational performance or how the people/social and context influence and interpret the (management) accounting and control so it is used in the way that people interpret it to be. The sociomaterial practice approach can offer a fresh lens in the way we understand the MACs practices and accounting in general. Within the sociomaterial approach, the two elements (social and material) are brought together to explain the MACs practice. The missing ‘meeting point’ of the performativity of material/artefacts or technology and its ‘infrastructure’ with the social and context that was highlighted by Dechow and Mouritsen (2005) can be addressed using the sociomaterial approach illustrated by the imbrication process and chain of imbrication concepts.

In my research, I will be using this imbrication concept to provide a framework to illustrate the MACs practice as a sociomaterial practice in a midstream palm oil production process. Instead of giving more attention to either one of the agencies, my research will illustrate that the MACs is a sociomaterial practice which emerges from the imbrication process between human and material agencies, and the changes that happen in the MACs practices are a sequence or chain of sociomaterial imbrication processes.

The focus of this research is on the production activities of a palm oil refinery. The activities involve a production technology (called PLC) that is utilized for controlling the process of production. A few groups of people such as the plant employees, the lab analyst and the refinery management as well as the head office administrative management are directly and indirectly involved with the daily decisions and long term planning and decision making

related to the production process and performance. Using the sociomateriality approach and imbrication process, I will show that the MACs practices at the production site emerge from the entanglement of these people with the technology which are in every aspect calculative in nature. The interactions that happen among the people are also fundamentally sociomaterial. Moreover, the dynamic property of the chain of imbrications will illustrate the dynamic nature of MACs practices, i.e. firstly how the MACs are implicated in the daily practices at the production sites, and then, in turn, how the imbrications at the production site are implicated in the discussion of MACs and the changes that happen over time on the MACs.

The next chapter will describe the methods used during the data collection process and the steps I took in analysing the data. Following the methods chapter are three chapters where I illustrate the MACs practices from the perspective discussed in this chapter; this is then followed by the discussion chapter and conclusion.

CHAPTER 4
RESEARCH METHOD

4.1 INTRODUCTION

This chapter outlines the research methods that have been employed in conducting this research. First, I will discuss the broad philosophical stance that underpins this research and the suitability of methods used in relation to the philosophical/methodological stance. Then, I will outline the steps taken during data collection, the duration of the data collection period, the kind of data that was collected during the field visit and the way it was analysed. This is followed by discussion of the validity of the data collection and analysis. Lastly, I briefly discuss issues of an ethical nature related to my research.

4.2 OVERVIEW OF INTERPRETIVE RESEARCH

Myers (1997. p.2) states that any "research is based on some underlying assumptions about what constitutes 'valid' research and which research methods are appropriate". In other words, a research method/technique may be more suited to the particular ontological and epistemological beliefs that underlay one research project in comparison to another (Morgan & Smircich, 1980; Searcy & Mentzer, 2003; Silverman, 2001). In line with the philosophical stance of this research study that has been discussed more extensively in Chapter 3 (see also Chapter 1), I will briefly explain here more about the interpretive research framework that I apply and the methods most appropriate for it.

Interpretive researchers hold an assumption that the world can only be understood as a social construction consequent on discourse and language which produces shared meanings and understandings (Chua, 1986; Morgan & Smircich, 1980; Searcy & Mentzer, 2003). In contrast to the positivist/functionalist accounting research, which assumes objectivity and external nature of social reality towards the subjects, the interpretive research is based on the assumption that "social reality is emergent, subjectively created, and objectified through human interaction" (Chua, 1986, p.615). Interpretive epistemologies are broadly based on the idea that the social orders are generated and changed through the interactions and activities of actors in a specific context (Ahrens & Chapman, 2006; Hopper & Powell, 1985; Scapens, 1990). It also assumes that the world does not exist independently from the researcher (Searcy & Mentzer, 2003) and is "shaped by the theoretical interest of the researcher"; thus, individuals are not just part of an independent, objective, empirical world, as is assumed by the positivist researcher (Ahrens & Chapman, 2006).

The focus of an interpretive study is “to enrich peoples understanding of the meanings of their actions, thus increasing the possibility of mutual communication and influence” (Chua, 1986, p.614). It also describes the way subjects make sense of their relationship with their world and how it is “constructed and negotiated” (Hopper & Powell, 1985, p.446; Morgan & Smircich, 1980). Interpretive researchers emphasise the subject’s perceptions of what constitutes the reality they experience rather than assuming that reality is independent and external to them (Hopper & Powell, 1985). Therefore, interpretive research helps develop an understanding of “human thought and action in social and organizational contexts” (Klein & Myers, 1999, p.67) and can produce deep insights on social phenomena. The way in which this research is conducted is in line with the assumptions discussed above where interrelations between actors in the organisational context are observed in order to understand the way the context is constructed and negotiated and the meanings that are attached to it.

In management accounting research, interpretive researchers try to understand day to day practice by having a “close contact analysis of human interaction” (Ahrens & Chapman, 2006; Ahrens et al., 2008, p.844; Boland & Pondy, 1983). Accounting systems and practices are not treated as natural phenomena (phenomena that is ‘out there’) but are socially constructed (Scapens, 1990). Accounting systems are viewed as “grounded in the social process of the organization and its environment” (Chua, 1986, p.617), rather than a tool to shape behaviour in order to achieve goals in organisational settings. In other words, interpretive researchers seek to explain that people have different perceptions toward accounting systems when they are used and in response to how they are used at different times and in different situations (Hopper & Powell, 1985). While positivist researchers try to help decision makers understand the interaction of variables in the real world (which is external to the participant) (Scapens, 1990), interpretive accounting research tries to explore the use of accounting “as a symbol that structures ongoing day to day organizational action” (Ahrens & Chapman, 2006, p.832). In accordance with this philosophical lens, my study tries to uncover the MACs practices and the changes that happen in an organisational context. The approach I use requires close contact with the different actors (human and non-human) and close observation of their day to day activities to understand their interactions and the interpretations of the social and sociomaterial processes of which they are a part.

4.3 CASE STUDY METHOD

As mentioned earlier, Myers (1997) states that specific types of research inquiry are inseparable from their underlying assumptions and epistemology which makes certain methods more appropriate than others (Bryman & Bell, 2011; Silverman, 2001). According to these authors, interpretive research primarily applies qualitative field research because the ontological and epistemological stance of this kind of research "requires close engagement [with the organization, its actors and environment] rather than objective, distance capture" (Ahrens & Chapman, 2006, p.827) in order to understand the context and process and capture the way they shape each other. Accordingly, this study adopted the qualitative research method – more specifically, a case study method in a single organisation. This approach provides an appropriate means to develop a rich understanding of accounting and associated functions, the use of management accounting and controls together with the nature of the environment and context (Ahrens & Dent, 1998; Chua, 1986; Jørgensen & Messner, 2010; Scapens, 1990).

An in-depth case study was undertaken over two different periods - a period of 3 months from June to September 2012 and another visit consisting of several days in April 2014. Data was collected using multiple data collection techniques which included semi-structured interviews, informal conversation, analysis of documents, observations in work settings, and observations of meetings. Throughout this period, the usual time spent at the organisation was from 8.00am to 5.00pm (i.e. according to their office hours) every working day (i.e. Monday to Friday at the head office and depots, Monday to Saturday at the refinery). Occasionally, I did go to the refinery, either earlier at about 6.00am or after office hours up to 11.00pm. This was especially the case when I was observing the work that was routinely done early in the morning, such as taking daily stock at the storage tanks, and also when observing the night shift work at the refinery.

4.4 DATA COLLECTION PROCESS

4.4.1 Negotiating Access and Duration to Enable Data Collection

Getting access to organisations to conduct research is one of the critical challenges that most qualitative researchers have to face. A target case organisation was first approached in early January 2012. Being quite fortunate in using the network that I have, after emailing a brief proposal which explained the objectives of my research I managed to obtain an appointment with the CEO to negotiate further on the level of access I was permitted to

have. During the meeting, I further explained the nature of my study and was granted permission to conduct my study in the organisation. I was introduced to the human resource senior manager with whom I later communicated to arrange a schedule for visits to many of the different locations where the business operates. During the first visit I also had the opportunity to interview one human resource officer and one operation officer for an overview of the organisation's operations and locations. This information was used to help direct and schedule my data collection which started in June 2012.

The formal data collection procedure started in early June 2012 and lasted into September 2012. During that duration of time, one month was spent at the head office, six weeks were spent at the refinery, two weeks at the depots and a week at an outside location to observe the budget and strategy retreat meeting.

After the initial round of visits, observations, interviews and document identification and collection, data were analysed to identify the themes for the theorisation and discussions of this thesis. While doing so, some further questions were raised which led me to organise another later visit to the refinery. In April 2014, a one week visit was made to the refinery to clarify and further investigate the processes at the plant. This also provided the opportunity to identify any changes that happened during the 18 months between the first and second visits to the refinery. Extensive amounts of data were collected during both visits and will be discussed in the next section.

4.4.2 Data Collection

The organisation (Golden Crop Co. – a pseudonym) operates in several dispersed geographical locations which can be categorised into three main operations – the head office, the refinery and the depots. The head office is located in Kuala Lumpur, Malaysia. The refinery where the midstream and downstream production activities are conducted is located in the southern part of Malaysia which is about 350km from Kuala Lumpur. Lastly, the depots are situated at 11 different locations across the states in Malaysia (a more detailed description of the size and operations of the case organisation and its dispersed locations as well as the products is provided in Chapter 5). Although the focus of this research is mainly on the refinery and its related operational and managerial activities, data was collected across all locations. Time spent at these multiple locations was primarily used to understand the company, company policy, business activity, technical processes, controls employed and documentation involved in day to day operations across the organisation. As

mentioned earlier, multiple data collection techniques were employed which I will discuss next.

4.4.2.1 Interviews

Formal interviews and less formal conversations were conducted at multiple locations which included the head office, refinery and all depots (please refer to Appendix 1 for a list of the formal interviews). At the head office, interviews were conducted with the officers, managers, senior managers, heads of department and the CEO. Interviews at the refinery were with plant operators and supervisors in the different sections. In addition, production executives, engineers, factory managers and other administrative executives were also interviewed. Lastly, interviews at the depots were conducted with the heads of depots and a number of sales executives and sales persons. A total of 69 formal interviews were conducted out of which 25 interviews were at the refinery, 16 at the depots and 28 at the head office in the first round of data collection. An additional 10 further interviews at the refineries were conducted during the second visit in 2014. These 10 additional interviews were mostly conducted with the same people who were interviewed in the first visit with the exception of one chemist based in the laboratory and one refining plant operator. On average, the length of each interview was 1 hour and 45 minutes. Much of the analysis presented in the empirical chapters (Chapters 6, 7 and 8) is focussed on the interviews conducted at the refinery and head office that related specifically to the production and refinery processes and budget practices. However, the other interviews, such as those conducted at the depots and with some personnel of other functions unrelated to the production processes and budgets, have helped significantly in getting the whole picture of the workings of the organisation and a closer understanding of the marketing and distribution (within Malaysia and for export) of its products.

Interviewing is a method that is both frequently used and a justifiable method of data collection in interpretive research. However, researchers should not rely too heavily on highly structured questions (Bryman & Bell, 2011). Interview questions should be based on a broad framework to help the researcher keep track of his/her research aims. Usually, a semi-structured or unstructured interview approach is considered most appropriate for this kind of research (Bryman & Bell, 2011). According to Bryman & Bell (2011), structured interviews may be used to establish a broad framework for the case during the initial stages of the research, where similar questions will be asked of interviewees but still maintain a certain level of flexibility to explore emergent issues. Then, a more unstructured interview technique

is used as it gives more room for the researcher to be flexible and probe new issues and ideas as they arise while conducting the research.

During the interview session for my research, a semi-structured form of interview technique was employed as it kept the discussion within the frame of the research, while at the same time allowed for flexibility in following up the issues that arose. Mostly, the interview sessions started with similar inquiries about the role that interviewees play in the organisation and control practices related to their job. These questions were then followed by more unstructured questions that developed consequent to the earlier part of the interview. The interviews were mainly focussed on getting a sense of what constitutes MACs in the day to day activities in the organisation. A considerable flexibility was given to the interviewee to express their real interaction with the accounting and control system. All but one of the interviews were tape-recorded and transcribed. Written notes were also taken during and after the interview session.

Besides the formal interviews, informal and unrecorded interviews were also conducted during this time. This was done especially during breaks. Most of the information gathered from the informal conversations aimed to get a 'feel' for the deeper, personal feelings of the people and their relations with each other as well as their feelings towards the organisation. I made a practice of creating a written note at the end of each day during the data collection process to reflect my understanding and experience during the day.

4.4.2.2 Observations

Observations were done broadly in two ways - i.e. daily activity and at meetings. Daily activity observations included observing employees at the office and operations sites (plants, production areas, logistics locations) during their normal working hours, during breaks such as during lunch as well as after office hours. As suggested by Scapens, informal observations might suggest "new issues to explore [and might serve as] indications about the validity of information sources" (Scapens, 1990, p.274). A schedule of somewhat formal observations was conducted at the refinery including at the different sub-sections and individual parts of the refinery plant and within the refinery offices during the formal office hours, while the informal observations were mainly done during lunch break and after office hours. They took place on an opportunistic basis in the refinery canteen where most of the employees (both operational workers and managerial personnel) hung around during these times. Conscious attempts were made to have conversations; sometimes I just sat with

different groups of people at different times. Bryman & Bell (2011, p.432) also caution that "the more familiar you are with a social situation, the less you may be able to recognize the tacit cultural rules that are at work". Therefore, the researcher should always be attentive and consciously observe behaviour that might provide evidence that is directly and indirectly related to the scope of the study. The diarised notes prepared at the end of each day, mentioned earlier, were also an attempt to address this caution.

As for meetings observation, a total of 16 meetings were attended (please refer to Appendix 2 for a list of meetings attended) – 14 during the first visit for the data collection and 2 in the second visit. Out of these, 11 meetings were attended at the refinery and a 5 at the head office. Main meetings attended at the refinery were the 'morning meeting' between the refinery management team and plant employees (mainly plant supervisors) regarding daily production planning and performance. The data from the observation of these 'morning meetings' is discussed in depth in Chapters 7 and 8. Other meetings attended at the refinery were the operations briefing and one meeting with the suppliers. The meetings that were attended at the head office included one budget preparation meeting, one head of department meeting and three Marketing and Product Development Department's meetings, out of which one was with the Operation Department, one with the International Business Department and one was with the advertising company. Extensive written notes were taken for these observations as no tape recordings were allowed.

4.4.2.3 Review of Documents

In addition to the formal and informal interviews and observations mentioned above, a range of documents used and produced by the people and systems within the organisation were collected for the analysis procedures. Documents collected included samples of accounting reports such as budgets and budget variance reports, production reports, minutes of meetings and various manuals such as standard procedures. Besides documents within the organisation, other public reports such as the palm oil statistics and some other publications from the palm oil bodies were also collected in order to be analysed to better understand the organisation as well as the industry in general.

As mentioned earlier, research notes were taken during observations at all these locations. Notes were normally written after each interview, while doing daily observations and meetings observation, as well as after informal conversations and reflection at the end of each working day. This documentary evidence totalled more than six thousand pages.

4.5 DATA ANALYSIS

In line with the interpretive philosophical stance and sociomateriality perspective employed in this research, the data analysis processes were designed with the aim of making sense of the interactions between actors (human and material) and the meaning attached to their everyday activities within the context (Ahrens & Chapman, 2006; Ahrens & Dent, 1998; Chua, 1986). I took a broad approach to understanding and defining what constituted MACs practices in the day to day activities of the organisation.

As mentioned earlier, all interviews were transcribed. During the transcription process, patterns and themes were identified and used to try to construct explanations that could make sense of the data. At this stage, the data were analysed with the intention to identify the overall control practices in the organisation. While transcribing the interviews using Microsoft Word, themes and patterns were manually recorded in a separate worksheet in two ways i.e. record the theme and cross reference it to the transcripts (at specific elapsed times, and by drawing mind map style diagrams to provide further depictions of what appeared to be interesting/important linkages. Some of the recurrent themes were related to operation process flow, quality issues and controls, functional and individual performance measures, communication between divisions, support from the head office, accreditation, manual and electronic documentations processes, and market demands. These themes emerged and were commonly reinforced across interviews conducted at the refinery and head office.

As the main concern of this research is to understand what constitutes MACs practices and how these control practices are implicated in the day to day activities in the organisation, particularly in the operational/production processes, there were three main constructs used during the second round of systematic and careful reading of the transcripts - i.e. the existence of MACs, the relevancy/roles these systems play in day to day activities, and the actors (human and non-human) that are involved in exercising these activities and practices. These constructs help to link the various themes identified during the initial analysis (the diagrammatic representations noted above). Observation notes and documents collected were used to see the link between the various work and management groups as well as to see the bigger picture of the flow of controls throughout the organisation. The notes and document records were also used to cross check the consistency of the interview data collected and the story line constructed. The theorisation process was done in parallel with the writing up of the story/case interpretations Concepts within the theory employed (i.e. materiality, intentions/goals, affordance and constraint, imbrications, and chain of

imbrications) inform the construction of the story line during the second round of data analysis in making sense of the flow and linking between the three constructs mentioned above. The empirical chapters of this thesis are mostly informed by the 35 interviews (mainly with operators and supervisors at the production sites and with management personnel directly in charge of the production activities) as well as meeting observations at the refinery.

Throughout the data analysis process, a list of management accounting practices and controls were identified. The usage of MACs techniques such as budgets, functional performance measures, individual key performance indicators, and balance scorecard were observed. The relevancy of each of these techniques on the day to day control practices was traced. This was done, in part, by identifying the frequency and repetition occurring during interviews (Bryman & Bell, 2011), the importance indicated by the interviewees, the amount of importance attached to the preparing of specific documentation relating to the MACs as well as the frequency of use of these documents in the day to day discussions and decision making processes. Through this exercise, I could make sense of which of the controls played a significant role in day to day activities and which just served as formal documents and records but were somewhat dislocated from practice. The importance of budgeted figures and controls seemed to be of common significance throughout the organisation and produced the most important patterning in managerial activity identified throughout the organisation, not only at the production sites but at various hierarchical levels and functional areas.

In further processing the data, activities in relation to the budgeting cycle and numbers were recognised. Main patterns, especially the quality parameters (e.g. colour and IV value), were found to be significant concerns in the day to day operations and discussions within the organisation. Interactions and negotiations among actors (human and non-human) in exercising controls related to these patterns were recognised and theorised.

4.6 VALIDITY OF DATA COLLECTION AND ANALYSIS

Different concerns apply to the reliability and validity (internal and external) of research data and analysis between positivistic and interpretive research. Reliability in the view of the positivist researcher refers to “the extent to which evidence is independent of the person using it... [and consequently] implies an independent, impersonal investigator” (Scapens, 2004, p.268), while validity can be expressed as “the extent to which the data are in some sense a ‘true’ reflection of the real world [i.e.] objective reality”. However, this kind of

reliability and validity measurement is not suitable for qualitative field research (Ahrens & Chapman, 2006; Scapens, 1990) and is in fact “meaningless in much case study research” (Scapens, 2004). It follows then that there are different views and ways of determining reliability and validity that may be considered appropriate to be applied in case study research in order to develop a plausible research outcome or research story. Bryman & Bell (2011) outline four characteristics to assess the trustworthiness of a qualitative research study, namely credibility, transferability, dependability and conformability.

Firstly, the credibility criterion is parallel to the internal validity concept which “indicates the credibility of the case study evidence and the resulting conclusion drawn” (Scapens, 2004, p.269). Bryman & Bell (2011, p.397) suggest that one of the techniques to ensure credibility of data is triangulation (i.e. using “more than one method or source of data in the study […] resulting in greater confidence in [the] findings”. In order to maintain the credibility of the findings, a constant cross checking of different data sources from the interviews, observations and documents was conducted.

Secondly, the transferability criterion can be argued to be parallel to the concept of external validity (Bryman & Bell, 2011). This is reflected in the thick and rich presentation of the case data and findings and can be seen to provide a basis on which others might make judgements about the possible transferability of the findings to other contexts (Bryman & Bell, 2011). The analysis and presentation of the case research later in this thesis has been done in as much detail as possible in order to provide rich information to try and satisfy this criteria.

Thirdly, the dependability criterion may be considered to be parallel to the reliability concept (Bryman & Bell, 2011). It requires the researcher to have a comprehensive and complete record of the whole research process. Scapens (2004, p.268) stresses that “it is important to know that [the] researcher has adopted appropriate and reliable research methods and procedures” which he calls procedural reliability. According to Scapens, in order to make sure that the procedural reliability is achieved, the researcher should “have a good design that addresses clearly specified research questions; […have a] comprehensive research plan; [make sure] all evidence [is] recorded in coherent and comprehensive notes; and [make sure] the case study [is] fully documented” (ibid, p268). According to the discussions on the data collection section above and the research question outlined in Chapter 1, all items on Scapen’s checklist have been addressed.

Lastly is the conformability criterion (parallel to the concept of objectivity) where the concern is to ensure that the researcher "has not overtly allowed personal values or theoretical inclinations manifestly to sway the conduct of the research and findings deriving from it" (Bryman & Bell, 2011, p.398). As complete objectivity is not possible in this kind of research (Bryman & Bell, 2011; Scapens, 2004), the conformability criterion has been given attention by getting feedback from other researchers within and outside the research area to try to approximate a relatively unbiased interpretation through continuous discussion with the supervisors and research colleagues as well as presenting the findings in conferences/colloquia.

4.7 RESEARCH ETHICS ISSUES

4.7.1 Risk Analysis

There was no potential for either physical or psychological harm to participants in any of the methods used. The questions asked throughout the data collection procedure were strictly professional and technical in nature. The conduct of data collection also did not raise any physical or psychological harm for me because the data were collected either in the offices, or refinery and depots which have their safety rules in place. In the case where observations or interviews were done in the operational area, I followed very closely all the safety rules in the refinery plants and depots.

4.7.2 Selection of Participants, Informed Consent, Confidentiality and Anonymity

The selection of the organisation was based on the intention to fulfil the chosen scope of the research by identifying an industry that would provide a good setting in which to investigate a complex, technology rich environment. A refinery in the palm oil industry was ideal. After selecting the organisation, the initial contact with the Chief Executive Officer was made through someone I knew in the organization. The introduction was made in person.

As mentioned earlier, during that initial meeting, the CEO introduced me to the human resource senior manager who then liaised with me for the whole research process. Participants were selected/identified for interviews based on a comprehensive list of employees and their job description that were supplied to me and whose jobs fitted within the scope of the research. The interviews were either arranged through the human resource officer in charge or I personally approached the participants when necessary. Although the

arrangement was made through the human resource senior manager, the voluntary nature of participation was ensured. Each participant was given an information sheet (with dual language provision – English and the local language) at the beginning of the interview session with brief information about the research, confidentiality of the data, their rights, the output intentions and contact details (please refer to Appendix 2 for a sample of the information sheet given to participants for the interviews). At the beginning of each interview verbal assurance on the same matter was also given, especially concerning their rights and voluntary consent and that they could withdraw their consent at any time during the interview and even after completion of the interview (unless the data from the research had already been made public). If all this was agreeable to the participant, I then requested them to sign the consent form (please refer to Appendix 3 for a sample of the consent form).

Regarding the participant observations at meetings and in the work place, the person in charge introduced me to all staff on my first day at each location that I visited (i.e. the head office, the refinery and the depots). At the head office, it was the human resource officer who did the introduction for me to all the staff there. As for the refinery site, the refinery manager was the one who introduced me to all the refinery staff. Finally, for the depots, the human resource officer informed staff by phone or email about my visit. This introduction was done to ensure that nobody was misled regarding my presence at the sites. During this introduction, I explained my research objectives and that, besides conducting interviews, I would be observing them at work and in meetings for the duration I was there. I distributed the information sheet regarding my research and requested for their consent and got their consent (signed/oral) as feasible depending on the situation (please refer to Appendix 4 for a sample of the information sheet for the participant observations and meeting observations).

With respect to the documents, for those that are publicly available, such as data from the organisation's website or publicly published documents, no consent was necessary for their use. For documents not publicly available, I made sure that I obtained permission from the concerned parties prior to their use in my research. To make sure that the process was transparent, before leaving any of the visited premises, I gathered all the documents and photos that I had taken and asked the person in charge to run through them before I took them away.

All the data collected have been stored using a coded system where no link can be made between the participant's information and the interview records, interview notes and observations notes. The participant's identifiable information - i.e. their original identities and the assigned code or pseudonyms - are stored electronically in a separate protected file that

is only accessible by me. When referring to a specific participant, only pseudonyms or job position (which is not identifiable to the specific individual) have been used. This is to ensure confidentiality and/or anonymity for each individual involved in my research.

4.8 CONCLUSION

This chapter covered the data collection procedures and analysis. The data collected, as described in this chapter, is used in the analysis that will be discussed in great detail in Chapters 6, 7 and 8. The next chapter will provide a discussion of the palm oil industry in which the case organisation operates and the overall organisational business activities.

CHAPTER 5
THE PALM OIL INDUSTRY IN MALAYSIA AND AN ORGANISATIONAL CONTEXT

5.1 INTRODUCTION

This chapter presents a narration of the historical context of the palm oil industry in Malaysia where the case research organisation operates. This is followed by the historical background of the organisation covering the period from its incorporation through to the present structure. Some important explanation of its operations is also given.

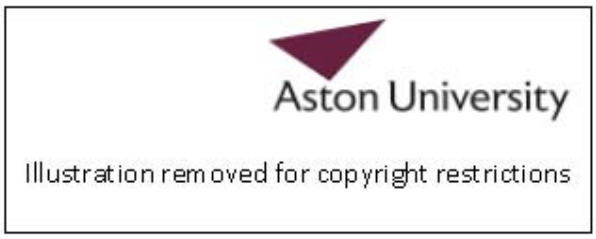
5.2 THE PALM OIL INDUSTRY IN MALAYSIA

The palm oil industry is (or, as some suggest, is possibly) the only Malaysian world class industry (Chandran, 2005). It contributed 4.67%, 5.7% and 4.5% of the country's Gross Domestic Product in 2010, 2011 and 2012, respectively (Department of Statistics, 2013). It also contributed a significant portion of the world's oils and fats production and exports (Carter et al., 2007). The industry also supported the country's faltering economic condition during the 1997 financial crisis. Malaysia was one of the ASEAN[1] countries that was badly hit during that crisis and the palm oil exports supported the economy and currency by stabilising the export earnings of the country (Fatimah, 2007).

Malaysia was the largest producer of palm oil for more than two decades until 2006 when Indonesia took its place as the highest volume producer of palm oil. The rise in Indonesian production was fuelled by investments in the Indonesian palm oil industry by a number of Malaysian companies, such as Guthrie Group Limited, Sime Darby Berhad and Lembaga Tabung Haji. However, statistics still show that until 2010 (MPOB, 2011), Malaysia remained the biggest exporter of palm oil in the world. Tables 5.1 and 5.2 below show the world's major producers and exporters of palm oil between year 2000 and 2010.

[1] Association of Southeast Asian Nations.

Table 5.1
World's Major Producers of Palm Oil: 2000 - 2010 ('000 Tonnes)



Source: MPOB, 2011

Table 5.2
World's Major Exporters of Palm Oil: 2000 - 2010 ('000 Tonnes)

*Note: * Re-Exporting Countries*
Source: MPOB, 2011

The economic importance and export earning value of the palm oil industry in Malaysia has led the government to give its development significant priority in policy formulation towards this industry. During the Second Industrial Master Plan period (1996-2005), the government approved investments for palm-based oil projects amounted to RM9 billion[2]. In the Third Industrial Master Plan (2006-2020), the industry is expected to expand into a wider range of high value added products and the government's investment target for the industry is RM26.1 billion for that duration (MITI, 2006).

Despite its importance and success, there are some worrying issues that have faced the industry in recent years which include declines in overall productivity, rising costs of production and skilled labour shortages throughout the value chain of the industry (i.e. at the plantations, mills, and the midstream and downstream activities) (Amna Awad & Fatimah, 2007; Carter et al., 2007; Chandran, 2005). As mentioned briefly in the introduction chapter, one of the most important factors that has enabled the Malaysian palm oil industry to capture the global market has been the relatively low price in comparison to other oils such as soybean, sunflower and rapeseed oil (Carter et al., 2007). Therefore, the increasing cost of production and reduction in productivity has been placing great pressure on the industry as it affects its competitiveness in the global market. This is especially problematic as, in recent years, Indonesia has surplus and cheap labour that has been used to aggressively expand its palm oil production and exports.

In an attempt to overcome these issues, people (the upstream, midstream and downstream producers - discussed later in section 5.4) in the industry have gradually shifted towards more technologically advanced production processing facilities equipped to produce a higher quality of oil in meeting global market demand. This action not only increases automation in the production process where less labour is needed, but also, it is hoped, helps increase efficiency and productivity of the process and lower effluent discharges. The technology intensive nature of the palm oil industry fits with the objective of this research given that the focus of this research is on examining the material and human role in the practice of management accounting and control. These issues are also discussed in chapters 2 and 3.

The next section will outline the historical development and the value chain of the palm oil industry in Malaysia. This is followed by a description of the organisation in which the case study was conducted.

[2] GBP1.00 equals RM5.37 (exchange rate as of 12th August, 2014).

5.3 HISTORICAL DEVELOPMENT

Although the palm oil industry has become an important industry in Malaysia over the last 40 years, it had relatively humble beginnings. The oil palm tree - *Elaeisguineensis Jacq* - is indigenous to West Africa (Teoh, 2002) and grew wild there until being developed into an agricultural crop. Four original seedlings from West Africa were introduced to the Bogor Botanical Garden, Indonesia in 1848 (Teoh, 2002; Yusof & Chan, 2004). Twenty-three years later, the seeds were brought to Malaysia and the resulting trees were initially used merely as decorative plants around government offices and public parks (Khoo et al., 2005; Yusof & Chan, 2004).

The first small scale commercial oil palm planting in Malaysia started in 1917 at Tennamaram Estate, Selangor, an estate which is still operating today (Amna Awad & Fatimah, 2007). According to Teoh (2002), the development of the Malaysian palm oil industry has undergone five phases (the experimental phase, development phase, expansion phase, expansion to East Malaysia and, finally, extension of upstream operations off-shore). The first three phases were in West Malaysia (all states in West Malaysia – Peninsular Malaysia), while the fourth phase was in East Malaysia (Sabah and Sarawak) which is separated from West Malaysia by the South China Sea.

5.3.1 Experimental and Development Phase

The experimental and developmental phase commenced in 1917 at the Tennamaran Estate and ran until around 1960. According to Corley & Tinker (2003), although the palm oil industry was already in full operation in 1947, the palm oil plantation/industry did not expand instantly since it was first commercially established because at that time (i.e. pre-independence – during the period of British colonisation) the main plantation players (dominated by the British companies) were placing more emphasis on the rubber plantations due to global demand (Fatimah, 2007).

5.3.2 Expansion Phase

The early 1960's saw a rapid expansion of the palm oil industry in peninsular Malaysia (West Malaysia). This was a consequence of a policy of agricultural diversification introduced by the then Deputy Prime Minister Tun Abdul Razak Hussein (Amna Awad & Fatimah, 2007; Yusof & Chan, 2004). The policy was introduced because of the diminishing return from the tin industry and a downward trend in rubber prices due to the introduction of substitute

products for rubber in the 1960s. Tin and rubber were the two major industries in Malaysia at that time. The development of the palm oil industry was supported by the government by

> [allowing] rubber-replanting funds to be used to plant oil palm... simplify[ing] the land registration procedure to facilitate the amalgamation of holding into viable unit[s]... lower[ing] export tax for palm oil... [moreover] growth of [the] small holders sector was encouraged and supported by the opportunities for milling and marketing provided by the infrastructure already existing for the plantation sector.
>
> (Amna Awad & Fatimah, 2007, p.377)

Furthermore, the cost of the transition from rubber to palm oil was considered to be low as the management and infrastructure requirement was similar to rubber.

5.3.3 Expansion to East Malaysia

In the 1970s, a large expansion of oil palm plantations was carried out in East Malaysia (Teoh, 2002), especially in Sabah which now has the largest oil palm plantation area among all the states in Malaysia. This was due to the limited amount of land in West Malaysia plus the government's plan to develop the East Malaysian social and economic position. Table 5.3 below shows the area under oil palm plantation in Peninsular Malaysia and the two states in East Malaysia (i.e. Sabah and Sarawak).

Table 5.3
Area under Oil Palm: 1975 - 2010 (Hectares)

Source: MPOB, 2011

5.3.4 Extension of Upstream Operations Off-Shore

Around 1995, Malaysian palm oil companies started to expand their palm oil plantation territories off-shore to places like Indonesia, Papua New Guinea, Liberia and other countries due to the difficulties in finding suitable land in Malaysia. Besides, the scarcity of the land, shortage of labour, especially with lower labour costs, was also one of the reasons for the overseas expansion (Teoh, 2002).

5.4 PALM OIL SUPPLY CHAIN AND ITS PRODUCTS

Teoh (2002) categorised the main players in the palm oil industry into seven categories, namely the upstream producers, downstream producers[3], exporters and importers, customers, industry organisations, government agencies, and others.

5.4.1 Upstream Producers

The upstream producers consist of private estates, government and state schemes and independent smallholders**.** Of the total planted areas in 2010, about 60% (approximately 2.9 million hectares) were under the private sector. The rest were smallholders - either participants of Federal Land Development Authority (FELDA) schemes, government and state schemes or independent smallholders. Table 5.4 below shows the 2009 and 2010 distribution by hectares and percentage of the oil palm planted area for the three categories.

[3] Please note that for clarity of exposition I subcategorise the downstream into midstream and downstream in this thesis, especially in the analysis chapters where I focus mostly on midstream production activities - chapters 6 and 7

Table 5.4
Distribution of Oil Palm Planted Area by Category: 2009 & 2010

Source: MPOB, 2011

Private estates were mostly owned by plantation companies (some of whom can be traced back to the pre-independence period) which started out as rubber estates and later shifted to palm oil plantations. These companies include Sime Darby Berhad, Guthrie Group Berhad, Golden Hope Plantations Berhad, Kuala Lumpur Kepong Berhad, and United Plantation Berhad. Others are 'home grown' plantation companies like Asiatic Development Berhad, Autral Enterprises Berhad, Hap Seng Consolidated Berhad, IOI Corporation Berhad, PPB Oils Palms Berhad, Tradewinds (M) Berhad and IJM Plantations Sdn Berhad (Teoh, 2002).

Government schemes are comprised of Federal Land Development Authority (FELDA), Federal Land Consolidation and Rehabilitation Authority (FELCRA) and Rubber Industry Smallholders Development Authority (RISDA) (Ayat et al., 2008). These three government agencies "were responsible for planting oil palm with large areas of land that were rehabilitated or newly opened" (Yusof & Chan, 2004). The schemes were implemented by encouraging landless people across states in Peninsular Malaysia to settle in a newly opened land scheme and plant palm oil; the government provided them with housing and infrastructure as well as provided them with financial facilities to survive until the oil palms matured, enabling them to trade and pay off these loan facilities (Yusof & Chan, 2004). These schemes were introduced as vehicles to eradicate poverty among the rural community and, indirectly expand the number of palm oil plantations in the country.

From among these agencies, FELDA has played the most significant role in the development of the palm oil industry in Malaysia (Teoh, 2002). FELDA is the largest grower of palm oil with approximately 15% (please refer to Table 5.4) of the total area of palm oil plantation in Malaysia. Originally, its establishment was with the objective to uplift the economic status of rural communities by "reallocating farmers from overcrowded uneconomical farms to new land schemes, developing new agricultural lands and also function[ing] as a redistributive scheme" (Fatimah, 2007, p.8). Initially the schemes were undertaken by coordinating with state governments and managing their development plan within each state - not having any involvement in palm oil. Later, in 1961, FELDA was assigned to conduct their own development schemes throughout the country using the opening of oil palm plantations as this was identified as a good approach to eradicate poverty while simultaneously developing the industry (Amna Awad & Fatimah, 2007; Yusof & Chan, 2004). The FELDA schemes also succeeded in diluting the monopoly of foreign plantation firms in the rubber and palm oil industry by the involvement of smallholders in the industry.

While FELDA, FELCRA, RISDA and the states manage the "organised smallholders" schemes, about 13% of the palm oil plantations are managed by independent smallholders. The interests of these smallholders is represented by the National Association of Smallholders (NASH), "a non-profit organisation created for the purpose of safe-guarding the welfare and rights of approximately 1 million smallholders cultivating various crops in Malaysia" (Teoh, 2002, p.127).

The big upstream producer companies are involved with the cultivation of oil palm, producing fresh fruit bunches (FFB) and operating mills to process them into crude palm oil and crude palm kernel oil. The independent smallholders sell their palm fruit to these companies to be processed because they do not own their own milling facilities. There are 420 mills throughout Malaysia (Directory of Malaysian Palm Oil Processing Sectors, 2010).

5.4.2 Midstream and Downstream Producers

The second category of stakeholders within the palm oil supply chain is the midstream and downstream producers. They consist of the refiners, palm kernel crushers, oleo chemical producers, and manufacturers of palm oil edible products and specialty oils and fats. The majority of refiners have an association with the oil palm plantation and milling sector or both (Amna Awad & Fatimah, 2007). The 2010 Directory of Malaysian Palm Oil Processing

Sectors listed 47 companies involved in palm kernel crushers, 54 refiners, 18 oleo chemical plants and 35 bio-diesel plants.

According to Teoh (2002, p.33), the midstream and downstream producers can be "broadly grouped under plantation-based companies, FELDA, independent manufacturing companies and subsidiaries or associates of multinational companies". As the largest upstream producer, FELDA is also a major player in the mid and downstream operations.

At the mill (upstream activity) the FFB are crushed and two main products are produced – i.e. Crude Palm Oil (CPO) and Crude Palm Kernel Oil (CPKO). This raw material is sent, by tanker or pipeline, to the refiners (midstream activity) to be refined into edible use (80%) and non-edible use (20%) which is then used by the downstream producers. The palm oil and palm kernel oil products that are categorised for edible use include processed palm oil (used for cooking), margarine, shortening, vanaspati, cocoa butter, and ice cream. The non-edible use includes oleo chemicals involving usage in products such as soap, polyacylate coating, printing ink, biodiesel (as diesel substitutes for fuel for transport and non-transport application) and drilling mud, and basic oleo chemical usage such as fatty acids, fatty alcohols, fatty nitrogents, and glycerols. (Amna Awad & Fatimah, 2007; Yusof & Chan, 2004). The company in which I did my case study is involved in the midstream and downstream activities mentioned above. Like most of the other organisations, this company also has associations with oil palm plantations and the milling sector for their supply of raw material (i.e. CPO) from upstream activities. I will further discuss the case company in section 5.5.

5.4.3 Importers and Exporters

The next stakeholder group is the importers and exporters. The main importing countries of palm oil over the past decade (year 2000 to 2010) have been India, countries from the European Union, the Republic of China, Pakistan and Bangladesh, while the world's major exporters of palm oil have been Malaysia and Indonesia (MPOB, 2011). Malaysia exported approximately 47% of the world's palm oil followed by Indonesia at 46% in year 2010. Plantation companies that are involved in midstream and downstream production and manufacturing companies of palm-based products are also exporters of palm oil products (Teoh, 2002, p.34). Rather than exporting CPO in its crude form, most of the products being exported are refined and processed. This is due, at least in part, to the government structuring of tax incentives that have been designed to encourage the adding of value to the

products and to encourage the industry to expand more into midstream and downstream production activities and research.

5.4.4 Customers

Besides the above three main players of the industry, there are another four groups of players among whom are the customers. Customers consist of institutional buyers, retail customers and investors. There are more than 200 licenced packers and distributors of palm oil that are registered with the Malaysian Palm Oil Board. They buy bulk oil, pack them into different types of small packaging and distribute them to the local or overseas markets.

5.4.5 Industry Organizations (Supporting Agencies/Organizations)

Next, representing the interests of the upstream and downstream producers, are the industry organisations. The table below shows some of the various supporting agencies which play different roles in mediating the activities of the industry.

Table 5.5
Main Supporting Agencies and Organisations to the Palm Oil Industry in Malaysia

No.	Agencies And Organizations
1	Plantation Sector
	- Malaysian Palm Oil Association (MPOA) - East Malaysia Planters Association (EMPA)
2	Planters Sector
	- The Incorporated Society Of Planters (ISP)
3	Independent Palm Oil Millers
	- Palm Oil Millers Association (POMA)
4	Palm Oil Refiners
	- Palm Oil Refiners Association Malaysia (PORAM)
5	Edible Oil Manufacturers
	- Malaysian Edible Oil Manufactures Association (MEOMA)
6	Packers And Distributors
	- Palm Oil Packers Association Malaysia (PPMMM)
7	Oleo chemical manufacturers
	- Malaysian Oleo chemical Manufacturers Group (MOMG)
8	Palm Oil Promotion
	- Malaysian Palm Oil Promotion Council (MPOPC).

5.4.6 Government Agencies

Government agencies are also one of the stakeholders of this industry that are mainly involved in research and development and regulatory functions. The main government agency directly involved in the palm oil industry is the Malaysian Palm Oil Board (MPOB), which was set up from a merger of the Palm Oil Research Institute of Malaysia (PORIM) and the Palm Oil Registration and Licencing Authority of Malaysia (PORLA) to develop national priorities and policies for the industry. Besides MPOB, other agencies include the Department of Environment Malaysia, Natural Resources and Environmental Board of Sarawak, Environment Conservation Department of Sabah and Malaysian Palm Oil Council. The policy and regulatory changes that are made in the palm oil industries are normally

discussed and negotiated between industry organisations representing the interests of the upstream, midstream and downstream producers with these government agencies.

5.4.7 Other stakeholders

Lastly, the other stakeholders of the palm oil industry in Malaysia include, among others, NGOs such as the Malaysian Nature Society and WWF Malaysia, and Unions such as the National Union of Plantation Workers, All Malayan Estates Union, Malaysian Agricultural Producers' Association and National Association of Smallholders.

As can be seen, palm oil has a long history in Malaysia and it is a well-established industry in terms of its national arrangement among these seven categories. The focus of my research is the midstream activities in a case study of a mid and downstream producer. The next section will discuss the background of the case company.

5.5 GOLDEN CROP CO. (GCC): THE CASE COMPANY

5.5.1 Historical Background

Established in 1975, Golden Crop Co. (a pseudonym) is a vertically integrated palm oil processing company with an involvement in refining and fractionation (i.e. midstream production activities) and packing and distribution (downstream) activities. The company began with a focus on the midstream activity of refining Crude Palm Oil (CPO) to produce Refined Bleach Deodorized Palm Olein (Olein - cooking oil) and selling it in bulk to local bulk breakers (re-packers) and for the export market. At this period in the company's history (from the 1970s to the early 1980s), the company only had a single refining and fractionation plant for CPO production with a capacity for processing only 200 Metric Tonnes (MT) and 100 MT per day, respectively. Refining and fractionation are the key part of the midstream production process – a process which will be discussed in great detail in Chapter 6 (section 6.2). In 1985, Golden Crop Co. was fully acquired by Palm Co. A year later, Golden Crop Co. expanded their operations and installed another refining plant and upgraded the existing fractionation plant.

In 1997, Golden Crop Co. relocated their operations to a larger refinery which enabled them to expand their business to downstream activities which included packing, selling and distribution of cooking oil, shortening, margarine and vegetable ghee. At this time,

downstream product sales were mainly confined to local industrial customers such as biscuit and bread manufacturers as well as to a variety of other food processing manufacturers.

2003 saw another wave of Golden Crop Co.'s expansion when they upgraded their original refining plant to significantly increase volume per day and also installed a new fractionation plant. They were also beginning to give increased focus to their downstream activities including the launch of their own brand of cooking oil.

After 5 years (in 2008), they installed another fractionation plant with 400MT capacity per day and which they upgraded the next year to 500MT. At the same time, a new warehouse was built to store their packed products and an additional cooking oil packing line. In 2010, they installed another refining plant with a refining capacity of 600 MT per day. In 2012, they engaged in the building of a new packing plant for the production of shortening while the old packing plant was to concentrate on the production of cooking oils.

Responding to the government's Third Industrial Plan (2006-2020) (as the CEO commented) of encouraging palm oil players in the industry to expand operations towards a wider range of high value added products, Golden Crop Co. continued to expand by giving increased focus to their downstream activities. This included putting significant effort into increasing added value to their existing products, diversifying the range of products under their own brand and improving their branding position in the market as well as their distribution channels. They launched their own brand of cooking oil in 2003 and upgraded their packaging plant facility (at the same premises as the existing refinery) to further expand and optimise production volume. The most recent developments in the past two to three years have been that the company has placed much emphasis on, and resources into, developing as a fast moving consumer goods (FMCG) company by not only selling their own branded products but also outsourcing products from third party companies to produce other FMCG products for them. It is in their long term plan to capture a larger market share and stabilise their brand name, after which they will start investing in building their own manufacturing facility for all these outsourced products.

The downstream business in the organisation started in 1997 and served primarily industrial customers. This part of the business has since significantly increased with the addition of FMCG products. They are now aggressively launching new products every year such as creamers, spreads for breads, mayonnaise and instant noodles. They also plan to commence the sale of non-food products (but which are still palm oil based) such as soap and personal care items from 2014 onwards.

Besides venturing into the FMCG segments of the domestic market, Golden Crop Co. also has started to penetrate further into export markets. These developments have been paralleled by continuing increases in exports of their own label products. Now, in addition to this line of business, they are making an effort to develop their own international brand to secure international markets.

The rapid changes in the organisation since 2003 with the expansion towards producing more palm oil based consumer products and increasing exports have had a significant impact on internal demand and the subsequent need to increase volume and operations in midstream activities. From only producing to cater for bulk sales, re-packers and walk-in export customers (with its expansion in sales year by year in this sector), they also now have to meet the demand of in-house downstream production. This is why, as mentioned above, the refinery and fractionation plant has been expanding and has been upgraded gradually over the years.

The analysis of this thesis in the next 3 chapters will focus on the operations and controls of the midstream activities in this company. But I will first describe the organisational structure to give a full picture of the overall operations of Golden Crop Co. in the next section.

5.5.2 Organisational Structure and Operations

The operations of this company are carried out at several dispersed geographical locations. The head office is in the capital city of Kuala Lumpur, Malaysia. Most management planning and decision making is focussed at the head office. The refinery is located in the southern part of Malaysia, at Pasir Gudang, Johor, which, as elaborated earlier, consists of the refining and fractionation facility which processes the CPO to produce Refined Bleached Deodorised Palm Oil (RBDPO), Refined Bleached Palm Olein (Olein) and Refined Bleached Palm Stearin (Stearin)[4], the product packing plant as well as the main warehouse and storage facilities. The finished products are stored here before being transported to smaller storage facilities at depots across the country. There are depots in each state including Selangor, Malacca, Perak, Penang, Kelantan, Negeri Sembilan, Terengganu, and two depots in Pahang and Sabah. The relative size of each depot is illustrated in Table 5.9.

[4] Refer to Chapter 6 for a detailed step-by-step explanation of CPO production.

5.5.2.1 Head Office

The head office consists of forty-six members of staff headed by a chief executive officer (CEO). The CEO is assisted by managers in six different departments, namely the head of marketing and product development, operations, domestic sales and distribution, international business, finance, and human resources and admin. The operation structure and reporting structure in the organisation is as shown in the organisation chart below (Chart 5.1):

Chart 5.1
Organizational Chart of Golden Crop Co. – Head Office

Source: Golden Crop Co.

5.5.2.1.1 Marketing Department

The marketing department is a newly established department in the organisation. It was set up in mid 2012. Prior to the establishment of the new department, some limited marketing activity (for over 15 years) was carried out as a joint function by the existing sales and distribution departments. During this time, the company focus was on the sale of bulk commodity products which were sold through a long established sales organisation around the country and based partly in the depots. Therefore, this division was established to support the expansion activities in the growth of the marketing (market awareness) of the downstream FMCG products.

5.5.2.1.2 Operations Department

The operations department is headed by a senior manager. The senior manager assumes responsibility for the refinery's operation and four other sub-areas at the head office. The operations manager supervises the procurement operation, which is responsible for the purchase of raw materials for production and also administrating the tenders of the company such as carrier tender and packaging material tender in supporting the production and logistics operations. Besides that, this department also follows up on technical matters such as the building of new factories and plants, installation of machinery, and renovations at the depots.

In addition to procurement and technical support, the operations department also handles the most traditional sales in this organization - sales to repackers (companies who buy oil in bulk between 20MT and 50MT and break it into smaller packing and sell it with their own brand). This sales function was the first type of sales this organization was involved in since its establishment and was handled by this department, and was maintained there. Besides this area at the head office, logistics activities are also handled by the operations department. All issues at the depots across the country are administered by personnel in the operations department at the head office and reported to the head of department.

Refinery management also reports to the head of the operations department on matters related to production, warehouse and other daily operations at the refinery. The production is split into two divisions - i.e. midstream production and downstream production. The midstream production is where the analysis of this thesis will mainly be focused (see emphasis in charts 5.1 and 5.2).

5.5.2.1.3 Sales and Distribution Department

The Sales and Distribution Department is headed by a newly hired manager. He was a senior manager of a multinational company that is one of the leading FMCG in the market. He replaced the previous sales manager who was transferred to a newly created international business department. The field work was conducted five months after this change. Golden Crop Co. categorises domestic sales into traditional markets where sales are conducted through salesmen located at the depots and modern trade where sales are to the chain of international hypermarkets like Tesco, Carrefour and other local hypermarkets. This modern trade business involves sales that are made and arranged directly by the sales

executive at the head office and delivery is made from the biggest depot (Depot 1) among the eleven depots they have (see Table 5.9 for a list of depots).

5.5.2.1.4 International Business Department

At the point when the field work was being carried out, the international business department had been recently established (just over five months previously). The company did small volumes of exports prior to this establishment but the exports were mainly to customers who walked in or inquired about prices from them. Previously, export sales took the form of packing the customer's brand oil and packing style and shipping the oil to the required destinations. There was no involvement in the selling activities of the oil in the market where the oils or other fats products were shipped. However, the objective of creating this division was to penetrate the Asian region and move to the other regions in time using their own brand. In contrast to the previous business model, they are now trying to find distributors in the target countries and make contracts with them to sell these products. They have started with selling cooking oil to a few of the South East Asian countries and are starting to ship and market their other products as well. As a newly established division, the manager was only assisted by one sales executive and another newly hired management trainee at the time the field visit was conducted.

5.5.2.1.5 Finance Department

The finance department is headed by a senior manager who plays two roles. One is to prepare financial accounting reports for the group finance division, and the other is to provide reports for the CEO and other heads of departments of Golden Crop Co. The reports that are submitted to the group finance division are monthly management financial reports which comprise profit and loss statements, cash flow statements, and bank reconciliation and balance sheet statements. The same reports are also used within the organisation together with other required financial statements such as accounts receivable, debtor and creditor aging, treasury, product costing, stocks and company tax. In addition to this, the finance department is also responsible for compiling information from all departments and preparing the monthly budget performance report for the organisation's performance which is set against the organisation's yearly budget.

5.5.2.1.6 Human Resources and Administration Department

Finally, the main responsibility of the Human Resources and Administration Department is to assist the CEO to fulfil HR requirements such as staffing, staff benefits as well as administration such as corporate communication and issues regarding board member meetings. Besides this, the head of this department is also responsible for the implementation and monitoring of performance evaluations of the staff throughout the organisation. The total number of staff in each department at the head office is listed in Table 5.6 below.

Table 5.6
Number of Employees at the Head Office

Source: Golden Crop Co.

5.5.2.2 Refinery

Having discussed the operations at the head office of Golden Crop Co., a description of operations at the refinery is now given - this is an area of the company which I emphasise in this thesis.

This research focuses on the midstream production division (and its relation to quality assurance) which is located at the refinery (see emphasis in chart 5.2). The refinery is located in the southern part of Malaysia, in Pasir Gudang, Johor. Overall, it consists of three

refining plants, three fractionation plants, a packing plant (another one was under construction during the field visit), a warehouse and a refinery office. It is located near two ports and is near to Palm Oil Mills. It is also fully linked by pipeline to the bulking installation tank. The total acreage of Golden Crop Co.'s refinery is ten acres with six acres being utilised for midstream activities (refining and fractionation plants), while the other four acres are for (downstream) packing production and storing facilities. The packing plant consists of a shortening production line, a margarine production line, a cooking oil line and a vegetable ghee line.

Chart 5.2
Organizational Chart of Golden Crop Co. – Refinery

Source: Golden Crop Co.

As illustrated in Chart 5.2 above, the refinery management is headed by a senior manager who has worked with the organization since 1979, four years after the incorporation of Golden Crop Co. He reports directly to the Senior General Manager (Operations) at the head office (see Chart 5.1). The refinery manager is directly in charge of the refinery and fractionation production, finance function, maintenance issues of the refinery (including the

production) as well as other administrative divisions. He also oversees the downstream production activities (which they call packed product production) whose operations are mainly handled by an assistant who has also been working for the organisation for quite some time (since 1982). The assistant manager is responsible for the downstream production, quality assurance, warehouse and also operations. The number of employees working at the refinery is as tabulated in Table 5.7.

Table 5.7
Number of Employees at the Refinery

Source: Golden Crop Co.

Briefly, the operations at the refinery involve the refining of CPO to produce RBDPO which will be fractionated to produce Olein and Stearin. These oils, which are produced at the

midstream production stage, will be sold out partly in bulk (domestically and as export), and will also be used for further processing at the production stage in the downstream production division. The capacity of the production plants for both streams is as follows:

Table 5.8
Refinery Production Capacity by Plant

Source: Golden Crop Co. – Briefing Notes for Visitors and Guests 2012

When this case study research was conducted, two refining plants and two fractionation plants were actively being operated in a 24 hour shift operation. For the downstream production section, however, all lines (cooking oil and shortening) were run during normal working hours but, when required, this was extended to 24 hours to meet demand. Details of the two stages of midstream production operations at the refinery are discussed in chapters 6 and 7. The data collected at the refining and fractionation plants and the discussions and meetings observed between the plant staff and refinery management as well as other supporting services such as the laboratory comprise the main data used for my analysis in this thesis.

Twenty-one staff are involved directly in the operations of the refining and fractionation plant; of these, fifteen are operators and six are supervisors. They operate the plant using a three

shift pattern. During any one shift, there will be three operators with one supervisor, and two operators and one supervisor are in charge at the refining and fractionation plant, respectively. They mainly monitor and control to ensure that production is running smoothly and efficiently according to the required quality and quantity demanded (the controls exercised by a joint effort between the plant employees and the controls technology are discussed throughout chapters 6 and 7). The midstream production performance progress is discussed with the production executive, engineer and refinery manager on a daily basis in the 'morning meeting' (see section 7.2.3 in Chapter 7 for a detailed description of this 'morning meeting'). During the data collection process, the work practices of these people at the plant as well as the refinery management were scrutinised in detail to form an in-depth understanding of the production processes and its related activities for the purposes of the analysis.

As mentioned above, the oils produced at the midstream production plants are then either sold out in bulk or used for further processing at the downstream production plant to produce and pack into smaller packing industrial and customer products such as vanaspati, ghee, shortening, margarine and others. These products plus the outsourced consumer products are then distributed across the country through their distribution outlets (depots). In the next section, a brief description is given of the operations at the depot in order to get a comprehensive picture of the operation of this company.

5.5.2.3 Depots

As mentioned earlier, the products that the company distributes across Malaysia include its own products of cooking oil, shortening and margarine from the refinery discussed above and also the outsourced FMCG products such as spreads for bread, instant noodles and creamer. These products are distributed across the country through eleven depots that are widely distributed geographically across almost all the states of Malaysia. The role of the depots is to store products and distribute them according to sales and market share achieved by the sales function. The people who are placed at the depots are the logistics officers as well as the sales teams. The logistics team report directly to the logistics executive at the head office while the sales team report directly to the sales manager also at the head office. Table 5.9 below summarises the volume of sales from each of the depots and refinery warehouses as well as the staff operating at each of the depots.

Table 5.9
Sales Capacity and Number of Employees at Each Depot

Source: Golden Crop Co.

5.6 CONCLUSION

This chapter has described the history of the palm oil industry in Malaysia and the organisational context in which the analysis of this thesis will be developed.

The forthcoming analysis chapters (chapters 6, 7 and 8) describe in detail the midstream production processes in this organisation. The analysis and theorisation will focus on explaining the entanglement of people at various sites with material/technological objects (such as the production process technology, and various reports) in exercising controls (operational and managerial controls). The discussions in chapters 6 and 7 will be around the day to day control practices exercised in achieving balance between attaining desired quality and optimising the production process to meet the needs of the target set in the budget. Chapter 8 will focus more on how the budget performance targets set at the senior management level are planned and governed as well as the dynamic of how the budgets get implicated in the day to day control practices and vice versa.

CHAPTER 6
SOCIOMATERIAL CONTROL PRACTICES: THE ENTANGLEMENT OF HUMAN AND MATERIAL IN THE REFINING AND FRACTIONATION PROCESS

6.1 INTRODUCTION

This chapter focuses on the process flow in midstream production which consists of the refining and fractionation plants (also known within the organisation as the midstream production process). Each and every step in the production process will be examined and discussed in detail. I will illustrate the way in which entanglement between the social - i.e. the staff at the production plant (operators and supervisors) and materials (the PLC system i.e. the production control system, and other production reports) happens at the production site. The imbrication process idea that was discussed in Chapter 3 provides the key theoretical concept used in discussing and illustrating the emergence of sociomaterial control practices in the oil refinery plant. The key planning and control discussions, in the organisation, take place around concerns of attaining the quality specification in the refining and fractionation process because production concerns about quality are tightly interconnected with achieving budgeted yield and cost targets.

The chapter is divided into two sections. In the first part of first section, I provide some description of the key aspects of the production objectives and targets that affect the production processes which were set by the senior management for the production team to achieve. Subsequent to this are two sub-sections where I provide more detail on the step-by-step production process (the refining and fractionation process) and within which I illustrate the imbrication process where people at the plant become entangled with the material and technology on site. This is where I make clear the sociomaterial control practice that emerges at the production site from the imbrication process. The second section is a brief summary of the discussion in this chapter.

6.2 MIDSTREAM PRODUCTION OBJECTIVES AND PERFORMANCE TARGETS

The midstream production process involves the refining and fractionation processes. In refining, various treatments are applied to the Crude Palm Oil (CPO) to produce Refined Bleached Deodorised Palm Oil (RBDPO), while the fractionation process involves further processing of the RBDPO to produce Refined Bleached Deodorised Palm Olein (Olein) and Refined Bleached Deodorised Palm Stearin (Stearin).

Generally, to produce RBDPO and its by-product Palm Fatty Acid Distillate (PFAD) in the refining plant, CPO will go through three main processes, namely the degumming (pre-treatment), bleaching and filtration, and de-acidification and deodorizing processes. RBDPO will then go through another processing stage at the fractionation plant (i.e. the cooling and the filter pressing process to separate Olein and Stearin). The outputs of these processes are either treated as final product to be packed as cooking oil or subjected to further processing in the production of dough fat, shortening, ghee and margarine, respectively. The non-food by-product of CPO (i.e. the PFAD) is used as raw material for many other industries such as the cosmetics, animal feed, oleo chemicals and bio-diesel industries.

The main controlling yardsticks that the people who run the production processes need to emphasise on are the *yield* from production and the *cost of production* where production personnel and refinery management will monitor closely the performance against targeted figures in the budget. Targets are set for these critical measures of efficient production (along with others) during the preparation of the budget. At this time (around July of each year), the refinery management team meets with key members of senior management from the head office to discuss and decide the strategy and way forward for the company for the upcoming year as well as the issues with production processes. These figures then become the yardstick for the senior management at the head office to monitor the performance of the production activities.

The yield of the refining process is calculated based on the throughput of RBDPO and PFAD extracted from CPO. The uncountable balance is considered as oil loss (this is mainly oil that sticks to the bleaching earth in the filtration process and during vaporization in the de-acidification and deodorization process). A yield calculation example is as follows: if 1,000MT of CPO is used in a day of production and production of 900MT of RBDPO and 60MT of PFAD is managed, then the RBDPO yield would be 900/1000 (i.e. a RBDPO yield of 90% with 6% PFAD and 4% of oil loss for the day). The monthly yield is also calculated based on this calculation for the total usage of CPO and RBDPO and PFAD extracted for the month. Table 6.1 provides the targeted RBDPO yield for year 2012, as well as the quality specification (for both BPO (Bleached Palm Oil – output of first refining stage) and RBDPO).

Table 6.1
Yield and Quality Target for the Refining Plant (2012)

Source: Golden Crop Co. Budget 2012

While the yield from the refining plant is the throughput of RBDPO, the yield from the fractionation plant is calculated based on the Olein (according to its grade) extracted from RPDPO. Just like the refinery, yield calculation for the fractionation is based on the Olein extracted from the RBDPO after separation of the Stearin. The unaccounted balance here is also considered as yield loss (oil loss). Table 6.2 below provides the information on the yield target and quality specification targeted for the year 2012 by Golden Crop Co.

Table 6.2
Yield and Quality Target for the Fractionation Plant (2012)

Source: Golden Crop Co. Budget 2012

[5] PORAM is a voluntary and non-profit organization whose members are the companies involved in midstream (mostly refining) and related downstream palm oil, palm kernel oil and other vegetable oil processing activities. PORAM has come up with a standard quality specification for palm oil and palm kernel products which has become the benchmark for the local and export trade.

From the perspective of the senior management at the head office, refinery performance is monitored based on the yield achievement and efficiency. The concern is to monitor the efficiency of material usage and that production is run within targeted production yield and cost figures. However, from the observation at the refinery, yield and cost is not the only consideration during the production process. There, quality is given first priority during the production process, notwithstanding the yield and cost. This is evidenced from the interview extracts below:

> *The quality is the most important thing to control. There's no point trying to maximize throughput if we don't meet the quality requirement.* (Refinery operator – PG017)

> *Our objective is to achieve the throughput targeted in the budget. But, the most important thing is to produce according to the quality. So I can say, our main focus here is to make sure production is run in a way where quality of oils produced meets the quality requirement… and as much as possible to meet the throughput.* (Refinery supervisor – PG033)

> *We are producing consumer goods. We pack using our own brand. Our products go straight to end users… of course our main concern is quality. Especially colour. Because when we put our oil side by side on the shelf at the supermarket, we want our oil at least to be on a par with the other brands, if not better. But at the back of our mind, we always want to achieve the yield and cost targeted in the budget.* (Production engineer/manager – PG040)

> *The first concern is quality. Although the management [head office] is pressing us on throughput and cost, my first concern is still quality. What is the point of meeting the target yield but can't sell, right? So as much as we can, we will try to achieve our yield target and minimise our cost - quality is still my first concern.* (Refinery manager – PG041)

These quotes are from people at different levels in the refinery who are directly and indirectly involved in production activities. They are involved in the daily monitoring of the production process at the plants and temporal (e.g. daily, weekly or monthly) operational planning and decision making related to production activities. The interview extracts above clearly demonstrate that although meeting target yield is one of the important elements that is

continuously checked, achieving and/or maintaining a certain level of quality seems to be the primary concern among the people who are closely involved with monitoring the activities and performance of the midstream production process. It is apparent that there are 3 main elements (yield, cost, quality) that are given emphasis at the refinery production stage but with quality as the top priority. The relatively higher level of importance given to quality achievement is more apparent at the individual process plant level as compared to the refinery managers, though both rank quality as more important than yield and cost. This will become clearer with the illustrations that I will discuss in this chapter and the next (Chapter 7).

Now that I have described the important monitoring factors for the overall production process, I will give some description of the supply of raw materials and then explain the first stage of the midstream process (i.e. the refining process); this will then be followed by the second stage – the fractionation process. Within these descriptions, I will illustrate the emergence of *sociomaterial controlling practices* as a consequence of the *entanglement between people and the technology (or part of the technology)* in the main process plant areas as operators and supervisors seek to achieve an optimum balance between the three variables (quality, yield and cost).

6.2.1 Stage 1 - Refining Plant

6.2.1.1 Raw material

Golden Crop Co. purchase their main raw material (CPO) solely from Palm Co. (part of the company group). Palm Co. has more than 70 palm oil mills across the country and about 20 of these supply CPO to Golden Crop Co. There are two methods used by Palm Co. to deliver CPO to Golden Crop Co. A pipeline is used to deliver it from their bulk storage facility while other CPO is delivered in 30-40MT road tankers directly from the mills. Almost all of the transfers to Golden Crop Co. are made through the latter method.

All incoming CPO is subject to a quality check before it can be accepted into storage at Golden Crop Co. Samples are taken at the receipt station to establish CPO quality. There are several parameters that need to be checked before receiving the oil and pumping it into the CPO tanks. The quality specification of CPO is checked for accordance with the PORAM Quality Standard Specification. Amongst others, the parameters being checked are the Free Fatty Acid (FFA) level, Volatile Matter (VM), Deterioration of Bleachability Index (DOBI),

moisture level, Iodine Value (IV), and Peroxide Value (PV). The first three parameters are used together to decide whether to accept or reject the batch of CPO (this is based on the PORAM regulation), while the others are checked to help decide the cause of action in the refining process which occurs later, as described by the lab analyst:

> *… to receive or to reject, we are only required to do these few tests, but we run other tests to first give some indication to the production staff on the characteristics of the material and utilities they need to use to produce [good quality refined oil] with this quality of raw material; secondly, this also helps us justify the outcome of production.* (Laboratory Analyst, PG039)

The quality check procedures normally only take five to ten minutes. Once approved, the crude oil will be unloaded into the CPO storage tanks. There are two storage tanks with holding capacity of 2,500MT each. This oil will be stored while waiting to be processed at the refinery plant. In the case of 'out of specs' supply, laboratory personnel will reject the oil or sometimes they will still accept it if the supplier negotiates discounts for that particular load. They will normally only choose the second option if there is critical shortage of CPO supplies in the market and the level of off-specification is still within the producible range. However, this rarely happens.

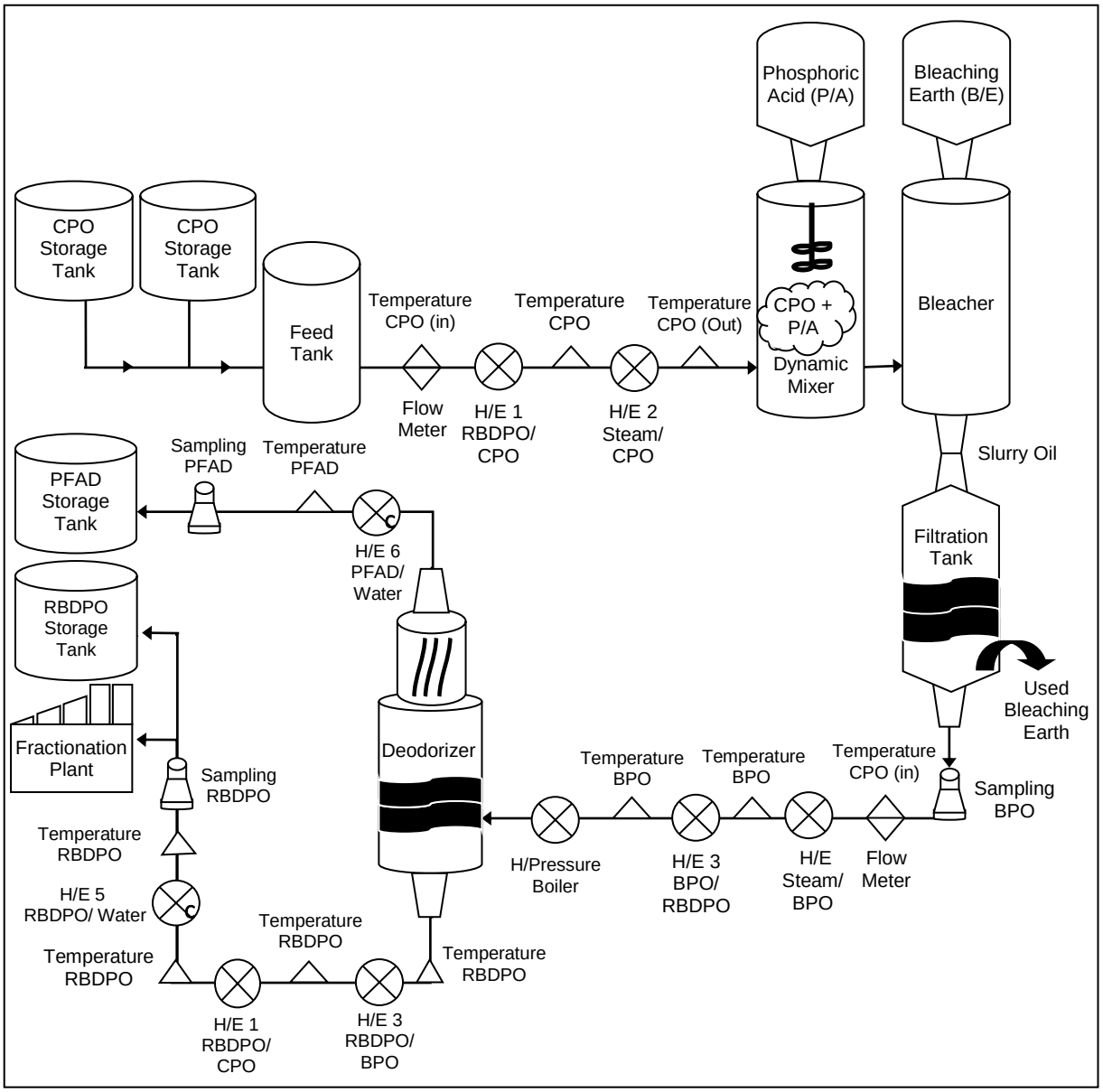
6.2.1.2 Refining Process – The imbrication process between people and material/technology

There are three main stages in the refining plant, namely degumming, bleaching and filtration and, lastly, the de-acidification and deodorization processes. Diagram 6.1 illustrates briefly these processes within the refinery plant. Golden Crop Co. had 3 operable refining plants at the time this field study was conducted, out of which 2 were actively used[6]. Production processes at both refining plants are supported by computerized systems with the newest plant (which started operation in January 2012) having a better and more automated process. The description that follows is based on the observation of the production process at this new refining plant. The computerised system assisting the production process will be referred to as the PLC system hereafter. In this section, I will illustrate the production process at the refining plant within which the controlling practice

[6] There are three refining plants, namely REFINE A, REFINE B, and REFINE C, with capacity of 400, 300 and 600MT, respectively. Only REFINE A and C are operated fully/actively. REFINE B only operates when any of the other two stop for maintenance for a few days in three to six monthly schedules. In 2014, REFINE A and B are going to be demolished so that a higher capacity refining plant can be built (REFINE D).

emerged as the outcome of the imbrication process between people and the material/technology such as the PLC system and lab reports.

Diagram 6.1
The Refining Process



Source: Developed by Author

As briefly described earlier, the refining process appears to be a simple process of degumming, bleaching and filtration, and de-acidification and deodorizing that extracts the RBDPO from CPO. However, the process is more complex than that since great reliance is placed on the process variables, such as temperature, vacuum, retention time, moisture level, the CPO quality and the amount of sub-materials used for proper chemical and physical reactions to happen (Brooks et al., 2013; Corley & Tinker, 2003; Sampaio et al.,

n.d.). Constant monitoring and controlling of all these variables is important to ensure that the specified quality can be met. This is where much of the effort among the plant staff is focused. The refining activities involve an iterative and continuous controlling and adjustment process throughout the production time between the people, movements in the PLC system as well as from laboratory results taken every 2 hours. I will now give a detailed description of how the technology works and how the imbrication process happens (which involves the entanglement between people's intentions and the materiality of the materials/technology which creates the perception of affordance and constraint), creating the sociomaterial management and control practices at the production site (i.e. the refining plant).

Table 6.3 below demonstrates the control measurement recorded by the automated PLC system (as set by the supervisor/operators), by the operators through physical checking and, the points where samples for laboratory tests are taken. The sample of laboratory results which is also used to manoeuvre the production process is illustrated in Figure 6.1 below. These are the descriptions of the control measures and controlling practices in the production flow processes that will be discussed in detail next.

Table 6.3:
Control Measures at the Refining Plant

Process/Stage	Controlling Measures	PLC Screen	Physical Check	Sampling
1. Degumming (Pre-treatment)				
a. CPO in	Temperature		√	
b. Heat Exchanger 1 (CPO to RBDPO)	Flow rate	√		
c. CPO out/in	Temperature		√	
d. Heat Exchanger 2 (steam)	Flow rate	√		
e. CPO out	Temperature	√		
f. Dynamic Mixer (Phosphoric Acid)	P/A Dosing (% stroke/frequency)	√		
g. Dynamic Mixer (Phosphoric Acid)	P/A Usage (kg/hour)	√		
h. Dynamic Mixer (Phosphoric Acid)	P/A level (kg)		√	

Process/Stage	Controlling Measures	PLC Screen	Physical Check	Sampling
2. Bleaching and Filtration				
a. Bleacher Tank (Bleaching Earth)	Vacuum	√		
b. Bleacher Tank (Bleaching Earth)	B/E Dosing (% stroke/frequency)	√		
c. Bleacher Tank (Bleaching Earth)	B/E Usage (kg/hour)	√		
d. Bleacher Tank (Bleaching Earth)	Level (kg)		√	
e. Bleacher Tank (Bleaching Earth)	Oil level (retention time)	√		
f. Bleacher Tank (Bleaching Earth)	Steam sparging & agitation		√ (side glass)	
g. Filtration Tank	Pressure	√	√	
h. Filter Bag	Pressure			
i. BPO Intermediate Tank	BPO oil			√
j. BPO in	Temperature		√	
k. Heat Exchanger 3 (BPO to RBDPO)	Flow rate	√		
l. BPO out/in	Temperature	√		
m. Heat exchanger 4 (High Pressure Boiler)	Flow rate	√		
n. BPO out	Temperature		√	
3. De-acidification and Deodorization				
RBDPO pipeline				
a. Deodorizer tank	Vacuum	√		
b. Deodorizer tank	Oil level (retention time)	√		
c. Deodorizer tank	Steam Sparging & Agitation		√ (side glass)	
d. RBDPO in	Temperature			
e. Heat Exchanger 3 RBDPO to BPO)	Flow rate	√		

Process/Stage	Controlling Measures	PLC Screen	Physical Check	Sampling
f. RBDPO out/in	Temperature	√		
g. Heat Exchanger 1 RBDPO to CPO)	Flow rate	√		
h. RBDPO out/in	Temperature		√	
i. Heat exchanger 5 (water for cooling)	Flow rate	√		
j. RBDPO out	Temperature	√		
k. RBDPO out	RBDPO			√
PFAD pipeline				
l. Heat Exchanger 6 (water for cooling)	Flow rate	√		
m. PFAD out	Temperature	√		
n. PFAD out	Sample			√

6.2.1.2.1 Degumming (Pre-treatment) process

The refining process starts from the uploading of CPO from the storage tanks (the first two tanks in the left hand column of Diagram 6.1) to the feed tank (an intermediate tank used to directly feed the production process) at the refining plant. The objective of this first stage is to separate the oil from foreign particles. At this very early stage of production, the CPO's temperature will be quite low - usually less than 50°C. In order for the oil to separate from the waste matter prior to being mixed with the phosphoric acid in a dynamic mixer for the degumming process, the oil needs to reach a higher temperature of about 90 - 110°C. Only when the appropriate temperature is achieved will the particles break off as phosphoric acid is induced into the oil. Therefore, the main controls that need to be maintained by the operators at this stage are maintaining the required temperature and making sure that the correct amount of phosphoric acid is dosed into the oil, as listed in the 'Controlling Measures' column in Table 6.3.

The heating is done by passing the CPO through the heat exchanger (indicated by a crossed circle in Diagram 6.1 – labelled H/E1) where there are several plates with large surfaces arranged side by side so that oil of different temperature can flow through. At this stage, the

low heat CPO will be on one side of each plate passing through with high temperature RBDPO at a temperature of above 200°C on the other side – exchanging heat through conduction (the RBDPO output is fed back through this process from the next process – the deodorizer). The flow rate of oil passing through the plates in the heat exchanger will be adjusted accordingly to optimize, as far as possible, the heat exchange process. The flow rate speed (indicated by a downward triangle in Diagram 6.1) is displayed on the PLC screen for monitoring purposes for all heat exchangers in the whole system. By setting the flow rate, the openings of the valve that allows oil to flow from one tank to another will automatically be adjusted. All this speed and other readings that are displayed on the PLC system's monitoring screen are marked by a tick in Table 6.3 under the column 'PLC screen'.

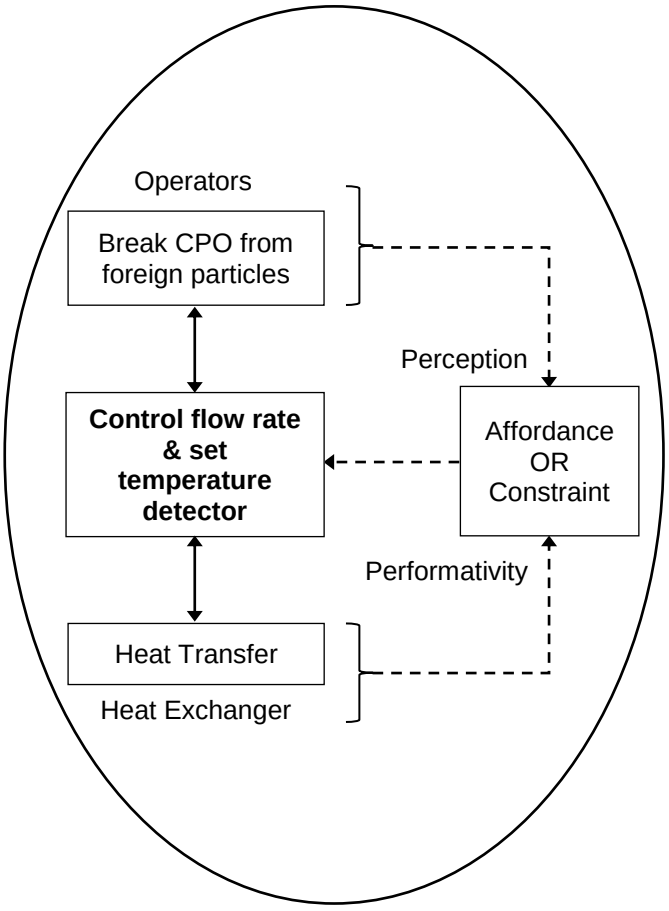
The heat needed varies according to the quality of raw material (CPO) used for production. Although the flow rate is usually set to the maximum to achieve maximum throughput, it will be reduced in cases where the input quality of oil is poor, such as too much volatile material in the CPO and/or when the lab report shows high colour readings[7]. In such cases, the speed of oil flow is reduced to give more time for the oil to capture the heat.
If the heat exchanger still fails to achieve the required temperature, then the steam heat exchanger will automatically operate to help in heating the oil to the specific set temperature. When this happens, it means that the heat exchanger only partially affords them (operators or supervisors) the opportunity to achieve the objective of meeting the temperature required. A temperature detector (the second upward triangle in Diagram 6.1) is placed at the process location and links to the PLC system so that the required temperature can be set and steam automatically released or stopped according to the requirement. This implies that as the quality of the CPO varies the perception of affordance of the heat exchanger changes.

This practice of controlling the oil temperature demonstrates the *relational perspective of affordance.* The perception of affordance towards the heat exchanger is constructed as the operators attempt to use it to pursue their goals; in this case, the goal is to control different temperature levels as the CPO's quality varies. Most times, the heat exchanger is sufficient, but there are times when the steam heat exchanger is necessary. Therefore, based on this understanding/perception, people at the plant make it a practice to set a minimum required temperature (based on the CPO quality) for the temperature detector so that whenever the oil does not capture enough heat, the steam heat exchanger will automatically operate.

[7] A high colour reading is considered low quality. The maximum acceptable level of colour reading for each type and grade of oil is listed in Tables 6.1 and 6.2.

Thus, the way operators change the flow rate of oil and make the decision as to what temperature to set the temperature detector is an outcome of the imbrication process between the operators and the heat exchanger. The perception of affordance was constructed as the operators, with the objective of capturing the 'right' temperature according to the variability of the CPO quality, approach the materiality of the technology which has the ability to transfer different levels of heat to the oil. This then, in turn, determines the imbrication process where the sociomaterial control practice emerges (i.e. the control of the flow rate speed so that the 'right' temperature is achieved). Diagram 6.2 illustrates an example of this imbrication process.

Diagram 6.2:
Example of Imbrication Process – Temperature Control



Now that the required temperature is achieved, the oil will flow through into the dynamic mixer tank (labelled as Dynamic Mixer in Diagram 6.1) where it will be mixed with phosphoric acid. Inducing phosphoric acid into the oil breaks the oil down so that the gums and foreign

particles such as carbon, copper and others will get separated from the oil. As mentioned above, in order to achieve this, it is crucial that the right temperature is maintained because, without it, the degumming process will not be completed appropriately. On top of this, by controlling the flow rate, the retention time of oil in the dynamic mixer is also adjusted (increased), and this allows more separation of oil from the foreign particles.

Having said that, it seems that most of the actions taken in handling the PLC system are based on the decisions made by the operators. However, this is only partially true. From the example above, it is apparent that not all that the technology is 'doing' is within the control of the operators. It is useful here to recall the example of the calculator that I gave in Chapter 3 where, although material agency is activated by people (i.e. the person punching in the numbers), the performativity of the calculator programming in solving the maths solution is out of the person's control. So, in this case, the way the heat exchanger works (i.e. its ability to transfer the heat) is not within the control of the operators. This represents the *materiality* of the technology. In response to the ability of the heat exchanger to heat the oil, the way operators control the flow rate is affected. In addition, the ability of the temperature detectors to accommodate the unmet heat ensures that the 'breaking' of oil happens. This produces a highly complex arrangement of variables that cannot be precisely controlled by just the operators or the PLC system but instead requires constant monitoring by both. The entanglement between the operators, with their goals to achieve their objective (in this case breaking the gums from the oil), and the performativity of the machines (capturing the required temperature) constructs the pattern of control practices that are necessary in regard to each batch of production.

6.2.1.2.2 Bleaching and filtration process

After the degumming stage, bleaching then takes place. The main purpose of the bleaching plant is to trap gums and foreign particles and also bleach the CPO to produce lighter coloured oil. Once the gums are separated (at the degumming stage discussed earlier), the CPO will flow to a vacuum bleacher tank for the bleaching process (labelled as Bleacher in Diagram 6.1). The control measures for this stage are also listed in Table 6.2.

Bleaching earth is added or 'dosed' at an appropriate amount varying from 0.5 to 2.0% per metric tonne of oil depending on the quality of the CPO. At this stage, the mixture of oil, phosphoric acid and bleaching earth is called slurry oil. This slurry oil will be in the bleacher tank for approximately 30 minutes with continuous agitation. Here, once again, the flow rate

plays an important role. The right setting of the flow rate will ensure the appropriate amount of time needed to maintain the contact time between the oil and the bleacher so that the bleaching earth will be able to capture all gums. Besides monitoring the flow rate to control the oil going into the bleacher tank, the vacuum and oil level in the tank is also monitored. The operator will set the low and high level of oils in the tank and if the oil reaches the set level, the alarm will make a sound so that the operators can take appropriate action.

Besides controlling the flow rate and retention time, the other important control at this bleaching stage is to monitor the dosage of bleaching earth dosed into the bleacher tank. The PLC system allows the bleaching earth dosage to be set at a specific kilogram per oil volume. For example, the operator may set 1 kilogram of bleaching earth per every 1MT of CPO. With this setting, the system will release the bleaching earth accordingly. Therefore, even if the flow rate is adjusted, the same amount of bleaching earth will be released to every 1MT of oil. This is also the case for the phosphoric acid in the dynamic mixer in the earlier process. However, although the PLC system seems to afford the operator the opportunity to set the volume of these two materials to be dosed into the oil and let the system automatically monitor the dosage, there is no guarantee that the specified amount of materials actually gets dosed into the tanks. This is discussed next.

At the initial stage of the implementation of the PLC system, there was an incident where although the dosage readings provided by the system seemed to be accurately set, the results from the lab continuously showed an off-quality outcome. They checked other measures (besides the dosage reading such as the vacuum level, flow rate etc.) and everything appeared to be fine. Eventually, after contacting the supplier, they discovered that the sub-material dosing system will show a reading to indicate that a batch has been dosed in accordance with required settings whenever the valve is opened, whether or not the materials actually flow into the tank. The control system simply operates on sensing how long the valve is open. Consequently, any blockage affecting the dosing machine will not be recorded by the system, which leads to the product quality not achieving what is required. This incident was mentioned in an interview in which two of the operators were present and in agreement on the following remark:

> *We still have to go and check the bleaching earth dosing physically. We do it every hour. Earlier, when we started using this plant, we had this problem… the reading on the screen shows bleaching earth was dosed but the lab report showed that the colour was off by a long way. We couldn't understand what was happening. So we called the supplier back*

and they told us the reading is taken every time the valve is open whether or not the physical bleaching earth goes through the silo. (Refinery Operator- PG035)

This happened due to the design of the dosing reader in the machine that provides information to the PLC system and is then recorded on the PLC screen. The machine was set up to open the valve for a calculated period of time in order to allow a specific amount of bleaching earth into the bleacher tank. However, the reader works in a way that it reads as having dosed the specified amount every time the valve is open, whether or not the exact volume of bleaching earth is physically fed into the tank.

Due to this constraint, although the information is given by the PLC system (on the screen) on the usage of materials (item 1f, 1g, 2b and 2c in Table 6.3), the operators have to make it a practice to check the physical dosage at the machine every hour (item 1h and 2d in Table 6.3). The operator will go and physically check the difference in the level (in kilograms) of materials every hour and write it in the log sheet (example as in Figure 6.1).

Figure 6.1
Refinery Log Sheet[8]

Source: Golden Crop Co. – Log sheet at refining plant

As can be seen, here in the bleaching stage, the control practices that the operators are concerned with are the flow rate, vacuum and oil level as well as the dosing of appropriate amounts of bleaching earth into the oil. I will be using the example of the bleaching earth issue to show what happens when the operators feel that the PLC system constrains them in achieving their goal. The key aim at this stage is to make sure that any foreign particles are captured by the bleaching earth and removed from the oil so that they can achieve the quality required, especially on the 'traced foreign particles' and 'colour' parameters. Therefore, the main controls are at two points: first, setting/deciding the approximate *amount/quantity* of bleaching earth that is needed to do the job (to capture foreign particles and bleach the oil to the desired colour) and, second, that the specified amount of bleaching earth that has been decided *actually goes into the bleacher tank* to be mixed with the oil.

As evidenced from the illustration discussed above, in regard to *setting the quantity* of bleaching earth needed, the system is perceived as affording the operators the ability to set

[8] This figure will also be discussed again in the next chapter.

the required amount of bleaching earth into the system, and the system will 'instruct' the valve to open so that the bleaching earth can be fed into the oil. The opening of the valve is automatically adjusted by the system depending on the flow rate set. Based on this perception the operators simply set the figure in the system with the understanding that the amount set will be dosed into the oil for every metric tonne of oil processed with flow rate adjustments determined by the control system according to the criteria entered by the operators. Here the material technology intervenes so that rather than doing their own calculation and adjusting the figure according to the time and flow rate of oil etc., the control system works automatically within set parameters.

However, setting the amount is not enough. The operators need to make sure that the *actual amount of bleaching earth goes into the tank* to ensure the process is effectively carried out. As we can see in the example mentioned above, during early implementation of the system, operators and supervisors at the refinery plant perceived that the dosage detector afforded them control of the amount of bleaching earth needed. This led them to only monitor on the screen and assume that as long as the reading on the screen shows that bleaching earth has been dosed, it means it is already dosed.

However, from the illustrated incident of the 'off-quality' outcome that occurred, they then realized that these figures and settings could not always be relied upon. They found that the system had failed them from their experience during early implementation. The materiality of the 'dosage detector' is seen as constraining the operators in achieving their goal. Thus, rather than relying on the information on the screen, they changed the routine by going to inspect the dosage physically/manually at the tank (see item 2d in table 6.3). Now that this has happened, as the operators approach the materiality of the technology (i.e. the way the automated system takes the readings which are outside the control of the operator), their goal of controlling the dosed bleaching earth is unchanged but their perception and experience of the processes has changed. The work practices have evolved as perceptions of the affordances/constraints of the control system have developed in line with the entanglement of human action, and perception is constructed alongside understandings of the technology. Based on this perception, the control practice of 'physical' inspection re-emerges again in the automated system to mirror or approximate earlier practices when the system was not automated.

This scenario illustrates the outcome of the perception of affordance or constraint that is constructed while the people and technology intertwine and imbricate. Although the design of the system is supposed to enable operators to set the specified amount of bleaching earth

and then only monitor on the screen the movement of bleaching earth, the way in which the reader works (i.e. the performativity of the reader) is perceived as constraining the operators from getting the correct/reliable information with regards to the dosage actually going into the tank. Therefore, because of this perception of constraint, instead of relying on the information provided on screen, the operators manually go and check at the machine. Here can be seen the different ways in which imbrications between people and machine/technology happen due to the perception of affordance and constraint.

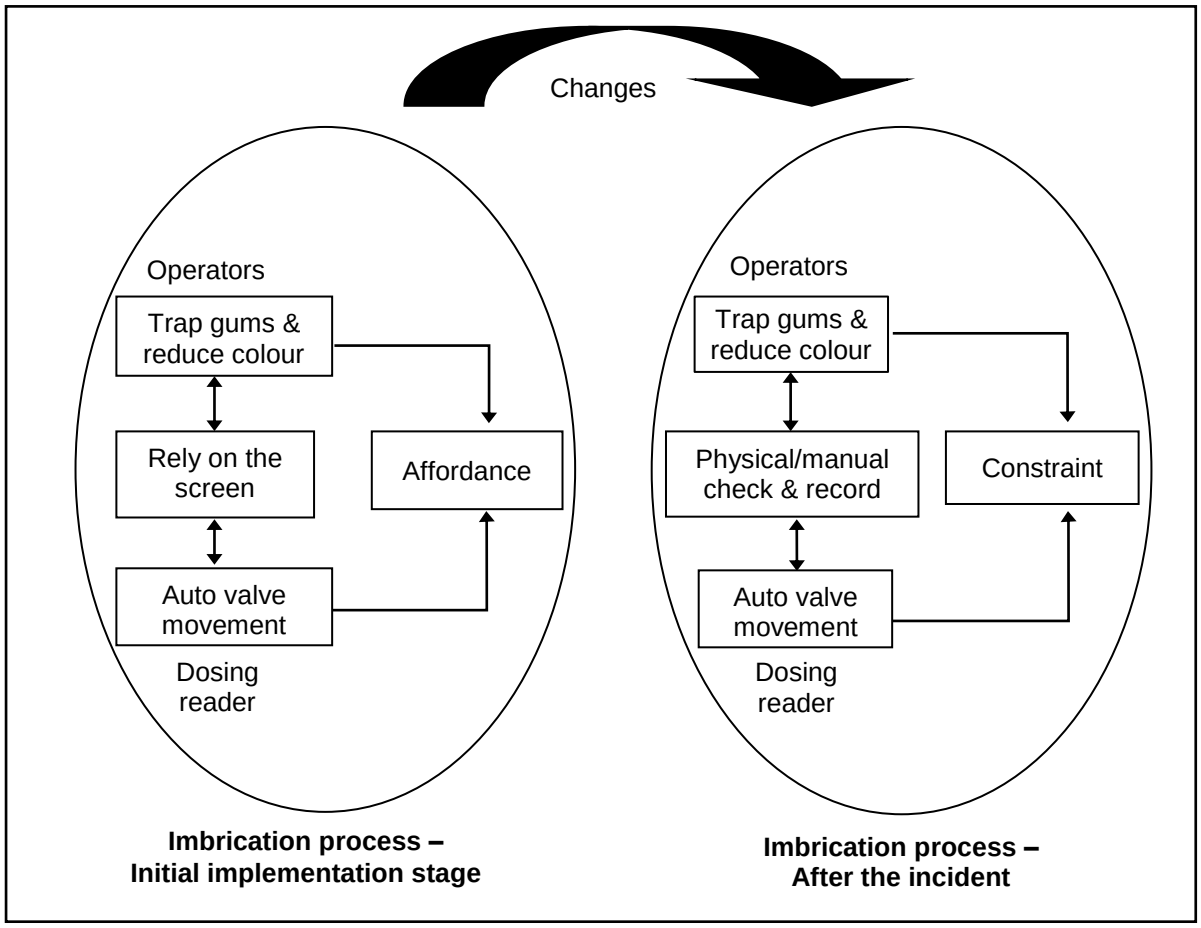
During the earlier stage of implementation, as the operators and technology intertwine, perceptions of affordance emerge though the performativity of the reader being able to read the dosing activity and link to the screen that provides information to the operator to maintain control. The practice of monitoring the bleaching earth dosage figure on the screen happens as the outcome of imbrication between an operator's objective and the dosing reader's performativity through the perception of affordance that emerges. As perception of affordance was constructed, operators and the PLC system (in this case the dosing reader and the screen providing dosage information) imbricate together, making sure that enough bleaching earth is dosed into the bleacher tank so that it can capture the foreign particles. However, when the operators find that the reader is constraining them to get the correct information to ensure the proper amount of bleaching earth is dosed, the operators stop relying on the screen information but instead imbricate with the machine (the bleaching earth silo at the tank) itself by looking at the amount (in kg) of reduced usage of bleaching earth. The controlling practice shifts from the imbrication between people and screen information to people and the tank/machine reader. The routine control changes as the perception of affordance and constraint changes.

This is a clear illustration of control as sociomaterial practice whereby *the practice of controlling emerges as the outcome of entanglement between the people (operators) and the technology/system (dosing reader) through the perception of affordance or constraint* – indicated by each of the ellipse in diagram 6.3.

Another point that can be highlighted in the above example is the temporal changes in control practice routine that happens and which is conceptualised by the *chain of imbrications*, as summarised in Diagram 6.3 below. The left ellipse indicates the initial imbrication process that happens between the operators and supervisors and the PLC system. As the perception of affordance (towards the mechanism of the dosing reader) was constructed, they rely solely on the information provided on the screen to monitor if the bleaching earth was dosed accordingly. However, when the incident happened, they started

to physically/manually check the machine at the tank (as indicated in the right ellipse of the imbrication process in Diagram 6.3). Like the analogy described in Chapter 3 in which change happens in the arrangement of rocks on a riverbed due to the flow of water, the incident changes the way monitoring and control is practiced with regards to the dosing of bleaching earth. It is also worth noting that the second imbrication does not just happen in isolation. It is influenced by the first imbrication – i.e. the failure of the system to provide them with accurate information just by relying on the information on the screen.

Diagram 6.3
Example of a Chain of Imbrications – Control of Bleaching Earth Dosage



Coming back to the refining production process flow at the bleaching and filtration stage, for the first control mentioned earlier (i.e. the setting of the amount of bleaching earth needed per metric tonne of oil), the ratio of dosage is decided based on the judgement of the operators and supervisor at the plant. This decision is based on the lab results of BPO - i.e. the outcome of the bleacher plant after filtration (labelled as 'sampling BPO' in Diagram 6.1). Whenever the input quality of CPO changes, the amount of material usage will also tend to

be different. If the lab result shows the BPO colour is higher than the set target, more bleaching earth will be added and the flow rate will be reduced to maintain longer retention time, which will then lead to better gums absorption and reduction of colour. As highlighted earlier, this can be achieved by changing the PLC settings for a production batch which alters the dosing to reflect the new settings of the flow rate. The quote below shows how the reports from the laboratory assist the operators and supervisors to make adjustments of materials usage into the system:

> *We actually run the production like blind people. We rely 100% on the lab result to manoeuvre our production process. When we get results from the lab then only can we see what actions we can take. Let's say the lab test shows a good colour of 2.2 - that's very good, right? Our target is 2.3 or 2.4. That means we don't need that much bleaching earth. From 10kg/MT maybe I can reduce to 9kg/MT and maybe can also reduce the phosphoric acid usage. Some savings on cost can happen here. All this is based on the lab results. If the results show off quality, then we maybe have to reduce the flow rate, increase bleaching earth and phosphoric acid and so on.* (Refinery supervisor-PG033)

Along with the monitoring measurement mentioned above (temperature, vacuum, sub-material dosage), operators will also intermittently look at the 'side glass' of the tank to see the steam sparging by observing the agitation of the oil. This is important to make sure that the bleaching earth is properly mixed with the oil and is able to capture the gums before it is filtered at an optimal level. However, this is more the trend of the 'old timer' (the more senior plant staff) who has worked at the refinery plant for more than 10 years and has had the experience of working from the semi-automated or fully manual system. The newer operators, who have only been working at the plant since the latest refinery (with the PLC system) was installed, tend to rely more on the information provided by the PLC system. Thus, they do not really bother to observe the agitation at the 'side glass' as much as the 'old timer'. This was also mentioned by one of the supervisors:

> *We old timers [the more senior refinery plant staff] will want to check at the side glass and make sure it is working okay and that the agitation of oil is good. But you know, all these new operators, they just sit in front of the monitor and control from there. If any indicator looks concerning, only then will they go down there and check it. But for me personally, I will only be satisfied if I go and see for myself rather than 100% relying on the indicator provided by the system.* (Refinery supervisor - PG014)

Below (figure 6.2) is a sample of a side-glass situated on the tank where the operator will go and look at the oil agitation.

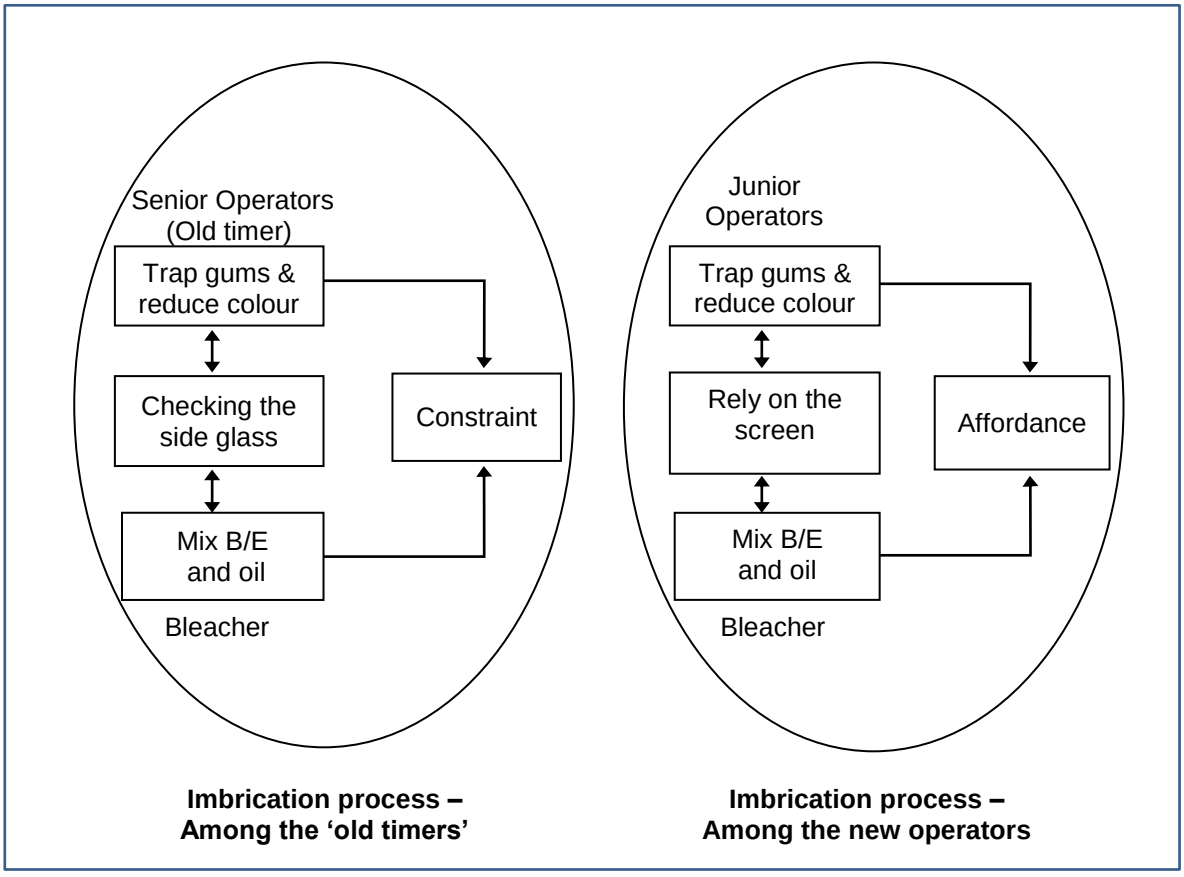
Figure 6.2
Side-Glass Observation Point

Source: Golden Crop Co – Photo of observation point at refining plant

This example shows that different people with the same goals (i.e. to control the agitation of the oil to break and capture the particles) form different perceptions as they engage and work with the system. They imbricate with the system differently. Even though the

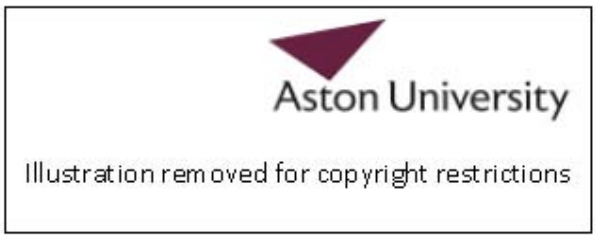
information on the indicators is available on the monitor screen, the 'old timers' perhaps approach the system with the mentality of the old technology, with much less confidence (perception of constraint) that the machine is doing the job as it claims, although the fact is that this was actually not necessary from the perspective of the technology supplier. The 'closed system' is meant to be controlled from the link it has on the monitoring screen. However, because of this perception of constraint, they (the old operators/supervisors) requested a light to be put at the side glass so that they could 'access' or look at the agitation of the oil in that close vacuum system. Thus, this leads them to establish a routine of going round to see the agitation at the side glass once every few hours. Most of the new staff, however, only rely on the closed vacuum system. Here, we can see that different perceptions are constructed as individuals try to use the technology. As different perceptions occur, the imbrication process happens accordingly. Diagram 6.4 shows the different imbrication processes that happen between the two groups of people as a result of different perceptions being constructed as they engage with the technology.

Diagram 6.4:
Example of Imbrication Processes -
Perception of Affordance vs. Constraint



At the end of the bleaching process, after the appropriate amount of bleaching earth and the right temperature, vacuum, and steam sparging have enabled the bleaching earth to absorb the gums including the residual phosphoric acid, relatively pure oil is allowed to flow out and is subsequently filtered at the filtration tank. At the filtration tank (labelled as 'Filtration tank' in diagram 6.1), the oil is separated from the gums that stick to the bleaching earth. The 13 steps of filtration process take about one hour, as illustrated in the picture below (Figure 6.3).

Figure 6.3
Filtration Steps at Filter Tank



Source: Golden Crop Co. – Photo of PLC display screen at refining plant

There are 13 steps taken at the filtration tank stage. The system allows the operator to set times for each step - within filtration - and monitor the actual run time the system takes to complete the filtration process. Any disputes/differences between the planned time and the actual run time indicate actions to be taken. For instance, filter 'leaf' may need to be cleaned, and issues with the blowing system and leakages dealt with, etc. One of the most important controls in the filtration process is for the slurry oil to be pressed to the maximum degree so

that as little oil as possible is still attached to the spent bleaching earth. This is to ensure that oil loss is kept to the minimum possible.

Here, the bleaching earth will stick to the filter leaf while the oil will flow out to the intermediate BPO tank where the oil is now already 'bleached' and called Bleached Palm Oil. The bleaching earth that sticks to the filter leaf will be dried up by the vacuum and thrown out as spent earth. Besides monitoring the actual versus run time on the screen, the operator also takes the pressure reading of the filtration process every hour – which is also available within the PLC system. The information on the screen is perceived as giving them reliable information to exercise control in making sure that the filter is working well at pressing the oil to the maximum. Thus, more reliance was given to the system information.

A sample of BPO is taken at the intermediate tank every two hours to make sure that the quality of oil, especially the colour, has reduced to the targeted point. The result of this test will determine whether or not corrective action needs to be taken, as mentioned by the supervisor:

> *We can have 2 problems [from the results from the lab]… we can have FFA problem [and/or] we can have a colour problem… If, let's say, it is caused by the colour, then we have to go back to square one… we [transfer the product to the] feed tank and consider it as CPO [and] we dose in bleaching earth again.* (Refinery Supervisor- PG014)

If there is any corrective action (especially the colour) that needs to be taken at this stage (BPO), operators will stop the incoming CPO and pump back the oil from the intermediate tank and treat the oil as raw/unprocessed CPO and reprocess the oil, as has been discussed before. If no corrective action is needed, after the degumming and bleaching and filtration process, the next stage is the de-acidification and deodorization process at the deodorizer plant.

6.2.1.2.3 The de-acidification and deodorization process

The de-acidification and deodorization process involves deacidification of free fatty acid (FFA) in the form of Palm Fatty Acid Distillate (PFAD) and deodorization treatment. In other words, it is a process of separating the PFAD portion in the BPO to get RBDPO and to take out the smell of the oil. Prior to the de-acidification and deodorising process, BPO needs to

be heated again because some reduction of temperature happens at the bleaching process, plus the de-acidification and deodorization process will need a much higher temperature than the bleaching process.

Here, two heat exchange stages occur. First, BPO will go through the oil to the oil heat exchanger (labelled as heat exchange 3 in diagram 6.1) where BPO meets RBDPO (a very high temperature oil of about 260°C – an outcome of the deodorising process). This will elevate the temperature of BPO by almost 100°C to over 200°C. Then, as the required temperature needed for the deodorising process reaches about 260°C, BPO will go through another heating (a high pressure boiler heat exchanger) to achieve the required temperature. Such a high temperature is needed because it is only as the BPO reaches a temperature of more than 260°C that the PFAD component in the BPO is released as vaporisation occurs. However, although it is important that the heat and vaporisation is maintained at that high temperature, operators also need to monitor that the heat does not get too high in order to prevent the palm oil from vaporising together with the PFAD, which will then reduce the RBDPO throughput (i.e. increasing oil loss). Therefore, besides monitoring the display of the on-going temperature reading on the screen, operators also take hourly readings of the temperature (from the system as well as at the instrument/pipeline for those readings not on the screen) to monitor the trend, as well as set the high temperature alarm in the system to make a sound if it goes beyond the set point.

In addition to maintaining the temperature, it is also important to maintain vacuum level so as to avoid oxidation of the oil, which can make it polymerised (burn the oil). The importance of measuring the vacuum level is to make sure all the moisture in the oil is sucked out to avoid oxidation of the oil or burning of the oil because of the high heat processing environment. The vacuum readings normally stay constant at a certain level unless there are activities happening in the production process, such as opening and closing the valves to allow oil flow from one tank to another. The vacuum will normally pick up once the valve is closed. From the observation at the site, operators control the vacuum level by monitoring the vacuum report figure on the screen. The way the operators imbricate with the system to control the vacuum level will be discussed later in this section when I discuss about the alarm.

As for the PFAD (i.e. the sub product of RBDPO), when the PFAD is released through the vaporisation, the PFAD vapour will be sprayed with cold PFAD to capture the newly vaporised fatty acids and liquidate it back so it can flow out to be stored in the PFAD tank. The remaining oil which has now become Refined Bleached Deodorised Palm Oil (RBDPO)

will flow through the packed column and out of the deodorizer. The temperature of RBDPO at this stage is too high to be sent to either the storage tank or to the fractionation plant for further processing. It will be cooled down to the required temperature depending on the decision as to whether the oil should be stored in the storage tank or pumped to the fractionation plant. The cooling of RBDPO is also done through three heat exchangers (labelled as H/E3, H/E1 and H/E5 in diagram 6.1). The cooling is done to about 70°C if it is to be sent to the fractionation plant for further processing, or 60°C if it is to be sent to a storage tank so it can maintain the stability of colour of the oil in the storage tank.

Another sampling, this time for the RBDPO, will also be sent for quality testing every two hours just like the BPO oil.

> *Besides the colour issue… we can have an FFA problem [and/or]… let's say something went wrong with our FFA reading… [maybe because] the incoming steam is not good or there is a problem in the vacuum system, the corrective action we take is… for FFA it is best we recycle it to the BPO tank. We stop the bleaching plant temporarily so that BPO can go back to the deodoriser and reduce the FFA… we don't need to go back to square one unless we detect the colour is also off the grid.* (Refinery Supervisor - PG014)

Similar to BPO, the results of this testing will determine the corrective action, but here, normally, the focus is on the FFA level. However, the colour reading is also tested as this will be the last chance to take corrective action on the colour and the FFA problem before the RBDPO is sent to the storage tank or fractionation plant.

As mentioned, besides the display of the controlling measurement on the screen, the system is also equipped with an alarm system to make sure operators are aware that there are changes happening in the production. Every time the system takes any action, the alarm will make a sound. This is to alert the operator that an action/step has been taken. As the alarm sounds, the operator will have to press a button to 'inform' the system that they are aware of the 'new' activity/steps (displayed on the top left of the screen) taken by the system. The colour of the on screen text changes when the operator presses the button (from red or green to black, as illustrated in Figure 6.4 below) indicating that he is aware of the changes.

Figure 6.4
Alarm Notification

Source: Golden Crop Co. – Photo of display screen at refining plant

It is important for the operators to monitor the changes happening every time the machine takes any action because if there is any problem, immediate action needs to be taken. This is the reason the alarm is set to make a sound every time any steps are taken even though everything is done automatically. For example, as the valve opens at the de-acidification and deodorization stages discussed earlier, the vacuum reading will drop and, when it closes back, the vacuum reading should start to pick up. However, if the reading does not increase back to the necessary level, the operator will know that the valve is not closed properly and immediate action then needs to be taken manually at the valve. This example is illustrated by one of the operators at the refining plant:

> *Every time the valve or anything it [the PLC system] wants to do, it [the PLC system] will sound an alarm. It's good because they call us or alert us with every movement it [the PLC system] does. Although it's auto[matic], we still have to monitor. Because, sometimes, let's say the machine may open the valve, but when it closes back it may not close properly. We can know this by looking at the vacuum reading. This is the*

indicator. The vacuum reading should pick up when the valve is closed. But if we see it doesn't , it means there is something wrong with the valve. And so action should be taken. (Refinery Operator – PG032)

The alarm helps in increasing the awareness of the operators in making sure they give attention to specific control measures for each of the actions taken by the system. This is another clear illustration of a sociomaterial control practice that emerges from the interaction and re-interaction or entanglement between people and the technology (in this example the alarm). As the system is trying to perform a job (opening the valve), the alarm will 'call' for the attention of the operators. In responding to the 'calling', the operator monitors the changes in the figures on the screen and presses a button (i.e. he interacts with the system and tells it that he is aware of and is monitoring the changes). The outcome of these complex interactions between the two entities creates the practice of controlling the vacuum level in the machine/plant.

The illustration about the vacuum level (indicating the valve movement) discussed above is one of the examples of a control measure for which the alarm system creates an alert. Different controls are to be given consideration at different times when different activities are taking place. The alarm sounds help in determining which control measures need attention at the time. Besides the sound of the alarm, the colour of notes (see Figure 6.4) given by the system also classifies the urgency of the actions that need to be taken by the operators at the time:

Every action it takes it will highlight for us. An alarm will sound and here at the box [the notes box for activity taken by the system], the activity will be shown either in green or red depending on the severity of the action. It will only turn to black when we click on it. It's like we are telling the system that "okay, we are aware of your action". It will turn back to red if there is a problem. (Refinery operator - PG035)

This illustrates the performativity (changes of colour according to urgency) of the technology that is not within the control of the people. However, together they (i.e. the materiality of the technology or material/artefacts and the people with a specific goal in mind) imbricates and as the outcome of this, a controlling practice emerges. These 3 stages (i.e. the degumming, the bleaching and filtration and, lastly, the de-acidification and deodorization process)

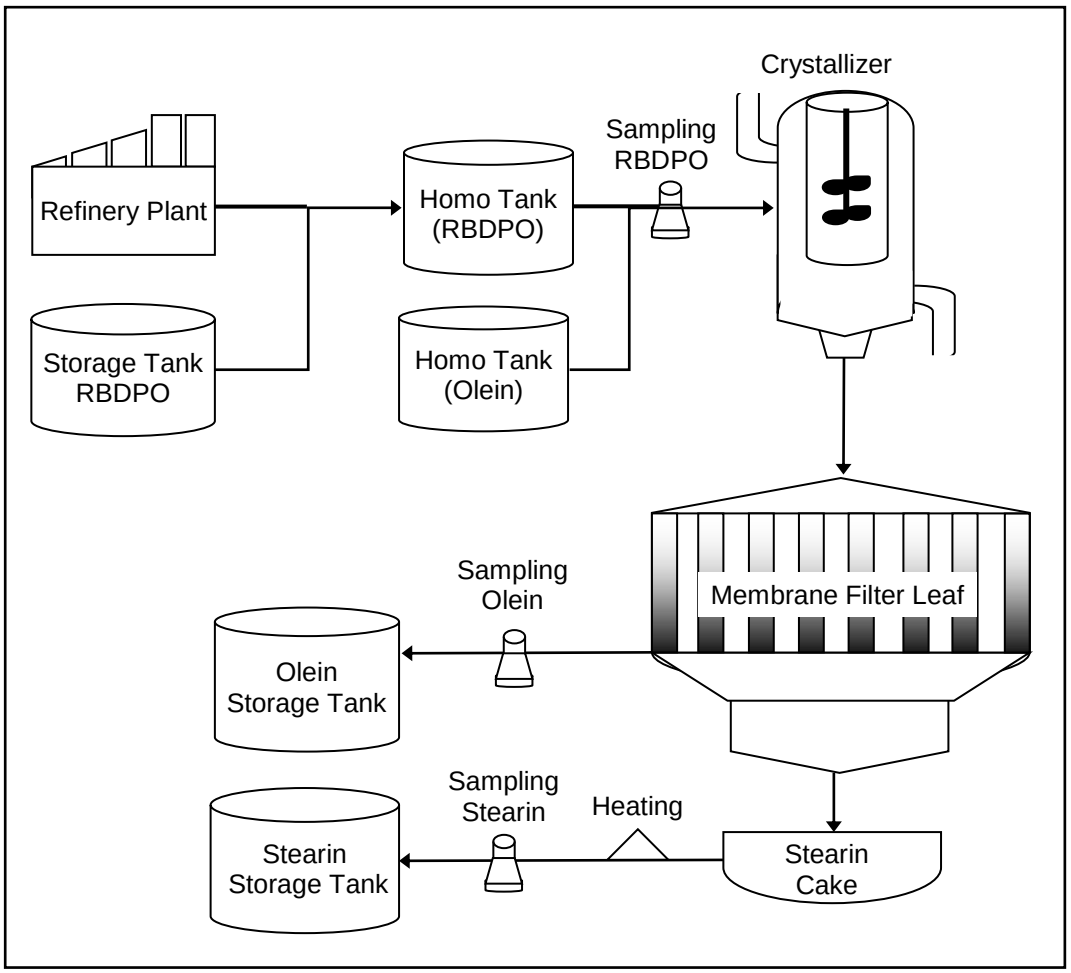
completes the process in the refining plant. RBDPO, which needs further processing, will then be sent to the fractionation plant to separate the RBDPL and RBDPS portions.

As has been seen here, the production process that is run by the automated and fully equipped monitoring devices together with the intermittent adjustments made by the people in response to the lab results and the process variables movement readings displayed on the PLC screen, play an important role in getting the appropriate quality of oils. None of the agencies (social/people and materials) work by themselves. People respond to the changes that are informed by the system as well as the quality results. At the same time, the system responds to the adjustments made by the people to produce oil according to the required measures. Therefore, the act of producing the required quality of specified oils is not just a practice of people running things the way they want with the technology, but it is the continuous imbrication between people and technology together with other materials that make the production process possible. I will continue to discuss the imbrication between the people and technology and other materials in the next section while describing the second part of midstream production at the fractionation plant.

6.2.2 Stage 2 - Fractionation Plant

After CPO has been refined, the RBDPO will be further processed at the fractionation plant (see Diagram 6.5 below). Fractionation of RBDPO proceeds in a batch process format. It is a process that involves separating Stearin (i.e. solid fine crystal molecules) and Olein from the RBDPO.

Diagram 6.5
The Fractionation Process



Source: Developed by Author

At the time the research was carried out, there were 2 fractionation plants in operation. Both plants were equipped with fully automated systems that monitored the whole production process. The detailed process of production at the fractionation plant is as follows:

6.2.2.1 Fractionation Process – The imbrication process between people and material/technology

6.2.2.1.1 Raw material

The raw material for the fractionation process is RBDPO and this comes straight from the refining plant or from the storage tank (filled from the refining plant). RBDPO is made up of Olein and Stearin and it is the function of the fractionation plant to separate these two elements. RBDPO (with a temperature of just over 60°c) is first loaded into the Homo tank.

There are 2 Homo tanks at the fractionation plant - one contains the RBDPO while the other holds Olein (see diagram 6.5). The usage of Olein will be explained later.

6.2.2.1.2 Cooling process

From the Homo tank, RBDPO is loaded into the crystallizers. The crystallizers are small tanks which contain stirrers and water hoses inside, that are used in the cooling process of the RBDPO at various stages with a set of pre-determined recipes. Figure 6.5 is an example of an empty crystallizer tank. The fan like leafs are the stirrer, while the circle hoses are water hoses.

Figure 6.5
Image of Empty Crystallizer

Source: Golden Crop Co. – Photo of an empty crystallizer at fractionation plant

Before RBDPO is loaded into the crystallizers, a sample of RBDPO will be taken to measure the quality of the oil prior to the cooling process. If the quality is low (e.g. if one of the quality parameters - i.e. IV of RBDPO - is less than 50), the processed Olein from the Homo tank (which has IV of 56 to 57) will be mixed with the RBDPO to average out the quality and only then will the cooling process proceed (see Table 6.2 for the list of quality parameters for different grades of oil to be produced). The mixing needs to be done because low quality RBDPO will not form proper crystals and the Olein and Stearin joint-products will not be separable. Therefore, it is necessary to mix some quantity of processed Olein in this circumstance so that the crystallization process will be effective and low quality RBDPO can still be processed. However, this action will lower the yield per MT of RBDPO. The following simple example can explain this: 100MT of RBDPO is expected to produce 78MT of Olein (78% - please refer to Table 6.2). However, if the RBDPO quality is low, Olein needs to be mixed into it. Therefore, the 100MT of RBDPO is not 'pure' RBDPO anymore as some percentage of it now includes the already processed Olein that has been mixed in. In such a

case, the 100MT may be made up of 70MT of RBDPO and 30MT of Olein. This mixture of oils will still only produce 78MT of Olein, out of which 30MT has been processed twice. So, the percentage of yield out of the pure RBDPO has dropped from 78% to 68%.

However, if the quality of RBDPO is good (having IV range between 51 and 52), no mixing will be needed. Thus, the RBDPO will be pumped directly to the crystalliser from the Homo tank for the cooling process.

Although the action of mixing the oils directly affects the yield and is not encouraged by the management, for reasons mentioned above it is still necessary at times to enable production to run effectively:

> *The decision on how much to mix is done here among the supervisor and operator. We normally get the approval from the manager… the supervisor will tell them during the morning meeting. But you know… they [the management] don't encourage mixing… we still mix… if not, the crystal won't form. We understand their concern about the cost of production and yield, but if the RPO's quality is really bad, and we still continue to filter there will be much sticking… then we have to do a lot of grubbing, risking tearing the filter cloth… and the yield also will not be that much plus the output quality also will not be good. So… as much as we can, we avoid mixing, but if it is necessary, we'll do it.* (Fractionation operator – PG018).

While this early corrective action is taken before the oil goes through the cooling process, it is necessary to bear in mind that the mixing is done based on experience and the use of approximation and estimation by the supervisors and operators. The outcome of this is not necessarily guaranteed, therefore operators still have to monitor the cooling process and take further corrective action when required. This again shows that an iterative and continuous monitoring and adjustment is necessary in the fractionation process of palm oil – similar to the production process in the refining plant.

Now I will briefly discuss the cooling process at this fractionation plant and how the controls and decision making on the production emerge when operators at this plant become entangled with the processing control system (the PLC system).

The cooling process commences after the RBDPO has been loaded into the crystallizers. The capacity of each crystallizer is approximately 40 MT at one plant and 60 MT at the other plant. They have 6 crystallizers with capacity of 40 MT and 3 crystallizers of 60 MT. Each of the crystallizers operate separately (i.e. the cooling process of each crystallizer is not linked to one another). The goal of this cooling process is to separate out the solids from the liquid oil. When the oil cools down, the Stearin will start to crystalize and become semi solid while the Olein part of the oil will remain as liquid. Therefore, the control that is important at this stage of processing is to make sure that the formation of the Stearin crystals is perfect and that the two elements of oil can be separated effectively. In doing this, after the oil has been loaded into the crystallizer, a pre-determined recipe will be set in the system which is affected by the final product grade that they are trying to produce. The recipe setting is a combination of water temperature, stirrer speed and time. Table 6.2 in the earlier section of this chapter demonstrates the timing of the cooling process for each of the oil grades.

The PLC system at the fractionation plant monitors the step-by-step reduction in the temperature of oil according to the recipe set earlier. Figure 6.6 displays the on screen iconic representation of the cooling process and the pre-determined recipe set (emphasis by the red box).

Figure 6.6
On-screen (PLC) - Fractionation Process

Source: Golden Crop Co. – Photo of PLC display screen at fractionation plant

Among others, one of the most critical and most referred to reports (that the system produces) is the graph showing the cooling process trend. It is used for decisions on corrective action while the cooling process is in progress. The graph provides the readings of the water temperature going in and out of the water hose for the cooling process as well as the temperature of the oil in the crystallizer. It is important to monitor the water temperature because the water temperature will determine the way the oil cools down and the proper formation of crystals. Oil needs to be cooled down gradually because sudden changes in temperature will result in non-proper formation of crystals. This is especially so at the critical time when the temperature is about 30 to 32 degrees Celsius and the crystals start to form.

> *We will have to monitor this graph. The cooling cannot be done in drastic changes because the crystal won't form. From around 70 or 60 degrees Celsius when we upload the oil into the crystallizer, it will cool down to about 16 degrees [depending on the oil grade and recipe]. The critical*

time is around 30 to 32 degrees Celsius. This is when the crystals will start to form. When the crystals formed, they will have lantern heat. If there is too much heat, it can lead to sudden increases in the oil temperature. The graph will show it like this – it's bounced. If this happens, definitely the crystals will not be formed correctly. If we insist on filtering this oil, it is guaranteed it will be flabby and stuck to the filter when they open the membrane leaf. Not good. We don't want that. (Production engineer/manager, PG013)

If we can filter, we will try filtering. [But] if by looking at the graph [while the cooling process is still in progress] we know it is not good, we already know that we have to stop and do the re-heating again. (Fractionation Operator, PG018)

Figure 6.7 and 6.8 show the difference between when there is a bounce and no bounce in the graph. Figure 6.7 shows the trend of a good cooling process where the graph shows that the cooling process happened smoothly and gradually and there is no evidence of inflation (the arrow shows where the inflation may happen).

Figure 6.7
Graph Image (Good Crystal Formation)

Source: Golden Crop Co. – Photo of graph report on cooling process produced by PLC system at fractionation plant

Figure 6.8 below shows the 'bounce' or inflated graph. The arrow in the figure shows the area where 'bounce' occurs.

Figure 6.8
Graph Images ('Bounced' Crystal Formation)

Source: Golden Crop Co. – Photo of graph (cooling) process on PLC display screen at fractionation plant

When the 'bounce' is detected, operators will immediately take corrective action by either (i)just reheating the oil in the crystallizer prior to re-cooling it, or (ii) pumping out some of the oil from the crystallizer and adding some Olein (to stabilize the quality of oil and help in the formation of the crystals), and then reheating the oil for another round of the cooling process.

As evidenced in the refining plant, from my observations at the fractionation plant the trend of sociomaterial control practices is omnipresent. The processing and various corrective actions at the cooling stage are one instance of this. Although at first glance we can only see what the technology and material is doing and what the people are doing separately, with careful analysis the entanglement that happens between the two agencies that create the control practices become apparent.

For instance, in the illustration of the cooling process, the operators as the human agency have the objective of running the cooling process so that the elements of oil can be separated. In order to achieve this objective, they have to determine the shape or formation

of the crystals. However, this is not fully controllable by the operators. Although the operators can set the recipe for timing and temperature of the water, the performativity of the technology's materiality (i.e. the process of cooling through stirring together with the temperature of the water flowing through the cooling coil that affects the gradual reduction of the oil temperature) is not fully controlled by the operators. It is the machine that does this and it is not fully under the control of the operator. As long as the perception that is constructed is one of affordance (to achieve the goal of enabling the good formation of Stearin crystals), the operators and the crystallisers imbricate in a way that the operator continues relying on the system to continue cooling the oil and forming the crystals until the process is complete. Otherwise, when the operators perceive that the system is constraining them from getting the crystals to form in the right/acceptable way (i.e. when they see the bounce on the graph), they will start recycling the oil and reprocessing it. Therefore, it can be seen again that humans and material have their distinct agency, but the precise controlling practices at a specific time in the fractionation process (and production batch) only emerge when they intertwine.

Besides the graph, operators and supervisors will also look at the physical formation of crystals as the processing proceeds. In contrast to the refining plant that is run under vacuum, the top of the crystallizer tanks can be opened and oil can be scooped out. This physical checking is usually done towards the end of the cooling process, especially if the graph indicates a slight bounce trend but the indication is not clear/drastic. So, to make sure, they will see the crystals physically:

> *Here [at the fractionation plant] the main important thing is the formation of crystals. Sometimes we go and physically check and feel the crystals. Yes… I mean we feel with our hand. It will feel like sand. We get different quality of feed oil all the time. So the crystal formation also varies. But normally if the graph shows okay… it should be okay. But if we want to make sure, we come up here [on top of the tank where he can scoop up small amounts of oil] and see the crystals... sometimes even if the graph shows a small bounce we'll check here first then only decide to reheat or not. If it feels okay we will still try to filter.* (Fractionation supervisor, PG015)

After all this has been done, the RBDPO that has gone through all the cooling steps and reached a certain temperature will be fed into the filter press membrane. The Stearin element (i.e. the crystals) will stick to the filter while the liquid portion (i.e. the Olein) is

drained out through the drain hoses into the storage tank. Then, air pressure will be loaded in-between the membrane plates to press the Stearin to get the remaining Olein. The Stearin will form a solid cake. The cycle time for the filtration process will depend on the oil grade that they are producing. The better quality oil will have more cycles because more of the Stearin element in it will be taken out. The higher the quality of Olein the longer it will take and the fewer yields it will give (see table 6.2). After finishing the pressing process, the filter membrane will be released and Stearin cake will fall into a container and be heated up to liquidate the solid Stearin before it is pumped into the storage tank. This is where the second point of sampling at the fractionation plant occurs.

The second sampling (at the filtration stage) is taken to check the Olein quality. The sample is taken from the first cycle of the processed batch. They measure the quality by its Iodine Value (IV), Clouding point, Free Fatty Acid Value (FFA), Moisture (VM) and its colour. If the first cycle does not meet the specification, they will have to start from scratch. Off specs Olein will be dealt in any of these 3 ways: (i) pump back to the crystallizer and reheat; (ii) pump back to the crystallizer, pump out some of the RBDPO and add some Olein into it and reheat; or (iii) pump back to the storage tank. The first two remedies are taken when recycling can help and then it will go through the cooling process all over again, while the third remedy is taken if the quality is too bad and cannot be averaged out just by mixing with a small amount of Olein in the crystallizer. Thus, it will be transferred to the RBDPO storage tank so that it can be mixed with a larger amount of oil to average out and stabilize the quality before being used again for the production later.

In the case where the sample gives good results, all the oil in the crystallizer is filtered and sent to the storage tank and operations proceed with another batch of oil for the cooling process. After completing the fractionation production process, both Olein and Stearin will be stored in the storage tanks and later will be partly used for the downstream business activities and partly sold in bulk locally and also exports. In the downstream production process, Olein is packed into smaller containers for the end consumer while Stearin is used to produce products such as margarine, shortening, vegetable ghee and vanaspati. These latter products are packed under the company’s brand and sold to end users and in bulk to industrial customers locally and internationally.

6.3 CONCLUSION

This chapter has described in detail some of the key elements of the production process at a typical midstream palm oil refinery plant where CPO is processed to produce RBDPO, PFAD, Olein and Stearin. There are two main stages of production: the refining process at the refining plant followed by fractionation process. Within the refining process, there are three sub-processes, namely the degumming (pre-treatment), bleaching and filtration, and de-acidification and deodorizing processes. The product of the first stage is RBDPO and PFAD. The second stage of production (i.e the fractionation process) consists of the cooling and filtration process, and this is where RBDPO is further processed to get Olein and Stearin.

Within the description of the production process at both plants, I have attempted to show that, fundamentally, the production process and activities including the control practices are consequences of multiple imbrication processes between people/social and material/technology. The illustrations discussed above provide illustrations of the entanglement between operators and supervisors together with the production controlling system (the PLC system) and reports such as the laboratory reports at the production plant. These imbrications among people and technology at the refinery and fractionation plant occur alongside attempts by management and staff to achieve the broader formal organisational goal of achieving budgeted yield.

The production process is run by the operators and supervisors together with the PLC system, which is reliant on a range of different types of recording instruments and sensors that link to a graphical representation screen. The operators and supervisors use the screen to help them exercise their intermittent judgement and make adjustments to achieve the targeted yield and cost mandated in the budget. This exercise corresponds to the daily and monthly performance report that compares performance to date to the targeted figures prepared by the production manager as well as daily production meeting between staff at the production sites and refinery management (this is discussed further in chapter 7 and 8) – refer to appendix 5 for sample of monthly report. Based on Diagram 3.1 of the imbrication process that I have discussed in the methodology chapter (Chapter 3), Table 6.4 below summarizes the elements of the imbrication process that describe some examples of imbrication discussed in this chapter that occur during the production process.

Table 6.4
Selective Examples of the Imbrication Process at the Production Sites

Site	Human/ Social	Intention(s)	Material/ Artifact	Materiality	Perception of Affordance/ Constraint	Sociomaterial Control Practice
Refining Plant						
Degum-ming (Pre-treatment)	Operators/ Supervisors	Break oil from foreign particles	Heat Exchanger	Transfer the heat between oils	Affordance	Control Flow Rate
					Constraint	Control Flow rate and set the temperature detector for steam heating
Bleacher	Operators/ Supervisors	Trap the gums and reduce colour	Dosing system for bleaching earth (volume setting)	Allow setting of bleaching earth amount which will automati-cally calculate dosing time according to flow rate adjustment	Affordance	Adjustment of the amount (based on the lab result) directly on the system.
			Dosing system for bleaching earth (Dosing machine)	Open and close the valve to dose bleaching earth	Affordance	Rely on the system on dosing the bleaching earth into bleacher rather than physically pouring it
			Dosing system for bleaching earth (Dosing machine)	Link the dosing information to recording reports	Constraint (Unreliable information on the dosage)	Physical checking at the instrument every hour
Filtration	Operators/ Supervisors	Trap all spent earth and pressed all oil out	Setting on the screen on the set time and actual run time	Record the different between set time and actual time	Affordance (provide appropriate information)	Monitor difference in the record and take action such as clean/ change filter leaf or adjust pressing pressure

Site	Human/ Social	Intention(s)	Material/ Artifact	Materiality	Perception of Affordance/ Constraint	Sociomaterial Control Practice
Refining Plant						
All stages	Operators/ Supervisors	Monitor every steps	Alarm system	Make sound for every steps taken	Affordance	Take action accordingly
			Coloured note system	Changes the colour of the font according to the severity	Affordance	Take action accordingly
Fractionation Plant						
Cooling process	Operators/ Supervisors	Separating Olein and Stearin	Crystallizer with water coil/hose and stirrer	Gradual cooling process	Affordance	Monitor the graph – with perception of affordance will continue to complete the cooling process
					Constraint	Monitor the graph – with perception of constraint will recycle and rework

From the descriptions and illustration provided in the discussion as well as the summary in the table 6.4, it is apparent that the control practices emerge from complex entanglements between people and material and/or technology. In this case, the technology is the PLC system and its instruments and other materials are the laboratory results and the quality trends as well as the reports that show the process variables trends. Operators and supervisors consistently and iteratively imbricate with the materials and technology and this results in a pattern of control practices, such as setting the temperature detector, adjusting the flow rate, and taking actions as the alarm rings.

In addition to the demonstration of continuous intermingling between people and materials on site in the production process, the illustration also shows that the process of imbrication happens based on the perception of affordance and constraints. The perception of affordance or constraint that was constructed as people with intentions engage with the materiality of the material/technology determines the way the two agencies imbricate, and this results in a control practice.

Referring to each of the imbrication episodes that are outlined in Table 6.4, it can be recognised that each of the human and material elements have their own agency (i.e. capacity for action which is inherently distinct from each other). People have their own intentions independent of the material or technology. For instance, as listed in the table under the 'intentions' column, operators and supervisors at the refinery plant have their own objectives, such as making sure that the foreign particles in the oil break off, get separated in the bleacher and filtrations process and, finally, are separated from the fatty acid to produce oil of a sufficiently good quality for the fractionation process. Similarly, the operators at the fractionation plant have the intention to separate the Olein and Stearin portion of the oils.

As for the material and technology (PLC system and other reports), it also exhibits distinct capacity apart from the people – *the materiality* – i.e. the capacity for action that is not fully controlled by the operators. Examples of this 'independent capacity' are the ability of the heat exchanger to transfer the heat between two different oils, the automatic opening and closing of valves in the dosing system as well as producing reports and charts of the cooling process at the fractionation plant.

Having said that, although the two agencies are inherently distinct and possess their own capacity for action, controlling practices only emerge and develop as the operators and system imbricate in a particular way. As mentioned several times before, the imbrication process happens according to the perception of affordance or constraint that is constructed when people and material become entangled. It is the overlapping arrangements between the plant staff with the different elements of the system that creates the controlling practices and production processes. An example of the sociomaterial control practice that emerges out of the imbrication process is listed in the last column of Table 6.4 above.

In general, this chapter has focused on showing the sociomateriality practices that emerge from the imbrication process between people and materials/technology. It has highlighted that every practice (including control practices) that is exercised at the production site is fundamentally sociomaterial in nature. The sociomaterial practices are evidenced every step of the way within the production process at both plants.

I have also shown briefly one example of a sequence of imbrications that happen at the production site – in the bleaching stage discussion. This concept of chain of imbrications will be illustrated more in the next chapter. The next chapter will show the interactions between different groups of people who are both directly and indirectly involved with the midstream production and the imbrications that happen along the way. The discussion will not only

illustrate the imbrication that happens but also discuss the effects of earlier imbrications on future imbrications.

CHAPTER 7
THE CHAIN OF SOCIOMATERIAL CONTROL PRACTICES: TEMPORAL CHANGES ACROSS MULTIPLE SOCIAL ARRANGEMENTS

7.1 INTRODUCTION

This chapter will continue to illustrate the control practices that emerge as a result of the imbrication process that occurs between people and material/technology. These interactions take place as people seek ways to maintain a balance between an organization's concern to meet desired product quality, while achieving the targeted yield and cost set in the budget. The discussion expands to consider key aspects of the work practices associated with different social arrangements that operate among different groups of people who are directly and indirectly involved in the production process. This includes the different teams of operators and supervisors who work in different shifts at the plants, the laboratory officers who help in reporting the quality of received and produced oils as well as the refinery management team.

The discussion revolves around a description of their interactions together with the material and technological objects they engage with and encounter within the plant, including records and reports which are compiled during the production process at different locations (i.e. the laboratory, refinery plant and fractionation plant). In illustrating the interactions between these social groups and their entanglement with the material objects (i.e. the imbrication processes), the chapter focuses, in part, on a description of how previous imbrications which are reflected in the reports (such as the laboratory sampling results, production progress and performance report) enable and influence discussions and/or sharing of information which help decision making. In other words, the illustrations in this chapter will show the way in which previous imbrication processes influence present and/or future imbrications. The chain of imbrications concept discussed in Chapter 3 will be utilised to explain this flow of production related MACs practices that occur across time and space within the organisation.

7.2 CHAINS OF IMBRICATION: INTERACTIONS AMONG PEOPLE, MATERIAL AND TECHNOLOGY

7.2.1 The Refinery and Fractionation Plant: Information Transfer between Shifts

Refining and fractionation staff work in a three shift pattern (refer to Chapter 6 for an overview of the flow of the production process in the refinery and fractionation plant). Because of the long and continuous hours involved in the process of palm oil refining and fractionating, it is essential for the people involved in different shifts to be informed about the flow of productions, any problems that arise, the cause of actions taken and any actions taken to solve them during the previous shift. In order to enable the transfer of information smoothly and not miss any essential points, operators and supervisors record all key actions that they take during their shifts in a 'plant log book' (hereafter referred to as 'log book'). They have one log book for each plant. The information that is recorded in the log book includes the following: (i) the standard information (i.e. the processing variable status at the time when shifts are taken over – this status would include information such as the tank number in which CPO (crude palm oil) and BPO (bleached palm oil) is consumed for production of RBDPO, the set flow rate, the set volume of sub-material usage, and the tank number (or fractionation plant) which the RBDPO (refined bleached and deodorised palm oil) produced is sent to; and (ii) the time taken and changes that occurred during the shift after the operator has taken over duty responsibilities (refer to Figure 7.1 for an illustration of this procedure). The changes that are recorded include the changing of the processing variables, such as flow rate and dosage of sub-materials, and also any technical issues such as technical or instrument failure and actions taken in response.

The log book serves as a medium that enables essential information to be recorded about the events occurring within each shift. It provides an opportunity for the workers in the new shift to get valuable information on what has happened during the previous shift and the corrective actions that have already been taken. This transfer of information is essential for the refining and fractionation process because of the nature of the continuous production process and the extended duration of processing required by each batch of production before laboratory test results can show the outcome of changes made in the processing variables. Therefore, it is highly probable that the action taken during the earlier shift(s) (S1) will influence the next shift's (S2) course of actions.

For example, in the refining plant, when the S1 shift operators find that the colour reading of the BPO and RBDPO has achieved the target, or is sometimes better than the targeted colour, they will start maximizing the flow rate and reducing the sub-material. In doing so, the

quality of oil produced will be affected; however, the effect will not be seen immediately. Depending on the adjustments made, the actions taken at this time might only have an impact on the result of lab tests three to five hours later. Therefore, changes made by S1 operators affect outcomes that need to be handled by the S2 operators and supervisors. This is also the same issue at the fractionation plant as sometimes the cooling process can take up to 22 hours for a batch (see Table 6.2 in Chapter 6 for information on cooling time for different grades of oil), meaning that the same batch of oil can pass through 3 shifts (i.e. 3 different groups of people).

As I have discussed in Chapter 6, input material (CPO) comes with a variable quality status which requires continuous monitoring and adjustment in accordance with the lab test results and the prior series of actions taken. There is no one standard way of production that can be followed by operators and supervisors in their daily production process. Below is the normal day description given by the refinery plant supervisor describing continuous controls in ensuring an efficient production process:

> *Quality is our most important concern. Assuming at present we've already got the level of quality that we want so we'll then start looking at what we can adjust. First we will try to maximize our throughput. So…with this level of my production now, and, with this level of colour quality [assuming here the colour is good] I'll check whether the flow rate has been set at the maximum or not. So I'll play with the flow rate and everything else will stay the same. Once I've adjusted the flow rate, we have to wait two to three hours to see the result [from the sampling], then if everything is okay [the quality is still good], I'll start playing with the sub-materials. I will reduce the amount of sub-material usage gradually and wait another two to three hours. If results are still within the acceptable level, I'll reduce temperature [to save steam]. That's how we do it. We check the production variables one by one from time to time.* (Refinery supervisor, PG033)

It is apparent in the interview extract above that in order to achieve optimisation in the production process while sustaining the required quality, operators and supervisors have to constantly and iteratively make adjustments to the processing variables and respond afterwards to the effects of each action. This description illustrates the chain of imbrications that occurs between the staff in that plant and the production system and how the previous imbrications that occur influence the present imbrication. Although it seems simple, the

actions described in the quotation demonstrate a complex and dynamic/continuous entanglement between the staff at the plant and the production systems with its instruments in creating control in order to achieve all those intentions mentioned in the quotation, such as achieving the required quality, maximising throughput and minimising sub-materials and utilities usage – all to achieve an optimised production outcome while keeping in mind the targeted budget (see Table 6.1 and 6.2 in Chapter 6 for information on yield target) set by the senior management.

Reflecting on the normal production day as described by the refinery supervisor in the quotation above, let us assume for a moment that the production process has a starting point[9]. As the production staff team (operators or supervisor) starts the production process, the main intention is to produce oils that meet required quality specifications. Having this intention in mind, the operators (and supervisor) together with the system and instruments will imbricate in a specific manner in their attempts to achieve this objective. As they seek to achieve the quality objective (in this case as indicated by the laboratory results) they now start forming new goals that respond to the need to optimise the production process to produce maximum output while using a minimum of sub-materials[10]. Based on this new goal, the operators will start approaching the system (such as the flow rate, dosing system for the sub-materials and temperature setting mentioned in the quotation above) and, depending on the perception of affordance or constraint, the people and the system will imbricate in a certain way to achieve this new objective and the cycle continues. Since the nature of the midstream palm oil production process is continuous and of long duration, the operators and supervisor who carry on trying to achieve their intentions go beyond one shift. Therefore, because of the long, continuous and iterative process they are involved with, which means actions taken at a point in time have an impact on upcoming results and the results then require further action, where this future action is based on the results plus previous action taken it is vital for the operators and supervisors at the plant to know exactly what has happened during the previous shifts because the impact of actions taken then may cross shifts. Thus, the transfer of information via the log book is essential in controlling the production process because actions taken in response to the information directly affects the quality of oil produced and the monitoring of cost of production as well as its efficiency. The information referred to in the log book reflects the imbrications in the previous shift and the sociomaterial efforts of control which emerged from those imbrications. Based on this

[9] According to the imbrication concept, the overlapping imbrications create a stable pattern (work and/or control practices) that has an arbitrary starting and ending point.
[10] The main sub-materials are the phosphoric acid and bleaching earth used to separate the CPO from the foreign particles and help reduce the colour of the oil (discussed in the Chapter 6).

information, the later shift operators will respond and, together with the system imbricate and take action to maintain control.

The statement given by the refinery supervisor (PG033) above describes the situation where the results of earlier production activities and practices have produced favourable quality oil and the actions that needed to be taken. The constant action/reaction process does not only occur during the production day when favourable results are obtained; information transfer is also especially important when there is a problem with the output quality from the oil production as more urgent actions need to be taken to remedy the problem and the solutions then monitored. The actions that will be taken when there is a problem in the output quality are illustrated in the example given below by the production executive:

> *To detect any problem in the production, we normally depend on the quality reports [from the laboratory]. There are two stages of checking that the operators and supervisor need to do [technical and sub-materials retention time]. If it is a colour problem, they will start checking at the bleacher plant. First, they'll check the steam sparging by the pressure gauge - also they can see the oil agitating through the side glass. Then they will check the timing and quantity of bleaching earth dosed, and next the vacuum and also the oil level for the retention time. If it's the FFA, they'll go and do the same thing at the deodorisation plant. These corrective actions take time. Checking and solving the technical stuff may take hours and hours… Then if all the technical things are okay, they'll see the second checking stage. They have to change the volume of sub material and retention time. They have to do it gradually one by one. They'll start increasing the bleaching earth gradually and wait for the test results. If still not okay, they'll increase some more. Then play also with the phosphoric acid volume. If it's still not working, then only they'll reduce the flow rate. You see… it takes time.* (Production executive, PG037)

As exemplified here, several steps need to be taken to detect and solve quality problems. In addition to this, it takes time for the results to be revealed as each step is taken, especially the second stage involving corrective action which involve adjustments to the quantity of sub-materials. Here, the log book information may save the efforts of the operators and supervisor of the present shift from having to go through the same indicators (that have been tackled by the previous shift) when a quality issue arises.

The example that follows will demonstrate clearly how the imbrications at one point in time influence future imbrications between the people and the material/technology (i.e. the PLC system and plant equipment/machineries) with the help of the information that is recorded in the log book.

Figure 7.1 is a sample of information recorded in the log book and the process in which a quality problem was addressed. The problem involved a technical issue within the plant concerning a failure to achieve the required level of vacuum in a particular part of the plant equipment. I will illustrate how the chain of imbrications that occur at different times across the two shifts (Shift 1 (S1) and Shift 2 (S2)) happen through the interactions between the two groups through the transfer of information in the log book – in this case the refining log book. The event goes as follows:

Figure 7.1
Image of Log Book Note

Source: Golden Crop Co. – Log book at refining plant

At 7.00am (see Figure 7.1 or extract below) the S2 operators take over the shift from the S1 shift. The following was noted down in the log book at the beginning of the shift:

7.00am: Take over shift plant in operation

Consumed BPO from tank 2701 [BPO intermediate tank]

Flow rate at 27.00 t/h

*Produced RPO [RBDPO] to tank 2701 (**recycle – H/FFA**)*

The information above (bold and underlined) shows that there was a high FFA problem in the sample of RBDPO produced, which normally indicates that there was a problem at the de-acidification stage (refer to Chapter 6 for an overview of the de-acidification process). What can be seen here is that at the time the shift was taken over the recycling process was taking place – where RBDPO was sent back to the BPO tank (tank 2710) for reworking at the de-acidification and deodorizer plant. The decision to recycle the RBDPO was taken by the S1 operators. As the S2 people had taken over shift duty, they then had to continue the efforts of the S1 shift to make sure the high FFA problem was solved. Below are the further actions the operators took:

7.10 am: Divert RPO [RBDPO] to fract. Colour: 2.8 FFA: 0.088.

10.00 am: Recycle RPO [RBDPO] to feed tank [CPO intermediate tank] (vacuum dropped).

11.20 am: Bypass exchanger 27E01 [exchanger from BPO tank to flow oil to deodorizer tank]. Repair by maintenance.

12.00 pm: High pressure boiler [heat exchanger before oil flows into deodorizer tank] trip [electrical problem].

12.00 pm: Re-operate heat exchanger 27E01

12.10 pm: Divert RPO to fract. Colour 2.8 FFA 0.100.

02.10 pm: Divert RPO [RBDPO] to tank S3. Open line S3 close line P1.

The RBDPO sample is taken every 2 hours. The lab result of RBDPO at 7.10 am was still off from the desired quality parameter where colour should be less than 2.2 while FFA should be less than 0.08. However, since the outcome of the S1 operator's decision had yet to show, they (S2 operators) decided to send the oil to the fractionation process[11] because it was expected that the RBDPO would be fine after the recycling process – and, in this case, they were right. The production went through as anticipated and the lab results that were obtained at 9.00am were also good. This continued for about three hours until 10.00am.

At 10.00am, the operators again detected a loss of vacuum at the deodorizer plant. They decided to recycle the RBDPO (that was produced in the low vacuum) to the feed tank. They found a leaking problem at the heat exchanger (27E01) and called the maintenance people to effect a repair. While the repair was being done, the production (at the deodorizer plant) continued in a less than ideal production environment, which then led to below targeted product quality. Therefore, they (with approval from the management) decided to dump the oil to the storage tank[12] (tank number S3) rather than sending the oil forward as normal to the fractionation plant. However, before all of these actions involving recycling of the oil through part of the process and the repair to the heat exchanger could show a clear impact on the final output of the production, there was a change of shift. The next shift took over the operating duties, bringing a different work group (S3) in at 3.00pm. Based on the log book notes and the quality reports from the lab, the people in the next shifts will be able to appreciate the status of the production process when they take over operating duties and have access to a record (the log book) on the actions that have already been taken to get to that point.

The records continue to show the new group of operators and supervisor (S3 shift) then continued logging their activities as follows:

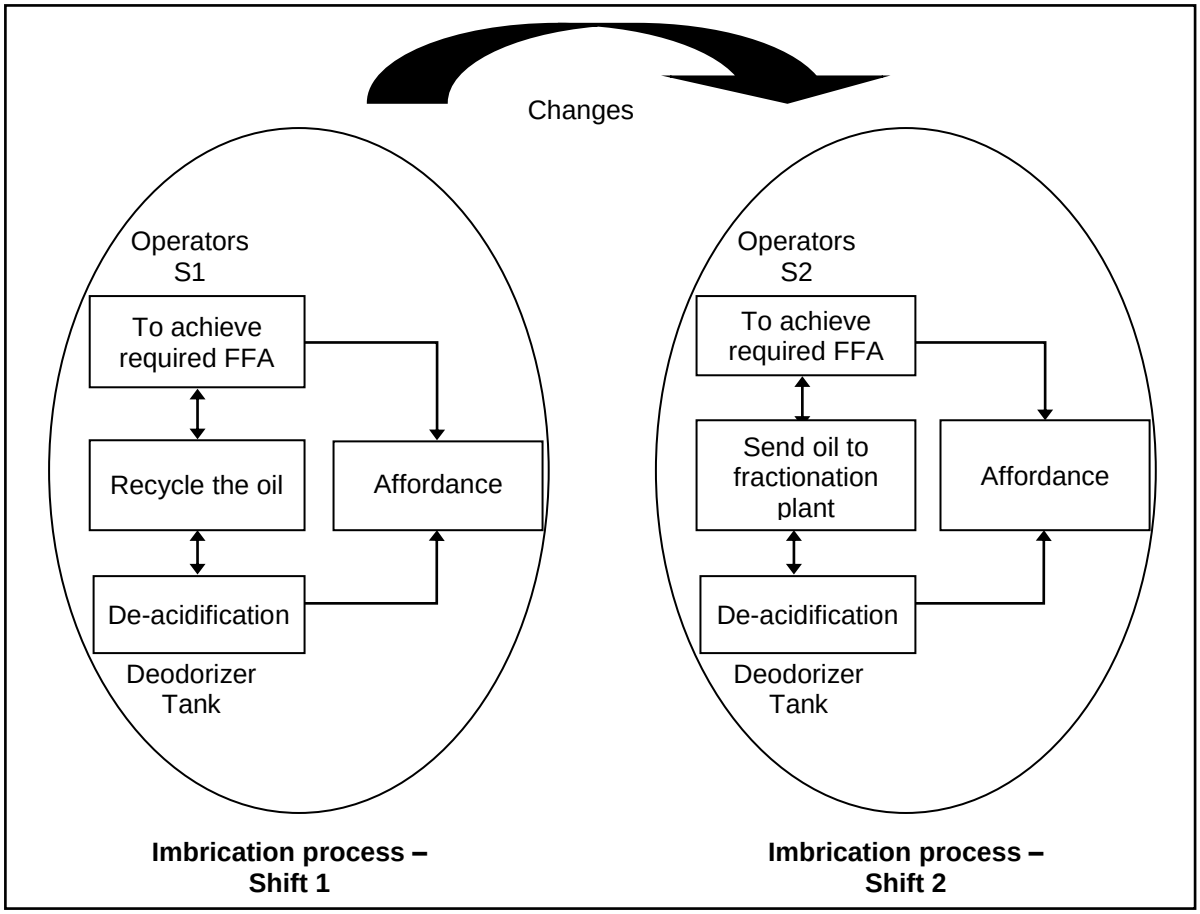
> *03:00 pm: Hand over shift in operation.*
>
> *Consumed BPO from tank 2701*
>
> *Flow rate set at 27.00 t/h*
>
> *Produced RPO [RBDPO] to tank S3, PFAD tank R5.*

[11] Only considerably good quality oil will be sent to the fractionation plant for further processing.
[12] It is acceptable to mix the slightly off quality oil which has gone through the refining process with the higher volume of normal quality oil (in the storage tank) as it will average out the quality. However, normally, if the quality is off by a long way, the oil will be treated as CPO and will have to go through the whole refining process again.

The example above illustrates two scenarios which show that the imbrication of one team affects or may affect the way that actions and controls will be taken up by the following shift handling the continuing production process.

The first scenario is the issue of high FFA quantity in the oil produced which is due to the quality of the raw material itself. Diagram 7.1 below shows how the two imbrications by different teams at the plant relate.

Diagram 7.1
Example of a Chain of Imbrications – Issue of Quality (High FFA) Result



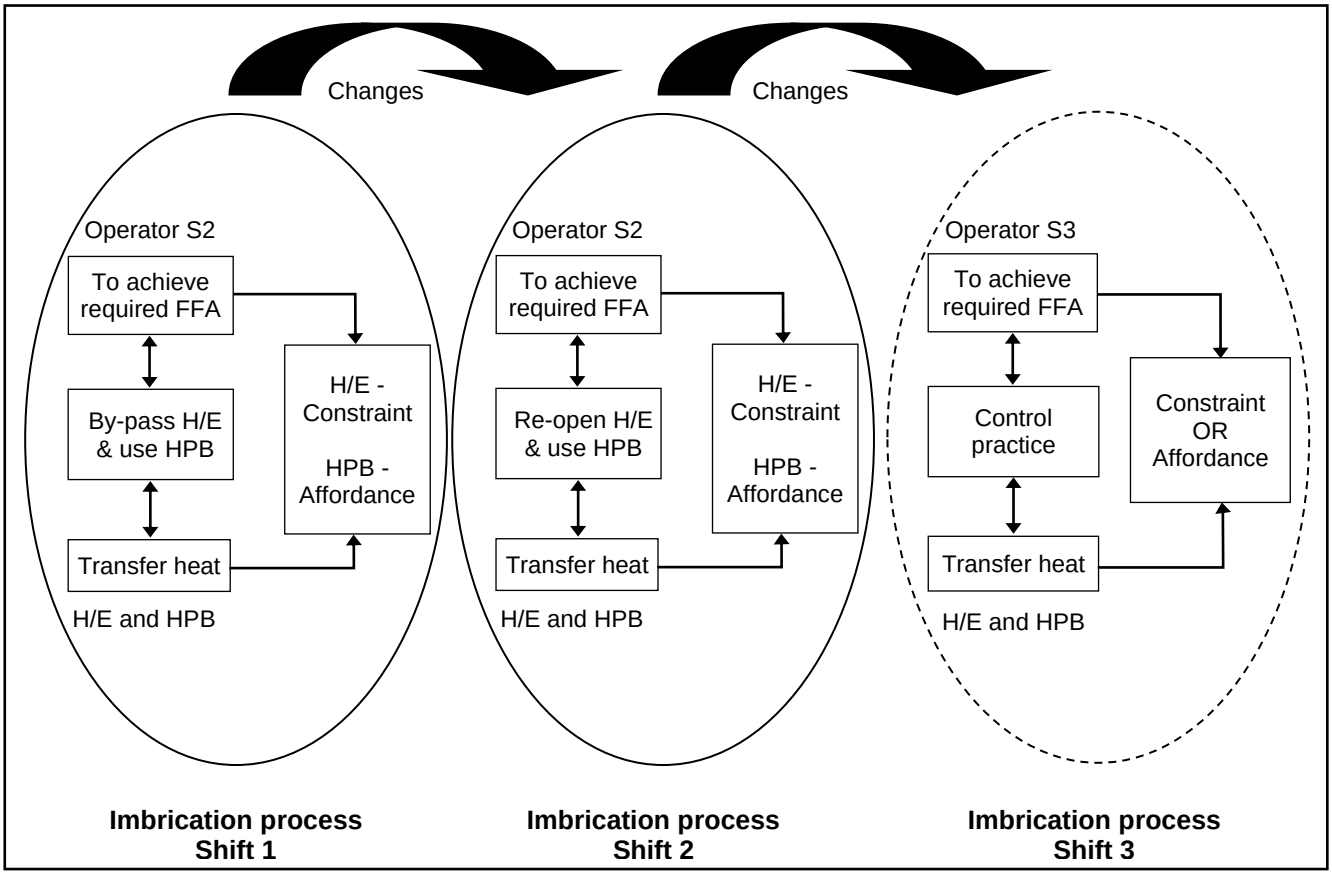
In attempting to reduce the FFA content in the RBDPO (in S1), the perception of affordance that was constructed when the operators became engaged with the deodorizer tanks (and its instruments) to reduce the FFA levels resulted in the action of recycling the oil. The action taken to recycle is intended to ensure that quality is controlled by achieving the desired level of FFA. Then, when the operators in S2 took over the duty and engaged with the system, the same perception of affordance was constructed and therefore the result of the imbrication was to wait for the oil to go through that process and send the recycled oil straight to the

fractionation plant for the next process rather than resorting to other corrective actions. However, if as they (the S2 shift operators) engaged with the system and perception of constraint (in achieving the objective of reducing the FFA level) was constructed, different ways of imbrication might have emerged, such as they might have chosen to resort to a different course of action (e.g. increasing the sub-materials or waiting for testing). But, because it was a perception of affordance that was constructed, the emergent control practice at that time was to send the oil to the fractionation plant for the next process.

Again, as illustrated in Chapter 6, this illustration shows that imbrications occur (between humans and material/technology) based on the perception of affordance and constraints that emerge from the reconciliation/entanglement of human intentions/objectives with the material's materiality. Here, the second imbrication emerges from the perception of affordance offered by the deodorizer instrument. Another important point is that the imbrication (at S2) does not happen in isolation, but instead it is influenced by the imbrications and decisions that occurred in the earlier shift (S1 and probably before).

The next scenario (Diagram 7.2 below) is with regards to the problem detected at 10.00am – which was due to the loss of vacuum – one of the processing variables which may influence the oil quality.

Diagram 7.2
Chain of Imbrications –
Issues of Processing Variable (Vacuum) and Quality (FFA Level)



When the heat exchanger (H/E) was checked around 10.00am, it was found to be leaking. Therefore, as the operators became entangled with the heat exchanger's materiality, a perception of constraint was constructed which resulted in a specific way of imbrication (i.e. by-passing the heat exchanger and relying solely on the high pressure boiler (HPB) to do the heating of the oil). This is because the entanglement between the operators and the material/technology (the high pressure boiler) constructs a perception of affordance, giving the operator an alternative way to achieve the required temperature. Later, when the heat exchanger was repaired, they re-commenced using it to accomplish this task.

However, as mentioned above, the imbrications that occur only show their effects at a later time. This means that the S3 operators will exercise control later according to the earlier decisions made by the S2 and (even) S1 controls. With the help of information recorded in the log book, it should now make sense to them why the oil had been sent to the storage tank rather than the fractionation plant and, according to this, they can decide on how they want to exercise control in the present. Moreover, if there is a further issue of loss of vacuum

during the shift, they would also be forewarned to check the repaired heat exchanger to detect if the same problem has reoccurred and, if not, move straight away to another source that might be the cause of low vacuum. This would save the operators from re-doing the detection and solving steps for the problem that had been carried out earlier by their colleagues. Therefore, we can imagine that the actions and control that will be exercised by the S3 shift not only will emerge based on the perception of affordance and constraint at that specific time and space but also affected and influenced by the previous controls and decisions made by the S1 and S2 team.

From the quotations and example given above, it is appropriate to say that the information in the log book acts to a significant extent in ensuring the production process is carried on in an efficient way from one shift to another because it reflects the way in which previous teams exercise control and maintain the production process. These procedures not only help operators and supervisors make further decisions and constant judgements on controls needed to be taken in the case of an off quality issue if it happens, but also indirectly enable operators to work towards an optimizing of the usage of resources in the achievement of 'good quality' production during their shift.

Besides the technical issues which are normally indicated on the PLC screen, quality sample results are one of the most important initiations for corrective actions. In the next section, I will discuss the records and reports at the laboratory and briefly talk about their interactions with the people on the plant floor, before proceeding to discussions of the 'morning meeting'[13] that brings together the plant and laboratory people with the management in discussing the production performance in terms of quality and quantity.

7.2.2 Interactions between Laboratory Staff and Refinery Plant Staff

As mentioned in Chapter 6, there are several points where samples are taken before and during the production process. Table 4 summarizes the sites and times where sampling is carried out.

[13] The quality measurement/performance is among one of the main discussions in the 'morning meeting' conducted every morning between the plant supervisor, production manager, engineers (mechanical, technical), laboratory officer and the refinery manager. The discussions are primarily about the production quality performance, throughput and yield from the previous day, and planning as well as decisions on actions that need to be taken for the present day.

Table 7.1
Sampling Of Oil for the Midstream Production

Source: Golden Crop Co and interviews

The objective of lab sampling for the refining and fractionation process is for quality control. Each tanker of incoming CPO from the suppliers will go through a quality check before it is accepted and unloaded into the storage tank. On average, daily incoming CPO is about 700MT from a range of three to ten different palm oil mills. As the CPO is received daily, it will be recorded in the 'daily oil analysis' report according to each supplier. Besides this, the report will also comprise a summary of the quality of the oil in all tanks in the refinery facility (sample taken every morning). Figure 7.2 below is a sample of the daily oil analysis report produced daily.

Figure 7.2
Daily Oil Analysis Report (From Lab)

Source: Golden Crop Co. – Quality report from laboratory

This report is used in the meeting between the lab officer, plant supervisors, production executive, production engineer and refinery manager to discuss the performance and daily planning for production at the refinery and fractionation every morning (the morning meeting) – discussion on this will be in the next section.

Besides this daily analysis, the more important lab results that are directly related to the on-going production are included in the report on ‘in-process inspection’ (see Figure 7.3 - see also item 2 and 3 in Table 7.1). At the refinery plant, samples are taken every 2 hours from the continuous process to measure the quality of oil from the bleaching stage (BPO) and deacidification and deodorization stage (RBDPO and PFAD), while at the fractionation plant samples of Olein and Stearin will be taken from every first extraction cycle of the completed cooling process batch.

Figure 7.3
Lab Results: In-Process Inspection

Source: Golden Crop Co. – Quality report from laboratory

The samples from the refinery are tested primarily for the colour and FFA levels. Results from the test direct the next action to be taken at the plant, which is either to correct the colour reading or FFA level or, if the quality is good, to try adjusting processing variables to optimize the production process. Although it is important for the plant people to know the results both ways (either good or bad), it is not the practice of lab staff to inform plant people if the quality is good. They will only raise the 'red flag' if the quality readings go off track. They will either inform them by phone (in cases where the readings are at the border line) or provide a memo for poor quality results (refer to Figure 7.3, for example – indicated by red box).

Although this practice is acceptable for the laboratory staff to act in this way and manage largely by exception, the plant supervisor complains that the lab staff do not inform them of all the test results, especially in the case of the quality of oils produced being better than the targeted parameters.

> *It is easier if they can inform us of the results… They are not concerned about the whole quality and cost issue. They are only concerned with filling up their report. Only if the quality has exceeded the border line, then only will they inform us or give us a memo when it exceeds the border line. At other times, if the refinery staff don't go there and update themselves with the quality report, they won't know.* (Refinery supervisor, PG014)

Although they have requested the lab to inform them immediately of the results via phone, it is not always the case that the lab will inform them. Over time, the plant people started making a practice of either waiting for the test results or calling them for the results which would then be recorded in their log sheet (please refer to the columns (with red box) before the 'remarks' in Figure 7.4 and 7.5 below).

Figure 7.4
Refinery Log Sheet – Processing Trend at Pre-treatment and Bleaching Stage[14]

Source: Golden Crop Co. – Log sheet at refining plant

[14] Same figure is used in Chapter 6 (Figure 6.1)

Figure 7.5
Refinery Log Sheet – Processing Trend at De-acidification and Deodorization

Source: Golden Crop Co. – Log sheet at refining plant

The important issue to realize here is that different levels of importance are placed on the information from the test results. The concern of the lab people is that the oils produced should be meeting the minimum requirement of PORAM specification. From their perspective, there is no urgency in delivering the good quality results information to the production staff – therefore, no control and extra actions are needed. For them, it is a good result as long as the qualities meet the minimum requirement, no matter how much better it is from the minimum requirement. The magnitude of how much better the results are from the minimum requirement does not make any difference to them. This kind of result indicates to them that the production is running smoothly.

In comparison to this, the plant people look at the information differently. Due to the daily engagement with the technology/production system, both ways are important information for them which warrant different actions and controls. The recording of poor quality results directs them to take immediate corrective action to remedy the problem, but the magnitude of good results also indicates to them that a range of actions can be taken. When the results are good, the intention changes from only meeting the required quality level to also improvising the production process in the sense of re-directing their effort to run the production in the most cost-efficient way as possible, as demonstrated in the quotation below (which was also discussed in the early part of this section) by the plant supervisor where they will try to reduce the sub-materials and utilities usage:

> *Assuming… we've already got the level of quality that we want… we'll start looking at what we can adjust… to maximise our throughput… The flow rate [which will reduce per unit resources and cost of production]… the sub-materials… the temperature [which will save steam/utilities/energy] and others… any where we can safe. (Refinery supervisor, PG033)*

This is a little different when poor quality reports are produced. The poor quality reports serve the same objective for both the groups, that is to 'raise an alarm' or red flag for immediate corrective action, while the good quality report offers a different meaning for the two groups. The meaning of the quality results affects the way the two groups of people interact because different levels of importance are attached to the information. The off-quality results are perceived as an indicator to take immediate action in the production process – the same perception shared between the lab and plant staff. On the other hand, good results indicate different sets of actions for the two groups - i.e. the lab staff perceive that nothing should be done and that the production should continue in the way it is being

done now, while it is perceived as a critical indicator of the opportunity for cost efficiency adjustments to be made by the operators and supervisor at the plant.

From an overall perspective, it can be seen that, from the moment oils are delivered to the refinery, both groups (the lab and plant staff) have the same intention - i.e. to make sure that oils (RBDPO and Olein) produced from the refinery and fractionation plant are within the required quality specified (either the PORAM specification or as demanded by the customer). However, only the plant staff are engaged with the production system. Thus, actions taken and control interventions made by the production staff are more reflective of the ability of the technology to change the production outcomes and affect the quality of the final product. This is an illustration of the way earlier imbrications between people and certain material/technology (in this case the production system – PLC system) affects future imbrications. This is a result of the affordances and constraints perception constructed as people and material/technology engage. The two different patterns of level of importance attached to the information results in different work practices - i.e. the lab people only take action when bad quality reports are produced (and just record in the log report if good quality results are produced), while the plant staff take the trouble to get the information with the intention of executing appropriate actions in the context of both good and bad product test results.

Until now, it has been seen how the recordings taken of work practices, the state of the product and the status of the plant enable communication between groups of different people involved in ensuring an efficient production process as well as the way in which these people take action in the context of actions taken earlier because of the different levels of engagement with the technology. The primary objective here is to produce oils that meet the specific quality requirements and the best cost levels that they are able to achieve. While discussing the work practices of these groups, I have also demonstrated the different kinds of records and reports that help them in monitoring the trends and progress in the production process. In the next section, I will describe the things that are discussed based on the outcome of the production process (which are recorded in the reports mentioned earlier – Figure 7.2, 7.3, 7.4, 7.5) and the decisions that are made which will then, in turn, result in future imbrications that happen at the production sites. The next section will illustrate how all these reports are brought together in a meeting among the plant, lab and managers/management to be used in discussing the production planning and performance on a daily basis. This will also illustrate how people (or the social) and the material are entangled in controlling and monitoring the production practice to achieve the objective of producing oil that meets the quality requirement as well as the yield targeted.

7.2.3 Information Sharing and Short Term Controls

It is a routine that all key production staffs who are involved in refining and fractionation meet every morning with the refinery management to discuss the previous day's production performance and also plan for the coming day's production. They call it the 'morning meeting'[15]. This meeting includes the morning shift supervisors of the refinery and fractionation plants, the production executive and production manager who are in charge of both refinery and fractionation production, the electrical and mechanical engineers who are mainly involved with any maintenance and instrument issues at the production sites and also the refinery manager.

As I have discussed above, Figure 7.2 ('daily analysis report') is the summary of oil quality in all storage tanks of different oils produced in the previous days and also contains a summary of incoming CPO quality. This is important as the quality of oils in the tanks will determine the decisions on which oils should be used in the production for the day according to the circumstances at that point of time. For example, the following exchange illustrates how the summary of results from the lab together with the reports on stock balance helps decide the production for the refinery and fractionation plant for the day:

> Refinery Manager: *So how about the mixing[16]? Do you still mix?*
>
> Fractionation supervisor: *Yes. But very much less than that day. Our feed oil's quality is getting better*.
>
> Production Executive: *The quality of Input CPO [from the mill] is also good now. Which tank to fill [for the incoming CPO]?*
>
> Refinery Manager: *The bad quality oil is finishing right?*
>
> Production Manager: *Yes. We only have a few hundreds Metric tonne left.*

[15] This meeting is conducted every morning around 10am except for Saturday and Sunday because the official working days are from Monday to Friday. Therefore, progress or issues to do with Friday, Saturday and Sunday's production are discussed on Monday morning.

[16] When the quality of RBDPO from the refinery plant is bad, Olein will be mixed with RBDPO to average out the quality so that the crystallization process can be completed. But this means yield will be low and costly because the price of Olein is expensive. Furthermore, since Olein is already a final product, using it for reprocessing represents excess cost. This is discussed in detail in Chapter 6 (section 6.2.2.1)

Refinery manager: *Mmm… Better we put fresh oil in the other tank. So from now you [fractionation supervisor] only take the fresh oil to produce CP6.*

Production Executive: *How about the balance of the CPO [the old stock]?*

Refinery Manager: *The balance of the bad quality CPO we can use to produce CP8 after we have enough CP6… Early next month is a critical time. We have to build up stock for next month, especially CP6. They [referring to packed product division and head office] are exporting XX containers. We have to make sure we produce enough.*

(Meeting 4)

This report is produced by the lab officer and it reflects the beginning position of the oils in hand that they have in stock – which also reflects the outcome of products produced on the day or on days before. Based on this information, the refinery manager sets a starting point of where/which oils are to be consumed. The decision when enacted will determine which tank to direct the unloading of new deliveries of CPO to (this relates to the lab officers), and which oils to use for production (this relates to the refinery and fractionation plant's staff).

While the daily analysis report informs the starting point of the quality for the day, the 'in-process inspection' report (Figure 7.3) shows the performance of production throughout the production process of the previous day. It shows the trend of quality of oils produced every 2 hours for the refinery production and also every batch of cooling in the fractionation plant. In addition to these 2 laboratory reports, other reports such as the daily 'log sheet' (Figure 7.4 and 7.5) from the refinery plant and operating records of the crystalizing process (Figure 7.6 below) and the Cooling Trend Graph (Figure 6.7 and 6.8 – from Chapter 6) from the fractionation plant also mediate the discussions during the morning meeting. These reports record the more technical and instrument processing trends of the whole production performance from the previous day.

Figure 7.6
Fractionation Processing Trend - Cooling Process

Source: Golden Crop Co. – Production process report at fractionation plant

The daily log sheet at the refinery records all the production variables trends such as temperature, sub-materials usage, vacuum, and pressure level on an hourly basis as well as the 2 hourly quality results from the laboratory. The reports from the fractionation plant records the cooling cycles of each of the crystallizers and its production variables (load pressure, squeeze time and pressure and others) and the cooling trend graph to show the crystallization formation process during the cooling process. After deciding on the starting point (such as the exchanges above), the exchange below is illustrative of some of the typical discussion on the issues of production process and planning during the morning meeting:

Refinery Manager*: …we have to start catching up with the yield. What's our capacity? Are we ok? We have to make sure that we can achieve our target [yield for the month].We only have 9 days. On the 30th they [HQ representative] are coming for stock take. Now we are still at 73% achievement. Are we still mixing Olein [in the fractionation plant]?*

Fractionation Supervisor*: We still have to mix. The quality is really bad, IV, and colour is far off the grid. We had to do a lot of grubbing up yesterday. I'm afraid if we do too much the filter could tear. So to avoid too much of this I have to mix more Olein (RBDPL) so the crystal will form better.*[17]

Refinery Manager*: Oh that's not good. Also takes time and delays our production. What is the input [RBDPO] reading?*

Laboratory officer*: The reading for tank #1 is bad. Tank #2 is slightly off but better than #1.*

Refinery manager*: How about the CPO?*

Laboratory officer*: Seems okay.*

Refinery Manager*: Refinery supervisor, so why is it?*

Refinery supervisor*: I think there is something wrong with the bleacher. But since yesterday we can't detect the problem. The exchanger leaking we already solved that day. But…*

Refinery Manager: You [Mechanical engineer], please check if the bleacher silo and piping is working well. We have to solve this problem! You [Production executive and Production manager], follow this closely with the mechanical engineer and maintenance people

Fractionation supervisor*: So… for now?*

[17] The streaine will form a solid cake between the filter leaf if the oil is good. But if it is bad, the crystallisation will not form in a good way which instead of becoming solid, the cake will be flaccid and stick to the filter leaf. They have to grub up the filter so that the next cycle of pressing process can be done efficiently. (See also discussion in Chapter 6 – section 6.2.2.1)

> Refinery manager*: Can mix but don't simply mix. Do the calculation. And you [refinery supervisor] make sure the refinery output to tank #2 can be used 100% then only send to fract. So we can reduce the mix at fract. If not fract[ionation] will have problems.*[18] *Later [oil in] tank #1 we can use to produce CP10 or something. Now focus on achieving production volume first.*
>
> (Meeting 1)

Although quality is given utmost importance in the production process, I have shown early in the previous chapter that the performance of the production team is measured by their ability to achieve the targeted/budgeted yield and efficiency of the production process. The exchange above reflects the fact that as important as quality is, production should always also aim to achieve the targeted yield. This is especially important in the third and fourth quarter of the month where the yield record has not achieved the target volume, such as in the case of the exchange above.

The reports, such as the lab reports and production trends, reflect the flow of production from the day before. It is a reflection of many imbrications between groups of people (refinery and laboratory staff) with the production technology, raw material and other material objects such as the PLC system and its instruments, the sub-materials, the lab instruments, etc. Based on this information, the discussion, such as the two exchanges above, can be understood. It enables the refinery manager together with others to discuss and decide on the next direction the production process should take. In the exchange, while placing emphasis on the yield, the discussions reflect the happenings in the production processes, the quality of oils, as well as the directions in which the various elements of the production process and work teams may proceed on that day.

For instance, the link between what the supervisors at the fractionation plant should do/were asking (level of mixing of the oil) was related to the poor quality of the oil produced from the refinery which can be either due to the poor quality of input oil (the CPO) or from shortcomings in the production process – in this latter case, the report (Figure 7.2 – the daily oil analysis report) was able to isolate the first cause and lead to the discussion of the technical issue on the bleacher tank. It brought out the fact that staff at the refinery plant were expressing the perception of constraint that was constructed when they engage with

[18] Tank #2 is the CPO tank that will be used at the refinery plant. If good quality CPO is used at the refinery, RBDPO produced will be good quality, and good quality RBDPO will not create a mixing problem at the fractionation plant, which leads to better yield.

the material (i.e. the bleacher instruments) which then leads to the next action (i.e. the involvement of the mechanical engineer) in solving the problem. The discussion enables all of them to form shared objectives as well as move towards a single direction to achieve an agreed target. For example, in this case, the refinery manager draws attention to the importance of achieving the targeted yield within 9 days and therefore making sure that refinery staff will focus on producing better quality oil in tank #2 so that the fractionation staff can consume it – reducing the 'mixing' of oil and increasing the yield. This decision will later affect the way each of the work groups take action and exercise control in production. For example, at the refinery when the refinery manager says *'make sure the refinery output to tank #2 can be used 100% then only send to fract. So, we can reduce the mix at fract',* and as he expresses his concern about the yield target, such statements indicate that emphasis will be on maximising yield and some sacrifices in the efficiency (if needed) will occur. Therefore, these discussions which are conducted through reflection on the previous imbrications will later influence the way controls are next conducted.

So, here we see that the reports reflect the outcome of the imbrications in the production site, and during the morning meeting they discuss the way forward based on these reflections (i.e. the previous day's production outcomes). Then, from this discussion, all the people will have certain objectives and this will influence the way of production and control in the future – i.e. influencing the future imbrication.

Besides a day to day discussion, the morning meeting discussions also serve as the platform on which the present day and future production are discussed and information about future expectations is talked about through sharing of information and concern as well as decision making. Another exchange (see below) is also another reflection that future imbrications are actually being influenced by the previous imbrications revealing the chain of imbrications that happen at the production sites:

> Refinery manager*: How was the refinery yesterday?*
>
> *Refinery supervisor: We had 3 hours delay yesterday because last night colour elevated a bit. We detected the problem already… the bleaching dosing was blocked. That has been tackled. The other plant has some moisture issue. That one also we've fixed - the dynamic mixer is now okay. We are continuing now to consume CPO from tank #C1.*
>
> Refinery Manager*: Colour?*

Refinery manager*: Okay… 2.8. FFA also okay, 0.8.*

Refinery manager*: For local okay. Next week we are sending to China. Make sure for this export you produce lower than that. How is our testing on citric acid[19]?*

Refinery manager*: Okay.*

Refinery manager: The thing is, our contract with this customer… they want the quality spec upon arrival, not upon shipment. So colour stability is very important. If we send the oil and it's reading here [at the refinery before shipment] is 2.8 or 2.9, [the reading of the colour quality paramenter] when they receive there[upon arrival at the destination]… the duration time taken to send the oil from here to there is about 14 to 20 days, I'm sure the reading will become over 3.0. The FFA also, here 0.8 or 0.9, when reach there sure burst [exceed the required reading]. So for the China shipment be more careful on the colour and FFA.

From this discussion we can see that in normal practice this kind of quality achievement is considered acceptable. However, as all of them are aware, when there are export shipments coming up, the standard acceptable level is going to change. This definitely will make a difference to the level of control and the required quality of the product. For example, heating, sub-materials and utilities will be controlled differently. This is because the intention has shifted from only achieving 2.8 for the colour reading and 0.8 for the FFA reading to one focused on achieving a better standard. The way people at the plant imbricate with the instruments will be different and the level of control will change.

[19] Citric acid is used to avoid the reversion of the colour reading of oil. Normally, even if during production the quality of oil has met the quality requirement, in time with exposure to outside temperature, there is a possibility that slight colour reversion can happen. The longer the time, the more reversion happens. Therefore, citric acid is used to stabilize the colour, especially for exports, because of the long duration of shipment.

7.3 CONCLUSION

The key point that I am trying to portray in this chapter is that every imbrication that happens at any specific point in time will influence the imbrications that happen in the future, just as any imbrications happening now are influenced by the imbrications that happened previously. Reports and notes made reflect the previous imbrications from a different space and time. These reports enable each group of people to understand the previous imbrications that also happened at different sites. When they get together, these are reflected in their discussions, as presented in this chapter. The reports mediate interactions between different groups of people, such as the refinery manager and production manager, although they are not there directly handling the production process. Through the sharing of information on the reports and in the meeting, discussion on controls and future actions are made possible. Besides, the reports also show trends in production which make it clear to everyone involved in the production to be prepared on the areas that need to be adjusted when higher demands on quality are made to meet market requirements or moves from competitors. It enables the people to interact with each other to understand the needs from one group to another- for example, the refinery people understand the needs of fractionation people, the plant people understand the targets that the managers need to fulfil and present to the management. This understanding then changes the things that they do at the plant at a later time.

This scenario illustrates that the production process which involves different groups of people and many kinds of material artefacts (such as reports, quality of raw materials, and instruments or technology at the plant and lab) become entangled with one another. Together they create the constant control practice at all levels of the production process.

The illustration provides description of how the interactions between people and materials come together to produce imbrications at one site which influence the discussions and decisions made during the morning meeting where representatives of each of the key groups involved directly or indirectly in controlling production come together. This in turn then influences the way that imbrication will happen later at their individual sites again and so the cycle continues.

To recap, Chapter 6 has shown the entanglement between the people and the technology at the production plant. This chapter extends the previous discussions towards the interactions of different groups of people that have different levels of engagement with the production control system and technology such as the PLC system. The transfer of information through reports and log books that reflect the previous imbrications at different sites (plant, lab,

office) enable each of them to understand each other's needs and requirements and help align their efforts towards certain short term objectives. These objectives will be carried out at their individual locations in the production process, which influences the way future imbrications occur. This is because as these intentions are formed, the workers approach the materials and other artefacts differently. As the two agencies come together, either a perception of affordance or constraint will be constructed and, based on the perception of affordance and constraint that they have in the ability of action of the material's agency, a certain kind of imbrication happens and the control and other work practices emerge from this socio-material imbroglio.

The description in this chapter still focuses on the day to day controls that are practiced by the production people – directly or indirectly, such as the plant staff, the lab staff as well as the management at the refinery. Attention in these two chapters (Chapter 6 and 7) is on the micro and short term control of the midstream production process. The next chapter will show the way in which the entanglement between the people and material objects at the production site and how the imbrications that occur influence the construction of performance measurements in the preparation of the budget. Thus, the discussions in the next chapter will emphasise the long term chain of imbrications that effect the way controls are designed, implemented and practiced.

CHAPTER 8
THE DYNAMICS OF MANAGEMENT ACCOUNTING CONTROLS: LINKS BETWEEN BUDGET SETTING AND DAY TO DAY CONTROL PRACTICES

8.1 INTRODUCTION

The two previous chapters have provided details of sociomaterial control practices that emerge through the multiple imbrications of social and material objects and technology at the production site as well as the short term influence that one imbrication can have on the next. This chapter provides an illustration of a more extended temporal chain of imbrications, illustrating the dynamic cycle of influence between the budget construction and day to day work and control practices.

In the following section, I will show how the day to day production practice and controls come to reflect aspects of the budgetary control systems (specifically the yield targets and cost of production figures) that are set to influence production performance. The discussion is intended to illustrate how the budget gets implicated in the day-to-day control practices. Following this, I describe how the setting of the budget targets and performance measures is influenced by the past daily production at the production site. This will show, in turn, how the day to day work and control practices influence the way in which the figures in the budget get decided. The discussion centres around the day to day work and control practices observed during the data collection period which reflect the implication of the 2012 budget (which was set in 2011), and the discussion of the meeting where the budget for 2013 was developed (this meeting was observed in June 2012).

8.2 PERFORMANCE CONTROL: HOW THE BUDGET INFLUENCES DAY TO DAY PRODUCTION MONITORING PROCESSES

As mentioned in the first section in Chapter 6, budgeted targets that relate to the midstream production include yield (i.e. the throughput of oils from the production processes) and cost of production targets such as measures of usage of utilities and oil loss allowances (wastage). This then will become the basis on which the midstream production at the refinery is carried out and the performance monitored. CPO (crude palm oil) yield is treated as a critical part of the refinery manager's responsibility. Yield performance is reported back to the head office on a daily and monthly basis. The reports are used to monitor the

performance on whether or not the targeted production yield and cost are achieved. This is reflected in one of the comments that the refinery manager made:

> *The way HQ monitors our performance is normally through budget. For example, for processing cost, they will monitor against the budgeted figure and see how the performance is. If there is variance like huge variance (20-30% variance) then we need to justify the reason for this happening. For example, in terms of our capacity, we are designed to produce 21,000 tonnes, but in certain months we don't achieve this 21,000 tonnes, so we have to give a reason for why this happens. The performance measures are normally related to areas which we can control… such as our cost and production.* (Refinery Manager- PG041)

The importance of achieving the targeted quantity in the budget is shared among the various parties that are directly and indirectly involved in the production process. As I have described in Chapters 6 and 7, although not as important as achieving the targeted quality parameters, these budget targets such as yield and cost of production are considered as critical measures in evaluating the efficiency of the production processes. It is not very clearly evidenced in the daily conversation among the people at the production plants, but occasionally the comments, such as by the refinery supervisor quoted below, indicate that the production activities are actually run with much emphasis on achieving the targets set in the budget. The way the plant supervisors still grumble about the lab people not giving enough importance/urgency in informing them about the 'good result' from the sampling (discussed at length in Chapter 7 in section 7.2.2) is also one indicator of their concern about cost saving in running the production process.

> *Actually, there are two purposes of our sampling. Obviously, the first reason is for quality purposes… to help us make corrective actions. The second reason is for production efficiency. We need to run the production efficiently… like I said before, quality is our main concern. But achieving the yield is also quite critical. Plus, as much as possible we try to be balanced between the quality achievement and the cost of production. All this runs parallel in our course of action at the production plants.* (Refinery Supervisor, PG 014)

As I have described in Chapter 6, the range of control in the day to day production process emerges from the synthesis of the people's objectives (i.e. balancing between achieving quality and the budgeted targets such as yield and cost of production) and the materiality of the material/technology as the humans and materials get entangled. The imbrications that occurred at the plant are then reflected in the reports that they use in the morning meeting and these influence the decisions made during the meetings. This again affects the way people choose to implement controls within their work practices during future production episodes, and so the cycle continues.

While the example I have given above shows consideration of budget figures among the employees at the plant, below is a typical example of the exchanges from one of the morning meetings that I referred to earlier (these morning production meetings were observed during the field research which I conducted and are described more fully in Chapter 7). It also reflects the fact that achieving the targeted critical figures such as yield is shared among the various people involved in the production sector of the company.

> Refinery Manager: *In a few days we have to start catching up with the yield… if not we will not be able to achieve our target [budgeted figure]. What's our capacity? Are we okay? We have to make sure that we can achieve our target [yield for the month]. Are we still mixing Olein [in the fractionation plant]?*
>
> Fractionation Supervisor: *We still have to mix. The quality is really bad.*
>
> Refinery Manager: *Production executive, follow this closely. Reduce the mix. Make sure tank #2 can be used 100% then only send to fract[ionation]. If not fract[ionation] we will have a problem[20].We have 10 days to catch up. If the yield is bad we can't achieve the target.*
>
> Production Executive: *Stearin tank is full.*
>
> Refinery Manager: *Chase the sales people to empty the stearin tank. We want to catch up [yield per month]. We have to prepare. We only have 10 days left this month. We need the space. We have to do this so that our monthly report will not be tainted.*
>
> (Meeting 2)

[20] Tank #2 is the CPO tank that will be used at the refinery plant. If good quality CPO is used at the refinery, RBDPO produced will be of good quality, and good quality RBDPO will not create a mixing problem at the fractionation plant and so leads to better yield.

Conversations like this among the people at the refinery who are directly involved in production activities are typical of discussions during the morning meetings, especially towards the end of each calendar month. They relate to concerns about the efficiency and performance of production over a specific period. People show concern that the budget is achieved and any problems in progressing toward targets are solved as quickly as possible so that back logs are avoided and the target is achieved. For example, in the exchange above, the refinery manager was checking on the production flow and performance, giving emphasis to the actions that need to be taken to ensure that incoming oil from the refinery is of good quality and fractionation runs smoothly (without the rework and loss of time incurred in mixing a part finished product with work-in-process materials) and that storage is clear to enable smooth production.

The exchange also reflects how important it is for the refinery manager to achieve the target when he states that *"we have to do this so that our monthly report will not be tainted".* As described previously, the issue of achieving the targeted figure is actually not only the concern of the refinery manager. As I said earlier, although it is not very obvious, the evidence from the observations at the plant also reflect that these are shared concerns among all staff involved in production. While the first priority of the production people is always to achieve the required quality, achieving budget cost and volume targets is always also strongly emphasised. This is reflected in the controls and decisions made during production such as the various steps taken to try to optimize the efficiency of the production process whenever possible to ensure the costs of production are within the budget allowance, and the attempts to maximize throughput to achieve targeted yield (this has been shown in Chapter 7).

In order to ensure effective production progress, one of the 'must discuss' topics at the daily morning meetings is the production output and cost (such as the example exchange given earlier). The budget figures are allocated to daily production and this is monitored closely through the meeting and immediate corrective action is then taken when necessary. This is to ensure that production progress is run according to the budgeted target. We can see that this monitoring is followed closely by the refinery management team (especially the refinery manager), as he mentions:

> *We decide daily production according to the budgeted figure. We calculate the daily figure according to the monthly figure specified in the budget. We monitor all this especially the yield and cost of production. …we keep on asking ourselves: are we on track with the figure or not? That's why we have that morning meeting every day to monitor very closely. If there is any problem we take care of it immediately. So this is how we meet the budget target and serve the sales requirement.* (Refinery Manager- PG041)

To ensure that the refinery management is running the production process according to set targets agreed in the budget, the operation manager at the head office monitors the production progress through the daily (please refer to Figure 7.4 and 7.5 in Chapter 7 for a sample of these reports) and monthly reports (please refer to Appendix 5 for a sample of the monthly report) submitted by the refinery management reflecting the whole of the production activities. The daily reports are as discussed in Chapter 7 while the monthly report is about the performance of the production process with regards to its yield, quality, usage of sub materials, downtimes and maintenance. It is prepared based on the actual performance and compared to the budgeted figures. This report is reviewed by the operation manager at the head office and used as the basis for any action plan if interference from the head office is deemed necessary. As the operation manager states:

> *We have KPIs for the refinery - for example, the throughput for each process; the yield and oil loss. The refinery submits the daily and monthly report on the production to us. The reports will indicate if they [the refinery production team] were unable to achieve the throughput. The details that I normally will focus on are the throughput, yield, oil loss and quality of oil… if there is anything not okay I'll call them directly or I'll email them to find out about this. For the daily report… it is important because from there I'll know the smoothness of the production process, if there is any breakdown… whether it is serious, the quality and all that… eventually this is important for the end of the month because this determines whether we will achieve the targeted quantity in the budget or not.* (Operation senior manager- HQ029)

The discussions above show that the production process at the refinery is quite heavily influenced by the figure set in the budget. This is also reflected in the discussions of the day to day production activities in the plant (discussed in Chapters 6 and 7). We can see that once the critical measures such as yield and cost of production have been set in the budget, the activities and controls exercised at the production site and the discussions among people who are directly and indirectly involved with the production activities are very aligned towards performing within these targets. However, the influence of the budget on the production process is not a unidirectional effect. While my discussion in this first section typically emphasises how the budget figures are implicated in the way production activities are carried out, the influence goes both ways. I will discuss in the next section how the day to day production process in turn influences the setting of the budget figure for the next year.

8.3 SETTING THE BUDGET/PERFORMANCE CONTROL MEASURES: A REFLECTION OF THE DAY TO DAY SOCIOMATERIAL PRODUCTION PROCESS

Preparation of the budget is normally started in June/July of each year for the following year, which commences in January. Discussions on the budget development for the midstream production usually involve people from the refinery (such as the production executive and production engineer/manager, refinery manager), and from head office (such as the operation senior manager and finance manager). During the budget retreat, reflecting the demand from the sales department and production facility, they construct the yield target for the next year. This becomes the benchmark for the calculation of the cost of production and anything related to the production such as capital expenditure. Among the critical information that is discussed and set at the budget is the ratio for production costing.

Below are two extracts from exchanges that were observed during discussions between the senior operations manager and the head of finance together with people from the refinery at the budget retreat which I observed in June 2012. The exchanges show examples of a scenario where they discuss the use of utilities and other measures which are designed to account for production performance. Based on the compilation of monthly reports (Appendix 5 mentioned earlier) that the refinery submits to the head office, they discuss and set the next year's projection for these performance indicators.

1) The following exchange took place during a discussion (in the budget retreat) about one of the utility usage (i.e. gas for heating – which is among one of the highest costs of production after raw material and labour):

Finance HOD: *Our gas consumption seems to be doing very well. Last year our target consumption was 16% [for each MT of CPO consumption], but [referring to the average monthly achievement for the year] we managed to do 11%. Shall we put 11% for this year's target?*

Refinery manager: *I think we better put 12%.*

Operation Senior Manager: [Flipping through the performance report] *The latest we managed to achieve was 10%, right? Why do we still want to put 12%?*

Refinery manager: *I think we should put some buffer there because sometimes we use more depending on the quality of our CPO input. Sometimes we need more heating. Maybe we can put 11%. It's more realistic and gives us some flexibility.*

Operation Senior Manager: *Yeah. I guess. That's more realistic. Our CPO input quality fluctuates.*

Refinery manager: *Not just that. We are expecting to increase our quantity next year, aren't we? This means we will be producing more using our old plant. That plant… uses more gas for the same amount of oil produced compared to the new plant.*

Finance HOD: I think so. We should reflect the reality.

2) The following exchange took place during a discussion (also in the budget retreat) about the oil loss rate (wastage rate allowance). The exchange proceeds as follows:

> Finance HOD: *How about oil loss? We always put 0.6%*[21] *but we never achieve this. And the CEO always highlights this figure, remember? Even the group Chairman always highlights this matter to him. Why can company x (the sister company that also has a refinery plant) achieve 0.55% but we always exceed 0.6%? Maybe we should put a more reasonable figure, the figure that we can actually achieve.*
>
> Operation Senior Manager: *Our [the technology] plant is old. The capacity and advancement is not like the plant there [company x]. It is really almost impossible to get what they get [from the technology that x company has] especially with the quality that we require.*

The first exchange is about deciding the threshold for the gas consumption allowed for the next year for every MT of oil produced. As can be seen, this involves a certain negotiation between the refinery staff and the manager from the head office on the benchmark that they want to set to measure the efficiency of gas usage. Even though the managers at the head office would prefer to set a strict target, they still allow for some flexibility. The points that are highlighted by the refinery manager (on variation of CPO quality and usage of old plant) were reflecting the real imbrication that happens on a day to day basis. Even though on paper it showed that they managed to achieve 10% (of gas usage as compared to 16% - i.e. less than 6% of estimated gas usage from the budget) recently, the fluctuation in the quality of raw material (CPO) played an important part in the ability of the refinery staff to achieve any particular level of utilities consumption. The refinery manager also points out that as higher volume is planned for the next year, there is a need to utilise more capacity in the old plant. As mentioned in Chapter 6, they have two active refinery plants. The volume in the new plant is already fully committed; therefore, any extra production will totally be produced from the older plant which has less advanced technology and is less efficient in various areas, notably in utilities such as gas. This will certainly result in higher consumption of gas –

[21] Oil loss is the percentage of waste allowance given for the production of RBDPO from CPO and Olein from RBDPO. For example, if the threshold is set at 0.6%, for every 1000MT of CPO produced, only 6MT is allowed to be loss. And this figure is used to measure the efficiency of the CPO production process. The same goes for production of Olein from RBDPO.

due to the older technology (i.e. the level of performance of the old plant is significantly below that of the new plant in terms of gas consumption). This negotiation obviously reflects the perception of affordance and constraint that the refinery manager has on the materiality/capacity of the two plants and this then reflects on the decisions made on the target consumption in the budget. As we can see, the point was accepted by the senior managers and the head of finance and the new targets were set in accordance with these perceptions.

Similar points can be made in relation to the second exchange above where decisions are being made on the level of oil loss, or wastage to be allowed in production. In her remarks, the finance head of department highlighted that the production team was unable to achieve the desired target. This was followed by the senior operations manager justifying the outcome by explaining the level of affordance of the plant (and the technology) that they have as compared to their sister company in regard to the performance of the instruments at the plant in minimizing oil wastage. This exchange is similar to that on gas consumption and how it influences the decisions that are made with regards to the oil loss figures they are willing to accept for the coming year's production process.

8.4 DYNAMIC RELATIONS BETWEEN DAY TO DAY PRODUCTION PROCESSES AND THE SETTING AND IMPLEMENTATION OF BUDGET TARGETS

I have discussed in the first section of this chapter that the way that production is run and controlled is strongly influenced by the threshold/benchmark targets set in the budget. Although, as described in detail in Chapter 6 where it is the entanglement between the people and material/technology that results in the way production and controls are run at the production sites, it is also strongly influenced by the budget targets.

Then, throughout the discussion in the previous section I explained that the decision taken in setting the benchmark is also influenced by the day to day operations and imbrications at the production plant between the people and instruments. During the discussions, although the head of finance highlighted all of the negative variance, she and the operations senior managers are always likely (and tend) to accept the figures suggested by the refinery manager and production engineer.

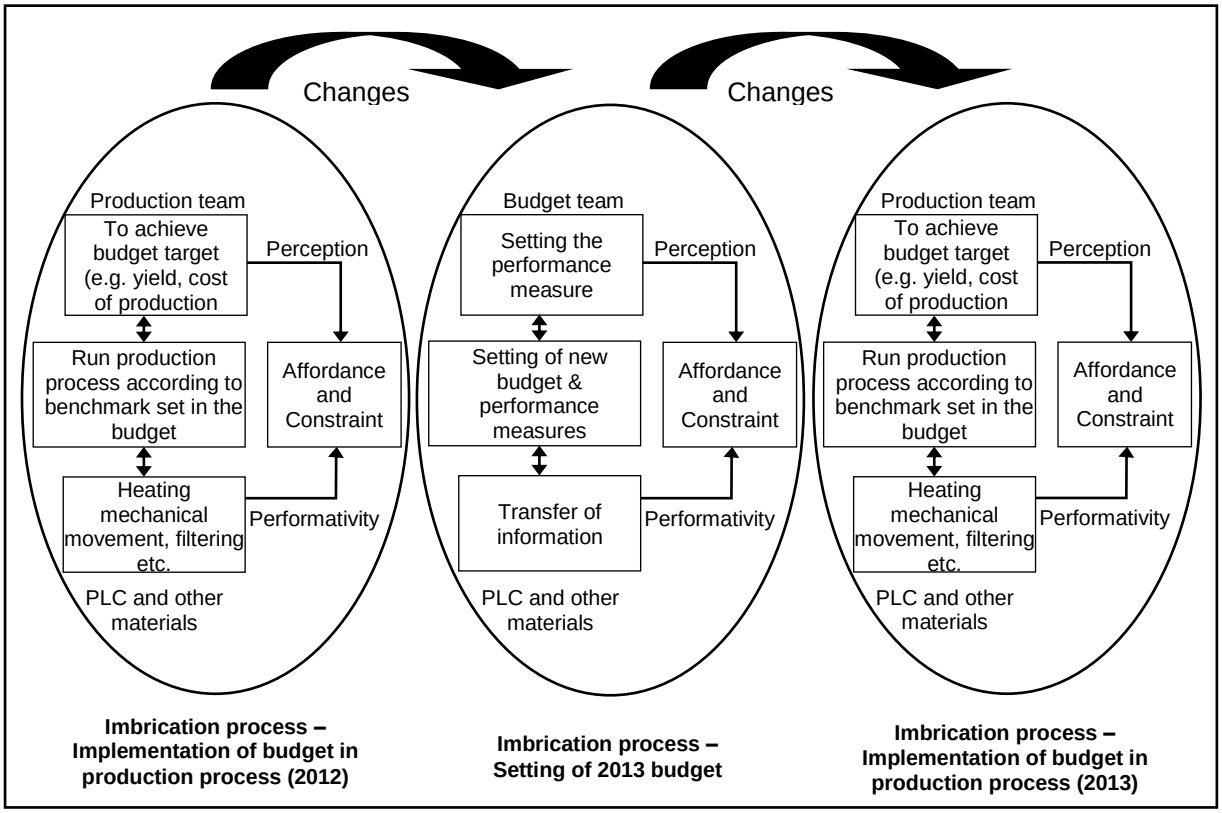
This indicates that the perception of affordance and constraint of the material that emerges from the entanglement between the two agencies has an impact on how production and control practices are planned and implemented. This then reflects on performance. This

performance then influences decisions made in the setting of future targets in the budget related to the production performance. Therefore, this shows that the building up of the budget and targets for future production periods are influenced by the imbrications and outcomes of previous or present production processes. It is a dynamic cycle that happens continuously over long time periods – certainly over several years.

8.5 CONCLUSION

In this chapter, I have sought to show how production control at Golden Crop Co. is affected by and affects management actions at a macro level and over extended time periods. As compared to Chapter 7, the illustrations here reflect longer term management decisions and processes and activity over periods in excess of a single budget period. This means that I am able to begin to identify and describe the changes that occur across imbrication episodes or between one imbrication and the next. Diagram 8.1 summarises these ideas about imbrication episodes in a simplistic way that I believe (and have described above) have occurred at the case company:

Diagram 8.1
Example of a Chain of Imbrication –
Day to day Production Practice and Budget Setting



The first imbrication process (which actually consists of multiple imbrications of various actors at the refinery) explains the overall imbrications that happen daily and continuously at the production plants (see the first ellipse in Diagram 8.1). I have explained in Chapter 6 some of these micro imbrications that happen between each of the instruments with people who are trying to perform certain activities such as heating the oil, mixing the sub-material into the oil, de-acidificating and deodorizing the oil, and so on. Each of those imbrications cumulatively form the overall activity we call production processing and control. Social groups, such as the operators and supervisors at the plant, lab officers, refinery management, and operation senior manager at the head office, entangle with material/technology such as the PLC system and its instruments as well as the reports produced on the production progress. From these imbrications, the sociomaterial practices (i.e. the production process and controls) emerge.

The way in which imbrications between social groups and materials objects and technology occur (as discussed above) reflects the influence of the performance measures set in the budget for the year. This is also reflected in the previous discussions in Chapters 6 and 7. It is in this way that I have sought to evidence and explain the way that the running of the production process and controls are influenced by the budget figures that were set for the year. It should be noted that these effects are not always predictable because of the complexity of the production processes and the effects that changes made to production targets may then have on work practices and the imbrications that follow (refer to section 6.2.1.2 in Chapter 6 and section 7.2.1 and 7.2.3 in Chapter 7 for examples).

Moving from the discussions about the influence of the previous budget on the current production process to the discussions of future budget preparation, it can be seen that the process of setting the budget is also influenced by the imbrications and sociomaterial practices that emerge on a day to day basis at the production sites and across the individual production stages. Information from the reports (which reflect the daily and monthly imbrications that happen at the production sites) facilitate some of the most significant discussions on operational issues among the people involved in the annual budget meeting. From here, it can be seen that the decisions made are influenced by the imbrication previously/currently happening at the plant. Therefore, it can be concluded that not only the day to day production activities at the sites are influenced by the budget figure, but the setting of the budget figures and targets are also influenced by practices at the production facility.

These scenarios discussed here illustrate how the control practices align with the concept of imbrications. As the people (social) entangle(s) with the materials and technological objects, the sociomaterial practices (i.e. the production activities and control practices) emerge. These sociomaterial practices occur through the imbrication of human and material agencies and are motivated, in part, through the perception of affordance and constraint. As these multiple imbrications happen, they eventually create a pattern of practices and routines that have temporal 'staying power' (Leonardi, 2012a) until the pattern is disturbed or changed by the next imbrications (as discussed in section 3.3.1 via diagram 3.2 in Chapter 3). Referring to example I have discussed in this chapter, the imbrications that happen between people and materials which create the practices within the production process and the setting of the budget targets.

As I have explained in the methodology chapter (Chapter 3), the process of imbrication creates a pattern which is different from the image of causality. As Leonardi (2012a, p.47, emphasis added) mentions:

> The products of earlier imbrications (e.g., a pattern of communication [similar to pattern of practice/routine] or a technology feature) lay the groundwork for continued organizing in that they provide communicative norms and technological capabilities that people can use to structure their actions… with this recognition… it enables theorists to explain accumulation over time without resorting to deterministic language… **Imbrication implies accumulation in the sense that the overlap of social and material agencies is not replicated in the same way over time and doesn't necessarily have inertial tendencies, but that the way imbrication occurs at time 1 will influence the way it occurs at time 2.**

The quote indicates that instead of one imbrication causing the other to happen, the concept of imbrication suggests that current imbrications influence future imbrications (but not in a linear, predictable way) where it captures the gradual process of continuous interrelations of the human and the material in the dynamic of work practice.

Here again, the examples discussed show that one imbrication episode (i.e. the setting of the current year budget) influences the way production targets for the refinery are set and, in consequence, affects control actions and practices which feed into immediate imbrications in the refinery. Then, when management sets new targets for the next year, the previous production processes (which are reflected in the reports and negotiations by the personnel in the refinery) influence decisions taken by senior managers as they try to decide how to figure out performance measures for the next year. This, then, will influence the production process the next year and the cycle continues. The way imbrications happen is influenced by

previous imbrications and not in a predictable and linear way, as we might anticipate causality effects to happen.

The next chapter will be an overall discussion of the three empirical chapters and the sociomaterial imbrication process theory used to theorise them.

CHAPTER 9
MANAGEMENT ACCOUNTING CONTROL PRACTICES, SOCIOMATERIALITY AND IMBRICATION

9.1 INTRODUCTION

This chapter discusses the overall findings of this thesis. Firstly, I will summarize and discuss the key findings from the empirical analysis provided in the three empirical chapters. This is followed by the empirical and theoretical contribution that the findings of this thesis have to offer, including some reflection on the experimental process in applying the theory and concepts of sociomaterial imbrication.

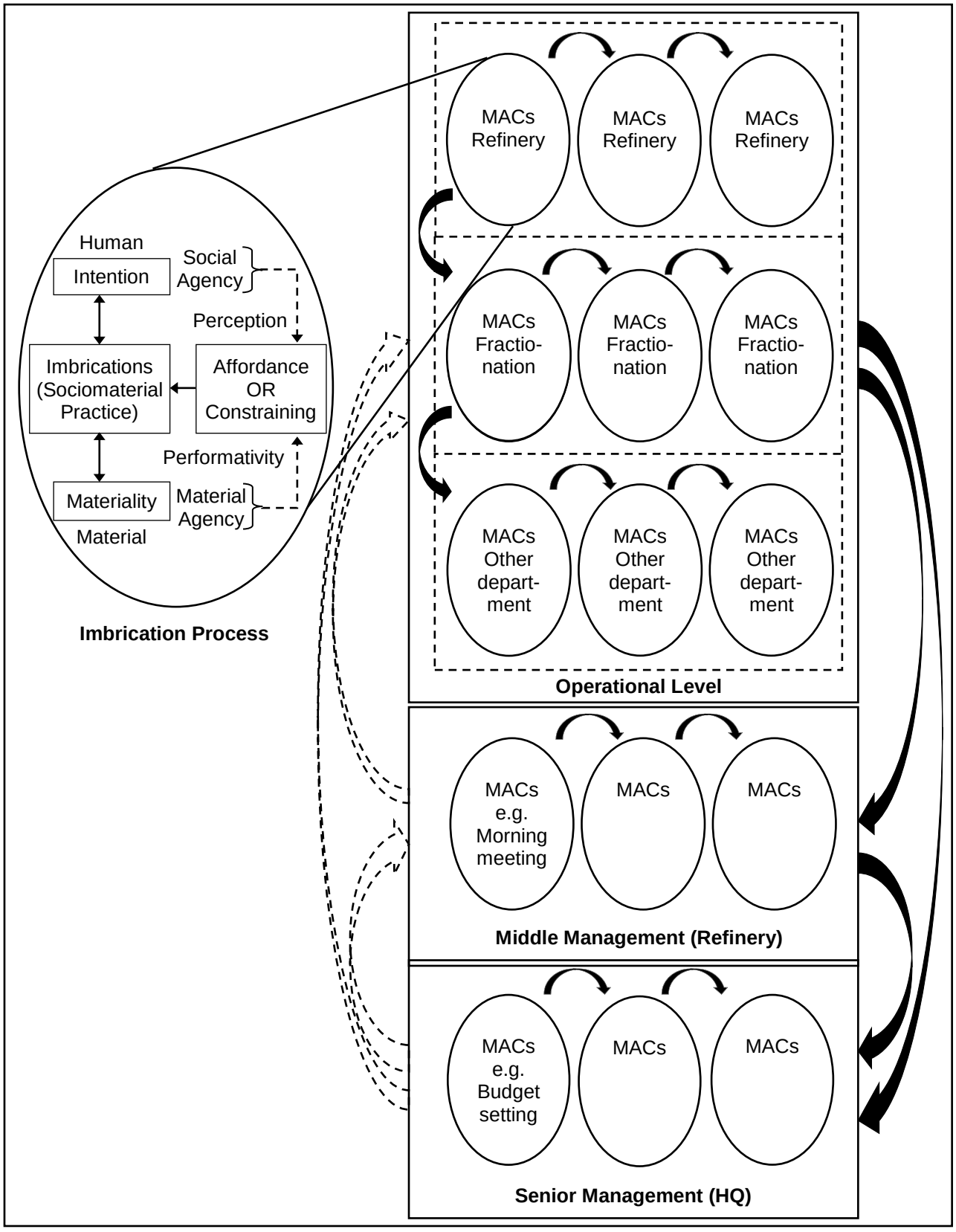
9.2 THE MAIN FINDINGS

A summary of the key research findings is depicted in Diagram 9.1 below. Each of the ellipses in the diagram indicate the imbrication processes between the social (people) and the material (including technology) that happen throughout the organisation. The large ellipse on the left side of the diagram shows the process of imbrication/entanglement between the two agencies when analysed at a more detailed level (this large ellipse is a magnified image of each of the small ellipses in the rectangular boxes on the right side of the diagram). It shows that, fundamentally, all happenings and activities in organisations including the management accounting and control (MACs) practices are sociomaterial. In the complex setting of organisations which consist of arrangements of many kinds of simple and complex material objects and technologies, explaining practices from a human centred perspective can, at best, provide only partial understandings of the organisational practice (Kallinikos et al. 2012; Leonardi, 2011, 2012a; Nicolini et al., 2011; Orlikowski, 2007, 2010a; Orlikowski & Scott, 2008; Schatzki, 2002). Using the sociomaterial imbrication framework is innovative and provides an interesting way to seek to understand and explicate the practices in organisations.

As I mention above, the ellipses in Diagram 9.1 depicts the sociomaterial imbrication processes which occur among human/social and material/technology actors. These processes occur in multiple locations context, such as at the refining plant, fractionation plant, refinery office and the head office, and take place continuously within the organisation. For analytical purposes, the happenings in the organisation have to be untangled to better understand the processes that are occurring. It is necessary to highlight the fact that the complexity of the interactions and activities are interrelated with multiple imbrications happening all at the same time. The interactions also overlap and cannot be separated with

certainty – this will be highlighted again later in the chapter. The sociomaterial imbrication framework used in this research enables us to see this complexity by using the concept of a chain of imbrications (Leonardi, 2011, 2012a) where each of the imbrications are shown to be influenced by the other imbrications before it – indicated by the solid black arrows in Diagram 9.1. However, that does not explain the whole story. The influence is not unidirectional and predictable. The findings from the analysis also show that the relations between one imbrication and another are dynamic and multidirectional (this is indicated by the dashed arrows in the diagram). The influences are cyclical and dynamic and are influenced by temporal changes not only at one site but across functions and hierarchical levels. An imbrication that takes place at one time commonly influences later imbrications that take place across multiple spaces and different times. In many organisations, practice related to the collection and aggregation of data for MACs and managerial control practices related to monitoring and action plays a central role in MACs reporting (Thomas Ahrens & Chapman, 2007; Nama & Lowe, 2014; Quattrone & Hopper, 2005). The key findings on the MACs practices within the case organisation uncovered through the application of the sociomaterial imbrication process within the diagram will be discussed in the next section.

Diagram 9.1
MACs as a Sociomaterial Imbrication Process



9.2.1 Production/Operational MACs as an Emergence of the Sociomaterial Imbrication Process

One of the objectives of this research is to develop an in-depth understanding of MACs practice – how it is constituted and how it is implicated in the daily practices of the organisations. The analysis seeks to construct this understanding at the micro level in order to be able to offer explanations of the complex relations and entanglements of technology, MACs practices and other organisational practices (Carlile, 2002; Dechow & Mouritsen, 2005; Howard-Grenville & Carlile, 2006; Lowe & Jones, 2004; Lowe & Koh, 2007). The findings from my analysis of the MACs practices at different hierarchical levels of Golden Crop Co. show that organisational activities (each of the small ellipses in Diagram 9.1) including the MACs practices are fundamentally sociomaterial (as indicated in the large ellipse on the left side of Diagram 9.1). This is in line with the notion of relational ontology argued by several recent scholars (Carlile et al., 2013; Leonardi, 2011, 2012a, 2012b, 2013a; Nicolini et al., 2012; Orlikowski, 2010; Orlikowski & Scott, 2008) as well as the notion of networks of actors promoted by scholars within the ANT perspective (Briers & Chua, 2001; Lowe, 2001; Quattrone & Hopper, 2005). According to these authors, organizational realities are constitutive of social and material entanglement which without any one of the separate constituent elements (the humans or the material) are considered to elicit only partial explanations of the field and the organisational context.

This can be evidenced by some of the examples I explore at the operational and managerial level of Golden Crop Co. with regards to their manufacturing and processing activities. As discussed in Chapter 6 and specifically highlighted in the early section of Chapter 8 (section 8.2), the main concern of the people in charge of production activities of the midstream production division of the case company was regularly stated to be the achievement of target yield and quality within the applicable budgeted cost of production. Throughout the analysis of interview and observational data around production processes and performance in Chapters 6 and 7, these objectives (i.e. achieving the targeted yield and cost of production as well as making sure production is done in accordance with quality required) can be seen as influential on how control practices are deployed and corrective actions taken at various levels in the production and refining facility. The theorisation of the empirics I describe in Chapter 6 and especially in Chapter 8, indicate that these targets and objectives are implicated in the daily production and production related monitoring and control activities.

While the main overall aim of the organisation and its managers is to make sure oils are produced in accordance with quality specifications, the target for yield and cost of production

(i.e. the management accounting and control measures) has always been a very significant consideration. My findings can be contrasted to different explanations in the literature on MACs, which tend to explain MACs and their effects on the organisation as the outcome of social structures that are embedded in the organisational culture, history, leadership and the interactions of people (Ahrens & Mollona, 2007; Alam et al., 2004; Baxter & Chua, 2008; Hyvönen et al., 2006; Jack, 2005). The findings of this research seek to show that the use of (management) accounting numbers and complex patterns of control practices over time are emergent and respond to imbrication between the social and the material/technology.

For example, the control practices that emerge at the refining and fractionation plant can be seen to be constituted as resulting from the entanglement of operators and supervisors with the materials of production, the material objects of the production process and the production and control technologies. This is illustrated in the way operators exercise or engage control practices when they work with the technology, such as in relation to the heat exchanger, temperature reader, bleaching earth dosing machine, and onscreen information displayed from the PLC system or specific reports provided by the PLC system (such as the graph of the fractionation plant production analysis). In attempts to achieve high efficiency outcomes within production, within specified quality requirements practices and control actions are modified in a dynamic manner. My findings demonstrate the way in which operators/supervisors and the material/artefacts and technology imbricate to produce a flexible and responsive organisational control practice.

One of the detailed examples I discussed to illustrate this point was at the first two stages of the refining process (please refer to section 6.2.1.2 in Chapter 6 for details) where operators are charged to control the flow rate of oil passing through the heat exchanger and the use of appropriate amounts of sub material (the bleaching earth) - (see also diagram 6.2 and 6.3 in Chapter 6). Here, the operators also have to strive to balance the consumption of utilities like heating and power, and the use of sub-materials in order to get the required quality while working within the target yield and cost of production. The higher the heat and bleaching earth use, the better the quality, but this necessarily results in a higher cost per unit of output and lower yield. When analysed through the imbrication process lens, the control exercised to get this balance was best perceived as being constituted in the entanglement of humans and material/technology. The operators alone or the machinery and plant alone were not able to reach an effective balance. It is notably when the operators and the technology/instrument/machineries get entangled that control could be seen. Other similar examples provided in Chapters 6 and 7 also point to this scenario. All the examples discussed are in line with the concept that Leonardi (2011, 2012a) mentioned when talking

about the distinct agential effects between social/human and material which together cause work practices to emerge and modify.

This part of my findings is closely related to a significant subset of MACs research employing actor network theory. Findings such as the example above (see also further analysis discussed in Chapters 6 and 7) suggest that in order to understand the development of MACs practices more fully, it is important to look at all actors - social and materials - because only by doing this can we explain MACs practices. For example, the studies by Briers & Chua (2001), Chua (1995), Jones & Dugdale (2002), Dechow & Mouritsen (2005), Preston et al. (1992), and Quattrone & Hopper (2005) support the view that it is the unique interactions of actors including human and non-human (or material/artefacts/technology) within the context that results in the specific emergence of MACs. Using the imbrication process (the large ellipse extracted on the left in Diagram 9.1), I was able to explore the MACs practices by analysing the detailed way in which these actors (i.e. the human and material) imbricate.

9.2.2 Construction and Modification of MACs: Temporal Changes

As discussed above, fundamentally each of the practices that emerge from the imbrication process indicated by each ellipse in Diagram 9.1 encompass human and material agency that inevitably becomes entangled as humans and technology interact. However, each one of the ellipses only explains the micro pattern of each of the practices. It is as a result of these processes that sociomaterial entanglements create and modify organisational and control practices over time – indicated by the solid arrows in Diagram 9.1.

The findings show that as multiple arrangements of entanglement between humans and material in organisations happen, the pattern/practices at the site will modify and can become visible and amenable to analysis. In this way, practices may be seen as pliable structures that develop and change to serve certain purposes, and shift over time to reflect variability in material elements of the production process (which can occur within a single shift) and changes in the nature of control technologies (which may only occur over a period of months if not years). As illustrated briefly above (for detail, see discussion in Chapters 6 and 7), we can see the practice of controls such as the flow rate of palm oil throughout the refinery plant, controlling the dosing, lab testing and sampling processes as forming complex assemblages that influence and pattern control practices within the production process. Similarly, as illustrated in Chapter 7, the combination of controls at the operational level and

discussions among the operational and production management personnel also become entangled with control technology to influence the arrangement and nature and deployment of MACs practices.

A number of the examples in Chapters 7 and 8 illustrate these points. One of the instances I discuss in Chapter 7 concerning the two groups of operators and supervisors working in shifts which immediately follow each other (one shift taking over from the other) show the temporal flow of the production control practices (see discussions on Figure 7.1 and Diagrams 7.1 and 7.2 in Chapter 7). The way in which the operators in the second shift imbricate with the PLC system and its instruments in order to monitor and control the production processes was very much influenced by the previous imbrications; such imbrications resulted from control activities and production issues that arose in shift 1 or even prior to this time during an earlier period of production or relating back to a decision perhaps on the quality of crude palm oil to accept from a supplier. In this example, operators/supervisors get engaged with the information in the 'log book' and exercise the required control at that moment in time together with the material/technology to achieve an efficient production performance. This shows the temporal nature of control practices.

In a similar example in Chapter 6, I illustrate the changes in the MACs pattern that happen at the refining plant with regards to the monitoring of sub-material dosage control. According to Sassen (2002) and Leonardi (2011, 2012a), the settlement of certain patterns of the 'riverbed' change as the water overflows and "upset[s] [the] existing patterns of rock imbrication along its shore" (Leonardi, 2012a, p.44). Similarly, when an event brings about or threatens change, the pattern of practice could be similarly disturbed and changed. In this example, during the event where the operators and supervisors found that the dosing machine was not providing reliable figures for the bleacher dosage, they made a conscious change to the control practices. In this instance, the change was set in motion as a consequence of a serious production problem occurring. Here, the change involved a technology work-around by not just monitoring the PLC screen but also carrying out a physical check at the tank to try to ensure the correct dosage had been applied. The change that took place was influenced by the outcome of the previous imbrications involving the technology and laboratory sampling and testing. This resulted in a change in the control practices of the human operators but this had been initially set in motion by new knowledge about the technology and likely problems in the automated control system.

The findings outlined above highlight two important points with regards to MACs practices. First, that the arrangement of multiple imbrication processes (i.e. ellipses in Diagram 9.1)

between human and material create a pattern of MACs practices. Second, that the MACs practices are an evolving process influenced by previous MACs practices within the organisational activities and context. In contrast to the research showing a definitive impact of one action (such as using a certain kind of production technology/or accounting technology) on another action or practices (e.g. performance changes and/or changes in behaviour) such as suggested by most contingency theory studies (Abdel-Kader & Luther, 2008; Cadez & Guilding, 2008; Chenhall, 2003), my findings show that control practice changes do not happen in a definitive, clear cut way. Similar to typical contingency theory studies, sociomaterial based conceptualisations of process and production controls (and practices) do reveal that MACs practices are influenced by the context or previous imbrication(s) but contrary to contingency theory this is not seen to occur in a predictable way.

In contrast to the example of flow of MACs and the temporal changes that happen at the same site (operational/production level) as discussed earlier, I also discuss the vertical flow of controls from the operational level to the managerial levels (see solid arrows linking the different hierarchical levels of the organisation in Diagram 9.1). One example that shows the flow of information and controls from the production sites to the middle management at the refinery is illustrated in the discussion about the 'morning meeting' (see section 7.2.3 of Chapter 7 for a detailed discussion). The imbrications that happen at the production plants get inscribed in the reports used to discuss production performance in the 'morning meeting'. The people engaging with this information (from the report – also a form of material object) then exercise their control such as deciding the next actions to be taken in order to make sure that targeted measures in the budget can be achieved. This supports the earlier point made, that the earlier imbrications (i.e. the imbrications at the production sites) influence the later imbrications that happen at the meeting.

Another example illustrating the same point which evidences that prior imbrications influence imbrications in the present is the flow of information from the plant to middle management to the head office (as discussed in section 8.2 Chapter 8). The previous production performances are inscribed in the performance report which is not only used in the 'morning meeting' mentioned above but is also deployed in ways that influence the way senior management at the head office monitor and exercise their controls on performance in the processing plant and elsewhere.

9.2.3 The Dynamic Nature of MACs Practices

The findings from the analysis of the case not only explain the changes that happen over time, but also explain the dynamic nature of the sociomaterial MAC practices. The overall findings as illustrated by the whole of Diagram 9.1 indicate that complex interrelationships operate among organisational objectives and MACs practices. In other words, the objective is implicated in the daily work practices of the organisation including the MACs practices (indicated by the solid arrows that go across hierarchical levels in Diagram 9.1) and, in turn, the practices also get implicated in the development of organisational objectives (indicated by the dashed arrows in Diagram 9.1).

This reflects another aspect of the imbrication process. According to Taylor (2001) and Leonardi (2012a), as the arrangement of elements form a pattern, such as the tegula and imbrex of the roof tiles or the bricks on the wall, there is no way to find at this later point where the starting and ending point is. Rather than one imbrication impacting the other, the imbrications process and the chain of imbrications concept reflect that the direction is arbitrary and dynamic, such as the way in which the budget influencing day to day work and MACs practices (at the operational and managerial level) and vice versa is dynamic and multidirectional.

9.2.4 Budgeting and Its Implication on Day To Day Operational and Managerial Controls

Throughout the analysis chapters (see Chapters 6, 7 and 8), in the discussions of the daily activities at the production plants and discussion among the people at the plants and at the management level, we see that the activities are implicitly influenced by the targeted performance from the budget such as the yield and cost of production. For instance, even though the primary concern at the refinery is to achieve the quality (discussed mainly in Chapters 6 and 7), the targeted performance measures are always implicitly influencing their work and control practices. This is apparent from the way operators were trying to optimize the throughput to achieve the targeted yield as well as placing so much concern on the lab results (even when it was a good result) so that they were able to optimize the usage of sub-materials (such as bleaching earth and phosphoric acid) and other utilities (such as gas for heating) whenever possible. This is part of what they are inclined to do in order to balance quality against yield and cost of production. These actions and motivations all seek to achieve the targets specified in the budget.

Other than examples at the production sites, I also illustrate the way in which the budget (and objective) which was set at the higher management level is implicated in the discussions and decisions made at the refinery management level. The agenda for discussion during the 'morning meeting' between plant supervisors and the refinery management such as the production manager, engineers and refinery manager involve all aspects of the production process and performance including the 'to date' achievement against budget (see section 7.2.3 of Chapter 7 for detailed discussion). This clearly indicates that the activities in the refinery and at the plants as well as the management are very much influenced by the targeted measures in the budget (emphasized in section 8.2 of Chapter 8).

The findings not only illustrate the flow of control practices from one time to another, but also illustrate the vertical flow of controls that happen from the operational level to the managerial level – middle and top/senior management. This is to some extent similar to the analysis made by Ahrens & Chapman (2007) in the restaurant chain MACs practices which show the way in which the management objective is implicated in the exercise of daily controls such as at the menu design, operational restaurant and senior management level. However, to add to that contribution, my findings include the temporal aspect of the changes and the flow from the operation controls to the middle and top management discussion and decisions and controls in the analysis more explicitly.

9.2.5 Day to Day Practices Implicated In the Setting of the Budget

As discussed above, the objective that is claimed to be set by the senior management at the head office has significant influence on the way operational and managerial controls are exercised at the refinery. However, this is not the end of the story. The link or influence of the imbrications are not unidirectional, which means it is not only the budget figures (which determine the performance measures) that get implicated in the daily practices within all levels of the organisation. In fact the relations are dynamic – indicated by the dashed arrows in Diagram 9.1. In other words, it is not only the work practices that are influenced by the performance measures in the budget - in fact, the development of the budget is also, in turn, influenced by the daily work practice and performance.

For example, the discussion in Chapter 8 describes changes that happened in the budget which are related to aspects of production, especially the targeted cost of production and yield. Changes in these variables take place due to prior day to day imbrications that happened at the production site and the refinery throughout the year. The plan and budget,

which would be the benchmark for the future performance, are not developed in isolation from what happened or is happening at the production sites and refinery as a whole. Instead, the decisions on the budget figures and what to include or not to include in the future plans are significantly influenced by the previous and present trend of production and organisational performance which not only include the social aspects of the context but also the material and technological aspects of it. Thus, previous imbrications are embedded in the setting of the present budget for the future and the changes incorporated within the budget due to the 'many overflows of water at the river' throughout the year at the production plants and the management decisions at the refinery (Leonardi, 2012a; Sassen, 2002).

Therefore, this finding of the dynamic nature of MACs not only shows how the objectives of the organisation are embedded in the budget and get implicated in day to day control practices within the organisation, but also how these day to day work and control practices are also embedded in the construction of the organisational plans, objectives and budget.

9.3 RESEARCH CONTRIBUTIONS

This research has presented several empirical, theoretical contributions to the field of management accounting and control.

9.3.1 Empirical Contribution

In summary, this research offers a primary focus on the short term imbrication processes in operational control practices at the palm oil refining stages within the plant. The description of the processes highlight several points that help to explain the MACs practices in the organisation and how they are implicated in micro day to day work practices. Focusing on such an area contributes to our understanding of the working of MACs and the role it plays within different intersections of organisational activities and hierarchical levels in organisations (Ahrens, 2009; Baxter & Chua, 2008; Nama & Lowe, 2014) In addition to the insights on the role and implications of (management) accounting and control systems in an intensively automated process industry such as the palm oil industry, the illustrations on the annual cycle practice of setting management accounting target numbers also help to explain the way in which the day to day work practices are implicated in the development of measures that constitute MACs and MACs targets.

MACs studies in the literature are mainly focussed on the implications of the materiality of (management) accounting control systems such as ERP. These studies also focus primarily on the macro level analysis and longer term effects of changes/implementation (Dechow &

Mouritsen, 2005; Quattrone & Hopper, 2001; Wagner et al., 2011). In contrast to that, the focus in this thesis is on the micro and day to day practices of operational and managerial controls which involve control practices that impact on short term production planning, decision making, and performance. The findings suggest that the variability nature of input materials and production environment in the processing industry such as palm oil refining warrant for intermittent adjustments and controls to be taken on a very short term basis to ensure productivity.

Similar to the mentioned studies (Dechow & Mouritsen, 2005; Quattrone & Hopper, 2005; Wagner et al., 2011), this research also considers the materiality of production and control technology and artifacts, but takes a different focus (i.e. the advanced production technology and other artifacts relating to the production activities in the organisation). In doing so, the findings provide valuable insights into the explanation of the situated functionality of (management) accounting and management accounting and control as practice (Ahrens & Chapman, 2007; Jørgensen & Messner, 2010; Nama & Lowe, 2014) by giving emphasis to the complex relations and processes of entanglement between bundles of social, material and technology as well as other organisational practices within the organisation in constituting management accounting and control practices.

The aim of this research was to examine what constitutes MACs or, more generally, management controls. The empirical material at the centre of this research, such as the concerns on yield and cost of production which were observed and described earlier in the case, have been described through the lens of sociomateriality. The descriptions of control practices has clearly indicated that the 'practicing' of management control is the outcome of specific but complex assemblages of human and material agencies. This is apparent in each of the controls practices in the micro organisational activities, such as have been illustrated in the refining and fractionation steps (see Chapter 6). The affordances and constraints offered by the bundle of materials (such as the PLC system, its instruments and the raw materials) influenced the way in which people engaged and imbricated in practicing controls. Each of these imbrications that happen at a specific time and location (such as at the production sites) is based on the capacity of both agencies for action in that context. This is similar to the examples given in the decision making and planning exercise undertaken by the refinery staff and senior management and was influenced by the affordances and constraints of the materials and technology at the plant perceived by the human actors.

However, this does not happen in isolation to the (management) accounting numbers. These accounting targets trigger the intentions of people as and when they engage with materials

at the sites. For instance, the imbrications between operators/supervisors with the materials and artifacts that happen at the production sites align with the pursuit of the various accounting numbers and operational control targets. However, it is important to highlight that, though the accounting numbers/targets set (i.e. the result of previous imbrications – of setting the numbers) influence the intentions of people and broadly the overall present imbrication processes, the way in which the present imbrication (control practice) happens is based on the perception of affordance and constraint at that time and context.

Similar experiences can be seen when exercise of control happens at other locations or times. For example, when changes in work shifts happen, reports and information provided in the log book may trigger the actions that need to be taken, but the way imbrication happens at that time is based on the perception of affordance and constraint of the technology systems and production material. Following these perceptions, the two agencies imbricate in certain ways and control practices emerge. Similar explanations can be made at the middle management level when they respond to controls when making decisions on the planning of production which are triggered by the reports of production performance as well as accounting numbers specified in the budget targets. This is why I report in this research that previous imbrications influence the present and future imbrications. In these imbrication processes the flow is not linear and predictable, as the specific capacity of action of the agencies at that particular moment as well as the relational affordance or constraint perceived from the imbrication decides how the imbrication (control practice) transpires.

The point to be made here is that (management) accounting numbers serve as the triggering effect on the day to day control practices at the operational/production level as well as the managerial level. The 'happening' of the controls (the controlling) at specific production sites, though influenced by these accounting numbers, are also the outcome of the imbrication processes that happen at specific times and locations between people and materials through the perceptions of affordance or constraint that are constructed when they engage. The concept of chain of imbrication allows us to capture and explain the triggering effects of (management) accounting numbers while the imbrication process itself show the practice of controls at the sites as they 'happen'. This extends our understanding of (management) accounting and the link to control practices that happen in organisations in their day to day activities – i.e. how the management accounting numbers are implicated in the day to day operations.

Another important point that emerges from the findings is how the human/social and material/technology has distinct agential capacity of action, but only through the imbrication

of the two agencies that the control practices emerge. Clear examples of this point can be seen from the descriptions of control practices at the refining and fractionation plants (in Chapter 6) where the PLC systems and the people have their individual capacity/performativity but only together are they able to manage and control the balance between the conflicting objectives of quality, yield and cost of production. Other examples are the usage of reports at multiple locations such as the log books and production performance reports presented in Chapter 7. Though the capacity of action of these reports is not as clear cut as the PLC system (which has its automated ability of 'doing'), there is heavy reliance on the report by the people working around the production processes, be it at the actual production sites or, one step removed, at the refinery office. Here, factory managers and supervisors regularly expressed the ability/credibility of information within the reports to help direct their actions. The fact that decisions were made based on reports suggests that the log book and other reports have the ability to reflect the imbrications that happen at the production site and are also able to assist people at different times and/or locations to make appropriate decisions even in the absence of human actors from the plant itself (operators/supervisors and the PLC system or other materials).

The analysis that I have developed using the imbrication process extends our understanding about how MACs shape and are shaped by the organisational context by bringing to the surface the process of interactions of both social and material agencies and how the accounting numbers influence these interactions. The concept of affordance and constraint helps in explicating the capacity of action of each of the agencies and how the intermingling influences the way in which decisions are made on the numbers or targets that are to be used for control practices. The descriptions of these imbrications explicitly portray the way goals and intentions of the human/social actors are reshaped in a relational dynamic with material/technology. These processes are acted out in the context of the site and through the affordances and/or constraints, the control practices are exercised in the day to day activities at the plant as well as at managerial levels. Therefore, instead of giving a simple explanation that past performance or the interactions and negotiations of the past inform the way in which MACs are developed (Emmanuel, Otley, & Merchant, 1990), the imbrication processes detail the capacity of agencies in action.

Therefore, in line with the debate in the interpretive management accounting and control research literature, the findings of this research suggest that MACs are complex and inseparable from organisational practices – as illustrated in Diagram 9.1. It is through the continuous interactions, actions and discourse among the actors (human and non-human) within the organisation that the MACs emerged. They are shaped by organisational context

and, in turn, shape the organisational context and organisational practices (Ahrens & Chapman, 2007; Lowe & Jones, 2004; Nama & Lowe, 2014; Preston et al., 1992). However, instead of only giving primacy to the role of human/social agency in translating or deciding the MACs practices (i.e. MACs are socially constructed) as many of the interpretive management accounting and control research studies suggest, this research, through the lens of sociomateriality, emphasizes that complex MACs are constituted just as much of social elements as they are of material (i.e. they are socio-materially constructed) (Dechow & Mouritsen, 2005; Quattrone & Hopper, 2005; Wagner et al., 2011) – this is summarised by the large ellipse on the left side of Diagram 9.1.

The findings also illustrate that MACs practices do not emerge independently of the other activities within the organisation. Each of the MACs that emerge at a specific time and space are influenced by the previous events and problems that arise and control practices. Cumulatively they form MACs practices like production/operational controls and managerial controls as in my analysis looking at the efficiency and effectiveness of the production process against targeted measures in the budget (Ferreira & Otley, 2009; Otley, 1999). Similar to the argument made by Ahrens and Chapman (2007) and Nama and Lowe (2014), MACs can be seen to be comprised of bundles of activities cutting across operational activities and hierarchical levels within the organisation. That being said, an important contribution revealed by this case study is that the modification of control practices is very much influenced by the affordance and/or constraint posed by the materiality that is relationally perceived by the people/social in each of the contexts (or functions) where the (management) accounting as well as the control practices are meant to be practiced. For example, the decisions made in the 'morning meeting' and the control mechanisms such as the reports for refinery management and head office, though meant to achieve the budget figures, are influenced by the affordance and/or constraint of the materials/technology perceived at the production sites. To highlight this point, even the examples of decisions made in setting the budget figures are influenced by the imbrications that reflect the perception of affordance and/or constraints faced at the production sites.

Therefore, analysing control practices at both operational and managerial level of the organisation shows that, in order to understand the management accounting effects and control practices, researchers should not only examine the management accounting techniques or advanced management accounting and control systems such as ERP/SAP systems, as most socio-material management accounting research has done. Instead, researcher should also consider the link between operational and managerial activities within the organisation. The findings of this research illustrate that the relational perception of

affordance and/or constraints posed by the range of materials at the micro level of organisational activities have impacts on the way in which planning and decision making for management accounting and controls are constructed and modified.

In addition to the main focus of this research, which is to see the short term imbrications and chain of imbrications in the more micro operational and managerial activities as well as the accounting implications arising from them, the opportunity to observe a considerably longer period (annual process of developing the management accounting planning and controls) has also contributed to an understanding of MACs. The findings of the dynamic nature of MACs reveal the interdependence of organisational objectives and operational and managerial activities in organisations. I have described how the formulation of organisational objectives is influenced by the daily activities of the organization and then, in turn, how the organisational objectives influence the daily activities again. This helps us to understand the role that accounting plays and how it gets implicated in the daily activities as well as how the daily activities get implicated in the setting of new accounting targets such as yield and cost of production (Thomas Ahrens & Chapman, 2007; Jørgensen & Messner, 2010; Preston et al., 1992).

Besides showing the interdependence of organisational objectives, these findings of the dynamic nature of MACs enable us to trace to some extent the stability and change of practices over time as well as the non-linear nature of the change. These concerns about change have been the subject of considerable effort in research and consistently debated in the MACs literature mostly within institutional theory inspired research on MACs (Lukka, 2007; Quinn, 2014; Ribeiro & Scapens, 2006). The findings from my analysis indicate that when the engagement between the people and material/technology constructs the perception of affordance (to achieve the objective), the MACs practices will remain and become more stable – i.e. maintain the existing control patterns. However, when perception of constraint was constructed, MACs practices tend to change to accommodate the initial objective. Thus, changes in and the stability of MACs practices are not deterministic and are not linear. This point will be made clearer in the discussion of the theoretical contribution, discussed in the next section.

9.3.2 Theoretical Contribution and Reflections

As detailed in Chapter 3, the underpinning framework of this thesis draws on a sociomaterial practice theory perspective that reflects a relational ontology of human and material agency. It rejects the ontology of separateness between the two agencies in explaining social phenomena within organisations (Kallinikos et al., 2012; Leonardi, 2012a, 2012b; Orlikowski & Scott, 2008; Orlikowski, 2010). To reflect this ontological perspective, this research operationalizes the work practice in the organisation, specifically the MACs practices, using the concept of imbrication advocated by Leonardi (2011, 2012a, 2012b). This perspective provides an interesting alternative lens for the understanding of control practices within a range of activities in organisations. Instead of attempting to understand the MACs from either a 'purely'/or largely social perspective or an interpretation based on a deterministic view of material/technology, the sociomaterial practice approach is able to unfold the entanglement of meanings and materiality that influence the way MACs emerge (Wagner et al., 2011). As will be described below, the concept employed has helped explain several aspects of our understanding of MACs practices and how these relate to other organisational work practices.

The methodological tool of the *imbrication process* and *chain of imbrications* that was employed in analysing the empirical data has contributed to our understanding of several aspects of MACs, as described in the previous section. These concepts help in analysing the complex and constantly intermingling, and changes that occur in organisational activities and practices at the micro level. They enable the slicing up and untangling of the complex interrelations within the empirical data that was collected so that it can be explained and presented in an understandable way. The framework provides the researcher with a guide through which to structure the writing up of the empirics in a way which is a simplification but in simplifying helps to produce a readable account.

Firstly, the imbrication process provides a tool to lift the veil of MACs practices to see how the social and material, which are the two building blocks of organisational practice (such as the different shape of tiles 'tegula' and 'imbrex' whose arrangement forms a waterproof roof structure (Leonardi, 2011, 2012a), become entangled and facilitate the dynamic development of MACs practices. In general, the sociomateriality perspective argues that, fundamentally, MACs practices are constitutively composed through successive interactions among people and the material. Leaving either one of these elements out of an explanation of organisational practices will exacerbate the deficiencies in our understanding of organisational realities (Leonardi, 2012a, 2012b; Orlikowski, 2007). This is similar to the

point made by Wagner et al. (2011) and other MACs researchers employing ANT theory. However, the imbrication process tools summarized in the large ellipse on the left hand side of Diagram 9.1 enable us to open the black-box of MACs practices or other practices and show the 'what' and 'how' of the interactions of two distinct types of actor (social and material).

These constructs delineate the point of departure between the sociomaterial approach employed by Wagner et al. (2011) and this research. The framework of this research takes the view that although control practices (or work practices, for that matter) emerge from the entanglement of social/people and material/technology; they are still distinct at their agential level. However, the practices only emerge as the two agencies imbricate, and this happens, or is a response to, the perception of affordances and /or constraints that are constructed as they become entangled through action. The implication of this view is that a researcher who engages with the MACs practices in the specific context could "see" how (i.e. tracing the process) the two agencies imbricate in creating MACs in any specific context. The imbrication process approach of explaining sociomateriality sensitises the researcher to become aware of how entanglement acts to produce every day work and MACs practices (Leonardi, 2011, 2012a).

Next, the concept of affordances and/or constraints also provides insights for understanding why MACs practices differ contextually. The way that actors' perceptions of affordances and/or constraints (in the large ellipse on the left side of Diagram 9.1) differ in different situations can be used to explain the way practices emerge from the imbrication/entanglement process. Detailed examples of this concept were illustrated in the empirical chapters; especially Chapter 6 (see section 6.2.1 and 6.2.2) and Chapter 7 (see section 7.2.1). Leonardi (2011, 2012a) claims that as people and material become engaged, the perception of affordance or constraint will be constructed and this then determines the way imbrication processes subsequently happen. Leonardi suggests that when perceptions of affordance are perceived/constructed, changes in the routine of practice will happen, but when perceptions of constraint dominate, changes in the material or elements of the materials and production processes are likely to happen. However, the findings in this research unfold a slightly different outcome compared to the concept promoted by Leonardi (2011, 2012a). In my case organisation, both perceptions of affordance and constraint have led to changes in the routines of work and MACs practices - these are summarised in the last paragraph of section 9.3.1 above.

This is possibly due to differences in the research setting. In Leonardi (2012a) case, the study was conducted over a longer time period as compared to my research, and also the technology in his study was developed within the case organisation compared to a significant reliance on outsourced technology in my study. These two reasons might explain the differences in the findings of the change process and highlight the point of departure between my research and the nature and setting for the research Leonardi (2011, 2012a) conducted employing the concept of imbrication. First of all, the technology that is analysed in my case is not built in house, thus making it less flexible to change. Secondly, even if changes in technology are possible, the duration of time in which this study was conducted and the nature of the industry (and its capital intensive nature) combine to make the technology or control technology changes infrequent. Therefore, in line with the other control studies that examine technology that is less flexible to change, when the perception of constraint is constructed, practices change, such as working around the system (Dechow & Mouritsen, 2005; Grabski et al., 2011; Lowe & Koh, 2007). However, in my case, the 'work around' does not indicate working around the system to avoid or subvert its original control purpose, but actually changing the practice to enable control (such as the changes in the way bleaching earth dosage is monitored – from relying on the system to manual checking, as briefly explained in the previous section). For more details, see section 6.2.1.2.2 in Chapter 6. Having said that, the concept of affordance and/or constraint is still found to be a useful tool in explaining the divergence of MACs practices in different contexts as it may be able to explain how the relational perceptions are constructed through the interaction of materiality and the intentions of people which eventually results in the specific imbrications that occur.

The second important conceptualisation of the imbrication metaphor is the *chain of imbrication*. The idea of the chain can be used to reveal or focus attention on the temporal flow of practices and controls and the formation of practice patterns across different hierarchical levels and locations within the company. This helps in unravelling the way organisational objectives are set at the higher level of management and how the organisation gets implicated in the daily operational and managerial control practices. Using this concept, I was able to integrate the MACs practices that happen at different hierarchical levels of the organisation (indicated by the three solid arrows on the right side of Diagram 9.1 above showing the flow from operation to middle management and senior management levels) as well as the flow of control practices from one function to another (indicated by the solid arrow on the left side of Diagram 9.1 which shows the flow refinery to fractionations and other departments). Illustrations related to the concept of chain of imbrications that show flow of control practices between different hierarchical levels are discussed in Chapter 7 (see

section 7.2.3 where I discuss the 'morning meetings' - i.e. the control flow between production/operational employees with the refinery management) and Chapter 8 (see section 8.2 where I show the link of controls between the three hierarchical levels). One of the detailed illustrations of the chain of imbrications between different functional areas can be found in section 7.2.2, where I show the link between the production plants and the laboratory.

The concept of chain of imbrication also enables the tracing of stability and change in practices over time. The imbrication processes that seem to be happening in isolation from one another at many locations and different times actually interlink and interact with each other, where past imbrications influence current imbrications and so on – indicated by the solid arrows in Diagram 9.1 (both solid vertical arrows and solid horizontal arrows). The metaphor of imbrication indicates that imbrications that happen do not happen in isolation. The imbrications that happen in the present are always influenced by the previous imbrications, eventually forming chains of imbrications. As this study was conducted in a relatively short period of less than 2 years, not much major change could be identified in either the main technology observed or the MACs practices. However, the concept of chain of imbrications is still found to provide a valuable perspective for looking into the flow of controls that happen across functions and hierarchical levels as discussed above, and also for observing temporal stability and change that happens during this period. The study findings demonstrate the flexibility in the way MACs and other operational controls are deployed in often subtly different ways in the face of micro level changes in production data.

The concept helps make clear the changes that may have upset the existing pattern of work and MACs practices. Employing the concept of chain of imbrications helps identify the factors that bring about the changes in the first place and then helps highlight the way that these changes influence the future work practice. Having said that, however, while showing that the present or future imbrications are influenced by the previous ones, this concept does emphasise the non-linear and non-deterministic nature of change. This is because, rather than just saying this action impacts or changes another action, the underlying concept is that each imbrication happens depending on the way people and material/technology become entangled and imbricate at the specific time and context. This is an acceptance of the unpredictable nature of changes in practice. The same illustrations in Chapters 6 and 7 mentioned earlier in the previous paragraph also highlight this point.

Lastly, the chain of imbrications also helps us to see what I have called the dynamic interactions and interdependence of various operational and managerial control practices in

the organisation (indicated by all the solid and dashed arrows in Diagram 9.1). Leonardi (2011, 2012a, p.44) highlights that "the metaphor of imbrication implies a gradual process of interrelation [which is in] contrast to the image of causality provided by the metaphor of impact". Another explanation from the imbrication metaphor that also reflects this dynamic interaction and interdependence is that as the arrangement of the distinct roof tiles (the tegula and imbrex) settles and forms the structure of a waterproof roof, the starting and ending point will become arbitrary (Leonardi, 2012a; Taylor, 2001) – which means there is no way to find out which element is impacting which element (discussion in section 8.4 in Chapter 8 specifically illustrates this point). This indicates that the reality of the relationships among the daily activities within different functional and hierarchical levels in the organisation are complex and dynamic and influencing each other in an unidentifiable direction. This supports the interpretive research arguments in MACs studies such as the concept of 'drift' (Quattrone & Hopper, 2001) and research on change in organisational studies in general (Ciborra & Associates, 2001). The detailed descriptions of the entanglement between the agencies of each imbrication process combined with the concept of chain of imbrications may compliment the concept of 'drift' by giving details on the flow of the 'drifting' of practices as these concepts allow tracing of the gradual changes from one state of practice to the other as well as identify the triggering factors of the gradual change (Andon et.al., 2007; Quattrone & Hopper, 2001; Wagner et al., 2011). Therefore, although in this research the focus and illustrations are about changes in the short term chain of imbrications of operational and managerial control practices, it also highlights the possibility of this concept being a useful framework for studying change in management accounting practices, controls practices and management accounting and control system/technology.

Having mentioned these various contributions that have helped enrich our understanding of organisational and MACs practices, applying the concept of sociomaterial imbrications is not without its challenges. In the next section I will raise some issues and challenges on some aspects of the sociomaterial imbrication process during the application of these concepts in analysing the case data.

9.2.3.1 Reflection on the Application of Sociomaterial Imbrication Processes

There were several difficulties in employing the imbrication process concept in analysing and making sense of the empirical data. One of them is the concept of *materiality* [and associated concepts such as *performativity*] which is defined as the part/function of the materials and/or technology that is uncontrolled or only partially controlled by humans. This

conception of materiality makes sense in the setting where it was originally employed - i.e. where Leonardi (2011, 2012a) uses it to explain the changes that take place in certain kinds of sophisticated computerised technology (specifically an automated computer simulation technology). I found it was not so easily applied in describing more static/unresponsive material objects such as reports. In explaining this term/concept, I have given an example of the working of a calculator in Chapter 3 (section 3.3.1). There I showed how the 'programming' in the calculator 'does' the maths calculation by itself without the human having control of the 'programming' that is built into it. This kind of 'response' is not very much apparent in a more static material.

In overcoming this problem, I treat these 'static/unresponsive' material objects, such as reports or the log book, as technology - i.e. as 'provider of information' – such as the example of the 'morning meeting' I described in the earlier section where I mentioned that the imbrications at the production sites get inscribed in the reports and people at the 'morning meeting' react to the reports (material) accordingly. Although the reports are prepared by people (who have control over what is included in the report), once it is ready and submitted or distributed to the relevant people, the 'property' of the report is assumed to be independent and not controllable by the preparer – meaning that it (the report as material) has its materiality that is no longer 'controllable' by the originating actor [there are linkages that could be drawn here to the concept of inscription in ANT (Latour, 1987; Lowe & Koh, 2007). Having said that, however, I still feel that the concept of materiality is still more suitable or more easily applied in analysing computerised accounting technology such as the ERP system, or perhaps a more comprehensive explanation may be further developed to include all kinds of material.

Another recurring confusion that occurred during the analysis of the empirical data was in categorizing the technology. Within my analysis, there are several materials that are cumulatively involved in explaining certain sociomaterial practices. However, the imbrication process (the one described in Chapter 3 and summarized by Diagram 3.1 or the left ellipse in Diagram 9.1) shows the material as one material. It was not a problem during the analysis at the micro operational level - i.e. when I analysed the specific instrument such as the heat exchanger, temperature detector or the dosing machine. This is because it is clear cut that as this instrument as material and people imbricate, the sociomaterial control practices emerge. However, when I start analysing the imbrication that happens at the higher level, such as at the morning meeting and during the development/setting of the budget, the 'technology'/material part of the analysis quickly becomes complex and potentially confusing.

For example, at the morning meeting, there are reports that are used during the discussion (which can be treated as material) but at the same time the technology at the plant (the PLC system and its instruments) also influence the discussion and decisions made in the meeting. On top of that, I tried to also explain that the budget (which also can be treated as material/ accounting technology) plays a role in the way imbrication happens to bring about the emergence of control practice at the managerial level. In overcoming this issue, I treat the production performance reports which represent the inscription of human and material imbrication at the plants, and the budget targets (and its related reports) as 'material/technology' which entangles with the people involved in the meeting to create the managerial level controls. Having done that, however, I feel that a more complex mechanism that might be better able to consider and aggregate multiple materials/artefacts/technologies which combine different objectives and functions could be valuable. Again, this may arise, in part, because of the different context and the concerns that I have as compared to the way Leonardi has applied the imbrication concept. The simplified imbrication process which is reflected in Leonardi's work would probably be most useful when the focus is on a single technology.

Overall, although I faced a challenge in my adoption and experimentations with the imbrication metaphor in explaining the sociomaterial practices, from a broader perspective this experience has changed, in some way, how I see work practice specifically, and activities and/or happenings/events in organisations and elsewhere generally. I have become more attentive to the interactions between actors - not only human actors but also non-human actors - within contexts which I used to take for granted. I now realize that actions taken by people are not totally up to them. Human actions are influenced by the restrictions and affordances of the material objects that surround us. At the same time, people are still able to purposefully, at times, actively reacting to the systems and material – they are not always passive. In short – they imbricate.

As compared to before, the experience of working with this theory has made me become more critical when things that are claimed as facts. The concepts such as the chain of imbrications and dynamics nature of work/tasks and activities has made me realize and appreciate that things that we try to explain should not be taken for granted and assumed just to exist as it is, or as we currently see it. Specific happenings can always be explained in relation to things that happen at some other time and in some other place which might involve some other actors. I also have become more appreciative of the 'small' actions/incidents and decisions that are made at any site because each 'small' thing contributes to other small or larger things – the things that we try to explain, such as the

MACs practices, as in this research case. In short, phenomena are very dynamic in nature and rather than insisting that there is only one way/perspective that is the truth, I believe that reality is more complex and so cannot, or should not, be explained in only one way.

The next chapter will summarize the whole thesis and highlight its limitations. Some other interesting avenues for future research that were noted during the data collection and analysis stage that could not be pursued in this thesis due to the limitations of time and space are also suggested in the next chapter.

CHAPTER 10
CONCLUSION

10.1 INTRODUCTION

The purpose of this chapter is to summarize the research and highlight the limitations that arose in conducting and analysing the stages of this research. Based on the limitations, some suggestions for future research and implications of the study are discussed. Some reflections on my personal journey in doing the research are also outlined.

10.2 SUMMARY OF RESEARCH

This research has sought to provide an enriched understanding of management accounting and control (MACs) practices. The aim of this research is to understand what constitutes MACs and how these control processes are implicated in the day to day practices within the related activities of the organisation.

The literature review, in Chapter 2, indicated that studies of MACs have discussed them from two broad perspectives (Ahrens & Chapman, 2006; Chua, 1986; Lukka, 2010). One stream of MACs studies sees MACs as objective systems that are implemented or put in place within organisations and certain predictable outcomes are then expected (Abdel-Kader & Luther, 2008; Cadez & Guilding, 2008; Chenhall, 2003), while the other stream suggests that MACs are complex, socially constructed mechanisms which shape and are shaped by different actors within the context of the organisation where they operate (Ahrens & Chapman, 2007; Englund et al., 2011; Justesen & Mouritsen, 2011; Siti-Nabiha & Scapens, 2005; Wagner et al., 2011).

Following the second stream of MACs research, this study examined MACs and other related controls in the midstream production process of a palm oil refinery in Malaysia. I applied a broadly practice theory of sociomateriality to the study (Leonardi, 2011, 2012a; Orlikowski, 2010; Scott & Orlikowski, 2012). This approach (discussed in detail in Chapter 3) is based on the concept that human and non-human (material) actors should be seen to have complex and potentially equal influence in explaining organisational practices including control practices. This research, in particular, uses the imbrication process framework to show the process in which these actors become entangled and, once entangled, produce or construct sociomaterial practices. These imbrication processes are constitutive of the control practices that I report in Chapters 6 through 8.

The data for which this research is based on was collected through case study method which is described in detail in Chapter 4. Data was collected over a period of three months on the first visit and one week on the second visit 18 months later. Techniques including interviews, observations and collection of a range of public and organisational documents were employed during the field visit. The case was conducted in a palm oil refinery in Malaysia. The operation of this refinery and a detailed description of this industry in which it operates has been described in Chapter 5.

Evidence from the empirical findings reveals that (as the imbrication process framework suggests) MACs practices emerge as a result of the entanglement of humans and materials in multiple episodes of engagement to produce MACs and practices (these engagements are the focus of discussions in Chapters 6 and 7). By mapping the temporal chain of imbrications, this research also shows the flow of control practices across locations and hierarchical levels and the often small adjustments and changes that occur over time in response to these imbrication processes. Observations and interpretations developed in the case study reveal that small modifications in control practices happen throughout these imbrications across time as a consequence of the perception of affordances and/or constraints constructed as the human and material engage. This leaves the more formal elements of MACs and associated systems appearing relatively stable.

The findings also reveal the dynamic and non-deterministic nature of influences that take place between the process in which MACs measures are set at the higher level of management (in this case the (management) accounting target numbers for control measures in the budget) and the day to day MACs or control practice at the production level. The development and setting of budget targets and measures are influenced by the day to day organisational activities and the interactions of human and material and, in turn, the day to day control practices are influenced by the budget target and measures. In other words, the influences and effects that occur sporadically between day to day control practices and the development of (management) control and control numbers are cyclical and unpredictable. The influences are not deterministic as the way in which control practices emerge is based on the specific way imbrications among humans and materials happen in the specific context which results from the perception of affordances and/or constraints as they come to bear on work practices. This can be evidenced throughout the discussion in Chapters 6 and 7 and especially Chapter 8.

Reflecting on the objective of this research, which is to understand what constitutes MACs practice, this research shows that MACs emerge consequent to the entanglement process

between human and material agencies. The research also shows that modifications in the patterns of MACs practice in organisations happen in relation to the chain of the imbrication processes between these two agencies. Therefore, in conclusion, findings of this research suggest that considering both human and material agencies and their repeated interlocking processes is necessary for an understanding of the way in which MACs occur. It is the simultaneous, continuous and dynamic imbrication processes that produce the unique MACs practice in the context in which they operate.

10.3 LIMITATIONS OF THE RESEARCH AND SUGGESTIONS FOR FUTURE RESEARCH

This research contributes to several empirical and theoretical areas of MACs literature as described in Chapter 9. However, despite the contributions to and rich explanation of MACs and organisational work practices in general, there are a number of limitations that need to be addressed where future research may be taken up. This section will briefly list the study's limitations and some suggestions for future research.

10.3.1 Limitations of the Research

This research has closely followed the concept of imbrication used by Leonardi to theorise the sociomateriality of MACs practices and its changes over time. As the sociomateriality approach considers both the material/technology and human/social agencies in explaining practice, Leonardi (2012a) stresses that in order to capture the changes that happen to the material aspects, the data should ideally be collected at an organisation which is involved in developing, implementing and using a new technology so that the changes in the technology under study can be recognized. This is not the case in my study and this could constitute a limitation of my research since the data for my study was collected in an organisation which did not develop its own technology in-house but instead was outsourced. The plant and control software and hardware were purchased from an independent outside vendor. However, although I was not able to see if there were any developments and changes to the technology's functions/materiality, I was able to observe the interaction between the people and the technology and how they imbricated in producing specific work practices and responses to MACs and other operational control systems..

Secondly, in order to see a more concrete change over time (in the technology as well as the routine work practice), a longer period of data collection could offer advantages. Leonardi (2011, 2012) reported on a study for which data was collected over a period of two years

and sought to extend this period by seeking evidence over a 10 year period to observe the development of the technology. Another limitation of my study is that data was collected only for an intensive period of about 3 months. An attempt was made to overcome this issue by visiting the field site again after 19 months but no obvious change in the technology and practices was evidenced during the second visit. However, the close observations of the day to day control practices and other related activities as well as careful analysis of the reports produced at various levels within the organisation provide a coherent idea about the small modifications that happen in day to day control practices which serve to provide cost effective production while maintaining quality standards. In the palm oil processing/refining industry it is these hourly and daily control practices that are central to the viability of production in a highly complex and variable environment. More formal aspects of MACs are relatively ineffective in this context where technology and the variation in raw materials is critical in determining how production processes are best adjusted and controlled on a very short term basis.

Thirdly, this research has not described the material and technology in depth. Although I have explained in detail about the PLC system and some of the other materials (such as reports), effort (during data collection, analysis and discussion) has been placed more on describing the MACs at multiple functional sites and hierarchical levels. Yet, given that the focus of this research is to look at the emergence of MACs, this seems practical.

Lastly, this study focuses more on the MACs practices at the production sites and the flow towards the higher management levels. Although some attempts have been made to show the linking of the control flows and interconnection with other functions (such as the laboratory), it would be much more interesting if more consideration and attention were given to exploring the flow of control practices across other functional areas in organisations.

10.3.2 Suggestions for Future Research

In addressing the limitations of this research, it would be interesting for future research to take up some of the points outlined below.

As mentioned earlier, this research was conducted in an organisation that purchased its plant and control software/hardware from an outside vendor. It would be more interesting and fitting to the sociomaterial imbrication processes framework if future research could attempt to conduct experimentation on the framework within a context where development,

implementation and use of the technology is made in house. This would give a more holistic picture about all the stages of changes in the technology and the impact of each stage on the MACs.

In the limitations section, I also mention the relatively short time periods over which data was collected. During the second visit (19 months after the first visit), I found that a plan was being developed by middle and top management to evaluate the possibility to purchase new technology to replace the plant in the refinery together with new computerised control systems replacing the PLC (which was studied in this research). The new plant is planned to be operating some time in 2015. Therefore, it could be beneficial to carry out further research at a later period to see the changes that happen (or perhaps the differences between the old and new technology) and how they may influence the control practices. This might allow recognition of a more significant long term change in the MACs and the technology as compared to the relatively short run description of work and control practice change that I have discussed in this research.

The main technology that was studied in this research (i.e. the PLC system) is a complex system that relies on collaboration involving human actors, various material elements including software and equipment. As the focus of this research was more on MACs, less emphasis was given to the details of the hardware and software of the technology. Being the popular technology in use within the midstream palm oil processing industry in Malaysia, and perhaps elsewhere, future research should place more emphasis on the specifics of the hardware and software of the technology to gain an in-depth understanding of the PLC system/technology.

Next, the findings of this research have provided another important lens for understanding organisational work practice by developing a deeper understanding of the process in which human and material elements get entangled to create an emergent practice, as discussed in detail in the methodology chapter (Chapter 3). However, there are only a limited number of studies that have explored the MACs practices through this theoretical lens (see Wagner et al., 2011) and have analytically taken one step back and ‘untangled’ the elements and showed the process of entanglement that brought about the emergence of the practices. Therefore, future research should consider employing this approach when more deeply investigating the MACs, especially when discussing accounting related materials/technology such as ERP systems, its affordances and constraints and how it influences the creation and operation of the MACs and other work practices as this kind of technology usage is nowadays quickly spreading throughout organisations.

From a practical perspective, managers at middle or top management should consider the findings of studies such as this one when planning to implement any new technology within their organisations. This is because, according to the findings of this research, the results and changes that happen from any implementation of new technology are not necessarily predictable, but may be strongly influenced by the complex and chance nature of social and material/technology imbrications.

10.4 REFLECTION ON THE OVERALL RESEARCH PROCESS

The process of conducting this research has been both exciting and challenging. When I first started, I had not even understood the different and often contrasting underpinnings of the worldviews within the research that I had been reading. Through the process of reading and exploring the literature, I started to realize and appreciate the different paradigms and the contributions they offer. This understanding led me to start associating myself with and appreciating the way the interpretive researcher looks at social phenomena. I started to enquire more deeply and ask myself more questions on the meaning of things rather than taking them for granted, not only in my research process but also in my daily life.

During my field data collection process, the interviews and observations I conducted at the case organisation have enabled me to learn to see phenomena in a more realistic way rather than in a text book fashion. As I had the opportunity to explore all aspects of the organisation at various locations, I managed to collect a large amount of data not all of which could be incorporated into this thesis. The data analysis process was quite challenging as the richness of my data puzzled me on where to start, what to highlight and what to leave out. Although part of the data was left out in the discussions of this thesis (such as the interrelations between actors at the midstream production activities with the downstream part of the business as well as the flow of products to the distribution centres), the experiences and understandings gave me a more complete picture of the organisation.

One of the many examples is the issue of ‘colour’ being one of the critical quality parameters in palm oil products. I got to understand why certain things, such as the colour of oil, were given such a great deal of emphasis by the employees working at the refinery. When I was visiting one of the distribution centres, I was shown several packs of cooking oil of different brands (the company’s brand and competitor’s brands) and how different they look on the shelf –the lighter oil colour is generally regarded as being of superior quality. Discussions

with some of the sales people on clients' feedback also reconfirmed this as they shared experiences of how they had to take back a delivery batch because of an off-colour issue. Experiences like these, to some extent, inspired me in choosing some of the themes for this thesis, such as the discussion on quality in Chapters 6 and 7. As the colour of the oil was the critical indicator of quality at the midstream production stage (which was also clearly a concern of people in various different operational areas within the organisation), I decided it would be interesting to focus my descriptions and theorisation in this part of the refinery.

Although unable to incorporate all the data in the limited space of this thesis, this exposure allowed me to 'feel' the complexity of interconnected activities within organisations and again confirm that the thing we call a 'system' or MACs is not as simple as it might seem and that MACs practices are often the outcome of great complexity. The observations and careful examination of all the empirical data, especially through the sociomateriality lens, have given me a realisation of the complexity of the management accounting and control practices which are not straight forward but consist of numerous human and material elements - just like the example of colour that I have just mentioned which affected so many people across different areas of operations in the organisation.

All in all, reflecting back from the time I started thinking about conducting this PhD research until the point of submission, it seems that I have learned a lot and changed a lot in the way I think and see the world. Having said that, the ultimate realisation that I get from the whole process is that there is so much more that I need to explore and still learn. Now that I have obtained a considerable number of tools and skills required for research, I am excited to continue this journey further. Just like my supervisor once said, "the world is your oyster".

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LIST OF APPENDICES

APPENDIX 1
LIST OF INTERVIEWS AND MEETING OBSERVATIONS

LIST OF INTERVIEWS

No.	Date	Interviewee
Head Office		
Preliminary Visit		
1	06/01/2012	Human Resource Officer
2	06/01/2012	Operations Officer
First Field Visit		
3	05/06/2012	Officer at the History Gallery of the Organisation
4	07/06/2012	Senior General Manager – Operations (Head of Department)
5	07/06/2012	Chief Executive Officer
6	06/06/2012	Senior Manager – Finance (Head of Department)
7	02/08/2012	Senior Executive – Finance
8	02/08/2012	Senior Executive – International Business
9	03/08/2012	General Manager – Human Resource (Head of Department)
10	06/08/2012	Manager – Marketing and Product Development
11	06/08/2012	Senior Executive - Logistic
12	06/08/2012	Executive - Logistic
13	07/08/2012	Executive - Procurement
14	07/08/2012	Management Trainee – Domestic Sales and Distribution
15	08/08/2012	Manager - Marketing and Product Development
16	09/08/2012	Executive – Feed Stock Purchasing
17	10/08/2012	Manager – Domestic Sales and Distribution
18	13/08/2012	Executive – Domestic Sales and Distribution (Modern Trade)
19	13/08/2012	Senior Executive – Finance
20	14/08/2012	Management Trainee – Finance
21	14/08/2012	Management Trainee – Finance
22	16/08/2012	Executive - Marketing and Product
23	16/08/2012	Executive – Operations
24	16/08/2012	Senior Executive - Finance
25	27/08/2012	Senior General Manager - Marketing and Product Development
26	27/08/2012	Senior General Manager - Domestic Sales and Distribution
27	27/08/2012	General Manager – International Business
28	28/08/2012	Senior Manager – Finance (Head of Department)
29	29/08/2012	Senior General Manager – Operations (Head of Department)
30	03/09/2012	Chief Executive Officer

Depots		
31	02/07/2012	Head of Depot (Depot 1)
32	02/07/2012	Finance Executive (Depot 1)
33	03/07/2012	Head of Depot (Depot 2)
34	05/07/2012	Head of Depot (Depot 3)
35	05/07/2012	Head of Depot (Depot 4)
36	06/07/2012	Sales Executive (Depot 4)
37	06/07/2012	Sales Person (Depot 4)
38	08/07/2012	Head of Depot (Depot 5)
39	08/07/2012	Sales Executive (Depot 5)
40	09/07/2012	Clerk – Admin and Store (Depot 6)
41	10/07/2012	Head of Depot (Depot 7)
42	11/07/2012	Head of Depot (Depot 8)
43	11/07/2012	Head of Depot (Depot 9)
44	16/07/2012	Clerk - Admin (Depot 10)
45	18/07/2012	Head of Depot (Depot 11)
46	18/07/2012	Sales Person (Depot 11)
Refinery		
First Field Visit		
47	14/06/2012	Refinery Senior Manager
48	15/06/2012	Admin Clerk – Procurement
49 50	15/06/2012 18/06/2012	Senior Supervisor - Operation
51	15/06/2012	Assistant Executive – Accounts
52	16/06/2012	Operation Clerk – Export
53	16/06/2012	Operation Clerk – Domestic Sales
54 55	18/06/2012 27/06/2012	Accounts Executive
56	18/06/2012	Accounts Clerk – Accounts Receivable
57	18/06/2012	Admin Executives – Administration, Procurement, Human Resource
58	19/06/2012	Assistant Manager – Quality Control
59	20/06/2012	Refinery Supervisor
60	21/06/2012	Fractionation Operator
61	21/06/2012	Fractionation Supervisor
62	22/06/2012	Production Manager
63	23/06/2012	Packed Product Supervisor
64	23/06/2012	Packed Product Assistant Supervisor
65	25/06/2012	Production Manager
66	25/06/2012	Packed Product Supervisor
67	26/06/2012	Production Clerk
68 69	26/06/2012 27/06/2012	Warehouse Executive
70	27/06/2012	Assistant Manager – Quality Control
71	29/06/2012	Factory Senior Manager

Second Field Visit		
72	01/04/2014	Refinery Operator
73	01/04/2014	Refinery Supervisor
74	01/04/2014	Refinery Operator
75	01/04/2014	Refinery Operator
76	02/04/2014	Production Executive
77	02/04/2014	Production Executive
78	02/04/2014	Laboratory Officer
79	03/04/2014	Production Manager
80	03/04/2014	Refinery Manager
81	04/04/2014	Fractionation Supervisor

LIST OF MEETING OBSERVATIONS

No.	Date	Briefings/Meetings Attended
Head Office		
First Field Visit		
1	10/06/2012 – 12/06/2012	Budget Retreat Meeting
2	06/08/2012	Marketing/Operation Meeting
3	08/08/2012	Meeting on Export Launching
4	09/08/2012	Meeting with Advertising Company
5	14/08/2012	Head of Department Meeting
Refinery		
First Field Visit		
6	14/06/2012	Safety Briefing and Briefing Notes for Visitor – Official Plant Visit
7	18/06/2012	Meeting with packaging material supplier
8	20/06/2012	Refinery “morning” meeting
9	21/06/2012	Refinery “morning” meeting
10	22/06/2012	Meeting with supplier of contract workers
11	22/06/2012	Internal Audit Closing meeting
12	22/06/2012	Official Plant Visit – Packed Product
13	26/06/2012	Refinery “morning” meeting
14	29/06/2012	Refinery “morning” meeting
Second Field Visit		
15	01/04/2014	Refinery “morning” meeting
16	02/04/2014	Refinery “morning” meeting

APPENDIX 2
INFORMATION SHEET FOR INTERVIEWING PARTICIPANTS

Management Control System in Palm Oil Industry
Sistem Pengurusan Kawalan dalam Industri Minyak Sawit

INFORMATION SHEET
LEMBARAN MAKLUMAT

Purpose:

I am interested to understand the management control systems in the Malaysian palm oil industry and it's interaction with the day to day practices in relation to the operation of a major organization in this industry. Malaysian palm oil industry has been contributing a significant amount to the national gross domestic products and also is one of the major contributors to the world's oils and fats production and exports. As an important industry, it is interesting to understand how a company within this industry apply management accounting functions and related practices in their organizational interactions and processes in order to monitor and maintain their position and competitiveness.

Tujuan:

Saya berminat untuk memahami sistem pengurusan kawalan dalam industri minyak sawit di Malaysia dan interaksi di antara amalan harian berhubung dengan operasi organisasi utama dalam industri ini. Industry minyak sawit Malaysia telah menyumbang jumlah yang penting kepada keluaran dalam negara kasar dan juga merupakan penyumbang utama dalam produksi dan eksport minyak dan lemak dunia. Sebagai satu industri penting, ia adalah menarik untuk memahami bagaimana sebuah syarikat dalam industri ini menggunakan fungsi-fungsi perakaunan pengurusan dan amalan yang berkaitan dalam interaksi dan proses di dalam organisasi untuk memantau dan mengekalkan kedudukan dan daya saing mereka.

Data Collection and Confidentiality:

I would like to digitally record the interview with you regarding your view of management control systems in your organization and the extent to which it is implicated in organizational processes and interactions in the day to day practices. The data you provided will enlighten my understanding of the management control systems in palm oil industry in general and your organization specifically. It will also help me understand the interpretations of employees at different levels of and within different locations of your multi-site organization. I will code the interview so that your identity will be kept separate from the data and I will not use your name in the research output. If I wish to quote verbatim anything you have said I will include the quote using pseudonym (e.g. Officer 1, Manager 1).

As part of the requirements for the academic audit of research I will store the anonymised data from the interview on secure computers for a period of 5 years. Your information i.e. original identity and the assigned code or pseudonym will be stored electronically in a separate password protected file that is only accessible by me and my two supervisors.

Pengumpulan data dan Kerahsiaan:

Saya ingin merakam secara digital temu bual dengan anda tentang pandangan anda berhubung sistem kawalan pengurusan dalam organisasi dan sejauh mana ia terbabit dalam proses dan interaksi di dalam amalan harian organisasis anda. Data yang anda berikan akan meningkatkan pemahaman saya berkenaan sistem kawalan pengurusan dalam industri minyak sawit secara amnya dan organisasi anda secara khususnya. Ia juga akan membantu saya memahami tafsiran pekerja di setiap peringkat pengurusan dan di lokasi yang berlainan organisasi anda.Saya akan memberi kod temuduga supaya identiti anda akan disimpan berasingan daripada data dan saya tidak akan menggunakan nama anda dalam hasil penyelidikan saya. Jika saya ingin memetik kata demi kata daripada temubual ini, saya akan menggunakan nama samaran untuk petikan tersebut. (contohnya:Pegawai1,Pengurus1).

Sebagai sebahagian daripada keperluan untuk audit akademik penyelidikan, saya akan menyimpan data temubual yang berkod pada komputer yang selamat bagi tempoh 5 tahun. Informasi berkenaan diri anda iaitu maklumat identiti asal dan kod yang diberikan atau nama samaran akan disimpan secara elektronik dalam fail yang berasingan yang dilindungi kata laluan yang hanya boleh diakses oleh saya dan dua orang penyelia saya.

Output:
I seek to present the findings at conferences and in academic publications.

Hasil:
Saya bertujuan untuk menyampaikan temuan penyelidikan di persidangan dan penerbitan akademik.

Your rights:

You may choose not to participate in this research, or refuse to answer any question, retract any comment or the whole of your interview up to the end of September 2012 (after which I may have made the research findings public).

You may ask me questions to clarify any further points about the study and I will be happy to send you a copy of the report if I have your email address.

Hak-hak anda:

Anda boleh memilih untuk tidak mengambil bahagian dalam kajian ini, atau enggan untuk menjawab apa-apa soalan, menarik balik apa-apa komen atau keseluruhan temu bual anda sehingga akhir September 2012 (selepas itu, saya mungkin telah menyampaikan temuan penyelidikan di persidangan dan penerbitan awam).

Anda boleh bertanya saya apa-apa soalan mengenai kajian ini dan saya juga boleh menghantar satu salinan laporan jika saya mempunyai alamat e-mel anda.

The researcher can be contacted as follows:
Penyelidik ***yang boleh dihubungi seperti berikut***

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APPENDIX 3
SAMPLE OF CONSENT FORM

Management Control Systems in the Palm Oil Industry
Sistem Pengurusan Kawalan dalam Industri Minyak Sawit

CONSENT FORM
BORANG KEBENARAN

Date/*Tarikh*:…[redacted]

I have read and understand the information provided in the information sheet regarding this research.

I freely agree to participate in this research according to the outlined conditions in the information sheet including my rights to refuse answering any questions and withdraw from my participation in this research any time before November 2012 without having to give any reason.

The researcher has agreed that the data/information I provide will be stored in a secured filing system whereby only the research team will have access to it.

The researcher has agreed not to reveal my identity and personal details in any presentation and publication to the public.

Saya telah baca dan faham maklumat yang disediakan dalam lembaran maklumat mengenai kajian ini.

Saya bersetuju untuk mengambil bahagian dalam kajian ini mengikut syarat-syarat yang digariskan dalam lembaran maklumat termasuk hak saya untuk tidak menjawab apa-apa soalan dan menarik diri daripada penyertaan saya dalam kajian ini pada bila-bila masa sebelum November 2012 tanpa perlu memberi sebarang alasan.

Penyelidik telah bersetuju bahawa data/maklumat yang saya berikan akan disimpan dalam sistem pemfailan yang selamat di mana hanya pasukan penyelidikan akan mempunya akses kepada maklumat tersebut.

Penyelidik telah bersetuju untuk tidak mendedahkan identiti dan maklumat peribadi saya dalam mana-mana persidangan dan penerbitan awam.

I hereby consent:

(a) to be interviewed	(Yes)/No (Please circle)
(b) that the interview session being digitally recorded	(Yes)/No (Please circle)
(c) that the interview be recorded in written form	(Yes)/No (Please circle)
(d) to be quoted directly if I remain anonymous	(Yes)/No (Please circle)
(e) to be observed at work	(Yes)/No (Please circle)
(f) to be observed in the meeting	(Yes)/No (Please circle)

Saya bersetuju:

(a) untuk ditemuduga	*Ya/Tidak (Sila bulatkan)*
(b) bahawa sesi temubual direkod secara digital	*Ya/Tidak (Sila bulatkan)*
(c) bahawa temubual ini direkod dalam bentuk bertulis	*Ya/Tidak (Sila bulatkan)*
(d) bahawa kata-kata saya dipetik terus sekiranya identiti saya dirahsiakan	*Ya/Tidak (Sila bulatkan)*
(e) diperhatikan ditempat kerja	*Ya/Tidak (Sila bulatkan)*
(f) diperhatikan di dalam mesyuarat	*Ya/Tidak (Sila bulatkan)*

Participant's Name:
Nama Peserta: .....

Signature:
Tanda tangan: .....

Date:
Tarikh: .....

APPENDIX 4
INFORMATION SHEET FOR OBSERVING PARTICIPANTS AT WORK AND DURING MEETING

Management Control Systems in the Palm Oil Industry
Sistem Pengurusan Kawalan dalam Industri Minyak Sawit

INFORMATION SHEET
LEMBARAN MAKLUMAT

Purpose:
I am interested to understand the management control processes and systems in the Malaysian palm oil industry and its interaction and effect on day to day practices in a large organization engaged in the industry. Malaysian palm oil industry has been contributing a significant amount to the national gross domestic products and also is one of the major contributors to the world's oils and fats production and exports. As an important industry, it is interesting to understand how a company within this industry applies management accounting procedures and practices in their organizational interactions and processes in order to monitor and maintain their position and competitiveness.

Tujuan:

Saya berminat untuk memahami sistem pengurusan kawalan dalam industri minyak sawit di Malaysia dan interaksi di antara amalan harian berhubung dengan operasi organisasi utama dalam industri ini. Industry minyak sawit Malaysia telah menyumbang jumlah yang penting kepada keluaran dalam negara kasar dan juga merupakan penyumbang utama dalam produksi dan eksport minyak dan lemak dunia. Sebagai satu industri penting, ia adalah menarik untuk memahami bagaimana sebuah syarikat dalam industri ini menggunakan fungsi-fungsi perakaunan pengurusan dan amalan yang berkaitan dalam interaksi dan proses di dalam organisasi untuk memantau dan mengekalkan kedudukan dan daya saing mereka.

Data Collection and Confidentiality:

I would like to observe you at work and during meetings and make note of your conversations and actions in order to explore the management control systems in your organization and the extent to which it is implicated in organizational processes and interactions in the day to day practices. The data collected will inform my understanding of the management control systems in palm oil industry in general and your organization specifically. It will also help me understand the interpretations of employees at different levels of and within different locations of your multi-site organization. I will code the observations so that your identity will be kept separate from the data and I will not use your name in the research output. If I wish to quote verbatim anything you have said or done during an observation, I will include the quote using a pseudonym (e.g. Officer 1, Manager 1).

As part of the requirements for the academic audit of the research I will store the anonymised data from the interview on secure computers for a period of 5 years. Your information i.e.

original identity and the assigned code or pseudonym will be stored electronically in a separate password protected file that is only accessible by me and my two supervisors.

Pengumpulan data dan Kerahsiaan:

Saya ingin memerhatikan anda di tempat kerja dan semasa mesyuarat serta membuat nota berkenaan perbualan/percakapan dan tindakan anda bagi meneroka sistem kawalan pengurusan dalam organisasi dan sejauh mana ia terbabit dalam proses dan interaksi di dalam amalan harian organisasis anda. Data yang anda berikan akan meningkatkan pemahaman saya berkenaan sistem kawalan pengurusan dalam industri minyak sawit secara amnya dan organisasi anda secara khususnya. Ia juga akan membantu saya memahami tafsiran pekerja di setiap peringkat pengurusan dan di lokasi yang berlainan organisasi anda.Saya akan memberi kod temuduga supaya identiti anda akan disimpan berasingan daripada data dan saya tidak akan menggunakan nama anda dalam hasil penyelidikan saya. Jika saya ingin memetik kata demi kata daripada temubual ini, saya akan menggunakan nama samaran untuk petikan tersebut. (contohnya:Pegawai1,Pengurus1).

Sebagai sebahagian daripada keperluan untuk audit akademik penyelidikan, saya akan menyimpan data temubual yang berkod pada komputer yang selamat bagi tempoh 5 tahun. Informasi berkenaan diri anda iaitu maklumat identiti asal dan kod yang diberikan atau nama samaran akan disimpan secara elektronik dalam fail yang berasingan yang dilindungi kata laluan yang hanya boleh diakses oleh saya dan dua orang penyelia saya.

Output:
I seek to present the findings at conferences and in academic publications.

Hasil:
Saya bertujuan untuk menyampaikan temuan penyelidikan di persidangan dan penerbitan akademik.

Your rights:

You may choose not to participate in this research, or refuse to answer any question, retract any comment or the whole of your interview up to the end of November 2012 (after which I may have made the research findings public).

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The researcher can be contacted as follows:
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APPENDIX 5
SAMPLE OF REFINERY MONTHLY PERFORMANCE REPORT

REFINERY OPERATION REPORT – MARCH 20X2

A. <u>Midstream Operation</u>

1. Refinery Plant

1.1 Performance of the refinery plant for March 20X2 is a following table:

Table 1
Refinery Plant

Product	March 20X2		Cumulative to March 20X2		March 20X1	Cumulative to 20X1
	Actual	Budget	Actual	Budget	Actual	Actual
Crude Palm Oil (MT)	XX	XX	XX	XX	XX	XX
RBDPO (MT) % Yield	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)
PFAD (MT) % Yield	XX XX %	XX XX %	XX XX %	XX XX %	XX XX %	XX XX %
Oil Loss (MT) Oil Loss (%)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)

1.2 XX Metric Tonne of Crude Palm Oil was processed in March 20X2 that is of XX Metric Tonne (XX %) higher/lower compared to budget. Oil loss in March 20X2 is at XX % is higher/lower than budget.

2. Fractionation Plant

2.1 Performance of fractionation plant for March 20X2 is a following table:

Table 2
Fractionation Plant

Product	March 20X2		Cumulative to March 20X2		March 20X1	Cumulative to 20X1
	Actual	Budget	Actual	Budget	Actual	Actual
RBDPO (MT)	XX	XX	XX	XX	XX	XX
Olein – CP10 (MT) % Yield	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)
Olein – CP8 (MT) % Yield	XX XX %	XX XX %	XX XX %	XX XX %	XX XX %	XX XX %
Olein – CP6 (MT) % Yield	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)
Stearin (MT) % Yield	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)	XX (XX %)

1.3 XX Metric Tonne of RBDPO was processed in March 20X2 that is of XX Metric Tonne (XX %) higher/lower compared to budget. Yield of CP10, CP8 and CP6 are XX%, XX%, and XX% respectively.

3. Quality Control

3.1 Average quality of CPO and products produced by it in March 20X2 is as following table:

Table 3
Oil Quality

Product	FFA (%)	DOBI	Colour (R)	IV	CP/SMP (Deg C)
CPO	XX	XX	-	-	-
RBDPO	XX	-	XX	XX	-
Olein – CP10 (MT)	XX	-	-	-	-
Olein – CP8 (MT)	XX	-	XX	XX	XX
Olein – CP6 (MT)	XX	-	XX	XX	XX
Stearin (MT)	XX	-	XX	XX	XX

3.2 Quality of CPO receipt in March 20X2 is good except that the Iodine Value is rather low that is XX. Qualities of product produced are within specified specification.

4. Sub-materials utilization

4.1 Sub-materials utilized in March 20X2 is as following table:

Table 4:
Sub-Material Utilization

Product	March 20X2		Cumulative to March 20X2		March 20X1	Cumulative to 20X1
	Actual	Budget	Actual	Budget	Actual	Actual
Bleaching Earth (MT) (Kg/MT)	XX (XX)	XX (XX)	XX (XX)	XX (XX)	XX (XX)	XX (XX)
Phosphoric Acid (MT) (Kg/MT)	XX (XX)	XX (XX)	XX (XX)	XX (XX)	XX (XX)	XX (XX)

4.2 Usage of Bleaching Earth and Phosphoric Acid in March 20X2 are XXKg/MT and XXKg/MT respectively.

5. **Utility Utilization**

5.1. Utility utilizations at the refinery and fractionation plants in March 20X2 is as the following table:

Table 5
Utility Utilization

Product	March 20X2		Cumulative to March 20X2		March 20X1	Cumulative to 20X1
	Actual	Budget	Actual	Budget	Actual	Actual
Refinery Plant						
Gas	XX	XX	XX	XX	XX	XX
Electricity	XX	XX	XX	XX	XX	XX
Water	XX	XX	XX	XX	XX	XX
Refinery Plant (CP10)						
Gas	XX	XX	XX	XX	XX	XX
Electricity	XX	XX	XX	XX	XX	XX
Water	XX	XX	XX	XX	XX	XX
Refinery Plant (CP8)						
Gas	XX	XX	XX	XX	XX	XX
Electricity	XX	XX	XX	XX	XX	XX
Water	XX	XX	XX	XX	XX	XX
Refinery Plant (CP6)						
Gas	XX	XX	XX	XX	XX	XX
Electricity	XX	XX	XX	XX	XX	XX
Water	XX	XX	XX	XX	XX	XX

5.2 Utility utilization at the refinery and fractionation plants are under control

6. Damage and Downtime Report

6.1 Details of damage and downtime report at the refinery and fractionation plants in March 20X2 is as table below:

Table 6
Damage and Downtime

	Refinery Plant				Fractionation Plant			
	March 20X2		Cumulative to March 20X2		March 20X2		Cumulative to March 20X2	
	Refine-ry Plant 1	Refine-ry Plant 2	Refine-ry Plant 1	Refine-ry Plant 2	Fractio-nation Plant 1	Fractio-nation Plant 2	Fractio-nation Plant 1	Fractio-nation Plant 2
Controlled Damage (Hour: Minute)	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx
Uncontroll-ed Damage (Hour: Minute)	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx
Total Damage (Hour: Minute)	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx
Available Time for Production	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx	xx:xx
% Downtime	XX	XX	XX	XX	XX	XX	XX	XX

7. Maintenance

7.1
Maintenance Cost Incurred In March 20X2 Is As Follows

	March 20X2		Cumulative to March 20X2	
	Actual	**Budget**	**Actual**	**Budget**
Maintenance Cost (RM)	XX	XX	XX	XX
Maintenance Cost (RM/MT)	XX	XX	XX	XX

7.2 Maintenance cost for March 20X2 is RMXX/MT that is lower/higher than budget.